Twenty Years of Work-Related Injury and Illness Among Union Carpenters in Washington State

Amanda J. McCoy, MD, MPH,[1,2] Kristen L. Kucera, PhD,[3] Ashley L. Schoenfisch, MSPH,[2,3] Barbara A. Silverstein, MSN, PhD, MPH, CPE,[4] and Hester J. Lipscomb, PhD[3]*

Background *Individuals who work in the construction industry are at high risk of occupational injury. Robust surveillance systems are needed to monitor the experiences of these workers over time.*

Methods *We updated important surveillance data for a unique occupational cohort of union construction workers to provide information on long-term trends in their reported work-related injuries and conditions. Combining administrative data sources, we identified a dynamic cohort of union carpenters who worked in Washington State from 1989 through 2008, their hours worked by month, and their workers' compensation claims. Incidence rates of reported work-related injuries and illnesses were examined. Poisson regression was used to assess risk by categories of age, gender, time in the union, and calendar time contrasting medical only and paid lost time claims.*

Results *Over the 20-year study period, 24,830 carpenters worked 192.4 million work hours. Work-related injuries resulting in medical care or paid lost time (PLT) from work occurred at a rate of 24.3 per 200,000 hr worked (95% CI: 23.5–25.0). Medical only claims declined 62% and PLT claims declined 77%; more substantive declines were seen for injuries resulting from being struck and falls to a lower level than from overexertion with lifting. Differences in risk based on union tenure and age diminished over time as well.*

Conclusions *Significant declines in rates of reported work-related injuries and illnesses were observed over the 20-year period among these union carpenters. Greater declines were observed among workers with less union tenure and for claims resulting in PLT.* Am. J. Ind. Med. 56:381–388, 2013. © *2012 Wiley Periodicals, Inc.*

KEY WORDS: occupational injury; construction workers; carpenters; longitudinal analysis; cohort study; injury rates; worker's compensation

INTRODUCTION

Construction workers bear a disproportionate burden of work-related morbidity and mortality; this fact alone illustrates the importance of robust surveillance systems that can be used to monitor their occupational injury experiences over time. Bureau of Labor Statistics (BLS) data and workers' compensation (WC) records are the primary sources of information on occupational injuries and illnesses in the United States.

BLS data on non-fatal injuries and illnesses, based on reports from Occupational Safety and Health Administration (OSHA) logs, are derived from a probability sample of employers. Numerous concerns have been raised about

[1]Duke University School of Medicine, Durham, North Carolina
[2]Gillings School of Global Public Health, University of North Carolina, Chapel Hill, North Carolina
[3]Division of Occupational and Environmental Medicine, Duke University Medical Center, Durham, North Carolina
[4]Safety and Health Assessment and Research for Prevention (SHARP) Program, Washington State Department of Labor and Industries, Olympia, Washington

Contract grant sponsor: National Institute for Occupational Safety and Health; Contract grant number: 1 U600H009761-1.
Disclosure Statement: The authors report no conflicts of interests.

*Correspondence to: Hester J. Lipscomb, PhD, Division of Occupational and Environmental Medicine, Duke University Medical Center, PO Box 3834, Durham, NC 27710.
E-mail: hester.lipscomb@duke.edu

Accepted 4 October 2012
DOI 10.1002/ajim.22134. Published online 9 November 2012 in Wiley Online Library (wileyonlinelibrary.com).

the potential for undercounting through this data source [Glazner et al., 1998; Morse et al., 1998; Azaroff et al., 2002, 2004; Leigh et al., 2004; Rosenman et al., 2006; Friedman and Forst, 2007a,b; US House of Representatives, 2008]. WC data provide an alternative source of information on reported work-related injuries and conditions. However, WC reports alone provide no information on the population at risk, limiting analyses to descriptive or proportionate comparisons. Work-related injury reporting requirements vary by state which makes cross-state comparisons challenging. The most recent National Occupational Research Agenda (NORA) specifically calls for exploration of collaborations and linkages that might enhance surveillance efforts in the construction sector [NIOSH, 2008].

This study updates data for an important occupational cohort of construction workers. Longstanding collaboration among academic researchers, a union health care trust, and a state agency make the evaluation of rates of reported work-related injuries and illnesses possible among this large, retrospective cohort of union carpenters over a 20-year period.

MATERIALS AND METHODS

Using data from the Carpenters Trusts of Western Washington (CTWW), the organization that provides health and pension benefits to members of the International Brotherhood of Carpenters and Joiners in Washington State, and the Washington State Department of Labor and Industries (L&I), the agency that administers the statewide workers' compensation program, we identified union carpenters who worked in the State of Washington between the years 1989 and 2008 and their reported workers' compensation claims. Data were provided with a blinded, unique carpenter identification number, and records were merged on an individual basis; these methods have been previously described in detail [Lipscomb et al., 1997, 2000, 2003].

Data from the trust included each carpenter's date of birth, gender, earliest date of union activity, and hours of union work recorded for each month. The WC data included the date of injury, cost of medical care received, whether the injury involved paid lost time (PLT; which occurs after the 3rd lost day in Washington State), and codes describing the nature of injury, the body part affected by injury, the source of injury (brick, drywall, etc.), and the event or exposure causing the injury. American National Standards Institute (ANSI) codes were used to code claims prior to 2005 and Occupational Injury and Illness Classification System (OIICS) codes were used in later years.

The study cohort was limited to individuals who worked at least 3 months of union hours during this 20-year period. Observation, for study purposes, began in the month eligibility criteria were met (i.e., the 3rd month of union work). Hours worked each month was the measure of time at risk. Each carpenter was considered to be at risk for work-related injuries in any month in which they worked union hours.

Events of interest were limited to WC claims that occurred during months in which the individual worked union hours to ensure that injuries and time at risk were defined on the same basis. Claims involving paid lost time from work were further stratified into the common injury mechanism groupings of ''struck by an object,'' ''fall to a lower level,'' and ''overexertion with lifting.'' Claims from self-insured employers in Washington State were captured and were included in overall rate analyses. However, claims from self-insured employers that did not result in paid lost time (medical only or first aid) are not assigned specific ANSI/OIICS codes at L&I. Therefore, analyses of the major types of injury (''struck by an object,'' ''falls to a lower level,'' and ''overexertion with lifting'') were limited to paid lost time claims for which all claims were assigned injury codes regardless of whether they were covered by the state fund or were from a self-insured employer.

We calculated the age of each carpenter upon first entry into the cohort and the average age of the cohort over calendar time. Duration of time observed in the cohort was calculated for each carpenter and was used to derive average time observed in the cohort. Poisson regression was used to assess rates of injury, rate ratios, and 95% confidence intervals among sub-populations within the cohort and across calendar time. Age and time in the union were treated as time-varying variables. Stratified analyses compared patterns of injury rates over time across different categories of age and union tenure.

All study procedures were approved by the Institutional Review Boards of Duke University Medical Center, the University of North Carolina at Chapel Hill Gillings School of Global Public Health, and the Washington State Department of Health and Human Services.

RESULTS

The Carpenter Cohort

We identified 24,830 carpenters who had union work hours in the State of Washington between 1989 and 2008 after meeting cohort entry criteria of working at least 3 months of union hours in the state. Over the 20-year period, these carpenters worked a total of 192,371,021 union hours. Carpenters entered the cohort at a mean age of 34.2 years (median = 32.7 years). The average age was 38.3 years in 1989, peaked at 44.9 years in 2005, and declined to 42.0 years in 2008 (Fig. 1). The cohort was

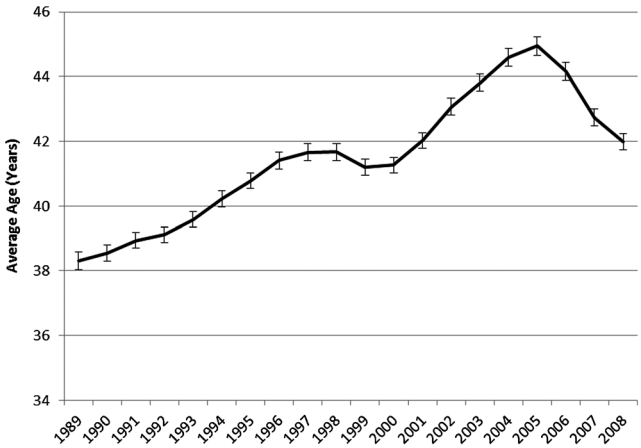

FIGURE 1. Average age (95% confidence intervals) of union carpenters in Washington State (1989–2008).

predominantly male (97.4%). The proportion of females ranged from 1.6% to 2.4% over the 20-year period. Time observed in the cohort ranged from 1 to 238 months. Overall, the average time of observation in the cohort was 68.7 months (standard deviation = 73.6 months, median = 34 months). For males, the average time observed in the cohort was 70.6 months (standard deviation = 74.1 months, median = 37 months). Females were observed in the cohort for an average of 53.2 months (standard deviation = 61.7 months, median = 25 months).

Claims Reported by the Carpenter Cohort

A total of 27,080 claims were reported and accepted for workers' compensation coverage between 1989 and 2008 resulting in an overall incidence of 28.2 (95% CI: 27.4–29.0) claims per 200,000 hr or 100 fulltime equivalents (FTEs). Overall injury rates peaked in 1991 at 44.9 (95% CI: 41.9–48.2) per 100 FTEs; the lowest rate occurred in 2008 with an incidence of 15.9 (95% CI: 14.5–17.3) per 100 FTEs. There were 3,729 claims that were first aid only; these claims were omitted from additional analyses.

Medical Care and Paid Lost Time Claims

Eighty-six percent of the claims (n = 23,351) resulted in medical care or paid lost time representing an incidence of 24.3 (95% CI: 23.5–25.0) per 100 FTEs. Twenty-two percent (n = 5,048) of these claims involved more than 3 days of lost time resulting in PLT in Washington. Paid lost time claims accounted for approximately 25% of claims in the early years of observation of this cohort (1989–1991); this proportion declined to about 16% in later years (2005–2008; Fig. 2).

Time at risk, number of claims, crude incidence rates, and rate ratios by categories of age, gender, union tenure, and calendar year are presented in Table I, separately for medical only claims and claims that resulted in PLT. Union carpenters with less union tenure, particularly those in the apprenticeship years (1st 4 years of union tenure), had higher claim rates. Younger carpenters had rates of medical only claims that were higher than those of older carpenters, while their rates of injuries resulting in PLT were lower. No differences were seen between men and women in rates of medical only claims, but women had 37% higher rates of events resulting in PLT. Marked declines in rates were seen over the 20-year period; we observed a 62% decline in the rate of medical only claims and a 77% reduction in rates of claims resulting in PLT.

Injury rate patterns varied somewhat when claim rates resulting in paid lost time were stratified by the more common mechanisms of injury (Table II). Women had modestly higher rates of injuries resulting from ''being struck by an object'' and ''overexertion with lifting'' while men had higher rates of ''falls to a lower level.'' Individuals in the early apprenticeship years had higher claim rates for all three types of injury mechanisms. Younger carpenters had higher rates of injuries in which they were ''struck by an object'' but not higher rates of ''falls to a lower level'' or ''overexertion with lifting'' even after adjusting for union tenure. Paid lost time injury rates for ''struck by an object,'' ''falls to a lower level,'' and ''overexertion from lifting'' declined 96%, 95%, and 75%, respectively, over the 20-year period.

There were more significant reductions in medical only and paid lost time injury rates over time among workers with less union tenure (Fig. 3A,B). Younger workers also had more marked reductions in claim rates over time (not shown).

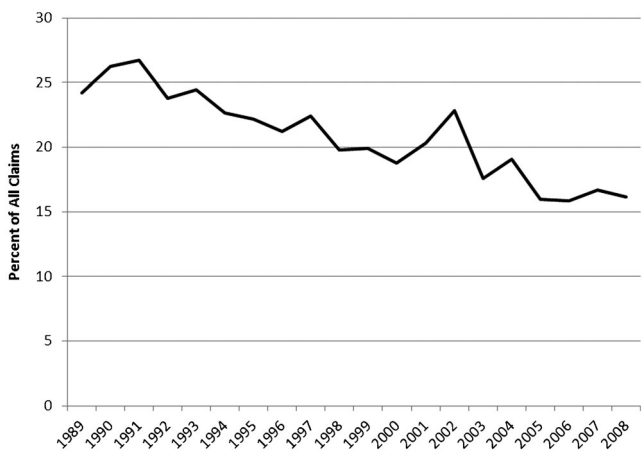

FIGURE 2. Proportion of claims involving paid lost time among union carpenters in Washington State, 1989–2008.

TABLE I. Hours Worked, Number of Claims, Crude Incidence Rates, Adjusted Rate Ratios, and 95% Confidence Intervals (CI) for Claims Involving Medical Care Only and Claims Involving Paid Lost Time by Age, Gender, Union Tenure and Year Among Union Carpenters in Washington State, 1989–2008

		Medical only claims (n = 18,303)			Paid lost time claims (n = 5,048)		
	Hours worked	# of claims[a]	Incidence rate[b]	Adjusted rate ratio (95% CI)	# of claims[a]	Incidence rate[b]	Adjusted rate ratio (95% CI)
Age							
<20 years	853,405	144	33.7	1.59 (1.34, 1.90)	23	5.4	0.68 (0.44, 1.03)
20–29 years	31,689,317	4,113	26.0	1.30 (1.23, 1.38)	814	5.1	0.69 (0.61, 0.77)
30–39 years	63,159,376	6,700	21.2	1.18 (1.13, 1.24)	1,883	6.0	0.93 (0.85, 1.01)
40–49 years	60,781,105	4,713	15.5	1.02 (0.97, 1.07)	1,488	4.9	0.99 (0.91, 1.08)
≥50 years	35,415,373	2,564	14.5	1	813	4.6	1
Gender							
Female	3,187,355	360	22.6	1.07 (0.96, 1.19)	126	7.9	1.37 (1.15, 1.64)
Male	188,719,682	17,873	18.9	1	4,895	5.2	1
Union tenure							
<2 years	25,251,789	3,281	26.0	1.52 (1.45, 1.59)	833	6.6	1.82 (1.67, 2.00)
2–3 years	19,336,435	2,463	25.5	1.42 (1.35, 1.49)	662	6.8	1.67 (1.52, 1.84)
4–5 years	16,303,299	1,848	22.7	1.28 (1.21, 1.35)	456	5.6	1.37 (1.23, 1.53)
6–7 years	15,121,172	1,444	19.1	1.15 (1.09, 1.22)	409	5.4	1.42 (1.27, 1.59)
8–9 years	13,873,414	1,236	17.8	1.11 (1.04, 1.18)	337	4.9	1.26 (1.12, 1.42)
≥10 years	102,484,910	8,031	15.7	1	2,351	4.9	1
Year							
1989	6,070,969	857	28.2	2.79 (2.53, 3.07)	274	9.0	4.78 (3.92,5.84)
1990	7,955,039	1,187	29.8	2.94 (2.69, 3.22)	423	10.6	5.69 (4.72, 6.85)
1991	8,503,454	1,233	29.0	2.84 (2.60, 3.11)	450	10.6	5.55 (4.62, 6.68)
1992	9,103,419	1,256	27.6	2.68 (2.45, 2.93)	402	8.8	4.55 (3.77, 5.49)
1993	8,512,786	1,133	26.6	2.59 (2.37, 2.84)	380	8.9	4.63 (3.83, 5.59)
1994	8,018,041	965	24.1	2.37 (2.16, 2.61)	297	7.4	3.87 (3.18, 4.71)
1995	8,062,927	938	23.3	2.33 (2.12, 2.57)	277	6.9	3.60 (2.96, 4.40)
1996	8,165,628	920	22.5	2.28 (2.07, 2.51)	249	6.1	3.20 (2.61, 3.92)
1997	8,718,329	964	22.1	2.25 (2.05, 2.48)	281	6.5	3.37 (2.77, 4.11)
1998	9,291,889	1,059	22.8	2.31 (2.11, 2.53)	257	5.5	2.86 (2.34, 3.50)
1999	10,557,541	991	18.8	1.86 (1.69, 2.04)	244	4.6	2.34 (1.91, 2.87)
2000	11,514,489	1,115	19.4	1.89 (1.73, 2.08)	256	4.4	2.24 (1.84, 2.74)
2001	10,618,931	835	15.7	1.55 (1.41, 1.71)	214	4.0	2.04 (1.66, 2.52)
2002	9,748,095	695	14.3	1.43 (1.29, 1.59)	206	4.2	2.16 (1.75, 2.66)
2003	9,357,923	699	14.9	1.53 (1.38, 1.69)	145	3.1	1.60 (1.27, 2.01)
2004	9,017,509	607	13.5	1.41 (1.27, 1.57)	143	3.2	1.68 (1.33, 2.11)
2005	9,569,607	615	12.9	1.35 (1.22, 1.50)	117	2.4	1.29 (1.02, 1.65)
2006	11,049,495	675	12.2	1.26 (1.14, 1.40)	127	2.3	1.20 (0.95, 1.52)
2007	13,475,892	760	11.3	1.11 (1.00, 1.22)	152	2.3	1.14 (0.91, 1.43)
2008	15,059,059	799	10.6	1	154	2.1	1

[a]Paid lost time occurs after the 3rd lost day in Washington State.
[b]Incidence rates are per 200,000 hr worked (100 FTEs) Differences in injury sums by strata reflect missing data for some demographic variables.

DISCUSSION

We evaluated the workers' compensation claims experience of a large dynamic, retrospective cohort of 24,830 carpenters over a 20-year period (1989–2008). Calculation of injury rates was made possible by linking on an individual basis de-identified records from workers' compensation with union records that provided the hours each carpenter worked by month. During the observation period, marked reductions in rates of reported injuries were observed with declines more pronounced for claims that resulted in paid lost time.

TABLE II. Number of Claims, Crude Incidence Rates, Adjusted Rate Ratios and 95% Confidence Intervals (CI) for "Struck by Object," "Fall to a Lower Level," and "Overexertion With Lifting" Claims Involving Paid Lost Time* by Age, Gender, Union Tenure, and Year Among Union Carpenters in Washington State, 1989–2008

	Struck by object (n = 664)			Fall to a lower level (n = 570)			Overexertion with lifting (n = 835)		
	# of claims[a]	Incidence rate[b]	Adjusted rate ratio (95% CI)	# of claims[a]	Incidence rate[b]	Adjusted rate ratio (95% CI)	# of claims[a]	Incidence rate[b]	Adjusted rate ratio (95% CI)
Age									
<20 years	5	117.2	1.28 (0.50, 3.23)	3	70.3	0.83 (0.26, 2.69)	4	93.7	0.67 (0.24, 1.84)
20–29 years	147	92.7	1.13 (0.83, 1.54)	98	61.9	0.83 (0.59, 1.16)	129	81.4	0.66 (0.49, 0.87)
30–39 years	243	77.0	1.06 (0.82, 1.37)	211	66.8	1.02 (0.78, 1.34)	341	108.0	1.04 (0.84, 1.30)
40–49 years	168	55.3	1.01 (0.78, 1.30)	169	55.6	1.11 (0.86, 1.45)	230	75.7	0.97 (0.78, 1.21)
≥50 years	94	53.1	1	85	48.0	1	127	71.7	1
Gender									
Female	15	94.1	1.23 (0.73, 2.05)	3	18.8	0.29 (0.09, 0.89)	20	125.5	1.28 (0.82, 1.99)
Male	643	68.2	1	562	59.6	1	810	85.8	1
Union tenure									
<2 years	125	99.0	1.78 (1.39, 2.29)	99	78.4	1.86 (1.42, 2.44)	152	120.4	2.12 (1.71, 2.64)
2–3 years	89	92.1	1.50 (1.15, 1.96)	69	71.4	1.49 (1.11, 2.00)	107	110.7	1.65 (1.30, 2.09)
4–5 years	61	74.8	1.26 (0.94, 1.70)	49	60.1	1.28 (0.93, 1.77)	76	93.2	1.40 (1.08, 1.82)
6–7 years	45	59.5	1.12 (0.80, 1.55)	47	62.2	1.42 (1.02, 1.98)	74	97.9	1.57 (1.21, 2.04)
8–9 years	47	67.8	1.26 (0.91, 1.74)	38	54.8	1.27 (0.90, 1.81)	48	69.2	1.10 (0.81, 1.50)
≥10 years	297	58.0	1	268	52.3	1	378	73.7	1
Year									
1989	54	177.9	28.17 (11.24, 70.60)	40	131.8	21.84 (8.61, 55.41)	39	128.5	4.36 (2.61, 7.27)
1990	65	163.4	26.70 (10.74, 66.37)	54	135.8	21.92 (8.75, 54.90)	79	198.6	6.82 (4.31, 10.78)
1991	76	178.8	28.91 (11.68, 71.58)	55	129.4	21.22 (8.48, 53.09)	81	190.5	6.33 (4.00, 10.01)
1992	64	140.6	22.11 (8.88, 55.05)	57	125.2	20.23 (8.10, 50.52)	65	142.8	4.61 (2.87, 7.39)
1993	46	108.1	17.62 (6.99, 44.39)	39	91.6	14.05 (5.52, 35.81)	66	155.1	5.18 (3.24, 8.28)
1994	41	102.3	16.83 (6.64, 42.64)	44	109.8	17.80 (7.05, 44.97)	43	107.3	3.60 (2.18, 5.95)
1995	41	101.7	16.96 (6.69, 43.00)	27	67.0	10.91 (4.20, 28.39)	48	119.1	4.03 (2.46, 6.59)
1996	32	78.4	13.22 (5.14, 33.99)	15	36.7	5.59 (2.01, 15.56)	47	115.1	3.92 (2.39, 6.43)
1997	33	75.7	12.34 (4.80, 31.73)	34	78.0	12.62 (4.93, 32.32)	40	91.8	3.12 (1.87, 5.18)
1998	41	88.2	14.29 (5.63, 36.26)	26	56.0	8.94 (3.43, 23.32)	44	94.7	3.18 (1.93, 5.24)
1999	21	39.8	6.40 (2.41, 16.98)	22	41.7	6.51 (2.46, 17.19)	44	83.4	2.73 (1.66, 4.49)
2000	29	50.4	7.99 (3.09, 20.66)	23	40.0	6.19 (2.35, 16.28)	41	71.2	2.31 (1.40, 3.83)
2001	14	26.4	4.24 (1.53, 11.78)	26	49.0	7.68 (2.95, 20.01)	28	52.7	1.73 (1.00, 2.99)
2002	24	49.2	8.13 (3.10, 21.33)	26	53.3	8.19 (3.13, 21.42)	45	92.3	3.09 (1.88, 5.08)
2003	14	29.9	5.05 (1.82, 14.05)	13	27.8	4.48 (1.59, 12.59)	22	47.0	1.59 (0.89, 2.84)
2004	12	26.6	4.60 (1.62, 13.08)	12	26.6	4.37 (1.54, 12.42)	21	46.6	1.61 (0.90, 2.91)
2005	15	31.3	5.41 (1.96, 14.91)	15	31.3	5.14 (1.86, 14.16)	20	41.8	1.45 (0.80, 2.64)
2006	17	30.8	5.16 (1.90, 14.01)	17	30.8	4.94 (1.82, 13.40)	22	39.8	1.35 (0.76, 2.42)
2007	20	29.7	4.69 (1.76, 12.49)	20	29.7	4.57 (1.72, 12.19)	16	23.7	0.77 (0.41, 1.45)
2008	5	6.6	1	5	6.6	1	24	31.9	1

[a]Paid lost time is defined to occur after the 3rd lost day in Washington State.
[b]Incidence rates are per 20,000,000 hr worked (10,000 FTEs). Differences in injury sums by strata reflect missing data for some demographic variables.

The high-risk groups we identified among the carpenter cohort were consistent with previous work among members of this cohort [Lipscomb et al., 1997, 2003, 2008, 2009] although differences in rates by union tenure, as well as age, became insignificant in more recent years of observation. Prior research has suggested that women are more likely to seek care than men [Verbrugge, 1985; Klonoff and Landrine, 1992; Almeida et al., 1999], and the modest differences we observed by sex may be related, in part, to differences in health care seeking behavior between

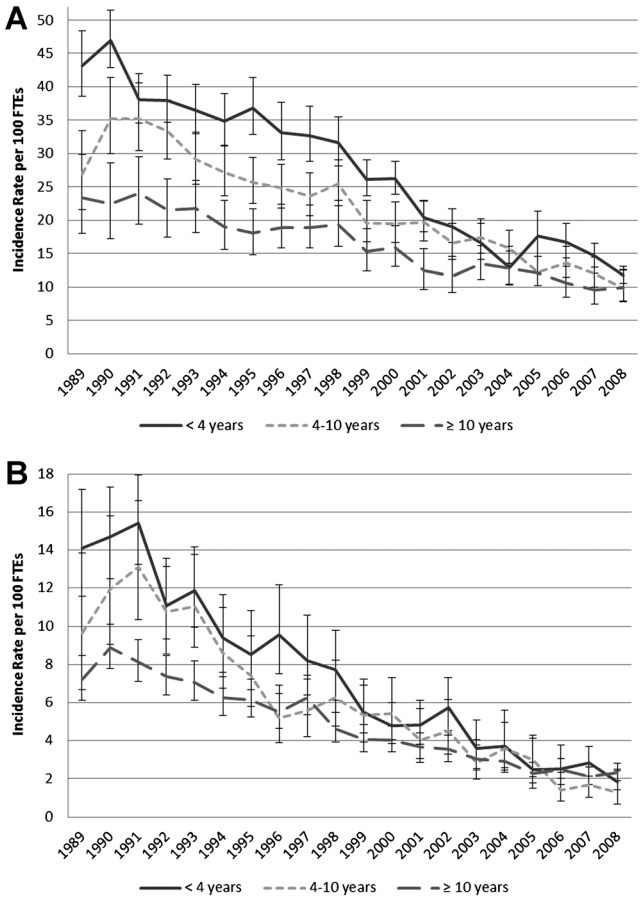

FIGURE 3. Incidence rates of claims resulting in (**A**) medical expenses only stratified by categories of union tenure among carpenters in Washington State, 1989–2008 and (**B**) Paid Lost Time Stratified by Categories of Union Tenure among Carpenters in Washington State, 1989–2008. *Note:* Paid lost time occurs after the 3rd lost day in Washington State.

men and women. If care-seeking behavior were responsible for the increased incidence observed in female carpenters, we might expect to see the same incidence rate for more severe claims—or claims with paid lost time. However, females had a higher incidence of paid lost time claims compared to men (IRR = 1.37). It is interesting that we observed lower rates of more serious falls to a lower level among women which could indicate lower exposure to work at height or more effective control of risk than men. However, women make up a very small percentage of this cohort; their estimates are based on only a few cases and are quite unstable, particularly for serious falls.

This was a dynamic cohort with both entrances and exits of members. It is of note that the mean age of the cohort increased over time with fewer younger carpenters entering the cohort in later years of observation. This is likely a reflection of economic conditions and selection of more experienced workers for jobs in tight economic times. Reduced job security surrounding the economic downturn in the U.S. in the latter years of observation may have influenced injury reporting by workers. Construction workers might have been influenced to not report work-related injuries and illnesses for fear of reprisal through the reduction of hours and/or job loss [Rosenman et al., 2000; Shannon and Lowe, 2002; Center for Construction Research and Training, 2007].

Economic downturns are often associated with increased self-employment and misclassification of employed construction workers as independent contractors [The Center for Construction Research and Training, 2007]. Employers are incentivized to reduce the number of workplace injuries and illnesses because companies with high injury and illness rates as determined by OSHA logs are more likely to undergo OSHA inspection [Welch et al., 2007]. However, the Washington program specifically states OSHA log reports will not be used for targeting/scheduling inspections. By hiring independent contractors or by some accounts misclassifying their "employees" as such, employers then do not record these workers' injuries and illnesses on OSHA logs and can avoid paying workers' compensation on their behalf. However, the effect of this type of misclassification on the carpenter cohort, specifically, is unlikely to be of significance given that union membership and independent contractor status are mutually exclusive.

On the other hand, beginning in the late 1980s major construction owners began to pre-qualify bidders with safety and health performance included as a criterion [Welch et al., 2007]. This new attention to workplace safety served as the vehicle through which workplace safety programs and return-to-work programs gained popularity among construction employers and oversight agencies. The introduction of these programs may have resulted in safer workplaces accompanied by a concomitant reduction in injuries. It is plausible that such efforts might have greater influence on injury rates of less experienced and younger workers in line with trends we observed among the carpenter cohort.

Limitations

It is important to bear in mind that these WC claims data represent *reported and accepted* events. We cannot assume that they are an entirely accurate representation of actual injury experiences of these carpenters. Further, these administrative data provide a limited number of variables for analyses. For example, we were unable to identify injuries that resulted in restricted work activities. If workers were accommodated with restricted duty more in the latter years this could account for some of the reduction in paid lost time claims which we observed [Welch and Hunting, 2003].

Our analyses were limited to a unionized workforce in one state. There has been relatively little research conducted on how unionization affects rates of injuries and illnesses and reporting of injuries and illnesses. However, we might consider that union activity could reduce the actual number of injuries experienced by the cohort and also increase the reporting of these injuries. For example, union carpenters receive mandated training thorough their apprenticeship programs that could reduce their risks of injury. Union presence might also raise the level of regulatory activity of both WC and OSHA [Weil, 1992, 1996]. Because union workers are more likely to exercise their rights under labor statutes [Weil, 1992], they may behave in a manner differently from their non-union peers in regulating their exposure to work-related risks and reporting of work-related injury and illness. More effective union organization in states without right to work laws, such as Washington, may allow for increased regulatory activity in the workplace.

As part of their union benefits, carpenters in the cohort had access to private health insurance. Because of the ready availability of health care and the barriers to and stigmatization associated with reporting work-related injury and illness to WC [Dembe, 2001], carpenters in our cohort may have sought care for their work-related injuries and illnesses through their private health insurance rather than through the WC system. In a previous analysis of the cohort data for the years 1989–2003, Lipscomb et al. [2009] demonstrated that for musculoskeletal back disorders, private health care cost rates increased, while WC rates declined over the observed period of time. The access to private health insurance among carpenters in the study cohort may have contributed to the phenomenon of cost-shifting, which indirectly caused a reduction in the reporting of events over time to L&I.

Strengths

These analyses provide an important longitudinal appraisal of the experience of these construction workers. It is unusual to have access to data such as these for any worker cohort, especially construction workers who are hired by multiple contractors over the course of their work experiences. Such access in a non-union work group would be impossible. While these analyses are limited to union labor, the results still have wide applicability to the construction trades because these union carpenters perform a variety of work ranging from residential building and drywall installation to light and heavy commercial work, roadway construction, bridge building, as well as industrial installations and maintenance.

The linking of WC data to actual union work hours and demographic data allowed us to clearly define a large population and their time at risk for work injury as union carpenters. These data linked on an individual basis, which were initially combined for a 4-year observation period [Lipscomb et al., 1996], now allow a robust assessment of work-related injury patterns among this construction cohort. Similar methods, and collaborations, have been described for analyses of the experiences of construction laborers in Washington State [Pollack et al., 1998]. The construction of event histories for each carpenter allowed us to use Poisson regression techniques to explore high-risk groups and examine changes in rates overtime adjusted for demographic characteristics. This regression technique is particularly useful in the analysis of longitudinal data for a dynamic cohort, such as this one, by allowing maximal use of all data available for each individual regardless of their observation time. The large number of claims, secured from one state run system, and considerable amount of exposure time (192,371,021 hr worked) observed during the 20-year period facilitated robust analyses.

CONCLUSIONS

Through this study we sought to better define the burden of occupational injury and illness among a large well-defined cohort of carpenters over a 20-year period. Occupational injury and illness pose a significant burden to individuals and society at large [Leigh et al., 1997; Morse et al., 1998], and the characterization of this burden can help provide a focus for addressing a substantial public health problem. Over the 20-year period of observation, there were clearly marked reductions in the carpenter cohort's injury rates. The results of this work support the need for continued efforts to reduce injuries among workers with less union tenure and younger workers—particularly "struck by an object" injuries. However, surveillance data alone—even from this large cohort—cannot define, precisely, how much of the decline in reported rates of injury reflect actual changes in safety practices, and true reductions in the rate of work-related injuries.

ACKNOWLEDGMENTS

We thank Lin Conley and Larry McNutt at the Carpenters Trusts of Western Washington for their longstanding support and access to data on this carpenter cohort. We acknowledge Darrin Adams, Safety and Health Assessment and Research for Prevention (SHARP) Program Washington State Department of Labor and Industries, for providing the matched workers' compensation records. Funding was provided through the National Institute for Occupational Safety and Health (1 U600H009761-1).

REFERENCES

Almeida SA, Trone DW, Leone DM, Shaffer RA, Patheal SL, Long K. 1999. Gender differences in musculoskeletal injury rates: A function of symptom reporting? Med Sci Sports Exerc 31:1807–1812.

Azaroff LS, Levenstein C, Wegman DH. 2002. Occupational injury and illness surveillance: Conceptual filters explain underreporting. Am J Public Health 92:1421–1429.

Azaroff LS, Lax MB, Levenstein C, Wegman DH. 2004. Wounding the messenger: The new economy makes occupational health indicators too good to be true. Int J Health Serv 34:271–303.

Dembe AE. 2001. The social consequences of occupational injuries and illnesses. Am J Ind Med 40:403–417.

Friedman LS, Forst L. 2007. The impact of OSHA recordkeeping regulation changes on occupational injury and illness trends in the US: A time-series analysis. Occup Environ Med 64:454–460.

Friedman LS, Forst L. 2007. Occupational injury surveillance of traumatic injuries in Illinois, using the Illinois trauma registry: 1995–2003. J Occup Environ Med 49:401–410.

Glazner JE, Borgerding J, Lowery JT, Bondy J, Mueller KL, Kreiss K. 1998. Construction injury rates may exceed national estimates: Evidence from the construction of Denver International Airport. Am J Ind Med 34:105–112.

Klonoff EA, Landrine H. 1992. Sex roles, occupational roles, and symptom-reporting: A test of competing hypotheses on sex differences. J Behav Med 15:355–364.

Leigh JP, Markowitz SB, Fahs M, Shin C, Landrigan PJ. 1997. Occupational injury and illness in the United States: Estimates of costs, morbidity, and mortality. Arch Intern Med 157:1557–1568.

Leigh JP, Marcin JP, Miller TR. 2004. An estimate of the U.S. Government's undercount of nonfatal occupational injuries. J Occup Environ Med 46:10–18.

Lipscomb HJ, Kalat J, Dement JM. 1996. Workers' compensation claims of union carpenters 1989–1992: Washington State. Appl Occup Environ Hyg 11(1):1–8.

Lipscomb HJ, Dement JM, Loomis DP, Silverstein B, Kalat J. 1997. Surveillance of work-related musculoskeletal injuries among union carpenters. Am J Ind Med 32:629–640.

Lipscomb HJ, Dement JM, Gaal JS, Cameron W, McDougall V. 2000. Work-related injuries in drywall installation. Appl Occup Environ Hyg 15:794–802.

Lipscomb HJ, Li L, Dement JM. 2003. Falls among union carpenters. Am J Ind Med 44:148–156.

Lipscomb HJ, Cameron W, Silverstein B. 2008. Back injuries among union carpenters in Washington State, 1989–2003. Am J Ind Med 51:463–474.

Lipscomb HJ, Dement JM, Silverstein B, Cameron W. Glazner. 2009. Who is paying the bills? Health care costs for musculoskeletal back disorders, Washington State union carpenters, 1989–2003. J Occup Environ Med 51:1185–1192.

Morse TF, Dillon C, Warren N, Levenstein C, Warren A. 1998. The economic and social consequences of work-related musculoskeletal disorders: The Connecticut Upper-Extremity Surveillance Project (CUSP). Int J Occup Environ Health 4:209–216.

NIOSH. National Occupational Research Agenda, National Construction Agenda, October 2008. http://www.cdc.gov/niosh/nora/comment/agendas/construction/pdfs/ConstOct2008.pdf Accessed July 19, 2012.

Pollack ES, Franklin GM, Fulton-Kehoe D, Chowdhury R. 1998. Risk of job-related injury among construction laborers with a diagnosis of substance abuse. J Occup Environ Med 40:573–577.

Rosenman KD, Gardiner JC, Wang J, Biddle J, Hogan A, Reilly MJ, Roberts K, Welch E. 2000. Why most workers with occupational repetitive trauma do not file for workers' compensation. J Occup Environ Med 42:25–34.

Rosenman KD, Kalush A, Reilly MJ, Gardiner JC, Reeves M, Luo Z. 2006. How much work-related injury and illness is missed by the current national surveillance system? J Occup Environ Med 48:357–365.

Shannon HS, Lowe GS. 2002. How many injured workers do not file claims for workers' compensation benefits? Am J Ind Med 42:467–473.

The Construction Chart Book: The U.S. construction industry and its workers, 2007. 4th edition. Silverspring, MD: The Center for Construction Research and Training.

U.S. House of Representatives, Committee on Education and Labor Majority Staff Report, The Honorable George Miller Chairman. June 2008. Hidden Tragedy: Underreporting of Workplace Injuries and Illnesses. http://www.cste.org/dnn/Portals/0/House%20Ed%20-Labor%20Comm%20Report%20061908.pdf Accessed July 24, 2012.

Verbrugge LM. 1985. Gender and health: An update on hypotheses and evidence. J Health Soc Behav 26:156–182.

Weil D. 1992. Building safety: The role of construction unions in the enforcement of OSHA. J Labor Res 13:121–132.

Weil D. 1996. If OSHA is so bad, why is compliance so good? Rand J Econ 27:618–640.

Welch LS, Hunting K. 2003. Injury surveillance in construction: What is an ''injury'', anyway? Am J Ind Med 44:191–196.

Welch LS, Dong X, Carre F, Ringen K. 2007. Is the apparent decrease in injury and illness rates in construction the result of changes in reporting? Int J Occup Environ Health 13:39–45.