

# Predictors of Delayed Return to Work After Back Injury: A Case–Control Analysis of Union Carpenters in Washington State

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**Methods** Union administrative records identified 20,642 union carpenters who worked in Washington State from 1989 to 2003. The Department of Labor and Industries provided records of workers' compensation claims and associated medical care. Work-related back claims ( $n = 4,241$ ) were identified by ANSI codes (back, trunk, or neck/back) or ICD-9 codes relevant to medical care consistent with a back injury. Cases ( $n = 738$ ) were defined as back injury claims with  $>90$  days of paid lost time; controls ( $n = 699$ ) resulted in return to work within 30 days. Logistic regression models estimated odds ratios and 95% confidence intervals (OR, 95% CI) of delayed return to work (DRTW).

**Results** Thirty percent of case claims and 8% of control claims were identified by an ICD-9 code. DRTW after back injury was associated with being female (2.7, 95% CI: 1.3–5.5), age 30–44 (1.2, 95% CI: 0.9–1.7) and age over 45 (1.6, 95% CI: 1.1–2.3), four or more years union experience (1.4, 95% CI: 1.1–1.8), previous paid time loss back claim (1.8, 95% CI: 1.3–2.5), and  $\geq 30$ -day delay to medical care (3.6, 95% CI: 2.1, 6.1). Evidence of more acute trauma was also associated with DRTW.

**Conclusions** Use of ICD-9 codes identified claims with multiple injuries that would otherwise not be captured by ANSI codes alone. Though carpenters of younger age and inexperience were at increased risk for a paid lost time back injury claim, older carpenters and more experienced workers, once injured, were more likely to have DRTW as were those who experienced acute events. Am. J. Ind. Med. 52:821–830, 2009. © 2009 Wiley-Liss, Inc.

**KEY WORDS:** workers' compensation; back injury claim; paid lost work time; delayed return to work

## INTRODUCTION

Carpenters have high rates of low back injury [Waller et al., 1989; Lipscomb et al., 1997, 2008], yet as an occupation are often understudied. Characteristics that perpetuate this lack of research—no permanent work place, frequently changing employers, and small dispersed work sites—are also factors that may contribute to delayed reporting and treatment for on the job injuries in this population. Risk factors for low back injury identified in previous research constitute the daily work tasks of carpenters: heavy work (e.g., 100 pound drywall sheets),

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manual handling tasks, twisting, frequent heavy lifting, awkward postures, and dangerous work situations (ladders and scaffolds) [Schneider and Susi, 1994]. When carpenters are injured, there is little opportunity for light duty or modified work, potentially requiring workers to be out longer or to return to work prematurely increasing the risk for further injury.

Delayed return to work after a work-related back injury is associated with high medical cost and high paid lost days. Researchers have summarized the evidence regarding delayed return to work [Turner et al., 2000; Krause et al., 2001] and report associations [increased risk] with older age [Cheadle et al., 1994; Oleinick et al., 1996a], female gender [Volinn et al., 1991; Cheadle et al., 1994; Gatchel et al., 1995], small firm size [Cheadle et al., 1994; Infante-Rivard and Lortie, 1996], falls [Hogg-Johnson et al., 1994], lifting [Tate et al., 1999], shorter employment duration [Infante-Rivard and Lortie, 1996], greater time between injury and rehabilitative treatment [Infante-Rivard and Lortie, 1996; McIntosh et al., 2000], and construction work [Cheadle et al., 1994; Hogg-Johnson et al., 1994; McIntosh et al., 2000]. Injuries to the back account for more days away from work than any other body part in construction, and the rate of lost days in the industry is only exceeded by the transportation industry [CPWR, 2002]. Therefore, it is important to identify risk factors for delayed return to work specific for this working population.

Previous studies have used hospitalization as a marker of severity for disability following work related back injury [Cheadle et al., 1994]. Carpenters with prolonged work loss or hospitalization from their first injury were significantly more likely to experience recurrence than those with shorter absences or requiring outpatient care [Lipscomb et al., 2008a]. However, "severe" or hospitalized injuries were not responsible for the majority of injuries resulting in paid lost time: 75% of impaired carpenters at 6 months post injury had only outpatient care [Waller et al., 1989].

With this in mind, we conducted a case-control analysis nested within an existing cohort of union carpenters to contrast work-related back injuries that resulted in prolonged loss of time from work with those resulting in more rapid return to work. We were interested in the effect of age, gender, time in the union, and predominant type of work on delayed return to work following a work-related back injury. In addition, to help target cases for secondary prevention efforts, we were interested in whether the nature or mechanism of injury (ANSI codes from workers' comp) or ICD-9 diagnoses help distinguish cases that resulted in delayed return to work. We want to explore whether ICD-9 code assigned for medical care of work-related back injuries or time to seek medical care for injury influences return to work. Lastly, does prior history of paid time off back claim predict delayed return to work?

## MATERIALS AND METHODS

This case-control analysis was nested within a cohort of 20,642 active union carpenters working in the state of Washington from 1989 to 2003. Previous studies with the entire cohort described the incidence [Lipscomb et al., 2008b] and recurrence [Lipscomb et al., 2008a] of work-related back injuries. In order to identify risk factors for delayed return to work back claims, we limited our analysis to work-related back injury claims among union carpenters that resulted in paid lost days from work. This case-control analytical design [Rothman and Greenland, 1988] was appropriate for the research question of interest.

### Data Sources

Data for this analysis come from three administrative data sources. Health insurance eligibility files from the Carpenters Trusts of Western Washington were used to identify a cohort of 20,642 active union carpenters who worked at least 3 months from 1989 to 2003 [Lipscomb et al., 1996, 1997]. No restriction was placed on minimum number of hours worked per month and the 3 months did not have to be consecutive. Entrances and exits were allowed throughout the 15-year period. The Trust also provided records of private health care utilization for non-work related injuries. The Washington State Department of Labor and Industries provided records of workers' compensation claims filed by these individuals during this period, including medical only claims, as well as those that resulted in lost work time. Claims from companies that self-insure for compensation coverage are only coded in the Labor and Industries system if the claim resulted in paid lost time from work. As a state run program, medical claims with International Classification of Disease (ICD-9) codes that reflected medical care received for these claims (excluding claims from self-insured employers) were also provided. These data were used to identify all work-related back injury claims. Only events that occurred in a month during which the individual had worked union hours were counted. A unique identifier was assigned to each individual by the Carpenters Trusts of Western Washington. Data were provided from all three sources with this identifier to allow linkage of all data on an individual basis. All procedures were approved by the Duke University Medical Center Institutional Review Board and the Washington State Institutional Review Board, Department of Social and Health Services.

### Back Injury Claims, Cases, and Controls

For these analyses, back claims of interest were identified by American National Standards Institute (ANSI) codes (back "420," trunk "400," or back and neck "600") or by International Classification of Disease (ICD-9) codes

relevant to medical care for claims consistent with a back injury (i.e., lumbar sprain, spondylosis, lumbar spinal cord injury). All codes have been previously described in published work [Lipscomb et al., 2008b]. Since the ANSI body part code identifies only cases where the back or back and neck were thought to be most severely involved at the time of the initial injury report, the use of ICD-9 codes identified back injuries and disorders for which a peripheral body part or a non-specific region (multiple, musculoskeletal, nervous) were reported. Claims for which the ANSI code for body part was missing were identified as a back injury by at least two different medical visits with an ICD-9 coded back pain diagnosis.

In Washington State, an injured worker receives payment for lost time after 3 days of missed work. The claim rather than worker was the unit of analysis; individuals with multiple claims could serve as both a case and a control during the 15-year period. Cases were defined as back injury claims with more than 90 days of paid lost time or delayed return to work (RTW). Controls were defined as back injury claims resulting in more rapid return to work or return within 30 days. These groupings corresponded with the phases of disability described in previous studies: acute phase or 1st 30 days, subacute phase or 30 to 90 days, and chronic phase or >90 days [Cheadle et al., 1994; Oleinick et al., 1996b; Dasinger et al., 1999; Krause et al., 2001]. We excluded claims with 31–90 paid lost days to highlight potential differences.

## Covariates

Covariates considered in this analysis based on associations in previous delayed RTW research included age, sex, time in the union, predominant type of carpentry work, history of a previous paid time off back injury claim, and delay to medical care (<30 days vs.  $\geq$ 30 days). No race or ethnicity information was available from these data sources. Time in the union was dichotomized at 4 years to separate apprentices from journeymen carpenters. Typically, an inexperienced carpenter must be in the union at least 4 years and complete appropriate training to reach journeyman status. Since 1997 Standardized Industry Classification (SIC) codes were replaced by North American Industry Classification System (NAICS) codes. This transition is still in process with these data and NAICS codes were missing for 23% (332/1,437). Therefore, SIC codes were used to determine the type of work performed at the time of the claim.

ANSI codes are provided for the body part injured, the nature of the injury (e.g., sprain, fracture), the mechanism of injury (e.g., fall), and the source (substance or object associated with the injury). Diagnosis (ICD-9) groupings for each claim were categorized for all claims as: contusion, spinal fracture, spinal cord injury, non-fracture dislocation (common diagnosis associated with chiropractic care), low

back sprain or strain, symptom descriptor (i.e., lumbago, back pain), degenerative (i.e., spondylosis, spinal stenosis), first aid only, no back ICD-9/ANSI back, other (i.e., sacral instability), mixed back diagnoses (i.e., two or more ICD-9 codes), and unknown (employers' self-insurance). Multiple claims in addition to two ICD-9 codes per claim were available for injury coding.

## Analysis

Descriptive frequencies and univariate statistics were calculated by worker and claim. Distribution of claims was examined from 1989 to 2003 to identify any yearly variation in claim reporting. ICD-9 codes were compared with ANSI nature of injury codes. Logistic regression models estimated odds ratios (OR) and 95% confidence intervals (95% CI) for the odds of a delayed return to work back injury claim compared to more rapid return. Age and time in the union were treated as time varying covariates. Variables associated with delayed return to work in previous literature were included in multivariate models as were predictors from univariate analyses with an odds ratio of either 1.20 or greater or 0.80 or less. Confidence limit ratios (CLR, calculated as the upper confidence limit divided by the lower confidence limit) were produced to quantify precision for all estimates [Poole, 2001].

## RESULTS

### Characteristics of Case and Control Back Injury Claims

Of the 3,093 union carpenters with a back injury claim, 40% reported 1,699 claims resulting in paid time off over a 15-year period: 738 claims had over 90 days delayed return to work (cases, range 91–3,774 days, median 465) and 699 claims returned to work within 30 days (controls, range 1–30 days, median 8). Nineteen percent of the injured carpenters had multiple back injury claims: 15% had one previous, 3% had two previous, and 1% had three previous claims. Time between claims ranged from 3 to 4,453 days (median 746); few had 3–20 days between claims (1%).

The proportion of back injury claims with delayed return to work was lowest in year 1989 and in year 1997 (31%) and highest from years 2000 to 2003 (54%, 56%, 59%, and 52% respectively). Delayed return to work back claims occurred more frequently among carpenters 45 and over, journeymen (four or more years union experience), and those who's previous claim was a paid time off back injury claim (Table I). Claims among individuals working for residential operative builders were more frequently delayed return to work; claims among individuals working for non-residential general contractors were more frequently rapid return to work (Table I). Of the few females, twice as many claims were delayed return to work claims.

**TABLE I.** Demographic Characteristics of Case and Control Back Injury Claims Among Washington State Union Carpenters, 1989–2003

	Cases (claims with over 90 paid lost days)		Controls (claims with 1–30 paid lost days)		Total	
	n	%	n	%	n	%
Gender						
Male	709	96.5	686	98.4	1,395	97.4
Female	26	3.5	11	1.6	37	2.6
Unknown	3		2		5	
Age at injury date						
Under 30	101	13.7	141	20.2	242	16.8
30–44	435	58.9	419	59.9	854	59.4
45 and over	202	27.4	139	19.9	341	23.7
Union experience						
Apprentice (<4 years)	180	24.4	238	34.0	418	29.1
Journeyman (≥4 years)	558	75.6	461	66.0	1,019	70.9
SIC codes						
Non-residential general contractor <sup>a</sup>	183	24.8	212	30.3	395	27.5
Residential operative builder <sup>b</sup>	154	20.9	110	15.7	264	18.4
Heavy construction <sup>c</sup>	54	7.3	31	4.4	85	5.9
Specialty contractor <sup>d</sup>	135	18.3	122	17.5	257	17.9
Drywall <sup>e</sup>	142	19.2	134	19.2	276	19.2
All others	60	8.1	80	11.4	140	9.7
Missing	10	1.4	10	1.4	20	1.4
History of previous paid time off back injury claim						
No	618	83.7	633	90.6	1,251	87.1
Yes	119	16.3	66	9.4	185	12.9
Total	738		699		1,437	

Individual carpenters can be a case or a control during the 15-year period.

<sup>a</sup>SIC codes: 1541, 1542.

<sup>b</sup>SIC codes: 1521, 1522, 1531.

<sup>c</sup>SIC codes: 1611, 1622, 1623, 1629.

<sup>d</sup>SIC codes: 1711, 1721, 1741, 1751, 1752, 1761, 1771, 1791, 1793, 1794, 1796, 1799.

<sup>e</sup>SIC codes: 1742.

Thirty percent of case claims and 8% of control claims were identified by an ICD-9 code (ANSI body code was missing,  $n = 3$ , or multiple injuries were sustained,  $n = 281$ ). Delayed return to work most often occurred for claims with multiple body parts involved including upper and lower extremities, multiple injury types, dislocations (herniated nucleus pulposus), and fractures (Table II, Note: ANSI dislocation of back is used to code herniated nucleus pulposus). Traumatic events such as falls and being struck were more often delayed return claims. Injury claims to the back only, sprains and strains, and overexertion injuries were more likely to have a rapid return to work. ICD-9 code groupings for spinal fracture, spinal cord injury, symptom descriptor (e.g., “lumbago,” “back pain”), degenerative, and mixed back diagnoses occurred more often in delayed return claims. Sprains and strains and non-fracture dislocations were predominantly rapid return claims. The top four

sources of back injury claims for cases and controls included timber or slab (10% cases; 13% controls), sheetrock (9% cases; 9% controls), bodily motion, (7% cases; 8% controls), and work surface (8% cases; 5% controls).

Inpatient hospital care was predominantly for delayed return claims (18% vs. 1%) whereas outpatient care (90% vs. 77%) or first aid (9% vs. 5%) was more common for rapid return claims. For most injured carpenters we could identify medical care received within 30 days of the injury claim date; however, delayed return claims were more likely to be seen after 30 days (9%) compared to rapid return claims (3%).

### Predictors of Delayed Return to Work

Delayed return to work after back injury claim was associated with being female, age 30–44 and age over 45, journeyman status (four or more years union experience),

**TABLE II.** Characteristics for Case and Control Back Injury Claims Among Washington State Union Carpenters, 1989–2003

	Cases (claims with over 90 paid lost days)		Controls (claims with 1–30 paid lost days)		Total	
	n	%	n	%	n	%
Claim identified as back by ICD-9 code						
No	515	70	641	92	1,156	80
Yes	223	30	58	8	281	20
Grouped by part <sup>a</sup>						
Neck	23	3	5	1	28	2
Neck/back	65	9	71	10	136	9
Back	431	58	560	80	991	69
Head/face	5	1	0	0	5	0
Chest/abdomen	9	1	9	1	18	1
Trunk multiple	19	3	10	1	29	2
Multiple body parts	60	8	21	3	81	6
Upper extremity	76	10	12	2	88	6
Lower extremity	47	6	11	2	58	4
Unclassified	2	0	0	0	2	0
Missing	1	0	0	0	1	0
Nature of injury (ANSI coded)						
Sprain or strain	395	54	553	79	948	66
Contusion	4	1	12	2	16	1
Dislocation (herniated nucleus pulposus)	32	4	7	1	39	3
Fracture	15	2	6	1	21	1
Ill-defined symptoms	49	7	50	7	99	7
Multiple injury types	226	31	59	8	285	20
Other	5	1	0	0	5	0
Missing	12	2	12	2	24	2
Mechanism of injury (ANSI coded)						
Overexertion	419	57	502	72	921	64
Bodily reaction	52	7	58	8	110	8
Fall from elevation	102	14	53	8	155	11
Fall from same level	54	7	36	5	90	6
Struck against object	12	2	8	1	20	1
Struck by object or person	52	7	23	3	75	5
Motor vehicle crash	10	1	1	0	11	1
Other	17	2	2	0	19	1
Missing	20	3	16	2	36	3
ICD-9 grouping						
Sprain or strain	96	13	223	32	319	22
Contusion	4	1	8	1	12	1
Dislocation—not fracture <sup>b</sup>	26	4	130	19	156	11
Symptom descriptor <sup>c</sup>	48	7	17	2	65	5
Degenerative	50	7	24	3	74	5
Company self-insured claim	34	5	60	9	94	7
No back ICD-9/ANSI back	27	4	64	9	91	6
Mixed back diagnoses <sup>d</sup>	426	58	168	24	594	41
Other	4	1	1	0	5	3
Spinal fractures	18	2	1	0	19	1
Spinal cord injury	5	1	0	0	5	0
First aid only	0	0	3	0	3	0
Total	738		699		1,437	

ICD-9, International Classification of Disease; ANSI, American National Standards Institute.

<sup>a</sup>Primary body part injured from ANSI or ICD-9 code.<sup>b</sup>Common diagnosis for chiropractic care.<sup>c</sup>Symptom descriptors include lumbago, back pain, etc.<sup>d</sup>Mixed back diagnoses include two or more ICD-9 codes.

previous claim was a paid time off back injury claim, and a 30-day delay to medical care (Table III). There was a positive and statistically significant linear trend for age and delayed return to work ( $P$  for trend  $<0.05$ ). In multivariate analyses all associations remained except for the positive association with increasing age attenuated as a result of the positive correlation (0.68) between age and union experience (Table III).

For other predictors, the unadjusted estimates were identical to adjusted estimates, therefore we present adjusted estimates in Tables IV and V. Standard Industry Classification codes for heavy construction and residential operative building industries were associated with delayed return to work compared to non-residential general contractors (Table IV).

Evidence of more acute trauma was associated with delayed return to work and included being struck against or by an object or person, a fall from elevation or the same level, and motor vehicle crashes (Table IV). When compared to ANSI classified strains and sprains, dislocations (herniated nucleus pulposus), fractures, and multiple injury types were associated with delayed return to work. ICD-9 code groupings for symptom descriptor, degenerative, mixed back diagnoses, and spinal fracture or cord injury were associated with delayed return to work compared to sprains and strains. Unlike ANSI injury type dislocations which represent disc herniations, ICD-9 coded dislocations were associated with a rapid return to work.

There is a suggestion of a linear trend between increasing years between paid time off back injury claims and increased odds of delayed return to work (Table V). Previous care for back injury prior to the back injury claims, through private insurance or workers' comp, was associated with delayed return to work (Table V).

## DISCUSSION

We observed associations with delayed return to work for increasing age, years of experience, and acute injury events. These findings are consistent with previous occupational studies that reported delayed return to work among workers of older age [Cheadle et al., 1994; Oleinick et al., 1996a] and for falls [Hogg-Johnson et al., 1994]. In a previous study, shorter employment duration was associated with delayed return to work [Infante-Rivard and Lortie, 1996]. In this study we used time in the trade which does not equate to employment duration (e.g., carpenters generally work for multiple employers/contractors for different periods of time throughout their career). Washington State Union carpenters have clearly defined apprentice and journeyman experience levels. Our study considered less than 4 years whereas the study conducted in a rehab clinic by Infante-Rivard and Lortie included workers of different industries and defined employment duration as  $<2$  years.

Though carpenters of younger age and inexperience are at increased risk for a paid lost time back injury claim

**TABLE III.** Odds Ratios (OR) and 95% Confidence Intervals (95% CI) for Predictors of Back Injury Claims With Delayed Return to Work Among Washington State Union Carpenters, 1989–2003

	Cases, n = 738	Controls, n = 699	OR	95% CI	CLR <sup>a</sup>	Adjusted OR <sup>b</sup>	95% CI	CLR <sup>a</sup>
Gender								
Male	709	686	1.0			1.0		
Female	26	11	2.3	1.1, 4.7	4.2	2.7	1.3, 5.5	4.3
Age at injury date								
Under 30	101	141	1.0			1.0		
30–44	435	419	1.5	1.1, 1.9	1.8	1.2	0.9, 1.7	1.9
45 and over	202	139	2.0	1.5, 2.8	2.0	1.6	1.1, 2.3	2.1
Union experience								
Apprentice ( $<4$ years)	180	238	1.0			1.0		
Journeyman ( $\geq 4$ years)	558	461	1.6	1.3, 2.0	1.6	1.4	1.1, 1.8	1.7
Previous claim was paid time off back claim								
No	618	633	1.0			1.0		
Yes	119	66	1.9	1.3, 2.6	1.9	1.8	1.3, 2.5	1.9
Delay to medical care								
$<30$ days	668	679	1.0			1.0		
30 days or more	70	20	3.6	2.1, 5.9	2.8	3.6	2.1, 6.1	2.9

Adjusted model n = 1,431; five missing values for sex, one missing value for history of back claim.

<sup>a</sup>CLR, confidence limit ratio = upper confidence limit divided by the lower confidence limit [Poole, 2001].

<sup>b</sup>Multivariate model adjusted for all other variables in the table.

**TABLE IV.** Odds Ratios (OR) and 95% Confidence Intervals (95% CI) for Predictors of Back Injury Claims With Delayed Return to Work Among Washington State Union Carpenters, 1989–2003

	Cases, n = 738	Controls, n = 699	Adjusted OR	95% CI	CLR <sup>a</sup>
SIC codes <sup>b</sup>					
Non-residential general contractor <sup>c</sup>	183	212	1.0		
Residential operative builder <sup>d</sup>	154	110	1.6	1.1, 2.2	1.9
Heavy construction <sup>e</sup>	54	31	2.0	1.2, 3.2	2.7
Specialty contractor <sup>f</sup>	135	122	1.3	0.9, 1.7	1.9
Drywall <sup>g</sup>	142	134	1.3	0.9, 1.7	1.9
All others	60	80	0.8	0.6, 1.3	2.2
Missing	10	10			
Mechanism of injury (ANSI coded) <sup>b</sup>					
Overexertion	419	502	1.0		
Bodily reaction	52	58	1.1	0.7, 1.7	2.2
Struck against object	12	8	1.8	0.7, 4.7	6.5
Struck by object or person	52	23	2.9	1.7, 4.8	2.8
Fall from elevation	102	53	2.7	1.8, 3.8	2.1
Fall from same level	54	36	1.7	1.1, 2.8	2.5
Motor vehicle crash	10	1	13.9	1.7, 110.3	63.2
Other or missing	37	18	2.5	1.4, 4.6	3.3
Nature of injury (ANSI coded) <sup>b</sup>					
Sprain or strain	395	553	1.0		
Ill-defined symptoms	49	50	1.2	0.8, 1.9	2.4
Contusion	4	12	0.6	0.2, 2.0	10.1
Dislocation (herniated nucleus pulposus)	32	7	6.3	2.7, 14.5	5.4
Fracture	15	6	3.9	1.5, 10.3	7.1
Multiple injury types	226	59	5.4	3.9, 7.4	1.9
Other and missing	17	12	1.5	0.7, 3.3	4.9
ICD-9 grouping <sup>b</sup>					
Sprain or strain	96	223	1.0		
Contusion	4	8	1.5	0.4, 5.0	11.8
Dislocation—not fracture	26	130	0.5	0.3, 0.8	2.7
Symptom descriptor	48	17	5.8	3.1, 10.7	3.4
Degenerative	50	24	4.4	2.5, 7.7	3.0
Company self-insured claim	34	60	1.0	0.6, 1.7	2.8
No back ICD9/ANSI = back	27	64	0.9	0.5, 1.6	2.9
Mixed back diagnoses	426	168	5.8	4.2, 7.8	1.8
Other	4	1	7.5	0.8, 73.5	96.3
Spinal fracture or cord injury	23	1	55.8	7.4, 420.8	56.9
First aid only	0	3	No estimate		

ICD-9, International Classification of Disease; ANSI, American National Standards Institute.

<sup>a</sup>CLR, confidence limit ratio = upper confidence limit divided by the lower confidence limit [Poole, 2001].

<sup>b</sup>Adjusted for gender, age, experience, previous claim was paid time off claim, and  $\geq 30$  day delay to care.

<sup>c</sup>SIC codes: 1541, 1542.

<sup>d</sup>SIC codes: 1521, 1522, 1531.

<sup>e</sup>SIC codes: 1611, 1622, 1623, 1629.

<sup>f</sup>SIC codes: 1711, 1721, 1741, 1751, 1752, 1761, 1771, 1791, 1793, 1794, 1796, 1799.

<sup>g</sup>SIC codes: 1742.

[Lipscomb et al., 2008b], older carpenters and more experienced workers, once injured, were more likely to have delayed return to work. This finding provides some evidence for a cumulative trauma effect or the inability to adapt in

older age and our data for increasing experience supports this. Journeymen (76% vs. 66%) were more frequently cases and more frequently had previous paid time off back injury claims (90% vs. 68%).

**TABLE V.** Previous Back Injury Claim and Medical Care as Predictors of Delayed Return to Work After Back Injury Claim Among Washington State Union Carpenters, 1989–2003

	Cases, n = 738	Controls, n = 699	Adjusted OR	95% CI	CLR <sup>a</sup>
Years between paid time off claims <sup>b</sup>					
4 or more	35	17	1.8	1.0, 3.3	3.3
3 to <4 years	15	5	3.1	1.1, 8.6	7.7
2 to <3 years	21	9	2.3	1.0, 5.1	4.9
1 to <2 years	18	11	1.8	0.8, 3.8	4.6
Up to 1 year	30	24	1.3	0.7, 2.2	3.1
Zero	618	633	1.0		
Days lost in previous paid time off claim <sup>b</sup>					
90 or more days	46	7	6.4	2.9, 14.4	2.3
30 to 90 days	19	17	1.0	0.5, 2.0	3.9
1 to 30 days	54	42	1.3	0.9, 2.0	5.0
No paid lost days	618	633	1.0		
Previous recent care from private health insurance <sup>b</sup>					
Care in the previous year	174	121	1.4	1.1, 1.8	1.7
Care beyond 1 year	131	128	0.9	0.7, 1.2	1.8
No recent care	433	450	1.0		
Previous recent care from workers' comp <sup>b</sup>					
Care in the previous year	113	78	1.5	1.1, 2.1	1.9
Care beyond 1 year	127	99	1.2	0.9, 1.7	1.8
No recent care	498	522	1.0		

<sup>a</sup>CLR, confidence limit ratio = upper confidence limit divided by the lower confidence limit [Poole, 2001].

<sup>b</sup>Adjusted for gender, age, experience, and  $\geq 30$ -day delay to care.

Like age and experience, the observed associations for previous claim history and ICD-9 degenerative diagnosis also support a possible cumulative trauma effect. We observed some heterogeneity of the association between previous claim history and delayed return to work by injury mechanism. Among the overexertion and bodily reaction mechanism claims, the presence of a previous paid time off claim was associated with delayed return to work (OR 2.5, 95% CI: 1.7–3.6). We observed the opposite association for claim history among other injury mechanisms (OR 0.8, 95% CI: 0.4–1.6). Explanations for this finding include increased susceptibility to an overexertion or bodily reaction injury via incomplete treatment or rehabilitation after a previous paid time off claim and the natural history of back disorders.

Among these Washington State union carpenters, females and workers with a 30 or more day delay to medical care were a small proportion of the over all back injury claims, but were at the highest increased risk for delayed return to work. This association remained after adjustment for age and experience. With only 37 female carpenters in this study, we were unable to examine potential differences by type of work or other variables. An association for increasing time from injury and rehabilitative treatment is supported in previous rehabilitation clinic studies [Infante-Rivard and Lortie, 1996; McIntosh et al., 2000]. Claims that

had no medical care on file were coded as exposed or delayed care (4 cases and 11 controls). Excluding these observations, or alternatively, coding as unexposed or no delay to care, results in stronger effects (OR = 7.5 respectively); however, we reported the more conservative estimate. We used delay to any medical care in this analysis, and we could not determine from our data the myriad of potential reasons behind such delays to medical care for these cases and controls: exacerbation of issue or complaint, reluctance to get care, seeking care through private insurance, issues with workers' comp system and/or reimbursement, or job overlap.

While ANSI codes represent the body part injured in the first report of injury claim event, ICD-9 codes reflect treatment for a back injury by a provider. The inconsistent associations observed for ANSI coded "dislocations" or herniated discs (OR = 6.3) and ICD-9 coded "dislocations" (OR = 0.5) support these as different injuries.

We observed strong associations between delayed return to work and ICD-9 symptom descriptor (OR = 5.8) and mixed back diagnoses (OR = 5.8). ICD-9 coded symptom descriptor injuries (n = 65) were predominantly due to overexertion (42%) or falls (32%) and almost all involved ANSI body parts other than the back or neck/back (95%). ICD-9 codes for treatment of a back claim caught these claims. Involvement of other parts implies that the coder

identified the primary injury at exam as a part other than back, however the worker tends to be out a long time. This could signal delayed return to work due to multiple injuries (carpenter had more than just a back injury) or treatment for a chronic back problem in addition to a new injury or inadequate rehabilitation of a prior back injury. Injuries coded mixed back diagnoses by ICD-9 ( $n = 594$ ) were predominantly due to overexertion (64%), bodily reaction (9%), and falls from height (9%) and most involved the back or neck/back (87%). These mixed back diagnoses likely represent the evolution of back diagnoses of benign or non-specific categories that develop into other more specific diagnoses.

Over the 15-year period, the proportion of delayed return to work claims increased. This likely represents a decrease in less severe events or their reporting over time.

We used conservative case and control definitions (>90 days vs. 1–30 days) aiming to separate these groups more clearly. These groups corresponded with the phases of disability described in previous studies: acute phase or 1st 30 days, subacute phase or 30–90 days, and chronic phase or >90 days [Cheadle et al., 1994; Oleinick et al., 1996b; Dasinger et al., 1999; Krause et al., 2001]. In a study of industry insurance back sprain claims, Violinn et al. compared 90 or more days to  $\leq 14$  days and found similar associations with increasing age [Volinn et al., 1991]. Dichotomizing case and control definitions at 90 days (>90 vs.  $\leq 90$  days), we found similar associations for our main variables except for experience and delayed care which were attenuated.

## Limitations

We recognize the limitations of administrative and workers' compensation data sources. We only captured work related injuries for which workers filed claims. However, since this analysis was restricted to paid lost day claims we felt that our overall capture was adequate. Barriers to filing a workers' compensation claim for this population of union carpenters may include convenience and ease of seeing their personal care provider for treatment rather than filing a claim through the workers' comp system (Personal communication to H. Lipscomb from Carpenters Trust of Western Washington representative, 12-16-2008). The addition of private health insurance claim information indicated that a total of 446 claimants were cared for outside the comp system for a back injury prior to their first paid time off back claim. These union carpenters are provided medical coverage free through the union and generalizing these findings to other non-union carpenters without such medical care should be done with caution.

We were limited by sample size for certain variables (e.g., gender,  $\geq 30$ -day delay to medical care) demonstrated by wide confidence intervals and large confidence limit

ratios. This also prevented examination of all variables in a fully adjusted multivariate model. However, we included age, experience, gender, claim history, and delay to care in the multivariate models for variables with multiple levels – industry, injury and diagnosis descriptors, and mechanism (Table IV). The strength of association for all these variables did not change from unadjusted models.

We did not have access to information that would allow us to examine other variables known to be associated with delayed return to work: psychosocial factors, pain ratings, education, employer size, specific work exposures or tasks, and availability of light or modified work, etc. Confounding or correlation by work site may be present; a general lack of safety or a poor safety record at the job site may be associated with increased injury and delayed return to work after an injury [Lipscomb et al., 2003]. However these administrative sources did not provide data on the work site.

## Strengths

This case–control analysis was nested within a 15-year longitudinal cohort of over 20,000 carpenters. The linkage of administrative data with workers' compensation claim data and personal health insurance care data allowed us to examine occupational risk factors associated with delayed return to work.

The use of ICD-9 codes identified back injury claims with multiple injuries that would otherwise not be captured by ANSI codes alone. Previous literature suggests that 25% of back injuries are missed by using ANSI codes only [Oleinick et al., 1996a]. With the exception of the  $n = 94$  self-insured claims where ICD9 code was missing, using ICD9 diagnosis codes allowed a complete enumeration of back injury claims capturing 32% of the cases and 9% of controls. Although restricting analyses to only ANSI-identified back injury claims did not change observed associations for the main risk factors in this population of carpenters—sex, age, years union experience, and history of paid time off back claim—we were able to capture all back injury claims. Half of the motor vehicle crashes were ICD-9 identified as were falls from height and struck by mechanisms. Reliance on ANSI identified claims alone would have missed these claims.

## CONCLUSION

Individuals with multiple injuries often from acute traumatic injury and those with a previous back injury claim, especially if out a long time, were at increased risk of delayed return to work. The increased association we observed among females and those with delays to medical care is difficult to interpret with administrative data without substantive information from qualitative interviews. This information may reveal differences in work task distribution

by gender and care seeking or reporting behavior. Whether delays in medical care are related to other issues such as time constraints, pressure from employers and fellow workers, hassles with workers' compensation process, etc., we need more information in order to make appropriate recommendations. We know from site visits and qualitative research conducted with residential St. Louis carpenters that workers are influenced by the attitudes of coworkers and supervisors and the safety climate on their worksites [Lipscomb et al., 2003].

Though carpenters of younger age and inexperience were at increased risk for a paid lost time back injury claim, older carpenters and more experienced workers, once injured, were more likely to have delayed return to work as were those who experienced acute events such as falls, being struck by objects or persons, and motor vehicle crashes. Primary prevention of these work-related events is vital for occupations where the availability of modified work is limited if nonexistent. However, more than addressing manual materials handling is needed. There are work situations that cause acute traumas resulting in multiple injuries and it is important to address and prevent these events. Secondary prevention measures based on these findings would include prompt treatment for back injuries and development of modified work for injured carpenters who are not ready for full return to work.

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