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Back Injuries Among Union Carpenters in Washington State, 1989–2003

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Background *There is limited information on occupational back pain specific to carpenters despite their known exposures to recognized occupational risk factors and limited opportunities for modified work due to the predominantly heavy nature of their work.*

Methods *By combining union records with worker's compensation claims, we describe work-related back injuries, including associated medical diagnoses, among a well-defined cohort of union carpenters between 1989 and 2003. High risk subgroups were explored based on age, gender, union tenure, and predominant type of work. Paid lost time claims were contrasted to less serious events, and injuries sustained from overexertion activities were contrasted with those sustained through more acute trauma.*

Results *Back injuries occurred at an overall rate of 6.2/200,000 hours worked. Most injuries were coded in the compensation records as sprains, but there was little agreement between these nature of injury codes and ICD9 diagnosis codes. Injury rates declined most significantly over time for injuries secondary to overexertion. In multivariate analyses, we observed similar patterns of risk for the types of claims evaluated despite disparate mechanisms and severity. Those who worked predominantly in residential carpentry or drywall installation were consistently at greatest risk.*

Conclusions *Overexertion injuries from manual materials handling activities are responsible for the largest burden of back injuries among these carpenters, but a growing proportion of injuries result from acute traumatic events. Interventions are called for which specifically address risk among residential carpenters and drywall installers. These data provide additional evidence that Bureau of Labor Statistics data underestimate work-related injuries.* Am. J. Ind. Med. 51:463–474, 2008. © *2008 Wiley-Liss, Inc.*

KEY WORDS: occupational injury; back injury; construction workers; carpenters; longitudinal analysis

BACKGROUND

Carpenters have exposures to recognized occupational risk factors for back pain—heavy work, materials handling, pushing, twisting, frequent heavy lifting, requirements for sudden unexpected maximal efforts, and awkward postures [Schneider and Susie, 1994; NIOSH, 1997]. They also have limited opportunities for modified work due to the predominantly heavy nature of their jobs, and physical demands are increasing in some areas of their work. For example, the use of heavier, bulkier materials such as 12–16 foot sheets of drywall that weigh over 100 pounds per sheet are now common place in residential and commercial settings. Despite high rates of injury and prolonged disability

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associated with being employed in construction [Cheadle et al., 1994; McIntosh et al., 2000], there is little literature specifically related to occupational back problems among carpenters [Waller et al., 1989, 1990; Lipscomb et al., 1997; Luoma et al., 1998].

By combining union records with worker's compensation claims, we describe work-related back injuries among a well-defined cohort of union carpenters for the 15-year period between 1989 and 2003. The goals of the analysis were to evaluate rates of back injury over this 15-year period, to identify high risk sub-groups within the cohort based on age, gender, union tenure, and predominant type of work, to contrast risk factors for injuries that result in paid lost time (PLT) from work and those that were less severe, and lastly to contrast risk associated with injuries that resulted from overexertion with those that resulted from more acute traumatic events.

MATERIALS AND METHODS

Data Sources

Using data from the Carpenters Trusts of Western Washington (CTWW) and the Washington State Department of Labor and Industries (L&I) we identified a cohort of union carpenters who worked in the State of Washington between 1989 and 2003, their dates of birth, gender, earliest date of union activity, their hours of union work each month, and their workers' compensation claims. No race or ethnicity information was available from these sources.

The State of Washington has a state run worker's compensation program which allowed us to get claims data from one source. The state captures medical only claims as well as those which result in lost work time as they are filed. The compensation claims data included the date of injury, American National Standards Institute (ANSI) codes describing the events in terms of body part injured, the nature of the injury, the type of event causing the injury, and whether the claim resulted in medical costs or PLT from work, which occurs after the third lost day in the State of Washington. Claims from companies which self-insure for compensation coverage are only coded in the L&I system if they result in PLT from work.

Through this state run program we also had access to the medical care claims for the treatment of these injuries including provider assigned ICD9 diagnosis codes (excluding claims from self-insured employers). Data from L&I were extracted on August 26, 2004; this allowed 8 months time after the last claims were filed in December of 2003 for full development of claims including proper identification, and capture, of the self-insured claims that resulted in PLT from work.

The data were provided with a blinded unique identifier allowing us to merge the records on an individual basis without the use of personal identifiers; these methods have been previously described in detail [Lipscomb et al., 1997, 2003a]. Analyses were limited to individuals who worked at least 3 months of union hours during this 15-year period and had at least 1 month of eligibility for health insurance through CTWW.

Events of Interest and Diagnoses

For these analyses we wanted to identify all workers' compensation records for back injuries among the cohort. We first identified records with an ANSI code of "420," "400," or "600" representing a primary injury to the back, trunk, or the back and neck. We then identified any additional events that had a back specific ICD9 code (see Appendix B for listing) assigned for medical treatment of the injury; relevant ICD9 codes were selected by a review of all ICD9 codes for musculoskeletal and nervous system disorders, as well as acute injury and poisoning codes. To be included in our analyses claims without an ANSI code, designating a back injury, had to have at least two different medical visits with a back pain diagnosis in the workers' compensation treatment files. This process captured claims in which the body part code indicated multiple injuries as well as claims that may have had some other body part designated as the primary injury when first reported, while avoiding claims that may have been identified because of a single miscoded ICD9 diagnosis.

To assign a medical diagnosis to groups of medical claims, reflecting both inpatient and outpatient care an injured carpenter received, a priori, ICD9 codes were placed in groups felt to represent similar disorders. This was done in conjunction with an occupational medicine physician with particular expertise in musculoskeletal problems. A particular attempt was made to separate more acute trauma from injuries resulting from overexertion or bodily motion. Individuals who had a diagnosis of a spinal fracture or cord injury were assigned that designated diagnosis regardless of any other codes they may have been assigned. An attempt was next made to separate diagnoses which based on the face value of the ICD9 code represent acute events (contusions, dislocations, sprains, root injuries) from those which may be more likely to be the result of more chronic exposures. Dislocations, which are not fractures, and low back sprain/strains should theoretically represent acute events. The category "degenerative spine pain" was used for codes which have been used by others to potentially represent the result of cumulative trauma [Park et al., 1992]. Non-specific back codes (lumbago, unspecified back pain) were classified together as symptom descriptors. Individuals who had codes from more than one of these designated categories were assigned a mixed diagnosis code (see Appendix A for codes used).

Time at Risk

After the claims of interest were identified, event histories were created for each individual. Person-hours of work as a union carpenter were used as the measurement of time at risk. The carpenters were considered to be at risk of injury at any time they were working union hours beginning in the first month they met the cohort entry criteria. The occurrence of one injury did not remove the worker from the risk set for a new event as long as he/she was working. Although person-hours were used as the measurement of time at risk, the person-month was effectively the unit of analysis since we do not know when the hours in any given month were accumulated. All hours in months in which an injury occurred were counted as time at risk for that injury. Only injuries which occurred in a month that the individual worked union hours were counted so that events and time at risk were counted on the same basis for rate calculations.

Analyses

Descriptive statistics were generated on age, gender, time in the union, predominant type of work, and hours worked by the cohort. Carpenters typically spend 4 years in apprenticeship; strata were constructed to assess risk in each year of this training and at 2-year intervals afterwards. The union local affiliation was the only surrogate available for characterizing the work done by cohort members. The locals represented by the cohort members were grouped into categories based on the predominant type of carpentry work done by the locals. Assignments of predominant type of work from earlier work with this cohort [Lipscomb et al., 1997, 2003a] were updated through interviews with business agents for each union local.

These categories included light commercial, heavy commercial, drywall, millwrighting, piledriving, residential carpentry, and a mixed category. Light commercial work involved construction on projects two to three stories. Heavy commercial work involved high-rise buildings and interstate, freeway and bridge work. Millwrights are carpenters who work in industry and are often involved in repair and maintenance of heavy machinery. Drywall carpenters in Washington State hang drywall, but they do not tape or finish, in residential or commercial settings. We were unable to identify the type of work of carpenters affiliated with a local outside of the State of Washington; for this reason they were combined for the analyses.

Back injuries were described in terms of the ANSI nature and type (mechanism) of injury codes, type of medical care received and diagnoses assigned. Crude and stratified incidence density rates were calculated per 200,000 hr worked (the equivalent of 100 carpenters working full-time for 1 year). Age and time in the union were both treated as time-varying variables with time at risk accumulating in the appropriate strata over the 15-year period. Poisson regression was used to calculate crude rates and rate ratios and adjusted rate ratios [Nizim, 2000] because of its utility in the analyses of longitudinal data for a dynamic cohort, such as this one, since it allows maximal use of available data for each individual [Checkoway et al., 1989]. Claims for back injuries that did and did not result in PLT from work were analyzed separately and contrasted, and those that resulted from overexertion were compared to more acute traumatic events. All analyses were conducted using SAS Version 8.2 [SAS Institute, Inc., 1999].

RESULTS

Cohort

We identified a dynamic, retrospective cohort of 20,642 carpenters who worked at least 3 months in the State of Washington between 1989 and 2003. Of these, 18,768 worked hours after they met cohort entry criteria. Mean time the carpenters were observed over the 15 years was 45 months (median 23.0). The cohort was predominantly male (n = 17,879; 97.4%), and relatively young at first observation (range from 17 to 76 years, mean 35 years, median 34 years). Time in the union at first entry into the cohort ranged from less than 1 year to 48 years (mean 6.1 years; median 1 year).

Identification and Description of Claims

A total of 4,138 workers' compensation claims for back injuries were identified in months of union work by cohort members in 15 years; these injuries accounted for 19% of all workers' compensation claims filed. We identified 3,590 back injuries using an ANSI body part code. An additional 548 injuries, or 13.2% of the total, were identified using ICD9 diagnoses on claims for medical care. The latter included 372 claims in which another body part had been coded as the more significant injury, 167 claims that had an ANSI body part code of ''multiple,'' and nine claims in which the body part code was missing.

Just over 5% of the claims had no associated medical costs (n = 215) and 91% (3,764) had only outpatient care; 3.8% (n = 159) required hospitalization. The injuries occurred among 3,037 different carpenters or 16% of the cohort. The number of back injury claims among the injured ranged from 1 to 7; 73% had only one injury. Forty percent (40%) of the back injuries (n = 1,681) resulted in PLT from work.

Based on ANSI coding, the majority of the PLT and non-PLT claims were both classified as resulting from overexertion and they were most commonly coded as sprains (Table I). Proportionately more of the PLT claims were identified by an ICD9 code on a claim for actual medical

TABLE I. Nature and Mechanism of Injury and Medical Diagnoses by Whether Back Injury Resulted in Paid Lost Time From Work, Union Carpenters, Washington State, 1989–2003

	No paid lost time (n = 2,457), frequency (%)	Paid lost time (n = 1,681), frequency (%)
Mechanism of injury		
Overexertion	1,632 (66.5)	1,078 (64.1)
Bodily reaction	209 (8.5)	123 (7.3)
Fall from elevation	186 (7.6)	183 (10.9)
Same level fall	140 (5.7)	105 (6.3)
Struck by	134 (5.5)	91 (5.4)
Struck against	64 (2.6)	25 (1.5)
MVA	18 (0.73)	13 (0.77)
Caught	10 (0.41)	5 (0.30)
Explosion	1 (0.04)	—
Abraded	1 (0.04)	—
NEC/Unknown	58 (2.6)	58 (3.5)
Nature of injury		
Sprain	1,973 (80.3)	1,101 (65.5)
Ill-defined symptoms	148 (6.0)	121 (7.2)
Contusion	56 (2.3)	24 (1.4)
Dislocation/herniated disc	29 (1.2)	46 (2.7)
Fracture	7 (0.28)	27 (1.6)
Nervous system	5 (0.20)	7 (0.42)
Multiple injuries	4 (0.16)	4 (0.24)
Scratches	1 (0.04)	—
Amputation	—	1 (0.1)
Unclassified	10 (0.41)	26 (1.6)
ID by ICD9	224 (9.3)	324 (19.3)
Medical diagnoses		
First aid (no diagnosis)	101 (4.1)	114 (6.8)
Sprain	839 (34.2)	374 (22.2)
Dislocation without fracture	519 (21.1)	171 (10.2)
Degenerative condition	82 (3.3)	96 (5.7)
Symptom descriptor	65 (2.6)	70 (4.2)
Contusion	51 (2.1)	12 (0.71)
Fracture/cord or injury	4 (0.16)	24 (1.4)
Nerve injury	1 (0.04)	—
Mixed diagnoses	432 (17.6)	703 (41.8)
Unknown diagnosis	358 (14.7)	117 (7.0)

care rather than an ANSI code designating a back injury. More pronounced differences were apparent when comparing the ICD9 medical diagnosis groupings. Notably, more of the non-PLT injuries were coded as sprains and, the largely chiropractic diagnosis, dislocations without fractures. Other striking differences include proportionately more fractures and symptom descriptor diagnoses among the PLT claims, as well as the high proportion of claims that had mixed diagnoses.

Injury Rates and Risk Factors

The number of carpenters observed each year, their hours worked, injuries, and crude injury rates are presented in Table II. In the 15 years between 1989 and 2003, the overall back injury rate was 6.2 (95% CI 5.8, 6.6) per 200,000 hr worked. Overall back injury rates declined 54.8% between 1989 and 2003. Back injuries that resulted in PLT, which occurs after the third lost day in Washington State, and those that did not result in PLT both decreased over time (Fig. 1); the decrease in claims without lost time was 50%, while those with PLT time decreased 62%. There was a marked decrease in the rate of back injury claims associated with overexertion; there was a 66% decline from the high of 6.9/200,000 hr worked in 1990 and 1991 to 2.3/200,000 hr worked in 2003. Over the 15-year period, there was a less substantive decline (32%) in rates of injuries associated with more acute traumatic events (Fig. 2)

The distribution of time at risk, back injury frequencies, as well as the unadjusted rates and rate ratios are presented by strata of age, gender, union tenure, and predominant type of work for injuries that did and did not result in PLT from work (Table III). Unadjusted rates of injury decreased with increasing age and increasing time in the union. Individuals affiliated with locals that perform residential carpentry or drywall installation were at higher risk for both non-PLT and PLT injuries than their counterparts doing other types of construction work. Women had higher rates of PLT claims than men, but this is based on a small number of events. These patterns remained in the fully adjusted models.

Similar patterns of risk were seen for overexertion injuries and injuries resulting from more acute trauma by age and gender (Table IV). Rates of overexertion injuries decreased 30%, and remained so, after 4 years of time in the union, while back injuries associated with acute trauma did not substantially decline until after the 8th year of union tenure. Drywall and residential carpenters were at greater risk for overexertion injuries; they were also at greater risk for back injuries from acute trauma, as were millwrights.

DISCUSSION

By combining data from multiple sources for these retrospective cohort analyses we learned a considerable amount about back injuries in these union carpenters. Although the rate ratios are modest, they are based on internal comparisons of a population with high injury rates. Back injuries accounted for an average of over six injuries per 100 fulltime carpenters over this 15-year period, and they were responsible for nearly one-fifth of workers' compensation claims filed by the cohort. Injury rates declined significantly over time consistent with the overall decline of injuries among this group and others that have been reported [Murphy and Volinn, 1999; Center to Protect

TABLE II. Number of Carpenters Observed, Hours Worked, Back Injuries, and Rates of Injury by Year: Union Carpenters, Washington State, 1989–2003

Year	# Observed[a]	Hours worked	# Injuries	Rate[b] (95% CI)
1989	6,190	6,070,969	254	8.4 (7.4, 9.5)
1990	7,298	7,955,039	367	9.2 (8.3, 10.3)
1991	7,616	8,503,453	389	9.2 (8.3, 10.2)
1992	8,024	9,103,418	369	8.1 (7.3, 9.0)
1993	7,898	8,512,786	318	7.5 (6.7, 8.4)
1994	7,553	8,018,041	276	6.9 (6.1, 7.8)
1995	7,195	8,062,927	247	6.1 (5.4, 6.9)
1996	7,328	8,165,628	243	6.0 (5.3, 6.8)
1997	7,552	8,718,329	250	5.7 (5.0, 6.5)
1998	8,049	9,291,889	246	5.3 (4.7, 6.0)
1999	9,305	10,618,931	287	5.4 (4.8, 6.1)
2000	9,961	11,514,489	288	5.0 (4.5, 5.6)
2001	9,846	10,618,931	246	4.6 (4.1, 5.2)
2002	9,173	9,748,095	181	3.7 (3.2, 4.3)
2003	8,856	9,357,906	177	3.8 (3.3, 4.4)
TOTAL	18,768	134,199,443	4,138	6.2 (5.8, 6.6)

[a]Not mutually exclusive each year, so sum of observations does not equal total observed.
[b]Rates are per 200,000 hr worked.

Workers' Rights, 2002; Lipscomb et al., 2003a; NIOSH, 2004; US DOL BLS, 2007].

Despite disparate mechanisms of injury and severity, measured by claims resulting in PLT, we observed fairly similar patterns of risk for the types of claims we evaluated. It is of note that, consistently, the effect of age was diminished when adjusting for time in the union. From these data we cannot determine whether differences in risk by union tenure represent inexperience, different exposures based on seniority, or perhaps both. The decline in overexertion injury rates after 4 years in the union, or the end of the typical apprenticeship period, certainly raises suspicions that apprentices may be more heavily involved in manual materials handling. This has been previously reported among very early residential carpenter apprentices [Lipscomb et al., 2003b].

Through these analyses we observed differences in ANSI nature codes and ICD9 codes for the same injuries. Miscoding error, no doubt, occurs in both systems, but regardless, these data indicate that like descriptions from the two systems should not be assumed to represent the same thing consistent with an earlier report of Oleinik et al. [1996].

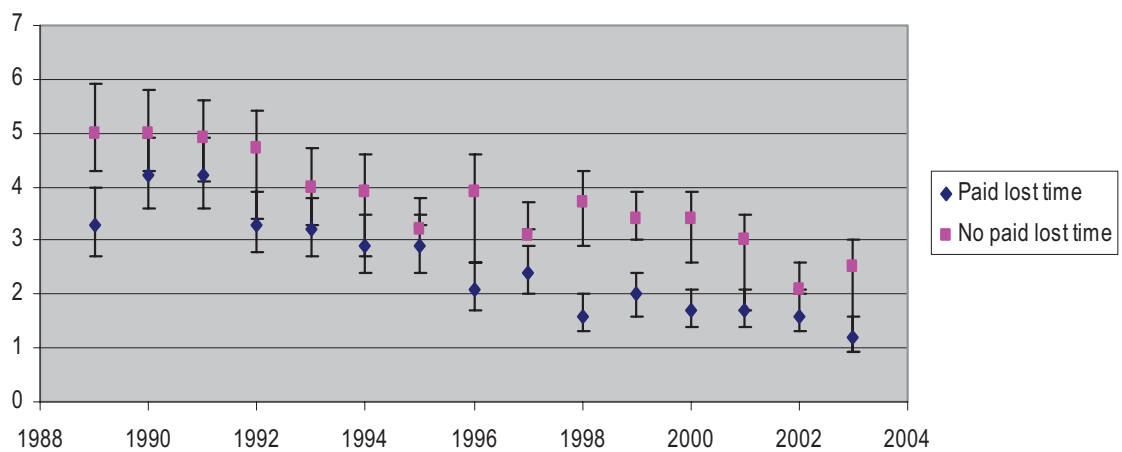

FIGURE 1. Back injury rates (per 200,000 hr worked) by paid lost time from work, union carpenters, Washington State, 1989–2003.

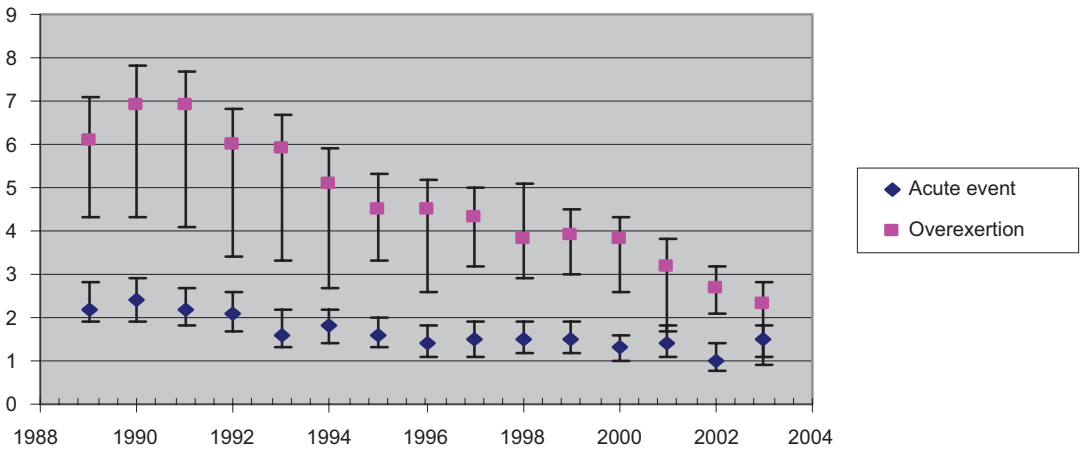

FIGURE 2. Back injury rates (per 200,000 hr worked) by cause of injury, union carpenters, Washington State, 1989–2003.

TABLE III. Stratified Time at Risk, Frequency of Back Injuries, Crude Rates and Rate Ratios, and Adjusted Rate Ratios, by Indemnity, Washington Carpenters 1989–2003

		Non-paid lost time (n = 2,457)				Paid lost time (n = 1,681)			
	Time at risk	Injuries	Crude rate (95% CI)[a]	Crude RR (95% CI)	Adjusted RR (95% CI)[b,c]	Injuries	Crude rate (95% CI)[a]	Crude RR (95% CI)	Adjusted RR (95% CI)[b,c]
Age									
<20	543,786	14	5.5 (3.3, 9.3)	2.2 (1.2, 4.0)	1.5 (0.89, 2.5)	12	4.3 (2.4, 7.8)	2.2 (1.1, 4.5)	1.1 (0.61, 2.1)
20–<30	22,001,842	494	4.4 (4.0, 4.9)	1.8 (1.5, 2.1)	1.4 (1.2, 1.6)	273	2.4 (2.1, 2.7)	1.2 (0.97, 1.5)	0.73 (0.59, 0.90)
30–<40	47,457,445	996	4.2 (3.9, 4.4)	1.7 (1.5, 2.0)	1.5 (1.3, 1.7)	712	2.9 (2.7, 3.2)	1.5 (1.2, 1.8)	1.1 (0.96, 1.3)
40–<50	41,745,886	667	3.2 (2.9, 3.4)	1.3 (1.1, 1.5)	1.2 (1.1, 1.4)	459	2.2 (1.9, 2.4)	1.1 (0.91, 1.3)	0.99 (0.84, 1.2)
50+	22,288,337	281	2.5 (2.2, 2.8)	1	1	221	2.0 (1.7, 2.2)	1	1
Gender									
Female	2,260,386	48	4.2 (3.1, 5.5)	1.0 (0.72, 1.5)	1.2 (0.88, 1.5)	44	3.8 (2.8, 5.1)	1.6 (1.2, 2.1)	1.6 (1.2, 2.0)
Male	131,773,547	2,402	3.6 (3.5, 3.8)	1	1	1,631	2.4 (2.3, 2.5)	1	1
Time in the union									
<1 year	8,083,156	209	5.0 (4.3, 5.8)	1.7 (1.4, 2.0)	1.3 (1.1, 1.6)	141	3.4 (2.9, 4.1)	1.7 (1.4, 2.1)	1.7 (1.4, 2.1)
1–<2 years	9,100,638	208	4.7 (4.1, 5.4)	1.6 (1.4, 1.9)	1.3 (1.1, 1.5)	161	34 (2.9, 4.0)	1.7 (1.4, 2.1)	1.7 (1.4, 2.1)
2–<3 years	7,921,782	181	4.5 (3.8, 5.2)	1.5 (1.2, 1.8)	1.2 (1.0, 1.4)	126	3.1 (2.6, 3.7)	1.5 (1.3, 1.9)	1.6 (1.3, 1.9)
3–<4 years	6,966,498	168	4.7 (4.0, 5.5)	1.6 (1.3, 2.0)	1.3 (1.1, 1.5)	106	2.9 (2.4, 3.5)	1.5 (1.2, 1.8)	1.5 (1.2, 1.8)
4–<6 years	11,659,061	229	3.9 (3.4, 4.4)	1.2 (1.0, 1.4)	1.1 (0.93, 1.2)	162	2.7 (2.4, 3.2)	1.4 (1.1, 1.6)	1.4 (1.1, 1.6)
6–<8 years	9,409,159	172	3.6 (3.1, 4.2)	1.1 (0.90, 1.3)	1.0 (0.86, 1.2)	147	3.0 (2.6, 3.4)	1.5 (1.3, 1.8)	1.5 (1.2, 1.8)
8–<10 years	8,843,898	168	3.8 (3.2, 4.4)	1.2 (1.0, 1.5)	1.1 (0.90, 1.2)	101	2.3 (1.9, 2.2)	1.1 (0.93, 1.4)	1.1 (0.88, 1.3)
10 years and over	72,203,905	1,122	3.1 (2.9, 3.3)	1	1	737	2.0 (1.9, 2.2)	1	1
Predominant work									
Drywall	24,129,911	646	5.4 (5.0, 5.8)	1.8 (1.5, 2.0)	1.5 (1.4, 1.7)	463	3.8 (3.5, 4.2)	1.7 (1.4, 2.0)	1.7 (1.4, 2.0)
Residential	1,675,730	47	5.7 (4.3, 7.6)	1.8 (1.3, 2.6)	1.5 (1.2, 2.0)	38	4.6 (3.3, 6.3)	2.0 (1.4, 2.8)	1.7 (1.2, 2.4)
Millwright	2,549,160	50	3.9 (3.0, 5.2)	1.1 (0.73, 1.5)	1.2 (0.94, 1.6)	32	2.5 (1.8, 3.6)	1.1 (0.76, 1.6)	1.1 (0.77, 1.6)
Pile driver	8,171,203	81	2.0 (1.6, 2.5)	0.61 (0.46, 0.81)	0.62 (0.50, 0.78)	36	0.88 (0.64, 1.2)	0.38 (0.27, 0.55)	0.40 (0.28, 0.56)
Out of Washington	1,826,138	29	3.2 (2.2, 4.6)	0.97 (0.62, 1.5)	0.93 (0.65, 1.3)	27	3.0 (2.0, 4.3)	1.3 (0.87, 1.9)	1.3 (0.85, 1.9)
Mixed commercial	58,917,900	882	3.0 (2.8, 3.2)	0.96 (0.62, 1.1)	0.91 (90.81, 1.0)	594	2.0 (1.9, 2.2)	0.88 (0.76, 1.0)	0.89 (0.77, 1.0)
Light commercial	14,919,760	322	4.3 (3.9, 4.8)	1.4 (1.1, 1.6)	1.3 (1.1, 1.5)	195	2.6 (2.3, 3.0)	1.1 (0.94, 1.4)	1.1 (0.95, 1.4)
Heavy commercial	20,253,804	339	3.3 (3.0, 3.7)	1	1	232	2.3 (2.0, 2.6)	1	1

[a]Rates are per 200,000 hr worked.
[b]Poisson regression models.
[c]Scaled deviance in adjusted models.

TABLE IV. Stratified Time at Risk, Frequency of Back Injuries, Crude Rates and Rate Ratios, and Adjusted Rate Ratios, by Injury Mechanism, Washington Carpenters 1989–2003

		Overexertion injuries (n = 3,042)				Traumatic injuries (n = 1,095)			
	Time at risk	Injuries	Crude rate[a] (95% CI)	Crude RR (95% CI)	Adjusted RR (95% CI)[b,c]	Injuries	Crude rate[a] (95% CI)	Crude RR (95% CI)	Adjusted RR (95% CI)[b,c]
Age									
<20	543,786	18	6.7 (4.1, 10.7)	2.1 (1.2, 3.8)	1.3 (0.78, 2.1)	8	3.1 (1.6, 6.3)	2.5 (1.3, 5.1)	1.5 (0.79, 2.8)
20–<30	22,001,842	571	5.1 (4.7, 5.5)	1.6 (1.4, 1.9)	1.1 (0.98, 1.3)	196	1.7 (1.5, 1.9)	1.4 (1.1, 1.7)	0.90 (0.73, 1.1)
30–<40	47,457,445	1,282	5.3 (4.7, 5.5)	1.7 (1.4, 1.9)	1.4 (1.2, 1.6)	426	1.8 (1.6, 1.9)	1.4 (1.2, 1.7)	1.1 (0.96, 1.4)
40–<50	41,745,886	799	3.8 (3.5, 4.1)	1.2 (1.0, 1.4)	1.1 (0.97, 1.3)	327	1.6 (1.4, 1.7)	1.3 (1.0, 1.5)	1.2 (0.97, 1.4)
50–<60	22,288,337	363	3.2 (2.9, 3.5)	1	1	139	1.2 (1.1, 1.5)	1	1
Gender									
Female	2,260,386	65	5.6 (4.4, 7.2)	1.3 (0.98, 1.6)	1.3 (1.0, 1.6)	27	2.3 (1.6, 3.4)	1.5 (1.0, 2.2)	1.5 (1.1, 2.1)
Male	131,773,547	2,965	4.4 (4.3, 4.6)	1	1	1,068	1.6 (1.5, 1.7)	1	1
Time in the union									
<1 year	8,083,156	259	6.2 (5.4, 7.0)	1.6 (1.4, 19)	1.4 (1.2, 1.7)	91	2.2 (1.8, 2.7)	1.6 (1.3, 2.7)	1.6 (1.3, 1.9)
1–<2 years	9,100,638	274	6.0 (5.3, 6.8)	1.6 (1.4, 1.8)	1.4 (1.2, 1.6)	95	2.1 (1.7, 2.5)	1.5 (1.2, 1.9)	1.5 (1.2, 1.8)
2–<3 years	7,921,782	228	5.6 (4.9, 6.4)	1.5 (1.3, 1.7)	1.3 (1.1, 1.5)	79	2.0 (1.6, 2.5)	1.5 (1.1, 1.9)	1.4 (1.2, 1.8)
3–<4 years	6,966,498	213	6.0 (5.2, 6.8)	1.6 (1.4, 1.8)	1.4 (1.2, 1.6)	61	1.6 (1.3, 2.1)	1.2 (0.92, 1.6)	1.2 (0.93, 1.5)
4–<6 years	11,659,061	268	4.6 (4.1, 5.2)	1.2 (1.1, 1.4)	1.1 (0.95, 1.2)	123	2.0 (1.7, 2.4)	1.5 (1.2, 1.9)	1.5 (1.2, 1.8)
6–<8 years	9,409,159	224	4.7 (4.1, 5.3)	1.3 (1.1, 1.4)	1.1 (0.95, 1.3)	95	2.0 (1.6, 2.4)	1.5 (1.2, 1.9)	1.4 (1.2, 1.7)
8–<10 years	8,843,898	205	4.6 (4.0, 5.3)	1.2 (1.1, 1.4)	1.1 (0.93, 1.3)	64	1.5 (1.1, 1.9)	1.1 (0.83, 1.4)	1.0 (0.83, 1.3)
10 years and over	72,203,905	1,371	3.8 (3.6, 4.0)	1	1	488	1.3 (1.2, 1.5)	1	1
Predominant work									
Drywall	24,129,911	837	6.9 (6.5, 7.4)	1.7 (1.5, 1.9)	1.7 (1.5, 1.9)	272	2.3 (2.0, 2.5)	1.4 (1.2, 1.7)	1.4 (1.2, 1.6)
Residential	1,675,730	59	7.1 (5.5, 9.2)	1.8 (1.4, 2.3)	1.6 (1.2, 2.0)	26	3.1 (2.1, 4.6)	1.9 (1.3, 2.9)	1.7 (1.2, 2.4)
Millwright	2,549,160	50	3.9 (3.0, 5.2)	0.98 (0.73, 1.3)	1.0 (0.78, 1.4)	32	2.5 (1.8, 3.6)	1.6 (1.1, 2.3)	1.6 (1.1. 2.2)
Pile driver	8,171,203	87	2.1 (1.7, 2.6)	0.53 (0.42, 0.67)	0.56 (0.45, 0.69)	30	0.73 (0.51, 1.1)	0.45 (0.31, 0.67)	0.47 (0.34, 0.65)
Out of Washington	1,826,138	38	4.2 (3.0, 5.7)	1.0 (0.74, 1.4)	1.0 (0.74, 1.4)	18	2.0 (1.2, 3.1)	1.2 (0.75, 2.0)	1.2 (0.79, 1.8)
Mixed commercial	58,917,900	1,098	3.7 (3.5, 4.0)	0.93 (0.83, 1.0)	0.95 (0.85, 1.1)	378	1.3 (1.2, 1.4)	0.79 (0.66, 0.95)	0.80 (0.69, 0.94)
Light commercial	14,919,760	374	5.0 (4.5, 5.6)	1.3 (1.1, 1.4)	1.3 (1.1, 1.5)	143	1.9 (1.6, 2.3)	1.2 (0.95, 1.5)	1.2 (0.98, 1.4)
Heavy commercial	20,253,804	407	4.0 (3.6, 4.4)	1	1	164	1.6 (1.4, 1.9)	1	1

[a]Rates are per 200,000 hr worked.
[b]Poisson regression models.
[c]Scaled deviance in adjusted models.

The injuries that resulted in PLT received more medical treatment over time and thus were more likely to get multiple diagnoses. An initial presentation of back pain may be labeled as a sprain/strain, which should be self-limiting; if the symptoms fail to abate the individual may receive diagnostic tests which result in additional diagnoses—perhaps from different types of medical providers.

The greatest limitation of these analyses is the limited risk factor information; beyond type of work of the local the carpenter affiliated with, we had no real exposure information. The analyses do not define cause of injury in anyway, and because of this, we view this work largely as an analytical passive surveillance effort that helps establish patterns of risk. We also recognize that there is misclassification in the process of assigning predominant work that may well have muted the effects we observed.

As is always the case in analyses of workers' compensation records, anything which influences whether a person files a compensation claim will be reflected in the results. In contrast to many construction workers [CPWR, 2002], these union carpenters have private insurance coverage removing some concerns that non-work-related care ended up in the workers' compensation system. We know we did not capture all injuries that occurred when carpenters worked for contractors who self-insured for WC and we could not identify the records of medical care with ICD9s for the self-insured claims. Some of the decline in non-PLT claims could reflect increasing self-insured hours. The

business agents we interviewed also reported some attention to providing, at least short-term, opportunities for light duty work in more recent years; this could have made a contribution to reduction of PLT claims.

In order to look at patterns of ICD9 diagnoses overtime in other analyses of these cases, we used a more inclusive list of ICD9 codes to identify potential cases of musculoskeletal back pain than others have in analyses of Washington State compensation data [Silverstein and Adams, 2006]. However, this made no substantive difference in the identification of cases.

Through the 1990s this cohort was almost exclusively Caucasian. While this pattern largely remains, there is an increasing immigrant presence—even in this union workforce. Unfortunately, because of lack of data, we were unable to look at risk differentially by race or ethnicity which could have been enlightening and important.

Obviously through these administrative data, we do not have information on psychosocial issues or work environment which others have reported as important predictors of back pain in other occupational groups [Rugulies and Krause, 2005; Turner et al., 2006]. Because of the frequent overlap of significant work organization issues and physical work exposures [Bernard et al., 1993; Bongers et al., 1993] we believe this information would be most enlightening with more precise knowledge of work exposures [Lipscomb et al., 2008].

This work also has several important strengths. We were able to assemble a large, well-defined cohort of carpenters with 15 years of follow-up data including their work hours each month and their work-related injury experience. These robust data allowed us to clearly define patterns of injury overtime and to assess risk in fairly fine strata of age and union experience. Because of access to medical diagnoses through ICD9 codes attached to claims for care we were also able to compare and contrast the ANSI codes, commonly available in coded compensation data, to medical diagnoses.

CONCLUSIONS

It is not surprising that overexertion injuries from manual materials handling activities are responsible for the largest burden of back injuries among these union carpenters. Despite their substantial decline, continued efforts are needed to clearly define tasks or activities that place them at risk of injury and to identify methods to alleviate relevant exposures. At the same time, we should not fail to recognize the contribution made by acute traumatic events to the burden of back injury.

This is particularly true in light of the report suggesting that degenerative changes are more likely to follow traumatic events [Luoma et al., 1998]. There is also laboratory evidence that ground slope angle influences lifting kinematics [Shin and Mirka, 2004] and that work environments with poor footing and requirements for manual materials handling, such as is the case on many construction sites, may interact to place workers at exceptionally high risk of slips and falls [Shu et al., 2005]. When asked about major causes of back injury among their members, the business agents we interviewed reported specific lifting activities including over-sized drywall sheets, walls, forms, and studs. They also reported that repetitive activities, unbalanced work positions, slips and falls, and speed of the work contributed to back injuries among carpenters.

Based on these findings, residential and drywall carpenters should be particular targets of prevention activities. Focused efforts are needed to identify ways to reduce risk of back injury among these small, and often dispersed, work groups. We acknowledge that in this particular cohort residential carpenters make a very small contribution to the overall injury burden. However, their risk is likely representative of other carpenters involved in the homebuilding industry—a group for which there is limited surveillance data [Dement and Lipscomb, 1999; Lipscomb et al., 2003b]. Beyond these two groups, these union carpenters perform a wide variety of construction work. The fact that they are not typical "hammer and nail carpenters" should be kept in mind in generalizing their experiences to other groups.

Besides knowledge of who within the cohort is at particular risk of back injury, these analyses identify additional areas worthy of further exploration. Most who report occupational back pain recover within 1 month, with as many as 90% returning to work in 3 months [Rossignol et al., 1992; Cheadle et al., 1994]. While return to work may mark the end of the first episode of work disability [Baldwin et al., 1996], many continue to have problems which require modification of activities [Von Korff, 1994; Carey, 1995; Pransky et al., 2000]. Thirteen percent (13%) of the back injuries among this cohort were not identified by ANSI body part codes. In addition, those identified through access to ICD9 codes represent a larger proportion of those with PLT. Both findings are consistent with report of Oleinik et al. [1996 ANSI]. We know relatively little about risk for prolonged time away from work or recurrence of pain or injury beyond effects of older age and lack of modified work opportunity [Oleinik et al., 1996; Gluck and Oleinick, 1998; Seland et al., 2006]. The data from this large cohort, including the actual medical diagnoses assigned at the time of their injury care, could also be used to explore these issues more fully.

The decline in injury rates, particularly those resulting from overexertion injuries, is encouraging. In contrast to concerns of cost-shifting to compensation, these carpenters describe the ease of seeking care outside the compensation system for injuries that are not likely to keep them out of work. A much more modest decline was seen for back injuries that resulted from acute traumatic events, and acute trauma is more likely to be reported through workers' compensation [Blessman, 1991]. Among this largely insured population, it will be useful to assess whether a contrasting

pattern is seen for treatment of back disorders in their private health insurance claims during the same time period.

Lastly, the injury rates we observed are considerably higher than those reported by the Bureau of Labor Statistics, providing additional evidence that the Bureau of Labor Statistics data under estimate work-related injury risk [Lipscomb et al., 1996; Glazner et al., 1998; Rosenman et al., 2006]. The BLS reported work-related injury or illness rates of 6.8 per 100 full-time construction workers in 2003 [US DOL BLS, 2005]. Among this well-defined cohort we observed an injury rate of 3.8 per 100 full-time carpenters for back injuries alone in that year. In light of the insured private health care access among this cohort of union workers, the findings are even more compelling.

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REFERENCES

Baldwin MJ, Johnson WG, Butler RJ. 1996. The error of using returns-to-work to measure the outcomes of health care. Am J Ind Med 29:632–641.

Bernard B, Sauter S, Fine LJ. 1993. NIOSH HETA report 90-013-3277. Cincinnati, Ohio: National Institute for Occupational Safety and Health.

Blessman JE. 1991. Differential treatment of occupational disease vs occupational injury by workers' compensation in Washington State. J Occup Med 33(2):121–126.

Bongers Pm, Winter CR, Kompier MAJ, Hildebrandt VH. 1993. Psychosocial factors at work and musculoskeletal disease. Scand J Work Environ Health 19:297–312.

Carey TS. 1995. Care-seeking among individuals with chronic low back pain. Spine 20(3):312–317.

Center to Protect Workers' Rights. 2002. The Construction Chart Book: The U.S. Construction Industry and it's Workers, Ed. 3. Washington, D.C.: Center to Protect Workers's Rights.

Cheadle A, Franklin G, Wolhagen C, Savarino J, Liu PY, Salley C, Weaver M. 1994. Factors influencing the duration of work-related disability: A population-based study of Washington State Workers' Compensation. Am J Public Health 84(2):190–196.

Checkoway H, Pearce N, Crawford-Brown D. editors. 1989. Cohort studies. Research methods in occupational epidemiology. New York: Oxford University Press. p 103–169.

Dement JM, Lipscomb HJ. 1999. Workers' compensation experience of North Carolina residential construction workers, 1986–1994. J Appl Occup Environ Hyg 14:97–106.

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

Gluck J, Oleinick A. 1998. Claim rates of compensable back injuries by age, gender, occupation, and industry: Do they relate to return-to-work experience? Spine 23(14):1572–1587.

Lipscomb HJ, Kalat J, Dement JM. 1996. Workers' compensation claims of union carpenters 1989–92: Washington State. J Appl Occup Environ Hyg 11(1):56–63.

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 J, Li L. 2003a. Work-related falls among union carpenters in Washington State before and after the vertical fall arrest standard. Am J Indus Med 44(2):157–165.

Lipscomb HJ, Dement JM, Li L, Nolan J, Patterson D. 2003b. Work-related injures in residential and drywall carpentry. Appl Occup Environ Hyg 18(6):479–488.

Lipscomb HJ, Kucera KL, Epling C, Dement JM. 2008. Upper extremity musculoskeletal symptoms and disorders among a cohort of women employed in poultry processing. Am J Ind Med 51(1):24.36.

Luoma K, Riihimaki H, Raininko R, Luukkonen R, Lamminen A, Viikari-Juntura E. 1998. Lumbar disc degeneration in relation to occupation. Scand J Work Environ Health 24(5):358–366.

McIntosh G, Frank J, Hogg-Johnson S, Bombardier C, Hall H. 2000. Prognostic factors for time receiving workers' compensation benefits in a cohort of patients with low back pain. Spine 25(2):147–157.

Murphy PL, Volinn E. 1999. Is occupational back pain on the rise? Spine 24(7):691–697.

National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention. 1997. Musculoskeletal disorders and workplace factors: A critical review of epidemiologic evidence for work-related musculoskeletal disorders of the neck, upper extremity, and low back. Publication No. 97-141 (July).

National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention. 2004. Musculoskeletal Disorders, Chapter 2: Fatal and Nonfatal Injuries, and Selected Illnesses and Conditions. Worker Health Chartbook 2004. Publication No. 2004-146. Accessed online November 15, 2007 [http://www2.cdc.gov/NIOSH-Chartbook/ch2/ch2-6.asp].

Nizim A. 2000. Poisson regression. In: Kleinbaum DG, Kupper LL, Muller KE, editors. Applied regression analysis and other multivariate methods, 3rd edition. Boston: PWS-Kent Publishing Co. p 687–709.

Oleinik A, Gluck JV, Guire KE. 1996. Concordance between ANSI occupational back injury codes and claim form diagnoses and a lower

bound estimate of the fraction associated with disc displacement/herniation. Am J Ind Med 30:556–568.

Park RM, Nelson NA, Silverstein MA, Mirer F. 1992. Use of medical insurance claims for surveillance of occupational disease, an analysis of cumulative trauma in the auto industry. J Occup Med 345(7):731–737.

Pransky G, Benjamin K, Hill-Fotouhi C, Himmelstein J, Fletcher KE, Katz J, Johnson W. 2000. Outcomes in work-related upper extremity and low back injuries: Results of a retrospective study. Am J Ind Med 37:400–409.

Rosenman KD, Kalush A, Reilly MJ, Gardiner JC, Reeves M, Luo Z. 2006. How much work-related illness and injury is missed by the current national surveillance system? J Occup Environ Med 48(4): 357–365.

Rossignol M, Suissa S, Abenhaim L. 1992. The evolution of compensated occupational spinal injuries: A three-year follow-up study. Spine 17(9):1043–1047.

Rugulies R, Krause N. 2005. Job strain, iso-strain, and the incidence of low back pain and neck injuries. A 7.5-year prospective study. Soc Sci Med 61(1):27–39.

SAS Institute, Inc. 1999. The SAS System, Version 8.2. Cary, NC: SAS Institute, Inc.

Schneider S, Susie P. 1994. Ergonomics and construction: A review of potential hazards in new construction. Am Ind Hyg Assoc J 55(7):639–649.

Seland K, Cherry N, Beach J. 2006. A study of factors influencing return to work after wrist or ankle fractures. Am J Ind Med 49:197–203.

Shin G, Mirka GA. 2004. The effects of sloped ground surface on trunk kinematics and L5/S1 moment during lifting. Ergonomics 47(6): 646–659.

Shu Y, Southard S, Shin G, Mirka GA. 2005. The effect of a repetitive, fatiguing lifting task on horizontal ground reaction forces. J Appl Biomech 21(3):260–270.

Silverstein B, Adams D. 2006. Work-related Musculoskeletal Disorders of the Neck, Back and Upper Extremity in Washington State 1996–2004. SHARP Technical Report 40-10a-2006. Olympia WA: Washington State Department of Labor and Industries.

Turner JA, Franklin G, Fulton-Kehoe D, Sheppard L, Wickizer TM, Wu R, Gluck J, Egan K. 2006. Worker recovery expectations and fear-avoidance predict work disability in a population-based workers' compensation back pain sample. Spine 31(6):682–689.

US Dept of Labor, Bureau of Labor Statistics. 2005. Workplace injuries and illnesses in 2003. http://www.bls.gov/iif/oshwc/osh/os/osnr0021.pdf [accessed Nov 15, 2007].

US Dept of Labor, Bureau of Labor Statistics. 2007. Workplace injuries and illnesses in 2006. http://www.bls.gov/iif/oshwc/osh/oc/oswr0028.pdf [accessed Nov 15, 2007].

Von Korff M. 1994. Studying the natural history of back pain. Spine 19(18S):2041S–2046S.

Waller JA, Payne SR, Skelly JM. 1989. Injuries to carpenters. J Occup Med 31(8):687–692.

Waller JA, Payne SR, Skelly JM. 1990. Disability, direct cost, and payment issues in injuries involving woodworking and wood-related construction. Accid Anal Prev 22(4):351–360.

APPENDIX A

Process Used to Assign ICD9 Code Groupings

Classification of cases using ICD9 codes

Process: Each workers' compensation claim was assigned one diagnosis based on a combination of ICD9 diagnosis codes and ANSI body part codes. The body part is used with the ICD9 code when necessary to define a body region. When the ICD9 code is specific for a body region this takes precedence over the body part code. To be assigned to any categorization the individual can only have ICD9 codes from that specific grouping, with the exception of additional symptom descriptor codes. If additional codes are assigned with symptom descriptor codes, the more specific code(s) were used. Only ICD9 codes which reflected a spinal condition were considered in the classification schemes. This ignored non-musculoskeletal codes and non-sensical codes which would prevent a person from being classified. Individuals who have ICD9 codes coming from more than one category were assigned the label 'mixed diagnosis'. Cases were not classified by ICD9 codes if they were from self-insured employers.

APPENDIX B

Case Definitions Based on ICD9 Codes Supplemented With ANSI Body Part Code

- Spinal low back fractures

805 vertebral fracture w/o cord injury
805.8 ", unspecified closed
805.9* ", unspecified open
806 vertebral fracture with cord injury + body part code=BACK (420)
806.8 ", unspecified closed
806.9 ", unspecified open

805.4 vertebral fracture w/o cord injury, lumbar closed
805.5* " , lumbar open
805.6 " , sacrum and coccyx closed
805.7 " , sacrum and coccyx open
806.4 vertebral fracture with cord injury, lumbar closed
806.5* " , lumbar open
806.6 " , sacrum and coccyx closed
806.7* , sacrum and coccyx open

839.2 dislocation Th and lumbar , closed
839.20 " , lumbar closed

839.3 " , th and lumbar open
839.41 " , coccyx closed
839.42 " , sacrum closed
839.51 " , coccyx open
839.52 " , sacrum open

839 dislocation and other ill-defined
839.4 dislocation other vertebrae, closed
839.40 " , unsp closed
839.49 dislocation other, closed + body part code= BACK
839.5 " , open
839.59 dislocation other, open
839.8 dislocation multiple, ill defined, closed

[If dislocation is labeled 'open' and treated in the hospital assumed to be fracture]
[839.3, 839.30, 839.51, 839.5 +BPCD, 839.9 +body part code]

- Spinal cord injury w/o fracture
952 spinal cord injury w/o bone
952.9 spinal cord injury w/o bone, unspecified site + body part code= BACK
952.8 * injury to nerves and cod, multiple sites

952.2 spinal cord injury w/o bone, lumbar
952.3* " , sacral
952.4* " , cauda equina

- Nerve injury
953 injury to nerve roots and spinal plexus
953.8 ", multiple sites
953.9 " , unspecified site
954 injury to nerves of trunk + body part code= BACK
954.8 " , unspecified site
954.9 " , unspecified nerve of trunk
953.2 injury to lumbar root
953.3 injury to sacral root
953.5 injury to LS plexus
956.0 injury to sciatic nerve

- Contusion of trunk
922 contusion of trunk
922.9 contusion trunk, unspecified + body part code= BACK

922,922.9 contusion of trunk
+
922.3 contusion of back
or
922.3 contusion of back

- Spine dislocation, not fracture
839 other multiple ill-defined dislocation
839.4 dislocation other vertebrae, closed
839.40 dislocation vertebrae unspecified site + body part code=BACK
839.49 dislocation other vertebrae, closed
839.8 dislocation multiple illdefined, closed

839.2 dislocation th or lumbar, closed
839.20 " lumbar, closed
839.41 dislocation coccyx, closed or any of these specific codes
839.42 dislocation sacrum, closed with 839

- Low back spr/strain
846 spr/str SI region
846.x any of 846 codes

847 Spr/str unspecified part of back
847.9 unspecified back spr/str + body part code= BACK

847.2 spr/str lumbar
847.3 spr/str sacrum
847.4 spr/str coccyx

847 or 847.x + 846

- Degenerative low spine pain (disc disorders)
721 spondylosis and allied disorders
721.8 allied disorders of spine
721.9 spondylosis unspecified site
722 intervertebral disc disorders + body part code= BACK
722.2 displacement disc sit unspecified
722.70 disc disorder w myelopathy unspecified region
722.80 postaminectomy syndrome, unspecified region
722.9 other unspecified disc disorder
724 other and unspecified disorder of back
724.00 spinal stenosis, unspecifed region

721.3 LS spondylosis w/o myelopathy
721.4 th or lumbar spondylosis w myelopathy
722.1x Th or lumbar disc w/o myelopathy
722.32 Schmorl's node lumbar
722.5x degeneration th or l disc
722.83 postlaminectomy lumbar
722.93 other lumbar disc disorder
724.02 spinal stenosis lumbar

- LS root lesion
353 nerve root and plexus disorders + body part code=BACK

353.1 LS plexus lesions
353.4 LS root lesion, NEC
355.0 lesion of sciatic nerve

-Symptom descriptor ICD9 codes for back

724.2 Lumbago
724.3 Sciatica
724.4 Radiculitis or neuritis, thoracic or lumbar
724.5 Backache
724.8 Other symptoms referable to the back

739.3 Non-allopathic lesion lumbar region (segmental or somatic dysfunction)
739.4 Non-allopathic lesion sacral region "

Mixed Diagnoses, not elsewhere classified (NEC)