

Contrasting Patterns of Care for Musculoskeletal Disorders and Injuries of the Upper Extremity and Knee Through Workers' Compensation and Private Health Care Insurance Among Union Carpenters in Washington State, 1989 to 2008

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Background *Musculoskeletal symptoms and disorders (MSDIs) are common reasons for visits to medical providers in the general population and they are common work-related complaints. Prior reports raise concerns as to whether declines in workers' compensation (WC) rates represent true improvement in occupational health and safety or shifting of care to other payment systems.*

Methods *By linking administrative records, we compared patterns of WC claims and private health care utilization for disorders of the upper extremity (UE) and knee among a large cohort of union carpenters over a 20-year period.*

Results *As WC claim rates declined, private health care utilization increased. The increase was muted somewhat but sustained when adjusting for other patterns of health care utilization.*

Conclusions *Findings suggest the decline of WC claim rates do not solely represent improved occupational safety in this population, but also a considerable shifting of care to their private insurance coverage over time. Am. J. Ind. Med. 58:955–963, 2015.*

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KEY WORDS: *construction; musculoskeletal; health care utilization; care-shifting; cost-shifting; workers'; compensation; health insurance; cohort; longitudinal*

BACKGROUND

Musculoskeletal symptoms, disorders, and injuries (MSDIs) are common reasons for visits to medical providers in the general population. They also are common work-related complaints. In the U.S., as well as globally, there are growing concerns about the incomplete capture of work-related disorders in commonly used surveillance resources [Morse, 2000; Azaroff et al., 2002, 2004; Shannon and Lowe, 2002; Friedman and Forst, 2003; Leigh et al., 2004; Rosenman et al., 2006; Welch et al., 2007]. For some time it has been recognized that musculoskeletal disorders may be less likely to be recognized as work-related and captured in standard surveillance sources than acute injury events [Blessman, 1991; Dembe, 1996; Morse et al., 2000]. Despite work-related patterns, clear attribution of musculoskeletal

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pain or discomfort to a single event or injury, or even a given work setting, has hampered our understanding of the true burden of these disorders in the workplace.

Previous analyses of back injuries and disorders among union carpenters document a marked decline in the yearly rates of back disorders treated through workers' compensation over time [Lipscomb et al., 2009a; Lipscomb et al., 2009b]. This pattern was accompanied by an increase in treatment and associated costs of the same disorders as captured through the carpenters' private health insurance—available to provide care for non work-related conditions. The findings raise concerns as to how much the observed decline in the rate of back disorders as captured through the WC system truly reflects improved occupational health and safety of the population over time; they suggest instead that these work-related events may still be occurring, with an increased propensity over time for care through a different care and payment system.

We subsequently documented marked declines in musculoskeletal soft tissue injuries and disorders involving the upper extremity (UE) and the knee through WC for members of this construction cohort [Lipscomb et al., 2015b; accompanying paper]. In light of these findings and the long-recognized difficulty in segregating MSDIs related to occupational exposure from those that are not related to work activities, we wanted to explore possible care-shifting related to treatment of these outcomes among this large, well-established 20-year occupational cohort of union carpenters [Lipscomb et al., 1997, 2003, 2009a,b; McCoy et al., 2012] at high risk of MSDIs due to their work exposures. In the current analyses, we examined and contrasted—over time—patterns in rates of work-related musculoskeletal conditions of the UE and knee as captured through the workers' compensation system to patterns in rates of health care utilization for similar conditions as captured through the carpenters' private health insurance claims.

METHODS

Using data from the Carpenters Trusts of Western Washington (CTWW) we previously identified a cohort of union carpenters who worked in the State of Washington between 1989 and 2008, their dates of birth, gender, earliest date of union activity, and their hours of union work [Lipscomb et al., 2013a, 2013b; Lipscomb et al., 2014; Lipscomb et al., 2015a, 2015b; McCoy et al., 2012]. Study cohort membership was limited to individuals who worked at least 3 months of union hours during this 20-year period and had at least one month of eligibility for health insurance through CTWW. These union carpenters receive health and retirement benefits through the CTWW which is a jointly trusted labor-management fund. Contractors who hire union labor pay a designated amount per hour of work that supports

the trust. Funds, such as this one, developed through collective bargaining processes over time in different geographic areas, industries, and trades to provide health insurance coverage for non work-related medical care. Such arrangements allow union construction workers who have multiple employers over the course of their work life to maintain health insurance coverage for themselves and their families. After meeting eligibility requirements based on work hours, the carpenters receive health insurance coverage at no additional cost. They are allowed to bank hours to provide for continued coverage during periods when they may be between jobs. In addition to enumerating the cohort, their hours worked, and union activity, CTWW also provided the records of eligibility for health care coverage through the trust each month and all claims for medical care covered through the trust. The latter included the actual line items for care including provider assigned ICD-9 diagnosis codes.

The Washington State Department of Labor and Industries (L&I) provided the WC claims for the cohort. Washington has a state run WC program which captures medical only claims as well as those which result in lost work time. Claims from companies which self-insure for WC coverage are only coded in the L&I data if they result in paid lost time from work. The L&I data include the date of injury, and 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 paid lost time from work, which occurs after the third lost day in the State of Washington [Lipscomb et al., 2015b; accompanying manuscript]. Data were extracted in August 2009 allowing 8 months after the last claims were filed in 2008 for fuller development of the claims and capture of the self-insured claims that resulted in paid lost time.

The data were provided by each source. Individuals had their own blinded unique identifier, assigned by CTWW, allowing us to merge the records on an individual basis across data sources without the use of personal identifiers. In so doing we were able to construct a comprehensive view of health care utilization by members of this working cohort over a 20-year period. No race or ethnicity information was available from these sources.

In line with our outcomes of interest in prior analyses of WC claims data [Lipscomb et al., 2014; Lipscomb et al., 2015b], the primary outcomes of interest in the assessment of private health insurance claims were outpatient health care visits for musculoskeletal UE and knee diagnoses. These outcomes were based on a primary ICD-9 code diagnosis assigned to the claim by the provider as a requirement for billing purposes. To select codes of interest for UE and knee disorders, we examined the codes assigned to medical claims for treatment of work-related disorders available in the WC data and then identified cases of interest in the private health insurance files using the same constellation of ICD-9 codes [Available in Appendix].

Care utilization was defined as one visit per carpenter per provider in any given day. For example, a given carpenter might see a physician and a physical therapist on the same day counting as two visits; however, if the carpenter saw the same provider for an exam, x-ray, and laboratory study, the encounter would be considered as one visit. Time at risk for health care utilization was based on months in which each carpenter was eligible for insurance coverage through the trust. To define time at risk and events of interest on the same basis for rate calculations, visits were limited to those occurring in months of insurance eligibility. This approach is similar to our analyses of compensation data [Lipscomb et al., 2014; Lipscomb et al., 2015b] but the measure of time at risk is months of insurance eligibility instead of hours of work.

Descriptive statistics based on the private health insurance claims data were generated to describe the frequency of diagnoses by body part injured, the number of carpenters with diagnoses involving the UE and the knee, and the distribution of months of insurance eligibility. Overall private outpatient health care utilization rates for musculoskeletal disorders were calculated per 100 person-years (or 1200 person-months) of insurance eligibility. Health insurance eligibility and health care visits were stratified by categories of age, gender, time in the union, predominant type of carpentry work of the local to which each worker belonged, and calendar year to allow comparisons to previously reported claims patterns in WC [Lipscomb et al., 2015b; accompanying paper]. Age and time in the union were both treated as time-varying variables with time at risk accumulating in the appropriate strata over the 20-year period.

Multivariate models, constructed separately for the UE and knee, explored factors associated with health care utilization. Crude rates and adjusted rate ratios were modeled. Age, as well as gender, are known to be associated with health care utilization [Bertakis et al., 2000; Ladwig et al., 2000; Owens, 2008; Haskell et al., 2011] and both were included as covariates of interest; time in the union and predominant type of work—both associated with work exposures and injuries in this cohort [Lipscomb et al., 2014; Lipscomb et al., 2015b]—were included as well. As expected, the distribution of utilization was highly skewed due to a significant proportion of the population who never sought care. Therefore negative binomial models were used to calculate stratified utilization rates and rate ratios. Sometimes referred to as the gamma Poisson distribution, the negative binomial distribution provides an alternative to the Poisson distribution when the mean and variance are not equal. Negative binomial models have an additional parameter allowing adjustment of the variance independently of the mean [Byers, 2003] but the form of the model equation is the same as that for Poisson regression. In this case, the natural log (musculoskeletal health care utilization)

= natural log(person-years of health care utilization) + β_0 + β_1X_1 + β_2X_2 + β_3X_3 + β_4X_4 , where X_1 = categories of age X_2 = gender, X_3 = predominant type of work, X_4 = time in the union. Further, to account for the correlation of health care visits within subjects, generalized estimating equations with an exchangeable correlation structure [Zeger et al., 1988] were used in the multivariate modeling of these longitudinal data.

To adjust for temporal trend in health care utilization among the cohort over the 20-year period, claims for acute respiratory conditions (ICD9 Codes 460-466) were used as an internal control. Acute respiratory problems and MSDIs are among the more common reasons for seeking medical care, providing robust yearly estimates. We acknowledge that respiratory disorders are associated with being a carpenter—as are musculoskeletal problems. The use of an internal control seeks to adjust for temporal variation in utilization of health care rather than seeking a diagnosis that would be uncommon among these carpenters. In so doing, we are able to address the question of whether what we are observing in terms of health care use for musculoskeletal outcomes is greater than (or less than) that which we would expect based on changes in the use of health care in general. The control should not be associated directly with the other conditions, and it needs to be relatively common to permit robust analyses; in this study, we believe respiratory disorders met these criteria. Respiratory care should be unrelated to factors that would directly affect musculoskeletal symptoms or disorders in the workplace (availability of assistive devices, lifts, production pressures) or otherwise. To accomplish this, we utilized regression models of counts of utilization for the UE and knee that included the natural log of the number of visits for acute respiratory diagnoses as the offset. The mathematical models took the form [natural log (musculoskeletal health care utilization) = natural log-(respiratory health care utilization) + β_0 + β_1X_1 , where X_1 = calendar year]. This approach is based on incorporation of external standard rates into multiplicative regression models in order to estimate standardized mortality ratios relative to an unexposed category [Breslow and Day, 1987]. The method has been demonstrated both in the context of health care utilization and occupational injury [Schoenfisch et al., 2013; Lipscomb et al., 2014]. This approach assumes there are no changes across calendar years that meaningfully affect rates of care for respiratory conditions alone. The adjusted (and unadjusted) patterns of utilization for upper extremity and knee disorders were then compared graphically to rates of WC claims filed for similar upper extremity and knee disorders by the cohort in the same 20-year period.

All analyses were conducted using SAS Version 9.3.; modeling of health care utilization counts, rates, and rate ratios was accomplished using the Genmod procedure. The institutional review boards at Duke University Medical Center and the Washington State Department of Social and

Health Services approved all procedures. Informed consent was not obtained; analyses involved use of de-identified secondary data.

RESULTS

The carpenter cohort consisted of 24,830 individuals who each worked at least 3 months of union hours in Washington State between 1989 and 2008. The vast majority (97%) were male. The number of carpenters who sought care for UE or knee disorders through WC and/or their private insurance is displayed in Table I. Care for UE disorders was more prevalent than that for knee disorders in both systems. More carpenters used the private health care system than the WC system; however, most had not sought care for either the knee (84%) or UE (71%) through either care system. Nearly 6% (5.8%; $n = 1,431$) of the cohort sought care for UE problems in both systems as did 2% (1.8%; $n = 457$) for knee problems.

A total of 38,438 visits were observed among members of the cohort for UE MSDIs and 21,914 for knee MSDIs, representing crude utilization rates of 29.5 (95%CI: 27.7, 31.4) and 16.7 (95%CI: 15.7, 17.8) per 100 person-years of insurance eligibility, respectively. While declines were observed in reported WC claims for UE and knee injuries and disorders (250% and 300%, respectively) [Lipscomb et al., 2015b; accompanying paper], health care utilization for these outcomes increased over the 20-year period, 300% and 340%, respectively (Table II). When adjusting for temporal trend, the magnitude of the utilization increase over time (as shown in Table II), is muted by approximately a third; however, the patterns of decreasing WC claims rates and increasing private utilization remain (Fig. 1A,B).

The negative binomial models of health care utilization rates and rate ratios are presented in Table III. Again, the models were adjusted for categories of age, gender, time in the union and predominant work. Health care utilization rates for the UE and the knee were higher among workers >50 years old compared to their younger counterparts, and the magnitude of this relative difference was similar for both

extremities. Women had 20% greater utilization than men for UE problems, and 70% higher utilization for knee disorders. For both the UE and knee, individuals who had been in the union the least amount of time (<2 years) had lower health care utilization rates than those who had been in 10 years or more, but otherwise we saw few differences across categories of union tenure. The patterns of risk based on predominant type of work were quite similar for the UE and the knee. Those who did heavy commercial work had 50% higher utilization rates for MSDIs of the UE (aRR = 1.5; 95%CI: 1.3–1.7) and the knee (aRR = 1.5; 95%CI: 1.2–1.8) compared to those who did predominantly light commercial work. Rates were also elevated among carpenters whose predominant type of work was drywall installation or pile driving.

DISCUSSION

We had the opportunity to compare patterns of health care utilization for MSDIs of the UE and the knee to patterns of WC claims filed for similar disorders over a 20-year period for a large, well-defined occupational cohort of union carpenters. A very small proportion of this population (<10%) with access to private health care coverage sought medical care through both the workers' compensation and private health care systems for MSDIs of the extremities. Although rates of care for the UE were nearly two times higher than those for care of the knee, the overall patterns of health care utilization by age, gender, time in the union, and predominant type of work were quite similar.

As the rates of reported WC claims for MSDIs of the UE and the knee declined substantively over 20 years, health care utilization rates increased comparably. Spector et al. [2011] reported a decline in paid lost time knee claims through the Department of Labor and Industries in Washington State, the source of the carpenters WC claims, between 1999 and 2007 of 27% and described this to be typical of the decline in other musculoskeletal claims during this period. A twofold greater decline in compensable knee claims (65%) was observed among this cohort of construction workers in the same state

TABLE I. Medical Care for Upper Extremity and Knee Disorders Through Workers Compensation and Private Insurance, Union Carpenters Washington State, 1989–2008

| Source of care | Upper extremity | Knee |
|--|-------------------------|-------------------------|
| | Frequency (% of cohort) | Frequency (% of cohort) |
| Only workers compensation system | 1460 (5.9%) | 765 (3.1%) |
| Only private insurance system | 4231 (17.0%) | 2657 (10.7%) |
| Both (WC and Private) | 1431 (5.8%) | 457 (1.8%) |
| Neither injury/disorder captured in WC or Private care | 17708 (71.3%) | 20951 (84.4%) |

TABLE II. Stratified Months of Insurance Eligibility, Frequency of Private Health Care Utilization for Upper Extremity and Knee MSDIs, Rates¹ (95% CI) and Rate Ratios² (95%CI), Union Carpenters, Washington State 1989–2008 by Calendar Time

| Year | Upper extremity (UE) | | | Knee | | | |
|------|----------------------|---------------------|---------------------------|-------------------------|-----------------------|---------------------------|-------------------------|
| | Eligibility (months) | UE MSDI utilization | Rate (95%CI) ^a | RR (95%CI) ^b | Knee MSDI utilization | Rate (95%CI) ^a | RR (95%CI) ^b |
| 1989 | 44,896 | 523 | 14.1(12.4–16.0) | 1 | 272 | 7.4 (6.2–8.8) | 1 |
| 1990 | 67,866 | 1,146 | 20.4 (18.5–22.4) | 1.5 (1.1, 1.9) | 619 | 11.1 (9.7–12.6) | 1.5 (1.1–2.2) |
| 1991 | 57,331 | 1,096 | 22.8 (20.6–25.2) | 1.6 (1.2, 2.1) | 536 | 11.1 (9.6, 12.9) | 1.5 (0.96–2.3) |
| 1992 | 73,331 | 1,182 | 19.4 (17.7–21.3) | 1.4 (1.1, 1.8) | 858 | 14.1 (12.4–15.9) | 2.0 (1.3–3.0) |
| 1993 | 72,580 | 1,329 | 22.1 (20.2–24.2) | 1.6 (1.2, 2.0) | 817 | 13.5 (12.0–15.3) | 1.8 (1.2–2.7) |
| 1994 | 69,364 | 1,233 | 21.4 (19.5–23.5) | 1.5 (1.2, 2.0) | 873 | 15.2 (13.4–17.2) | 2.1 (1.4–3.2) |
| 1995 | 68,076 | 958 | 16.8 (15.3–18.6) | 1.2 (0.90, 1.6) | 719 | 12.7 (11.2–14.5) | 1.7 (1.1–2.6) |
| 1996 | 67,777 | 1,468 | 25.8 (23.5–28.2) | 1.8 (1.4, 2.3) | 696 | 12.3 (10.8–14.0) | 1.6 (1.1–2.4) |
| 1997 | 71,336 | 1,426 | 24.0 (22.0–26.3) | 1.7 (1.3, 2.2) | 729 | 12.3 (10.8–14.0) | 1.6 (1.1–2.5) |
| 1998 | 74,736 | 1,649 | 26.5 (24.4–28.9) | 1.9 (1.4, 2.4) | 808 | 13.0 (11.5–14.7) | 1.7 (1.1–2.6) |
| 1999 | 86,355 | 1,939 | 27.1 (25.0–29.3) | 1.9 (1.5, 2.5) | 985 | 13.7 (12.3–15.4) | 1.8 (1.2–2.7) |
| 2000 | 91,589 | 2,288 | 30.1 (27.9–32.5) | 2.2 (1.7, 2.8) | 1,180 | 15.5 (13.9–17.3) | 2.1 (1.4–3.1) |
| 2001 | 94,618 | 2,615 | 33.0 (30.7–35.6) | 2.4 (1.8, 3.0) | 1,429 | 18.2 (16.4–20.2) | 2.5 (1.7–3.8) |
| 2002 | 86,714 | 2,360 | 32.7 (30.3–35.3) | 2.3 (1.8, 3.0) | 1,462 | 20.3 (18.2–16.4) | 2.8 (1.9–4.2) |
| 2003 | 90,601 | 1,765 | 23.4 (21.6–25.4) | 1.6 (1.3, 2.1) | 1,067 | 14.2 (12.7–15.8) | 1.9 (1.3–2.9) |
| 2004 | 79,611 | 2,582 | 38.9 (36.0–42.1) | 2.7 (2.1, 3.5) | 1,599 | 24.1 (21.6–29.9) | 3.1 (2.1–4.6) |
| 2005 | 76,653 | 2,587 | 40.5 (37.4–43.9) | 2.8 (2.2, 3.6) | 1,541 | 24.1 (21.6–27.0) | 3.0 (2.0–4.5) |
| 2006 | 85,080 | 2,961 | 41.8 (38.7–45.1) | 2.9 (2.3, 3.8) | 1,522 | 21.5 (19.3–23.9) | 2.8 (1.9–4.2) |
| 2007 | 97,988 | 3,378 | 41.4 (38.6–44.4) | 3.0 (2.3, 3.8) | 1,855 | 22.7 (20.6–25.1) | 3.1 (2.1–4.6) |
| 2008 | 111,299 | 3,941 | 42.6 (39.9–45.5) | 3.0 (2.4, 3.9) | 2,347 | 25.3 (23.1–27.8) | 3.4 (2.3–5.1) |

^aRates expressed as injuries per 100 person-years (1200 month) of insurance eligibility.

^bRate ratios calculated with negative binomial regression with GEE; adjusted for age, gender, tenure, and type of work.

in the same time period with a corresponding increase in their private health care utilization for knee diagnoses. Further, this excess was after consideration of temporal trend in health care utilization over the 20-year period.

These patterns over time are consistent with the shifting of care for work-related MSDIs of the UE and knee outside of the WC system to other payment sources, namely the private health insurance system, a concern that has been reported before [Dong et al., 2007; Lipscomb et al., 2009a,b; Schoenfisch et al., 2013]. However, these data alone do not provide insight into the factors influencing such patterns, their degree of influence, and whether their impact varies over time or worker characteristics. Care shifting could theoretically occur through a number of different scenarios. A worker might have a clear cut work-related event for which they chose not to file a WC claim, and for which in the case of these carpenters, he or she might seek medical care through the trust-provided insurance coverage. Use of the WC system may be viewed as stressful [Boden 2012], or more of a hassle than using one's private insurance [Boden, 2012; Lippel, 2012; Lipscomb et al., 2014; Lipscomb et al., 2015a, 2015b].

Behavioral-based safety approaches can influence workers' seeking of care outside of the WC system as well; these approaches—which may arise from supervisors'

or employers' concerns over increased WC insurance premiums or regulatory oversight—include practices such as individual or group rewards for no injuries or low injury rates, or policies of discipline (or threats of discipline) for reporting injuries [Lessin, 2010; Lippel, 2012; Lipscomb et al., 2013a,b; Lipscomb 2014a; Lipscomb et al., 2015a, 2015b]. We have heard concerns from carpenters [Lipscomb et al., 2010, 2013a,b; Lipscomb 2014a; Lipscomb et al., 2015a, 2015b], about not wanting to risk being labeled as “damaged,” and how such labels can be particularly problematic in times of economic uncertainty.

There are also plausible scenarios in which there is uncertainty about whether use, or continued use, of the WC system is appropriate due to the inherent nature of MSDIs, as well as individual perception and interpretation of the significance of symptoms, availability and expectations of treatment, and learned and cultural patterns of illness behavior [Waddell, 1987]. Workers may have pre-existing symptoms that a work exposure might exacerbate, and decisions regarding the coverage of these disorders in WC can seem arbitrary. Musculoskeletal symptoms could arise over time as cumulative exposures caused damage, or they could appear without clear cut causality. Finally, a worker might initially file a compensation claim and seek

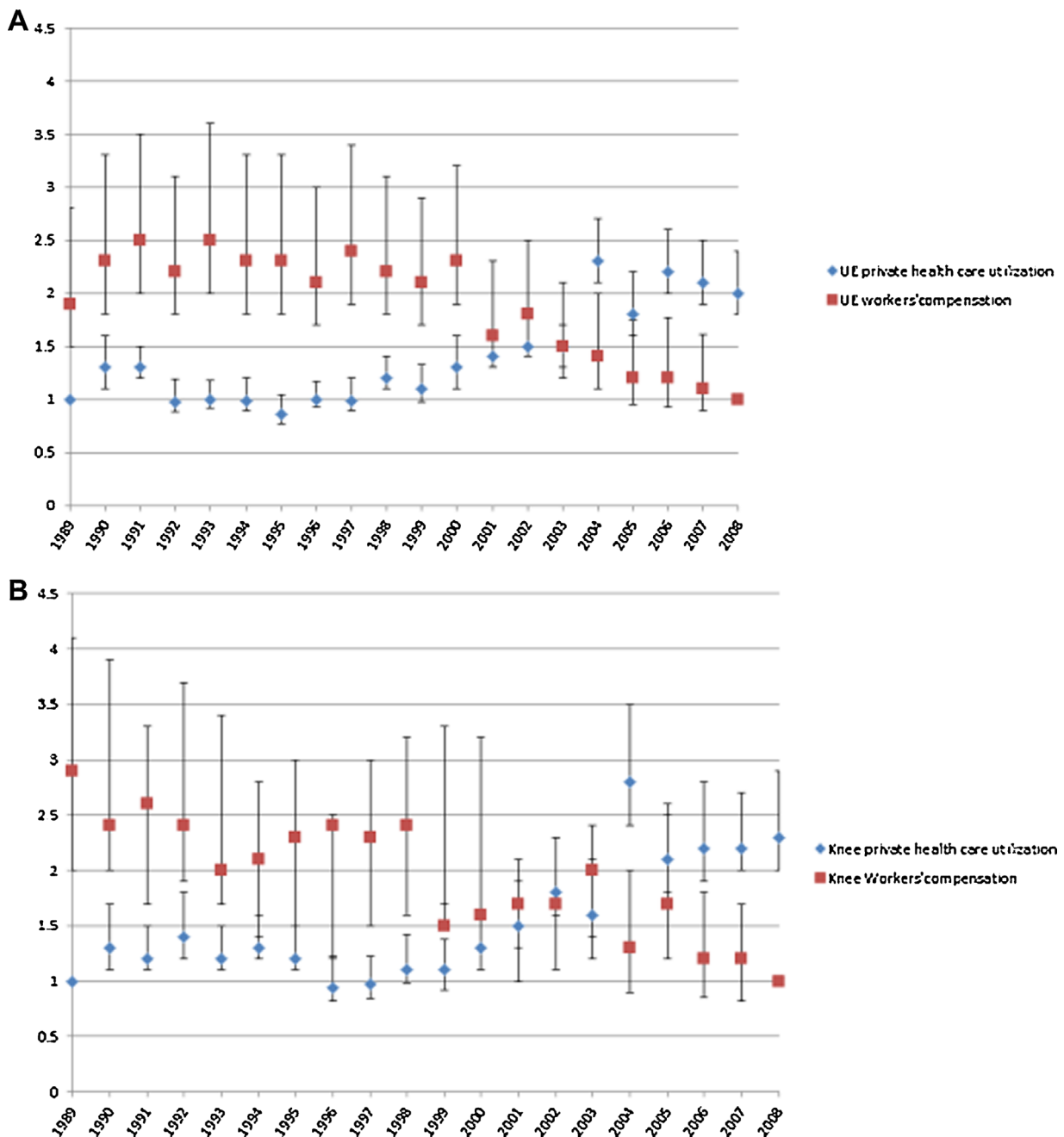


FIGURE 1. A. Rate ratios comparing upper extremity WC claim rates and private health care utilization rates, adjusted for respiratory utilization, union carpenters in Washington State, 1989–2008. **B.** Rate ratios comparing knee workers' compensation claim rates to private health care utilization adjusted for respiratory utilization among union carpenters in Washington State, 1989–2008.

subsequent care for related problems—sometimes years later—outside the WC system. It is important to note that these perceptions are not limited to those of workers. Physicians, or other caregivers, may be partners in the phenomena of care shifting as well. They may be aware that events occurred at work or they may not, work-relatedness may be unclear, one form of insurance may reimburse caregivers differentially

better than another, or the injured worker may not reveal the work-related nature [Azaroff et al., 2004, 2013].

The very nature of work organization in construction may serve to compound the issues described. Construction workers by definition constantly work themselves out of a job as building projects are completed, and they must then be hired on for the next assignment. This process, which is why

TABLE III. Stratified Months of Insurance Eligibility, Health Care Visits for Upper Extremity and Knee Injuries and Disorders, Utilization Rates and Adjusted Rate Ratios, Union Carpenters Washington State, 1989–2008

| | Months of insurance eligibility | Upper extremity | | | Knee | | |
|--------------------------|---------------------------------|-----------------|---|--------------------------------------|--------|---|--------------------------------------|
| | | Visits | Utilization rate ^{a,b} (95% CI) | Adjusted RR ^c (95% CI) | Visits | Utilization rate ^{a,b} (95% CI) | Adjusted RR ^c (95% CI) |
| Age | | | | | | | |
| <30 | 245005 | 5240 | 25.7 (24.5–27.0) | 0.63(0.55–0.73) | 2851 | 14.0 (13.1–15.0) | 0.65 (0.52–0.81) |
| 30–<40 | 460577 | 9853 | 25.7 (24.8–26.6) | 0.64 (0.57–0.71) | 5497 | 14.3 (13.6–15.1) | 0.62 (0.53–0.71) |
| 40–<50 | 441524 | 10760 | 29.3 (28.2–30.3) | 0.76 (0.69–0.84) | 5855 | 15.9 (15.1–16.7) | 0.69 (0.62–0.77) |
| 50+ | 415019 | 12489 | 36.1 (34.9–37.4) | 1 | 7681 | 22.2 (21.2–23.3) | 1 |
| Gender | | | | | | | |
| Female | 26393 | 625 | 28.4 (24.6–32.9) | 1.2 (0.97–1.6) | 495 | 22.5 (18.5–27.4) | 1.7 (1.1–2.6) |
| Male | 1535653 | 37717 | 29.5 (28.9–30.0) | 1 | 21389 | 16.7 (16.3–17.2) | 1 |
| Time in the union | | | | | | | |
| <2 year | 201427 | 3997 | 24.1 (22.8–25.5) | 0.85 (0.76–0.95) | 1951 | 11.8 (10.9–12.8) | 0.67 (0.55–0.81) |
| 2–<4 years | 147688 | 3575 | 29.1 (27.3–30.9) | 1.0 (0.90–1.2) | 1847 | 15.0 (13.8–16.4) | 0.85 (0.69–1.03) |
| 4–<6 years | 123449 | 2876 | 28.0(26.2–30.0) | 0.98 (0.85–1.1) | 1400 | 13.6 (12.4–15.0) | 0.73 (0.59–0.90) |
| 6–<8 years | 110780 | 2707 | 29.3 (27.3–31.5) | 1.0 (0.89–1.2) | 1591 | 17.3 (15.7–19.1) | 0.98 (0.79–1.2) |
| 8–<10 years | 99403 | 2470 | 29.8 (27.7–32.1) | 1.0 (0.92–1.2) | 1460 | 17.7 (15.9–19.6) | 1.02 (0.83–1.24) |
| 10 years and over | 885034 | 22801 | 30.9 (30.2–31.7) | 1 | 13665 | 18.5 (17.9–19.2) | 1 |
| Predominant work | | | | | | | |
| Drywall | 283428 | 6791 | 28.8 (27.5–30.1) | 1.2 (1.0–1.4) | 3570 | 15.1 (14.2–16.1) | 1.3 (1.0–1.6) |
| Residential | 24528 | 426 | 21.1 (18.0–24.8) | 0.97 (0.74–1.3) | 205 | 10.2 (8.1–13.8) | 0.88 (0.53–1.5) |
| Millwright | 29437 | 579 | 23.7(20.6–27.3) | 0.75 (0.58–0.97) | 340 | 13.9 (11.4–16.9) | 0.95 (0.63–1.4) |
| Pile driver | 87865 | 2072 | 28.3 (26.1–30.7) | 1.2 (0.93–1.4) | 1177 | 16.1 (14.4–18.0) | 1.3 (0.95–1.7) |
| Mixed commercial | 359248 | 8255 | 27.6 (26.5–28.7) | 1.1 (0.97–1.3) | 4565 | 15.2 (14.4–16.1) | 1.1 (0.93–1.4) |
| Heavy commercial | 314470 | 9240 | 35.3 (33.9–36.8) | 1.5 (1.3–1.7) | 5417 | 20.7 (19.6–21.9) | 1.5 (1.2–1.8) |
| Out of Washington | 287906 | 7211 | 30.0 (28.7–31.3) | 1.2 (1.0–1.3) | 4595 | 19.2 (18.1–20.4) | 1.4 (1.2–1.8) |
| Light commercial | 158492 | 3363 | 25.5 (24.0–27.1) | 1 | 1865 | 14.1 (13.0–15.4) | 1 |

^aRates are per 100 person-years of insurance eligibility.

^bNegative binomial regression model.

^cNegative binomial regression model with generalized estimating equations, adjusted for all variables shown.

health care trusts such as CTWW were established, may increase feelings of vulnerability in relationship to reporting of workers' compensation claims. Its influence may be of particular relevance during times of economic pressure and job insecurity, such as that observed in the construction economy in the last decade. It seems reasonable that such effects might vary by age or seniority. Although it would not account for the overall general patterns we observed in this study, a worker might have non work-related symptoms for which they seek care through the WC system; this possibility has often been described in terms of moral hazard [Dembe and Boden, 2000].

Analyses of injuries and disorders involving the extremities present methodological challenges that are not faced when looking at the axial skeleton. Neither injury codes that are used in WC data nor ICD-9 codes assigned by medical care providers define right or left-sided injuries, and handedness of the injured party is not typically available. The

latter could certainly influence ability to return to work while the former makes it impossible to determine if care received in the private insurance system for an extremity problem involves the same extremity that may have been injured in an earlier work incident. This inherent misclassification likely serves to make it more difficult to identify relationships that may exist for care across the WC and private insurance systems.

Our ability to link work records, workers' compensation claims, and private health care utilization claims on an individual basis provided a more comprehensive assessment of health care delivery for nearly 25,000 construction workers than could be gathered through the use of WC claims data alone. Further, measures of hours worked [Lipscomb et al., 2015b; accompanying paper] and months of eligibility for insurance coverage provided appropriate denominators for rate calculations. Analyses were robust for the outcomes of interest, allowing for adjustment for age and gender which

are known to be associated with health care utilization, as well as type of work, and union tenure that we have seen to be associated with work-related injury rates. It is difficult to access the data needed for analyses such as these. Many construction workers do not have health insurance coverage and they work for many employers over the course of time. Even workers' compensation data would need to be accessed from multiple sources in most states; an issue we did not face given Washington is one of few state run compensation programs. 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. They also received health benefits over time from the same trust even as they changed employers. Our access to records of care covered under their private insurance and through workers' compensation came from longstanding collaboration among the academic research team, CTWW, and Washington State Department of Labor and Industries. The use of a cohort approach that incorporated rigorous statistical analyses including use of an internal control for temporal trend with visits for a different diagnostic group allowed the opportunity to explore these issues in a fairly robust manner. These analyses, we believe, are an improvement on our earlier approach that compared crude rates over time for back disorders [Lipscomb et al., 2009a,b; Schoenfisch et al., 2014]. In the current analyses we adjusted for the pattern of private utilization for respiratory conditions to account for the temporal change in utilization patterns. So doing muted the magnitude of the observed changes over time and likely represents a more realistic appraisal of the magnitude of care shifting from workers' compensation to these workers' private health insurance system.

CONCLUSIONS

We believe the findings presented here provide strong evidence of a lack of independence in treatment of MSDIs for the UE and knee across payment systems in a large working population with significant work-related exposures. Care-shifting across different payment systems is not easy to explore from an epidemiological perspective, yet its existence calls for the need to respond in both our research and our applied efforts to address workers' safety and health concerns. The mechanisms that contribute to this dynamic phenomenon are likely to be quite complex, and they may involve both conscious and unconscious behaviors and decisions on the part of workers, employers and providers. Without assigning blame or attribution, the data demonstrate the difficulty in understanding the true burden of disease and its occupational components in this working population. While many questions remain to be answered, we believe, in this case, the approach improved our understanding of the

burden of musculoskeletal problems of the extremities for this specific occupational group. Further, it demonstrates how our overall understanding of work-related events can be improved by various methods that allow combining sources of data as called for by other investigators [Park et al., 1992; Reville et al., 2001].

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