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Relationship of Work Injury Severity to Family Member Hospitalization

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Background *Working while under stress due to a family health event may result in injuries of greater severity. Work leave might mitigate such consequences.*

Data and Methods *Workers' compensation data for 33,817 injured workers and inpatient medical data for 76,077 members of their families were extracted from the 2002–2005 Thomson Reuters Medstat MarketScan Health and Productivity Management (HPM) and Commercial Claims and Encounter (CCE) datasets. Using a probit model, the impact of family hospitalization on the probability that a subsequent injury would be severe (above average indemnity costs) was estimated, adjusting for age, sex, hourly versus salaried status, industry sector, state, and family size.*

Results *Family hospitalization within 15 days before injury increased the likelihood that the injury would be severe (from 12.5% to 21.5%) and was associated with 40% higher indemnity costs and 50% higher medical costs. Hospitalizations over 30 days before injury had no impact.*

Conclusion *The observed higher severity of work injuries following family hospitalizations suggests additional analyses may find higher injury rates as well, and that timely family leaves might help prevent severe workplace injuries.* Am. J. Ind. Med. 53:506–513, 2010. *© 2010 Wiley-Liss, Inc.*

KEY WORDS: severe workplace injury; family health status; outside workplace stress factors; work leave

BACKGROUND

Existing literature identifies a very wide array of risk factors for workplace injuries and illnesses. Factors such as long working hours, job stress, and workload [Hossain et al., 2004; Swaen et al., 2004; Barger et al., 2005; Corderio and Dias, 2005; Dembe et al., 2005; Nakata et al., 2006],[1] physical hazards and safety culture [Baker and Landrigan, 1990; Wong, 1994; Spurgeon et al., 1996; Berry, 1997], and other factors such as age, sex, and sleep problems [Laflamme et al., 1996; Breslin et al., 2003; Chau et al., 2004; Nakata et al., 2005] have been associated with the risk of being injured or becoming ill at work.

However, very little is known about the impact of important family health events or other stressful events on worker injuries. This study examined the role of such events as an independent risk factor for increasing the severity of workplace injuries. We hypothesized that hospitalization of a family member creates stress that increases the severity and risk of unintentional injuries, both inside and outside the workplace. In particular, we looked at the influence of family

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[1] See also previous studies in this area: [Poole et al., 1992; Johnston, 1995; Kirkcaldy et al., 1997; Greiner et al., 1998; Wilkins and Beaudet, 1998; Murata et al., 2000; Breslin et al., 2003; Folkard and Tucker, 2003; van der Hulst, 2003].

member hospitalization on the risk that work injuries will be costly, and how that risk changed as time elapsed from the time of hospitalization.

Understanding these risks better may help lead to improvements in policies relating to job leave near times of family health emergencies. The Family and Medical Leave Act "entitles eligible employees of covered employers to take up to a total of twelve weeks of unpaid leave during a 12-month-period . . . to care for a spouse, parent, son or daughter with a serious health condition; . . ." [29 U.S.C. Section 2612, U.S. Dept. Labor, 2007]. A recent analysis of public feedback on the impact of this law concluded that it was succeeding in allowing employees to care for family members with serious health conditions [U.S. Dept. Labor, 2007, p.v.]. However, only employees in employers with 50 or more employees and who have worked for their employer for at least 1,250 hr in the previous year are eligible for leave. In 2005, this meant that only 76.1 million out of 141.7 million workers (54%) were covered [U.S. Dept. Labor, 2007, p. 128]. Knowledge of the consequences of not taking leave for important family health events becomes especially relevant to workers and employers not covered by the FMLA.

Research using the Impact of Events (IES) scale has produced an approximate ranking of life events by the level of stress they tend to produce [Benson, 2006]. At the top of the scale is death of a spouse with a score of 100; near the middle is being fired from a job at 47; and towards the bottom is minor legal problems at 11. Change in the health of a family member comes in at 44, somewhat below one's own injury or illness, which has an average score of 53. Several studies have examined the impact of dramatic health events on family members. For example, a spell in the intensive care unit has been associated with post-traumatic stress reaction in a high proportion of family members [Jones et al., 2004; Paparrigopoulos et al., 2006] and with major life changes and increases in care-giving, as well as loss of the major source of family income [Covinsky et al., 1994; Swoboda and Lipsett, 2002] Other studies have found high levels of parental anxiety and stress following child surgery [Scrimin et al., 2009] and persistence of psychological distress following hospitalizations for child head trauma [Youngblut and Brooten, 2006].

There are several possible consequences of stress that could increase risk of occupational injury and illness. Stress symptoms include the following items that are most directly relevant: back aches, stiff and sore muscles, sleep problems, tiredness, increase in alcohol consumption or use of prescription, over-the-counter, or illegal drugs, poor concentration, difficulty completing work assignments, difficulty thinking and remembering, indecisiveness, irritability, anxiety, and depression [Benson, 2006]. (Some of these symptoms, such as tiredness from lack of sleep, and distraction, can also be a direct consequence of major health events, without being mediated by an experience of stress.) The relationship between several of these individual symptoms and workplace injuries has been investigated in a very large literature which we will not attempt to summarize here. Most relevant is the research that has focused directly on the association of stress and work injury.

In the early 1990s, Johnston [1995] reviewed the literature that quantitatively assessed the relationship between stress (either work or non-work-related) and injury rates. While there were serious methodological limitations among the 20 studies identified, most of them found a positive association, and supported the conclusion that there was compelling evidence that further research was warranted. Seven of the studies specifically examined life events, finding statistically significant associations with work injury, although these life events were not generally related to family health. More recent research on the relationship between work stress and work injury has generally found that higher work stress, or some components of work stress (high demand, low control, low support), have a statistically significant association with higher injury rates [Low et al., 1996; Murata et al., 2000; Li et al., 2001; Nolting et al., 2002; Wilkins and MacKenzie, 2007; Salminen et al., 2003; Swaen et al., 2004; Nakata et al., 2006; Soori et al., 2008; Smith et al., 2009].

Work-related, cumulative trauma, musculoskeletal disorders (WMSDs) represent a major share of workers' compensation claims. They may take a substantial amount of time to develop; so they may not be associated with temporary increases in stress due to family hospitalizations. However, there is a large literature investigating the relationship between musculoskeletal disorders and workplace psychosocial stress. The generally positive findings suggest that it is plausible to hypothesize that stressful events outside the workplace could tend to precipitate claims for cumulative trauma musculoskeletal symptoms [Hoogendoorn et al., 2000; National Research Council and Institute of Medicine, 2001; Bongers et al., 2006; Waters et al., 2007]. There is also a small amount of literature on the relationship between non-work-related stress and musculoskeletal disorders that is suggestive. In a review of research on psychosocial factors and work-related back pain, it was noted that there had been several cross-sectional studies showing a modest degree of association of life events or level of family support with musculoskeletal symptoms. There were also three case–control and cohort studies that suggested a possible influence of low family support or lack of social contact and participation on WMSDs, although the evidence of an association was rated as insufficient [Hoogendoorn et al., 2000]. Two reviews of psychosocial factors and upper extremity and neck symptoms found that they were consistently associated with non-work-related stress or general levels of distress, although almost all studies were cross-sectional [Bongers et al., 2002; Bongers et al., 2006].

METHODS

In this study, we hypothesized that workers whose family members are hospitalized could experience problems of concentration, sleep deprivation, high levels of fatigue, and other stress-related problems during work, and that these factors increase the likelihood that subsequent injuries at work would be severe and therefore costly. (While the relationship between severity and cost is a variable one, we assume higher cost generally corresponds with greater severity) Further, we hypothesized that workers would be more distressed in the early days following hospitalization of their family member, resulting in an inverse relation between the number of days by which hospitalization preceded injury and the probability that an injury would be costly.

The estimation strategy to test these hypotheses was as follows:

Let

$$Y = f(h_t, X, Z) \tag{1}$$

where Y is the incidence of a costly workplace injury given that a worker was injured and had a workers' compensation claim (1 if a worker had a high-cost injury claim and 0 if the worker had a low-cost injury claim), h_t is a dummy variable which takes a value of 1 if at least one family member was hospitalized before injury, and t indicates the time period over which family hospitalizations are observed preceding injury, Three different time periods were considered: between 0 and 15, 16 and 30, and 31 and 45 days before injury. X is a vector of injured worker characteristics such as age, sex, hourly versus salaried, industry, etc., and Z is a vector of family members' characteristics such as family size and location.

Estimating Equation (1) using probit/logit models will give the impact of hospitalization of family members on the probability that subsequent workplace injuries will be costly. However, two major potential problems may lead to biased and inconsistent estimates of the coefficient of the hospitalization variable. First, there can be reverse causality between hospitalization of family members and the incidence of severe workplace injury. In fact, an analysis showed that, ceteris paribus, family members of severely injured workers were more likely to be hospitalized than family members of non-severely injured workers [Asfaw and Pana-Crya, 2009]. The second problem is that the hospitalization variable can be endogenous in the system.[2] To address the first problem, workers who were injured within 2 months[3] before hospitalization were not considered, and this should reduce the impact of workplace injury on the hospitalization of family members. We also tested whether the hospitalization variable was endogenous in the system using the Hausman test.[4] The results (not reported) showed that the hospitalization variable was not endogenous. Therefore, we estimated the following equation with a probit specification:

$$Y_t = a + \sum_{j=1}^{3} h_r b_j + Ab_4 + A^2 b_5 + Gb_6 + O\beta_7 + Fb_8 + Ub_9 + \sum_{r=10}^{14} I_r b_r + \sum_{s=15}^{66} L_s b_s + \varepsilon \tag{2}$$

where A, A^2, and G stand for age, age squared, and gender of the injured worker, respectively, O stands for compensation status (hourly/salary), F is family size, U indicates unionization status of the worker, and I is a vector of 5 industry sectors. L represents 52 geographic location indicators that control for location-specific fixed effects.

DATA AND MEASUREMENT OF VARIABLES

The data source for this study is the MarketScan research databases compiled by Thomson Reuters (Thomson Reuters, New York, New York). Health insurance claims data for the private Marketscan databases are provided by nearly 100 large U.S. employers and 12 health plans each year. In this study, we used the Marketscan Commercial Claims and Encounters (CCE) and Health and Productivity Management (HPM) databases. The CCE database contains information on inpatient, outpatient, and pharmacy claims for over 73 million unique patients covered by employer-sponsored health plans. This includes, among other items, date of service, hospital admission, and payments. The enrollment file of the CCE database contains information on age, sex, relation to the employee, geographic location for all enrollees, including those not receiving medical services. The HPM database contains information on absence, short-term disability claims, and workers' compensation claims and payments. For this analysis, we linked the inpatient and the workers' compensation data sets.

Our study population was a cohort of injured workers between 2002 and 2005[5] who filed for workers' compensation benefits and whose case was closed during the year of the

[2] This means that unobservable factors that affect the probability of workers being severely injured can also affect the probability of family members being hospitalized.

[3] Two months after injury was considered based on the results of Asfaw and Pana-Crya [2009].

[4] The Hausman test was conducted as follows. First, we estimated $h_{it} = a + \Phi_t' b + Z'\eta + \nu$ (where Φ is a vector of exogenous variables that affect the probability of hospitalization and i is family member i) to determine factors that affect the hospitalization of family member i before a workplace injury (h_{it}). Second, we estimated an augmented equation given by $Y_t = \alpha + h_{it}\beta + X'\gamma + Z'\eta + \hat{\nu}\theta + \varepsilon$ (where $\hat{\nu}$ is the residual from the above equation). Finally, we tested whether $\hat{\nu}$ was statistically different from zero. The result (not shown here) showed that θ was not statistically significant at the 10% level.

[5] The validity of assuming that the relationship between family hospitalization and work injury did not change between 2002 and 2005 was tested using a Chow test.

TABLE I. Descriptive Statistics

Sample size: injured workers	33,817	
Sample size: family members of injured workers	76,077	
Variable	Mean	Standard deviation
Dependent variable: severely injured		
1 if received indemnity payments associated with workers' compensation case and 0 otherwise (%)	20.78	0.406
1 if the indemnity payment associated with workers' compensation case was above the average level and 0 otherwise (%)	12.54	0.331
1 if the medical payments associated with workers' compensation case were above the average and 0 otherwise (%)	19.45	0.395
Indemnity payments associated with WC per claim ($)	1979	9423
Explanatory variable		
Sex of the worker: 1 male and 0 otherwise (%)	67.37	0.469
Age of the worker	42.36	9.238
Family size	3.23	1.223
At least one family member was hospitalized within		
0–15 days before injury (%)	0.34	
16–30 days before injury (%)	0.41	
31–45 days before injury (%)	0.40	
Union status: 1 if unionized and 0 otherwise (%)	43.38	0.49
Employment status: 1 if hourly worker and 0 otherwise (%)	91.46	0.279
Industry (%)		
Manufacturing durable	36.68	
Manufacturing non-durable	12.87	
Transportation and communication	25.05	
Finance, insurance, and real estate	1.10	
Services	24.30	

injury. Family members who were not insured for at least 9 months of the year were dropped. Overall, 76,077 family members of 33,817 injured workers were included in the analysis.

In this study, injured workers were dichotomized into two categories (severely and non-severely injured) based on total workers' compensation indemnity payments.[6] Injured workers with below average values were considered to have a low-cost injury or to be non-severely injured, and those with above average values were considered to have a high-cost injury or to be severely injured. Out of 33,817 injured workers included in our sample, 12.55% were severely injured. For the sake of testing robustness of the findings, the severity variable was also measured in several other ways. First, all injured workers receiving indemnity payments were considered as severely injured (21.42%) and others as non-severely injured. Second, severity was measured as a continuous variable using the total value of indemnity payments. Finally, instead of indemnity payments, above average medical payments were used as an indicator of severe or costly injury.

We used hospitalization of a family member as an indicator of a family health event that might create insomnia, fatigue, memory problems, and other stress-related symptoms. In our sample, in nearly 0.34% of the households, at least one family member was hospitalized within 15 days before a workplace injury occurred. In 0.41% and 0.40% of households, at least one family member was hospitalized between 16 and 30 and 31 and 45 days before injury, respectively.[7] The descriptive statistics for the variables used in the analysis is presented in Table I.

[6] Strunin and Boden [2004] and Brown et al. [2007] also used Workers' compensation indemnity payment to measure severity of workplace injury.

[7] All hospitalizations with admission date 0–45 days before injury were categorized by date of discharge. Mean length of hospital stay was comparable for hospitalizations 16–30 and 31–45 days before injury (4.1 and 4.2 days, respectively). Mean stay for hospitalizations 0–15 days before injury was 6.1 days, but this did not significantly bias the results, because mean stay in this group was 4.3 days without two very long hospitalizations that were not succeeded by severe injury.

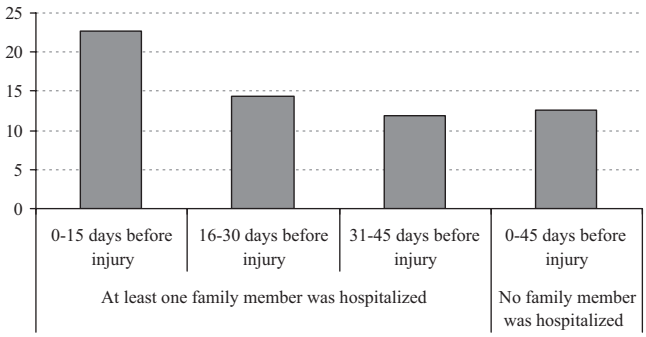

FIGURE 1. Workers with high-cost claims as percent of injured workers, in families with and without at least one hospitalized family member, by time period preceding injury.

RESULTS

Descriptive Results

Figure 1 presents the percentage of injured workers with high-cost claims in four groups of families: those with a member hospitalized 0–15, 16–30, or 31–45 days before injury, and those with no hospitalization 0–45 days before injury. In families with a member hospitalized 0–15 days before injury, nearly 22.6% of injured workers had high-cost claims compared to less than 12.5% in households where there was no hospitalization. This difference was statistically significant at less than the 1% (*F*-test, significant at 0.001) level.

The difference between families with a hospitalization 16–30 days before injury and families with no hospitalization was a relatively modest 3.4 percentage points, and there is very little difference between families with a hospitalization 31–45 days before injury and those with no hospitalization.

Multivariate Analysis

The results of the model are presented in Table II. Most of the control variables took the expected sign and were statistically significant. Higher probability of injuries being costly was associated with higher age, being male (non-significant) belonging to a union, and being an hourly worker. Among sectors, the highest shares of costly injuries were found in non-durable manufacturing and the lowest in services.

The coefficients of the hospitalization variables were positive, indicating that hospitalization of family members increased the probability that injuries would be costly, ceteris paribus. However, the magnitude of the effect and the statistical significance was much greater for hospitalization that occurred a shorter time before injury. The increase in probability of an injury being costly that is associated with a hospitalization, was about half as great for hospitalizations in the third and fourth weeks before injury as for hospitalizations in the first and second weeks before injury. Hospitalization of family members between 31 and 45 days before injury did not have any statistically significant impact on the probability of severe workplace injury. Figure 2

TABLE II. Impact of Hospitalization of Family Members on the Incidence of Severe Workplace Injury: Probit Model Results

	Dependent variable: severe workplace injury
Variable	**Coefficient**
Age of the worker	0.044*** (0.009)
Age square of the worker	−0.001*** (0.000)
Sex of the worker	0.035 (0.025)
Union status (1 if unionized and 0 otherwise)	0.466*** (0.027)
Hourly worker	0.508*** (0.042)
Industry	
Manufacturing, non-durable goods	0.120*** (0.033)
Transportation, communication, utilities	−0.182*** (0.030)
Finance, insurance, real estate	0.062 (0.109)
Services	−0.635*** (0.039)
Manufacturing, durable goods	Reference
Family size	−0.015* (0.008)
52 geographic location indicators (not shown for brevity)	
A family member was hospitalized:	
Between 0 and 15 days before injury	0.420*** (0.139)
Between 16 and 30 days before injury	0.123 (0.139)
Between 31 and 45 days before injury	0.040 (0.150)
No hospitalization between 0–45 days before injury	Reference
Constant	−3.876*** (0.343)
Observations	33,699
Wald chi^2 (58)	1824.63
Prob > chi^2	0.0000
Pseudo R^2	0.0849

*** and *: Significant at the 1% and 10% levels, respectively.

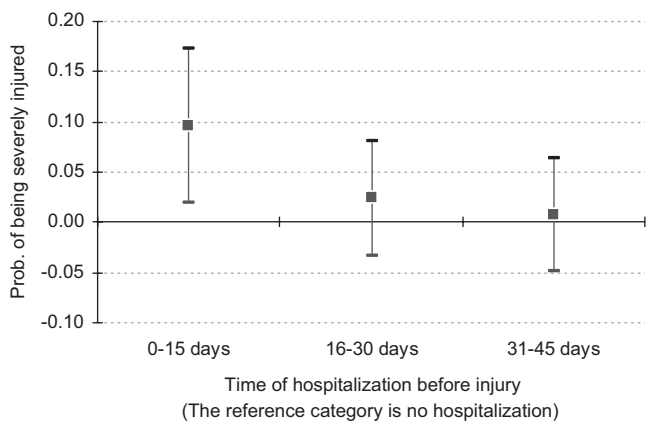

FIGURE 2. Marginal effects of hospitalization of at least one family member on the probability of being severely injured. Marginal effect—95% confidence intervals.

displays the marginal effects of family hospitalization in different time periods before injury.

Robustness Tests

The robustness of the results was checked by measuring severity of injury in three alternative ways as described above, and conducting analogous descriptive and multivariate analyses. In all cases, there was a strongly significant association of family hospitalization 0–15 days before injury with costly injury, and a lack of association of family hospitalization over 30 days before injury with costly injury.

DISCUSSION

While possible stress and other direct effects of family member hospitalization could not be observed, the descriptive and multiple regression results provided supporting evidence for the hypothesis that these events could increase the severity of subsequent work injuries (as measured by workers' compensation claim costs). The descriptive analysis showed that, in families where at least one family member was hospitalized within two weeks before injury, the percentage of injured workers that were injured severely (defined by above average workers' compensation indemnity payments) was nearly twice as high as in families where no family members were hospitalized (22.6% vs. 12.5%, a 10.1 percentage point difference). In the multivariate probit model, workers with at least one family member hospitalized within two weeks before injury had a 9.7 percentage point greater probability that their subsequent injuries would be costly, ceteris paribus.[8] More costly injuries could be due to greater severity of the initial injury, greater long run consequences of injury, or both.

We also examined if the risk that a workplace injury would be severe would decline as the time between hospitalization and injury increased. Both the descriptive and the regression results supported this hypothesis. The strongly significant association of family hospitalization with probability that subsequent injuries would be costly when hospitalizations occurred within 2 weeks before an injury, contrasted with a much more modest association when hospitalizations occurred in the third or fourth week before injury and the absence of association when hospitalizations occurred earlier than 4 weeks before injury. These results have potential implications for all stakeholders in occupational safety. First, employers could recognize that arranging for and allowing leave after hospitalization of family members could help to reduce severe and costly workplace injury and its costs. Employees could also recognize that they may be safer if they ask for appropriate leave when their family members are seriously injured or ill. Second, the timing of leaves with respect to hospitalization of family members matters. Both employers and employees may be able to avoid increased safety risks, if they act quickly in arranging leaves when such problems emerge.

The higher probability of costly injury associated with a recent family hospitalization translates into significantly higher mean claim costs. Claims of those who had a family hospitalization 0–15 days before injury had 40% higher indemnity costs and 50% higher medical costs than those with no hospitalization, in both a simple comparison of these two groups and estimates based on Equation (2) using ordinary least squares, with indemnity and medical payments as continuous dependent variables.

At least three limitations of this study should be kept in mind. First, only injured workers were considered. As a result, we could not examine the impact of family health status on the incidence of workplace injury. Second, due to lack of data, important variables such as wage level, education, employment status of the other spouse, etc. were not considered. However, because the association of hospitalizations with costly injuries was specific to a short period following hospitalization, it is less likely that including these types of variables would substantially reduce the observed relationship. Third, only claims closed within the calendar year and whose costs are therefore fully known (92% of claims) were included. However, this reduced disproportionately the number of high-cost claims included. (Open claims had mean indemnity costs approximately double those of closed claims.) This affected the percentage of claims classed as severe, and resulted in an underestimate of overall claim costs, but the relative shares of costly claims in the comparison groups should have been little affected.

CONCLUSION

This was the first study to examine the relationship between important family health events and the risk of being severely injured at work. The results revealed that a family hospitalization is associated with a substantially higher risk that any subsequent injury would be costly. It is logical to explore whether this risk could be reduced by reducing the psychological and physical problems of workers that arise from serious family health events, or by more frequent and timely use of family leave. Further research would be needed to determine whether the overall incidence of injuries is higher following family hospitalization, whether post-hospitalization injuries tend to be of certain types, and whether certain kinds of family health events or those involving certain members are more associated with costly work injuries than others.

[8] Complementary findings were reported by Nakata et al. [2006]. The authors reported that high depressive symptoms increased the risk of workplace injury in the manufacturing sector of Japan.

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