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Incidence and Costs of Family Member Hospitalization Following Injuries of Workers' Compensation Claimants

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Background *The consequences of occupational injuries for the health of family members have rarely been studied. We hypothesized that non-fatal occupational injury would increase the incidence and costs of hospitalization among workers' families, and that family members of severely injured workers would be likely to experience greater increases in hospitalizations than family members of non-severely injured workers.*

Data and Methods *We used the MarketScan databases from Thomson Reuters for 2002–2005, which include workers' compensation and inpatient medical care claims data for injured workers' families. We used a before–after analysis to compare the odds and costs of family hospitalization 3 months before and after the index occupational injury among 18,411 families. Severe injuries were defined by receipt of indemnity payments and at least 7 days of lost work. Family hospitalizations were measured by the incidence of hospitalization of at least one family member.*

Results *Among families of all injured workers, the odds of at least one family member being hospitalized were 31% higher [95% confidence intervals (CI) = 1.11–1.55] in the 3 months following occupational injury than in the 3 months preceding injury. Among the families of severely injured workers, the odds of hospitalization were 56% higher [95% CI = 1.05–2.34] in the 3 months following injury. Hospitalization costs were found to rise by approximately the same percentage as hospitalization incidence.*

Conclusion *The impact of occupational injury may extend beyond the workplace and adversely affect the health and inpatient medical care use of family members.* Am. J. Ind. Med. 55:1028–1036, 2012. *© 2012 Wiley Periodicals, Inc.*

KEY WORDS: occupational injury; family hospitalization; before–after analysis

INTRODUCTION

Millions of non-fatal occupational injuries and illnesses are reported in the United States every year [Bureau of Labor Statistics, multi-year series] and there is an extensive literature on their consequences. Several studies have estimated their costs to the nation [Miller and Galbraith, 1995; Leigh et al., 1997; Leigh, 2011]. Other studies have focused on the reduced income [Haveman and Wolfe, 1990; Biddle et al., 1998; van der Sluis et al., 1998; Boden and Galizzi, 1999; Reville, 1999; Reville and Schoeni, 2001; Weil, 2001] and functional limitations of injured or ill workers [Hensler et al., 1991; Morse et al., 1998; Keogh et al., 2000; Strunin and Boden, 2001, 2004;

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Bianchi, 2005], as well as the adverse psychological and behavioral consequences for injured or ill workers [Feuerstein et al., 1985; Ewan et al., 1991; Dawson, 1994; Morse et al., 1998; Dembe, 1999; Keogh et al., 2000; Strunin and Boden, 2004].

There are several reasons why these impacts on the worker might, in turn, have consequences for the family. First, occupational injuries may significantly affect family income, because workers' compensation benefits do not fully replace regular wages and because family members might be unable to seek employment or stay as fully employed while caring for an injured worker as they were before the injury [Weil, 2001]. In the most difficult situations, families may be forced to sell their assets, leave or change school, or move [Morse et al., 1998]. Second, family members may also have to shoulder greater physical burdens to care for the injured worker and perform household tasks to which the injured worker cannot contribute [Morse et al., 1998; Strunin and Boden, 2004]. Third, the psychological distress of the injured worker might also give rise to stress and psychological problems among family members [Morse et al., 1998; Strunin and Boden, 2004]. In a set of 15 in-depth case studies of the family consequences of severe occupational injuries in New Zealand, all the families experienced negative psychological and economic impacts, and most saw family relationships deteriorate [Adams et al., 2002]. If families of injured workers experience greater economic pressures, greater physical and time demands, and greater psychological stress, we may hypothesize that they also experience additional health problems.

A decade ago, Dembe [2001] noted that, even though some studies had examined the impact of cancer and other chronic illnesses on those who care at home for patients suffering from these illnesses [Weitzner et al., 1997], little comparable research had been conducted in the context of occupational injuries and illnesses. We could identify only one previous, large-scale study that examined the association between occupational injuries and the health and medical care use of the injured worker's family [Brown et al., 2007]. This study employed a unique database that integrated the medical care and workers' compensation claims data for most of the population of the province of British Columbia, Canada. Results suggested higher medical care use by the families of the injured workers over the 5-year period following the year of injury. However, these results were difficult to interpret due to inconsistent associations between injury severity and family members' health outcomes, as well as to fluctuations and major trends in medical care use in the observation period that were influenced by factors unrelated to the occupational injuries.

In this study, we used data and a before–after comparison methodology similar to those used by Brown et al. [2007] to determine whether occupational injuries for which workers' compensation claims were filed were associated with subsequent increases in medical care use for family members. As we explain below, there were some differences in our methods from those used by Brown et al. [2007] that allowed us to better isolate changes associated with occupational injuries from changes due to other causes. We also focused exclusively on hospitalizations because this is an indicator of the most severe potential impacts on health and medical care use and cost. We hypothesized that hospitalizations of family members would increase following an occupational injury and that increases would be greater following the most severe injuries.

METHODS

Data

We used the MarketScan Commercial Claims and Encounters (CCE) and Health and Productivity Management (HPM) databases constructed by Thomson Reuters, because they allow workers' compensation claims to be linked to the healthcare insurance medical claims of injured workers' family members. Thomson Reuters is a company that provides a wide array of data and analytical services, including assistance to employers in managing healthcare benefits, healthcare delivery, and workplace health promotion programs. The MarketScan data are fully Health Insurance Portability and Accountability Act (HIPAA) compliant[1] and no IRB approval was necessary because individual patients were not identifiable with the data. The databases cover 48 states and have been used extensively by researchers in the medical, occupational safety and health, and health economics fields. Since the first article was published in *The New England Journal of Medicine* by Hillman et al. [1990], more than 200 peer-reviewed articles have been published that use the MarketScan databases [Thomson Reuters, 2008].

The CCE database includes data files for inpatient, outpatient, and pharmacy group medical insurance claims for workers and their family members. Both workers and family members included in CCE have healthcare insurance provided by the workers' employers. The claims information includes dates of service, diagnoses, procedures, and payments. Hospitalization data for family members of injured workers were extracted from the CCE inpatient medical care data files for the period between January 1, 2002 and December 31, 2005.

[1] See http://thomsonreuters.com/products_services/healthcare/healthcare_products/a-z/marketscan_research_analytics/ accessed on August 3, 2012.

The HPM database contains information on workers' compensation claims for a relatively limited subset of the workers included in the CCE database. Between 2002 and 2005, HPM data were provided to Thomson Reuters by a total of 18 employers for at least one of these 4 years. These employers were clients of Thomson Reuters, and their identity was kept confidential. On average, each of these employers provided data for 28,782 workers in each year that they contributed data. We used the HPM workers' compensation file to identify workers who suffered an occupational injury between 2002 and 2005, and whose workers' compensation claim was closed by December 31, 2006 (the last date of data availability at the time of our analysis).

The HPM and CCE databases were linked through the HPM enrollment file that contains several variables for both workers and their families, including period of enrollment, age, and gender, as well as several variables for workers only, including industrial sector, workplace geographical location (state), union membership status, and hourly versus salaried status. We used the "enrollment id" variable within the HPM and the CCE files to link all injured workers' information to their family members' information.

The hospitalization of family members (excluding the injured worker) was determined from inpatient medical care claims data. In CCE, inpatient costs are recorded in a field that sums all costs incurred for services received during the period of hospitalization. These costs include copayments and coinsurance payments by family members. One common problem in analyzing cost data is the presence of outliers, which may unduly influence results, and sometimes reflect data errors. Different methods have been suggested in the literature to detect outliers, but there is no one universally agreed upon method [High, 2000; Hayden, 2005]. In this study, we used a box plot, the most convenient and commonly used method, to identify outlier inpatient costs.

Analysis

We made a before–after comparison of the incidence of hospitalization as measured by the odds of families suffering at least one hospitalization. We focused on short periods of time before and after injury so that any observed differences would be more likely to be related to occupational injury. The length of these comparison periods was chosen by examining family hospitalization rates among all injured worker families in each of the 6 months following injury. These rates were expected to rise over time at least initially, since even the acute impacts of injury would take some time to result in hospitalization of family members. The period of observation we would examine needed to be of sufficient length to capture much, if not all, of this rise in hospitalization rates.

Since there were two observations per family, one for the period before injury and the other for the period after injury, we used a conditional logistic regression to estimate the odds ratio of family hospitalization after injury versus before injury. As indicated by Chamberlain [1980] and Hosmer and Lemeshow [2000], conditional logistic regression is appropriate for matched case control groups or fixed-effects panel data (e.g., before injury and after injury data) since it takes into account the pairing information. With this method, if there was no change in the incidence of hospitalization before and after injury the family was dropped from the analysis. We used family enrollment id as the strata. The sole independent variable was a binary, before–after variable (1 = after).

We took two approaches to estimating the before–after difference in hospitalization costs. In the first approach, we viewed the cost difference as a product of the difference in family hospitalization incidence and the difference in hospitalization cost per family among those families with one or more hospitalizations. The latter was estimated using a regression of logged hospitalization cost on a binary before–after indicator variable. Costs were logged so that their distribution would be approximately normal. We did not use a single regression to estimate the before–after difference in total cost per family because, among all families, hospitalization costs had a non-normal distribution with a preponderance of zeros.

In the second, more direct approach, which is more fully based on the pairing of the before and after observations of each family, we calculated the before–after difference in hospitalization costs for each family, and then computed the mean of this difference to yield an absolute dollar difference that could be compared to the mean cost per family before injury. Despite the preponderance of zeros in the before–after difference, estimates of its mean would be unbiased and normally distributed in samples of sufficient size, according to the central limit theorem. As a final test of the statistical significance of the before–after cost difference, we applied the non-parametric Wilcoxon signed rank test.

These before–after comparisons addressed our hypothesis that incidence and costs of family hospitalization would be higher following occupational injury. We also hypothesized that the increases would be greater following the most severe injuries. Therefore, we divided workers' compensation claimants into two categories: severely injured (SI) and non-severely injured (NSI). An occupational injury was classified as severe if the injured worker received indemnity payments through workers' compensation and stayed away from work for at least seven working days following injury. This severity definition reduced the effect of variation among states in the minimum work absence required to qualify for indemnity benefits because

almost all states require 7 days or less. Before–after comparisons were carried out separately for the families of SI workers, the families of NSI workers, and the families of all injured workers together. To check the robustness of the findings, analyses were also conducted using two alternative definitions of severity based on (1) the presence of indemnity payments without regard to days away from work, and (2) total workers' compensation payments, including indemnity, medical, and ''other'' (i.e., attorney, legal, investigation, and related) payments. In the latter severity definition, the threshold level of payments was set so that the percentage of injuries classified as severe would be approximately equal to that for the original severity definition. We prefer the original definition of severity that was based on both receipt of indemnity payments and days away from work because we believe that absence from work is a more direct measure of severity than total claim costs.

The typical concern in a before–after study design is that there may be an unidentified, independent change near the time of the event of interest that could be responsible for observed before–after differences. However, this study avoids this concern. While for any individual family, there may be some other change near the time of injury that leads to a post-injury hospitalization, there can be no such change that is correlated with injury among all injured worker families, because the occupational injuries occur over a wide and randomly distributed range of dates.

RESULTS

Initially, 25,903 workers with injuries during 2002–2005 and with full information (i.e., no missing information in either HPM or CCE) were identified. Injured workers whose workers' compensation claims were not closed by December 31, 2006 were then dropped from the data set (9.5%). In each year's data, families of workers injured in that year were dropped if they were not insured for the entire year. In addition, nine households with outlier inpatient medical care costs (greater than $100,000) were excluded.

We then calculated monthly family hospitalization incidence rates over the 6 months following occupational injury for all the families of injured workers. This was done to determine how long the post-injury period needed to be in order to capture a large share of the acute impact of occupational injury on the family. We found that the incidence rate of family hospitalizations rose over the first 3 months following occupational injury and then fell to approximately the pre-injury rate in the sixth month. Recognizing that the entirety of the effect of injury may not have been realized within 3 months, we nevertheless chose to focus on comparison of 3-month periods before and after injury for two reasons. First, this length of period might increase the likelihood that differences of statistical significance are detectable, and second, a rise in hospitalization rates within a very short time after injury is more plausibly linked to the injury and would be virtually unaffected by long-term trends.

To be able to observe the healthcare insurance medical claims of family members within the 3 months before and after occupational injury, workers injured before April 1, 2002 and after September 30, 2005 were also excluded from the analysis. The data set we analyzed included 18,411 injured worker families. Since the claims of each family were observed twice (3 months before and 3 months after occupational injury), the final data set we used included 36,822 observations.

In our data set, 15.7% of all injured workers were SI. Descriptive statistics for all of the variables we used are given in Table I.

The before–after comparison results are presented in Tables II and III. Table II presents descriptive statistics on the incidence among families of at least one hospitalization before and after injury. Table III presents the conditional logistic regression results, with odds ratios for family hospitalization after injury versus before injury, and 95% confidence intervals (CI). Note that, in the regression analysis, 16,088 worker families (35,482 observations), 13,720 worker families (29,940 observations), and 2,687 worker families (5,582 observations) were dropped in the all injured, NSI, and SI data sets, respectively, because they either had no hospitalizations at all, or had at least one hospitalization in both the before and after periods. Therefore the worker families retained in the analysis had one or more hospitalizations in one period only, either before or after occupational injury.

Among all injured worker families, the odds of at least one family member being hospitalized within the 3 months following occupational injury were 31% higher [95% CI = 1.11–1.55] than within the 3 months preceding occupational injury (Table III). Among NSI worker families, the odds of at least one family member being hospitalized were 26% higher [95% CI = 1.05–1.52] following occupational injury. Among SI worker families, the odds of a family member being hospitalized were 56% higher [95% CI = 1.05–2.34].

As described in the analysis section, we checked the robustness of the results by using alternative definitions of severity based on (1) the presence of indemnity payments, and (2) total claim costs above the 85th percentile level. The results (not presented) were qualitatively similar to the results presented above.

Regressions estimating the before–after difference in logged hospitalization costs per family among families with at least one hospitalization resulted in very high *P*-values (all injured worker families 0.70, NSI families

TABLE I. Descriptive Statistics

Variables	All injured workers	Non-severely injured workers	Severely injured workers[a]
Number of injured workers (families)[b]	18,411	15,514	2,897
Mean age of injured worker	44 (9)	44 (9)	45 (9)
Gender (male workers %)	62	59	75
Mean family size, excluding injured worker	2.1 (1.2)	2.1 (1.2)	2.1 (1.2)
WC indemnity payment (mean, $ per claim[c])	2,449 (10,666)	1,045 (7,037)	9,972 (19,767)
WC medical payments (mean, $ per claim[c])	2,328 (7,211)	1,407 (4,167)	7,256 (14,446)
WC total cost (mean, $ per claim[c])	5,178 (17,345)	2,620 (10,696)	18,880 (32,812)
Number of families with hospitalizations before injury	262	217	45
Number of families with hospitalizations after injury	343	275	68
Inpatient cost before injury (mean, $/family)[d]	158(2,057)	160(2,107)	148(1,768)
Inpatient cost after injury (mean, $/family)[d]	206(2,202)	194 (2,069)	271 (2,812)
Mean number of days absent from work	64 (195)	38 (174)	199 (241)
Union membership (%)	63	61	71
Hourly occupation (%)	91	90	93
Industry (%)			
Manufacturing, durable	28	24	50
Manufacturing, non-durable	19	20	9
Transportation, communication, utility	19	17	29
Finance, insurance, real estate	1	2	0.1
Services	33	37	12
Region (%)			
Northeast	14	12	28
North Central	29	31	23
South	51	52	43
West	6	5	6
Unknown	0.1	0.1	0.1

Figures in parentheses are standard deviations.
WC: workers' compensation.
[a]Injured workers who received workers' compensation indemnity payments and were absent from work for $\geq$7 working days.
[b]Each family was observed two times (3 months before and 3 months after the incidence of occupational injury).
[c]All monetary values are nominal dollars of the years 2002–2005.
[d]For all families with or without hospitalization.

0.69, and SI families 0.93). These *P*-values indicated that there was no evidence that these costs were different in the pre- and post-injury periods. Because it is reasonable to assume that these costs did not change, we concluded that the percentage change in hospitalization costs was approximately equal to the percentage change in family hospitalization incidence (e.g., 31% among families of all injured workers).

TABLE II. Incidence of One or More Hospitalizations 3 Months After and 3 Months Before Occupational Injury (Percent of Families)[a]

	All injured workers	Non-severely injured workers	Severely injured workers
After injury (percent)	1.91	1.82	2.38
Before injury (percent)	1.50	1.48	1.62
Absolute difference	0.41	0.34	0.76
Percentage difference	27.33	22.97	46.91
Number of observations	18,411	15,514	2,897

[a]Among families with hospitalizations, 11.9% (before) and 12.5% (after) had more than one hospitalization.

In the second approach to estimating the change in costs, we found a mean before–after difference of $48 (CI: $6–$90) among families of all injured workers. Compared to the mean before-injury cost of $158, this represented a 30% increase in costs. For NSI worker families, the mean difference was $34, a 21% increase over the pre-injury costs of $160. For SI worker families, the mean difference was $123, 83% higher than the pre-injury costs of $148. The Wilcoxon signed rank test also indicated that before–after differences in hospitalization costs were statistically significant for all three injured worker family groups (all injured worker families: $P = 0.001$; NSI worker families: $P = 0.012$; SI worker families: $P = 0.078$).

TABLE III. Conditional Logistic Regression Results: Odds of One or More Family Hospitalizations 3 Months After Versus 3 Months Before Occupational Injury

	All injured workers	Non-severely injured workers	Severely injured workers
Odds ratio	1.31	1.26	1.56
Z-score	3.17	2.47	2.18
$P > \|z\|$	0.002	0.013	0.029
95% confidence interval	1.11–1.55	1.05–1.52	1.05–2.34
Number of observations (families)[a]	1,340	1,088	212

[a]In the conditional logistic regression analysis only families with change in hospitalization status before and after injury are considered.

DISCUSSION

The hypothesis that occupational injuries have adverse health impacts on injured worker families was supported by the observed increases in the incidence of family hospitalizations and their costs in the 3-month period following occupational injuries of workers' compensation claimants. This is the first study that presents empirical evidence of the impact of occupational injury on family hospitalizations using U.S. data.

The observed increase in family hospitalizations was clearer in our study than in the study by Brown et al. [2007]. Some of the results of that study suggested only modest impacts on family medical care use, and others were difficult to interpret. This might be because they examined periods of 5 years before and after occupational injury, while we focused on changes within a much shorter time period, during which other factors and secular trends affecting medical care use and costs were likely to be much less important. In addition, in the Brown et al. [2007] study, the before and after periods were the same calendar periods for all groups of families, so that their medical care use might have been affected by common trends in healthcare, whereas our method filtered out the influence of these factors by using before and after periods specific to each occupational injury.

To judge the substantive significance of the increases in family inpatient medical care costs that we observed, we need to compare them to the costs of the workers' compensation claims that they followed. However, it is important to recognize that the costs of workers' compensation claims include inpatient and outpatient costs, as well as indemnity payments for lost wages, whereas the only family costs we measured were inpatient costs. Clearly, a full accounting of family costs would also include outpatient and drug costs, as well as the cost to family caregivers of lost wages and lost work time within the household. Since we did not have estimates of the full family costs of occupational injury, the most appropriate comparison for the purposes of our analyses would be between the observed increase in family inpatient costs and the inpatient costs of the occupational injuries that they followed. The data we used included information on the total cost of medical claims that were handled through workers' compensation but no information on what portion of this cost was due to inpatient claims. Therefore, we assumed that 40%[2] of the medical costs of workers' compensation claims were inpatient costs, consistent with findings on non-occupational injuries by Finkelstein et al. [2006].

In our data set, mean medical costs per claim were $2,328 but national data from the National Academy of Social Insurance [Sengupta et al., 2005][2] suggest that mean medical costs of all workers' compensation claims in the U.S. were $4,090. The discrepancy may be due to the fact that our data set excluded claims that were not closed by a certain date (December 31, 2006) and that could have been more costly. An additional reason may be that the claims were from 18 large employers concentrated in the South where costs might have been lower than the average national medical costs. Based on the higher national medical cost estimate, the observed increase in family hospitalization costs was approximately 2.9% of workers' compensation hospitalization costs [$48/(0.40 × $4,090)]. To put these estimates in a national perspective, we multiplied the additional $48 family inpatient cost per injured worker by the estimated average total number of workers' compensation claims per year in the U.S. during 2002–2005 (6,276,677)[3] to yield a total additional cost of $301 million. On balance, as the discussion below suggests, this estimate appears more likely to be an underestimate than an overestimate.

While the increases in family hospitalizations we observed following occupational injury appear to support our hypotheses, it is important to consider possible alternative explanations of these increases. One possibility is that contact with the healthcare system due to occupational injury leads to increased demand for medical care use by family members. We believe that because hospitalizations

[2] Medical costs of injuries resulting in death or hospitalization expressed as a percentage of total medical costs of all injuries for persons aged 25–64 years. While most of the costs of these injuries would be inpatient costs, a small portion could be outpatient costs.

[3] Claims per worker in the private sector were multiplied by the total number of workers in the U.S. covered by workers' compensation to estimate total number of claims [Sengupta et al., 2011]. The amount of total medical benefits paid [Sengupta et al., 2005, 2007] was divided by the number of claims to yield the medical cost per claim. The mean of our calculations for 4 years, 2002–2005, was $4,090.

are generally not elective, this is an unlikely explanation. Another possibility is that the need to care for the injured worker causes family members to make different decisions about whether to agree to be admitted to the hospital and how long to stay in the hospital. On one hand, increased responsibilities of family members might reduce family hospitalizations following occupational injury. On the other hand, there might be bias in favor of inpatient care, if the injured worker would not be able to provide family members with the assistance they would need if they sought outpatient care, instead. This implies that outpatient care can be substituted by inpatient care and that family members are able to decide for themselves whether they will receive outpatient or inpatient care. We believe that both of these assumptions are unlikely to be true.

A third possibility is that an unobserved event occurring around the time of occupational injury might increase both the probability of the injury (Asfaw et al., 2010) and the probability of a family hospitalization. We may consider such an event, for example, to be a stressor of some type that would affect the entire family, including the worker. However, for this explanation of our findings in the before-after comparisons to hold, it would be necessary for the event to have, on average, a more delayed effect on family hospitalization than on occupational injury. We could not identify any type of event for which it would be logical to expect this time pattern. Finally, it may be speculated that an injury might lead to fear that the injured worker could lose their job and the health insurance linked to it, leading in turn to a decision to schedule anticipated hospitalizations before insurance is lost. However, loss of insurance after injury was not common, since only 10 percent of families were dropped from the data because they were not insured during the entire year of injury. Further, it seems unlikely that more than a modest proportion of hospitalizations could be moved up or delayed by several months.

There are other potential reasons to interpret our results with caution. First, the findings may not be generalizable to segments of the U.S. working population that were under-represented in the data set we used. These data were restricted to large employers who are clients of Thomson Reuters, and to workers who obtained health insurance for themselves and their dependents through their employer.

Second, the data we used were restricted to injuries that resulted in workers' compensation claims, but many occupational injuries do not. For example, a 2007 population survey in 10 states found that only 47% (Texas) to 77% (Kentucky) of the workers reporting an occupational injury in the previous year had medical expenses paid by workers' compensation [CDC, 2010]. The under-reporting of injuries in workers' compensation was likely to have increased the average severity of occupational injuries in our data set, since less severe injuries were more likely to have gone unreported.

Third, several characteristics of the data selected for our analysis tended to underestimate the increase in family medical care costs following an occupational injury. We did not include data on healthcare services that were not directly attributable to a stay in the hospital or for which claims were not filed. In addition, the 3-month comparison periods were designed to capture only short run impacts of occupational injury. Thus it would be useful for future research to examine longer time periods so that all potential impacts of injury are captured, and to confirm that short run increases in hospitalization are not offset to any degree by longer run reductions in hospitalization. Costs may also have been underestimated due to exclusion of worker's compensation cases that were not closed by December 31, 2006. If workers' compensation cases of more severe injuries take longer to close, this could have reduced the number and average severity of SI workers in our data set. Fourth, the before–after analysis did not control for some stable family characteristics or attributes that might predict differences in post-injury hospitalization changes. Finally, nine outlier observations with high inpatient costs were also excluded from our analysis, which might have resulted in an underestimate of costs.

CONCLUSION

The results of this study provided empirical evidence that the impact of occupational injury could extend beyond the workplace and adversely affect the health of family members. Results also suggested that the consequences were greater for severe than for non-severe occupational injuries. Thus, more attention to the adverse health consequences for injured workers' families is warranted.

The potential pathways between an occupational injury and the health of family members are complex, and additional research is needed to explore them in detail. Such research would benefit from data on specific stressors related to injury or perceived stress around the time of occupational injury, detailed information on the events and decisions which led to family member hospitalizations, and direct measures of family health based on surveys and medical examinations. Even without these types of data, further exploitation of medical care and workers' compensation claim data would enable examination of the specific nature of occupational injuries (e.g., acute vs. cumulative trauma) associated with increases in family health problems, and the specific nature of these family health problems (e.g., illness vs. injury). The latter topic is being examined in a forthcoming study that uses outpatient data, which contain many more observations than hospitalization data and, therefore, have the ability to

detect statistically significant changes in rates of specific health problems. Another obvious extension would be to identify specific family members who are more vulnerable to the effects of occupational injuries. For example, as in Brown et al. [2007], the healthcare use of children and spouses could be examined separately.

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