Final Performance Report: The Employment Impact of Workplace Injuries in 5 States
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ABSTRACT (Including Significant Findings)

This study measures lost earnings by comparing the earnings of all other injured workers with a comparison group, controlling for differences that could account for different earnings. The comparison group consists of workers who lost 7-9 days from work and then returned to their jobs. We studied lost-time injuries reported to workers' compensation systems in Wisconsin and Florida. The method is a linear-regression version of a difference-in-differences approach. The analyzed data are for 54,309 cases in Wisconsin and 71,189 cases in Florida. Workers' compensation administrative databases supplied injury and personal characteristics. To obtain earnings and employer characteristics, we matched the workers' compensation data with data collected by state unemployment insurance and labor market information agencies.

In this study, we also conducted two ethnographic interviews of workers with back injuries, including (a) 198 workers from Wisconsin stratified by gender and age (20-29, 30-54, 55 and older), and (b) 216 workers from a Florida telephone survey stratified by gender, age, and racial and/or ethnic background Black non-Hispanic, White non-Hispanic, and Hispanic). Interviews conducted about years after injury explored the workers' beliefs and attitudes about themselves as workers including their pre and post injury relationship to employment, their experience of the work injury, encounters with the medical and legal systems, and the effects of the injury on self-image and family relationships. The interviews were conducted about six years after the workplace injury.

Significant Findings: Economic Costs

Overall Costs. In Wisconsin, injuries involving permanent disability payments or temporary of more than one week caused about $530 million in lost earnings, with average lost earnings per injury of about $10,000. In Florida, lost earnings for the same group were over $1.4 billion, and average losses were about twice Wisconsin's.

Variation in Costs. A large proportion of injured workers suffer losses that continue at least four years into the future -- and perhaps over their entire working lives. This includes workers classified as having permanent disabilities, but also many who are classified by workers' compensation as having "temporary disabilities." Workers with 10 to 14 days of temporary disability benefits suffer small and short-term losses. However, in both Wisconsin and Florida, groups with permanent partial disability (PPD) benefits or receiving temporary disability benefits for more than 8 weeks (but no PPD benefits) appear to suffer substantial losses even 4 years post-injury. In Wisconsin, over 30 percent of workers with more than one week of lost time are in groups that suffer significant long-term lost earnings. In Florida, over 45 percent of workers fall into these groups

In both Wisconsin and Florida, women appear to lose a greater proportion of their earnings than men. Overall, despite the fact that men's earnings are about 50 percent higher than women's, average losses of men are only 9 percent and 13 percent higher than average losses for women in Wisconsin and Florida respectively. This raises a question about whether employers discriminate against women who were injured at work.

Disparities in Benefits Relative to Losses. Our research shows that, overall, Wisconsin workers' compensation income benefits average 47 percent of projected pre-tax lost earnings of injured men and 38 percent of projected losses incurred by women. These averages conceal striking differences among groups of workers categorized by their benefit status. Among people who received temporary disability benefits for more than 6 weeks but did not receive PPD or compromise payments, income benefits averaged only from 14 to 28 percent of pre-tax losses. For PPD and compromise cases, income benefits averaged between 43 and 57 percent of projected pretax losses. Florida shows a different relationship between workers' compensation benefits and losses. Overall, despite average losses that are much higher than in Wisconsin, Florida's workers' compensation system replaces a higher proportion of those losses. In Florida as in Wisconsin, workers with long temporary total disability) (TTD)-only cases had the lowest replacement rates.

Return to work A study of return to work partially funded by this grant found that the most important factors shaping return to work are: returning to work for the preinjury employer, preinjury employment history, firm size, and economic incentives facing workers.

Significant Findings: The Experiences of Injured Workers and Their Families

Return to work conditions. The first completed study using these interviews describes the paths to reemployment taken by injured workers and indicates that those who want to return to the pre-injury employer face an array of employer responses, ranging from "welcome back" to "stay away." The "welcome back" path provided workers with a sense of being valued by their pre-injury employers. This positive affect remained, even for those who were unable to continue working because of limitations imposed by their injuries. Other paths of re-entry caused workers to feel undervalued, as discarded or damaged goods, and generated hostility and resentment. In this study, female workers in all groups were less likely than males to have their injury-related needs met in the workplace and to be currently working. White males were more likely than other groups to be employed in skilled jobs and were also the most likely to remain in their pre-injury jobs over time.

Racial/ethnic differences in return to work. In Florida, workers from different racial and/or ethnic groups appear to experience different return-to-work conditions following an injury. The data also suggest that Black and Hispanic workers may be more likely than White workers to be employed in occupations in which they are less likely to be able to either return to their original job or to other employment. This could be the result of many factors, including more strenuous employment, lower education levels, more severe injuries, and employment discrimination. Still, some Black, Hispanic, and female workers describe perceived discriminatory behavior by their pre-injury employers.

Beliefs about discrimination. Although not specifically asked about racial or ethnic discriminatory practices experienced at work either before or after the injury, when workers were asked how they were treated compared to other workers who had been injured on the job a number of Black and Hispanic workers in Florida responded that they believed they were treated differently because of their race or ethnic background. Although female workers were not asked about gender issues and experiences at work before or after the injury, a number of females in Florida believed that they were treated differently because of their gender. White, Black and Hispanic females talked about issues of gender discrimination.

Sense of self. When asked how they see themselves or feel about themselves White, Black and Hispanic males and females in Florida discussed the injury as a threat to their sense of self. For males this was expressed in terms of a threat to their sense of masculinity and for females it was expressed in terms of a threat to their sense of self-worth. When asked how they felt emotionally after the injury many workers talked about feeling depressed, angry, afraid and many talked about using medications to overcome these feelings. Interviewees also talked about the effect of the back injury on relations with their spouse and partner, in particular the effect on their sex life.

Personal and role limitations. Among workers with back injuries in Wisconsin about 80 percent of men and 40 percent of women reported problems doing outdoor chores such as mowing the lawn, shoveling snow, and yard work. Two thirds of men and women reported some difficulty performing other household chores including cleaning, shopping, taking out the garbage, vacuuming, and carrying laundry. Approximately three quarters of the men and half the women could not engage in vigorous recreational activities. Twenty percent reported difficulty in having sex, and approximately one third could not lift their children or play with them. A majority of White, Black and Hispanic males and females in Florida reported that their back injury had negative effects on their sex life.

Use of pain medications. The use of pain medications, both prescription and over-the-counter pain medications and anti-inflammatory medications was widely reported among injured workers in Florida with approximately half of all those who were prescribed pain medication after the injury continuing to use some form of pain medication on a regular basis. More Black and Hispanic than White males and females initially used and currently use pain medications.

USEFULNESS OF FINDINGS

This research on the social and economic consequences of workplace injuries and illnesses has begun a process leading to a better understanding of the impact of workplace hazards on the lives of workers and their families and on productivity and employer costs. A clearer picture of the consequences of injuries and illnesses at work should help to frame the public discussion about the appropriate level of resources that our society should devote to the prevention of these conditions and to the amelioration of their impacts when prevention efforts fail. Legislative debates on topics like research funding, regulation, and workers' compensation benefits should all profit from a clearer understanding of the plight of injured workers, their spouses, and their children. A clearer picture of these impacts also will help us to target research and prevention activities toward the most important workplace hazards and to assess the impact of interventions designed to improve workplace safety and health.

The research funded under this grant is an initial step to providing the needed information. It provides information about the human and economic costs of workplace injuries and illnesses in two states. Some of this information shows substantial differences in economic costs, suggesting that research in other states would be useful in understanding the nature of these differences. Also, the qualitative research focuses on back injuries which, while they are important, may not be completely generalizable to other injuries. Closed-ended survey research building on the findings of this grant also could fill in some important gaps.

The findings provides a new knowledge base on economic losses from injuries, how workers conceive of their injury and how social norms, personal beliefs, and the illness environment influence their behavior. This information is important for advancing research knowledge about occupational injuries and illnesses.

Although studies of back pain prevalence illuminate the economic and health impacts in terms of workdays lost and health care costs little attention has been paid to describing and measuring the human costs of back pain. The study of the human costs of occupational injuries as described by injured workers includes the impact on their abilities to carry out job-related and non-job-related "work." Understanding workers' post-injury experience is critical to a full appreciation of their losses and in addition it promotes an understanding of factors that contribute to these losses, thus enabling us to design policies that reduce both economic and non-economic losses.

The ethnographic interviews focus on previously injured adult workers with back injuries. They do so for three reasons. First, based on frequency and benefit payments, low-back injuries are the most important type of work-related injuries. About 20 to 25 percent of workplace injuries (Antonakes 1981; Klein, Jensen, and Sanderson 1984) and one-third of workers' compensation costs (Antonakes 1981) are attributable to back injuries. Second, they present a major challenge to the functioning of medical care and workers' compensation systems. Back injuries cause much time lost from work during the healing process and considerable long-term physical impairment. Third, the extent of impairment often is difficult to measure, particularly because pain -- a subjective symptom -- can contribute significantly to the physical impairment of those with low-back injuries often leading to mistrust of limitations reported by workers.

The research is also useful in informing policy decisions about the workers' compensation system.

SCIENTIFIC REPORT

BACKGROUND

Economic Costs

Every year, millions of occupational injuries and illnesses occur in the United States. Their costs, both in human and economic terms, can justify devoting substantial resources to the control of workplace hazards. Yet, surprisingly little attention has been paid to describing and measuring these costs.

Economists have measured injury and illness costs from two different perspectives. The first approach, sometimes called the "human capital" approach, looks at direct and indirect monetary measures of the losses suffered by workers, employers, and other citizens. These include (1) income losses of injured workers (including loss of fringe benefits), (2) other costs paid by employers and insurers (medical costs covered by workers' compensation, production losses from disruption of work and damage to equipment, and so on), (3) costs to taxpayers, including tax subsidies to workers' compensation benefits and public administrative costs of workers' compensation. This approach sometimes refers to the existence of "pain and suffering," the nonpecuniary costs of injury and illness, but rarely goes beyond that to describe these costs.

The willingness to pay (WTP) approach addresses the full costs of workplace injuries and illnesses. It uses economic theory to infer that knowledgeable workers with labor market choices between safer and less-safe jobs will choose to work in the safer jobs unless paid a wage equal to their valuation of the expected losses from the less-safe job, including pain and suffering. Given this view, economists have estimated the implicit value of safer jobs by estimating the wage premium (hazard wage) associated with uncompensated injury risks. Estimates of the value of preventing fatal injuries and illnesses using willingness-to-pay (WTP) have been much higher than those using the human capital approach (for example Boden and Jones 1987). Although WTP estimates a generally higher than human capital estimates, the WTP approach still probably provides incorrect and low estimate of the value to workers of improving safety. It counts on well-functioning markets to produce reliable and meaningful results. Some of the most important assumptions underlying this approach are likely to be violated frequently. These include:

- Workers must accurately estimate the risks of their jobs
- Workers must have an adequate range of job choices, including jobs that differ in risk
- Labor markets must operate at or very close to full employment
- Workers cannot face substantial costs or other barriers to changing jobs
- Discrimination, employer market control, unionization, and other deviations from the competitive labor market must be unimportant

We use an approach that decomposes the costs of injuries into their component parts. This is similar to the human capital approach, described above. But, our approach diverges in two important ways from previous studies. First, we do not disregard the nonpecuniary costs of injuries, although we do not attempt to monetize them. Instead, we use survey data to provide a qualitative depiction of these losses. Second, we rely on a much better method than previously used to estimate lost wages.

The Experiences of Injured Workers and their Families

Understanding workers' post-injury experience is critical to a full appreciation of their losses. It also promotes an understanding of factors that contribute to these losses, thus enabling us to design policies that reduce both economic and noneconomic losses.

To understand fully the impact of workplace injuries on the lives of workers, we must use research methods that allow for rigorous in-depth investigation of workers' beliefs, experiences, and behaviors. Studies of chronic illness indicate that the recognition and classification of symptoms is a conditional and cultural event that is inseparable from political and social realities Kleinman (1978) distinguishes between

an illness, "the experience of a disease and the societal reaction to disease" and disease, "a malfunctioning in or maladaptation of biological and or psychological processes." Chronic illness like back pain or repetitive strain injury (RSI) invite disbelief particularly where they lack hard evidence of organic pathology. Because of their mysterious nature and the ambiguity of their symptoms chronic illnesses can be considered to breach social norms about disease.

Chronicity and uncertainty confront many injured workers with challenges not posed by acute and self-limiting diseases (Ewan, Lowy & Reid 1991). In a study of RSI in Australia, the experiences of workers with RSI were not recognized and satisfactorily managed by the culture within which they lived. The workers experienced chronic unexplained pain of "doubtful origins, uncertain prognosis, and ambiguous manifestations" in a culture that expects that pain can be both explained and treated (Ewan, Lowy & Reid 1991).

Little previous research has been designed to allow injured workers to present their perceptions, their beliefs, and issues of concern to them. Studies in this area have often focused on job stressors that result in injury, on psychosocial factors that may affect the duration of disability, or on injuries as psychological stressors, but not on workers' experiences after injury.

To augment this small base, we have done two ethnographic open-ended interviews of injured workers. These interviews were designed to allow injured workers to present the issues of concern to them. While the design of the interviews are informed by the researchers' understanding of the issues facing these workers, it is structured to encourage people to express topics of importance to them that we did not include in the initial survey design. Rigorous ethnographic methods make it possible to learn how workers perceive their injuries and how they experience components of the occupational injury systems that ultimately affect both the personal and social costs of occupational injuries.

Ethnographic research methods provide an important research strategy for studying questions and populations that may be inaccessible using other research techniques. Ethnographic methods produce qualitative data that provide depth and detail through direct quotation and careful description of situations, events, people, and interactions. In collecting qualitative data, the researcher seeks to capture people's experiences in their own terms (Agar 1980, 1986; Spradley 1979). The research methods include ethnographic interviewing and the collection of historical and demographic data about the population for contextual analysis (Agar 1986). Ethnographic interviewing using experienced and trained interviewers permits the researcher to understand the world as seen by the respondent within the context of the respondent's everyday life.

This study explores whether there are differences in the injury experiences of male and female workers from different age groups. The approach uses ethnographic open-ended interviewing of injured workers to provide information about the following issues that cannot be gathered in closed-ended structured surveys.

- Norms: What is the nature of the social norms that govern work?
- Beliefs: Do workers' personal belief systems violate or conform with cultural values about work and with concepts about the worker-employer relationship? Do post-injury labor-market experience and experience with the workers' compensation system alter their belief systems?
- Context: What are the important elements of variation in illness history, experience in the medical-care system, and workers' compensation experience that affect post-injury life?
- Behavior: How do gender, age and racial/ethnic background influence work related pre- and post-injury work related behavior?

There are two stages in the research design.

Stage 1 consists of development of an interview guide for ethnographic open-ended interviews with workers.

Stage 2 of the study consists of semi-structured ethnographic open-ended interviews with previously injured adult workers to assess (1) the direct effects of injury, (2) attachment to the pre-injury job and work in general, and (3) impact on the workers' post-injury experience of characteristics of pre-injury job; response of employer, coworkers and family members; relations with medical care providers; and

experience with the workers' compensation system including possible litigation. The use of an ethnographic interview to elicit conceptions of work and their responses to the problems encountered with their injury encourages more explicit explanations than the closed-ended questionnaires we used in the previous study. Furthermore, this method allows opportunity for data collection concerning beliefs. Carefully designed and administered interview methodologies can elicit respondent identified constructs about work and related health issues providing information that is not restricted to variables assumed *a priori* by the researcher to be important.

DATA AND METHODS

Economic Costs

Data

We rely primarily on four sources of data in each state: workers' compensation administrative records, unemployment insurance earnings records, and labor-market information records. The analyzed data are for 54,309 cases in Wisconsin and 71,189 cases in Florida.

(1) Workers' compensation administrative data include information on:

- the types and amounts of income benefits
- the total number of lost days paid for each claim
- the pre-injury wage
- attorney representation
- fees paid to the worker's attorney
- county
- age
- gender
- length of service for the pre-injury employer (job tenure)
- occupation (3-digit Census code)
- the part of body that was injured
- the nature of injury (for example, sprain, fracture, hearing loss, and so on)
- the type of ownership of the firm (public/private)
- the date of injury
- the amount and type of income benefits paid
- medical benefits paid

(2) Unemployment insurance earnings data provide information about workers' quarterly earnings and employer identifiers from the beginning of 1988 to mid-1994 (Wisconsin) and to mid-1996 (Florida).

(3) Labor market information data provide information about employers, including industry (4-digit Standard Industrial Classification code, SIC) and employment size.

(4) We collected data on unemployment rates for the month and county of injury from Local Area Unemployment Statistics series of the U.S. Department of Labor, Bureau of Labor Statistics.

We use these data to estimate earnings losses of injured workers, controlling for personal characteristics, employer and job characteristics, and general labor-market conditions.

Methods

The primary quantitative method on which we measure lost earnings compares the earnings of all other injured workers with a comparison group, controlling for differences that could account for different earnings. The comparison group consists of workers who meet two criteria: (1) they had a single workplace injury in 4/89 - 9/90 and no other injuries through 1993, and (2) they lost 7-9 days from work and then returned to their jobs.[1] Ideally, the comparison group would have had no injuries, but we could not ascertain comparable personal and employer data on such a group. Moreover, workers with minor injuries might be more comparable in unobserved characteristics to workers with more severe injuries than would uninjured workers. Also, we in part account for biases caused by using workers with minor injuries by adding their short-term income losses (derived from pre-injury weekly wage and the number of days lost) to our measure of others' losses.

The statistical analysis of lost earnings proceeds in two steps. In each step, we provide separate estimates for men and women, because their position in labor markets tends to differ. This difference is reflected in our data, as in other labor-market data, by the persistent difference in earnings, even after taking many observed individual and job characteristics into account.

In the first step, we estimate separately for men and women, using a random-effects model to account for both within-person variation over time and variations among people:

$$y_{iq} = \alpha_i + \gamma_t + x_{iq}\,\beta + \varepsilon_{iq} \qquad (1)$$

where y is the wage, x is a vector of fixed and time varying individual characteristics, and γ_t captures economic conditions affecting all workers in a given area during the period that we study. Here, i refers to the individual worker, q represents the quarter relative to the injury and t represents the calendar quarter. We estimate (1) on the comparison group (those who lost fewer than 10 days of work). If (1) is properly specified, we can use the estimated coefficients γ_t and β to calculate predicted wages for all the other workers if they were not injured (or that they had an injury but lost 7-9 days of work):

$$y_{iq} = \gamma_t + x_{iq}\,\beta$$

The second step estimates:

$$y_{iq} = y_{iq} - y_{iq} = \alpha_i + \Sigma_k F^k_{iq}\,\delta_k + \varepsilon_{iq} \qquad (2)$$

where the F^k_{iq} correspond to different time periods with respect to the time of the injury. We collected earnings data from the beginning of 1988 through the first quarter of 1994 for all workers injured from April 1989 through September 1990. For injuries in April 1989, we have income data for 5 quarters before and 24 quarters after the injury date; for injuries in September 1990, we have income data for 10 quarters before and 19 quarters after the injury date. So we estimate the model as an unbalanced panel.

In our implementation of this model, we first estimate equation (1) for our comparison group. We regress individual earnings on:

- age, age^2
- job tenure at the time of the injury
- 2-digit industry groups (SIC)
- 1-digit occupational categories (Census)
- calendar quarters (corresponding to γ_t)

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[1] Wisconsin compensates (and keeps records on) injuries with more than 3 days' lost time, but Florida only tracks injuries with at least 7 days' lost time. For interstate comparability, we use injuries with 7-9 days' lost time for the comparison group. We compared estimate of losses using a 3-6 day comparison group and found virtually no differences.

- type of firm (private. state or local government, federal government)
- number of the employees of the firm at the time of the injury

The following variables (both dummies and trends) capture earnings changes that we impute to the injury. Here q=10 corresponds to the quarter of injury.

- a pre-injury earnings trend: $F_1=(q-95)$ if $q >=6$ and $q<10$; $F_1=0$ if $q<96$; $F_1=4$ otherwise
- a post-injury drop: $F_2=1$ if $q>=10$; $F_2=0$ otherwise
- a recovery: $F_3=1$ if $q>=11$; $F_3=0$ otherwise
- a possible continuing rise: $F_4=(q-11)$ if $q >=12$ and $q<14$; $F_4=0$ if $q<12$; $F_4=2$ otherwise
- a "long-term" trend: $F_5=(q-13)$ if $q >=14$; $F_5=0$ otherwise

In the second step, equation (2) can be estimated for different groups of workers (for example, out of work for 1 to 2 months, between 2 and 4 months, more than 4 months, and, finally, for those who were classified by the workers' compensation system as permanently and partially disabled (PPD). It also can be estimated for all workers together.

Our analysis also takes into account the fact that a substantial number of workers had multiple claims for workplace injury over the observation period (20 percent of workers had two injuries, 10 percent had three injuries, and less than 1 percent had more than three injuries). We do this by using the same approach as in (2) to model the income effects of subsequent injuries. Thus, for people with two injuries, we would estimate:

$$y_{iq} = y_{iq} - y_{iq} = \alpha_i + \Sigma_k F^k_{iq} \delta_k + \Sigma_k G^k_{iq} \delta_k + \varepsilon_{iq} \qquad (2')$$

where the G^k_{iq} represent the pre-injury trend, drop, recovery, rise and long-term trend relative to the second date of injury.

The next step in the analysis allows us to estimate income losses, allowing for the possibility that worker, employer, or injury characteristics modify the size of the drop, recovery, or trend in income after injury. We do this by including in (2) interactions between the F_j variables and other variables of interest -- including age, job tenure, industry group, body part injured, nature of injury (sprain/strain, fracture, etc.).

This provides estimates of income losses from the date of injury through the next five years. But, as you can see in Figure 1, income losses do not necessarily end at that time. To estimate lifetime losses, we must project losses until retirement. On average, injured workers in our data are 36 years old. If we project from age 36 to retirement[2], we typically project more than 20 years out and must make assumptions about income growth outside the observed period. Perhaps the most reasonable assumption is that income losses that persist five years after an injury will continue until retirement. However, for this portion of the study, we did a sensitivity analysis of income losses, under a range of reasonable assumptions. We then convert the stream of income losses over time into a present discounted value. All incomes and losses are presented in constant (inflation-adjusted) dollars.

[2] We adjust income losses by age-specific labor-force participation rates and mortality rates, rather than assuming labor-force participation until an arbitrary retirement age. Labor-force participation rates may be lower for injured workers than for others on whom data typically are collected, including a younger retirement age; so this may result in our underestimating losses.

The Experiences of Injured Workers and their Families

Data

The research investigates injured worker's perceptions of and behaviors about the impact of the injury on their relationship to their pre-injury job and employer, their post-injury employment, their medical care, and their perceptions of fairness in the process. Interview data were obtained from April 1997 - January 1998. The study utilized ethnographic interviewing in order to provide information about injury-related norms, beliefs, context, and behavior of workers from different racial and/or ethnic backgrounds. Workers were selected randomly within each stratum from a list of those eligible. Basic demographic data was collected for workers who refused to participate in the interview in order to compare refusals with the interviewee sample.

Methods

Interviews were audio taped, but no full names were used on the tape. Only subject code numbers were used to identify respondents. To help maximize the response rate, we paid respondents $20.00 for the interview; notified them by mail prior to the interview; and used a forwarding address service for workers who may have moved since the injury. Before the interview, respondents were sent a letter describing the interview and informing them that an interviewer would be contacting them and that they would be sent $20.00 after they complete the interview. We included a self- addressed postcard to be returned if the telephone number had changed and/or there was a preferred time for the interview. The study was approved by the Institutional Review Board of Boston University Medical Center.

Interview Guide Design To help assure collection of comparable qualitative data, an interview guide listed specific questions and topics to be covered in a particular order in the interview. The guide was translated into Spanish and back-translated to check for accuracy. Questions were drawn from our previous survey studies (Galizzi, Boden, and Liu 1998), as well as from scripts shared with us by Reid, Ewan and Lowy (1991). Questions about perceptions of the behaviors of supervisors, employers, coworkers, worker's compensation, family members and friends were interspersed with questions about the worker's own behavior. Questions explored the workers' beliefs and attitudes about themselves as workers including their pre and post-injury attachment to employment, their experience of the work injury, encounters with the medical and legal system, and the effects of their injury on family relationships.

Analytic Procedures After the tapes were transcribed, the interviewers checked their own tapes for accuracy. Codes were developed that represented a category or theme found in the data and put directly into the text by attaching to segments of text. Each worker interviewed was evaluated by the set of thematic codes developed. In order to explore linkages between/among particular categories, Ethnograph software, a text retrieval program geared toward depth-exploration of data, was used.

Ethnographic interviews of workers with back injuries were conducted with 198 workers from Wisconsin stratified by gender and age (20-29, 30-54, 55 and older) oversampling for workers who litigate concerning the economic and medical problems resulting from their job-related injury, and 204 workers from Florida stratified by gender, age, and racial and/or ethnic background (72 White workers (12 males and 12 females in each of the three age groupings); 72 Black non-Hispanic workers (12 males and 12 females in each of the three age groupings); 60 Hispanic workers (12 males and 7 females aged 20-29; 12 males and 12 females aged 30-49; 12 males and 5 females aged 50+). The population of injured workers was very difficult to locate 6 years after their injuries, so we were only located 35 percent of the 845 people we attempted to contact. It was particularly difficult to locate younger and older Hispanic females, so we were unable to reach our goal of 12 interviews for these groups.

We have information from workers' compensation records on personal and job characteristics of people we could not locate, those who refused, and those who were interviewed. This information suggests that people who refused to be interviewed were older, had longer service, and were better-paid

than those we did not locate and respondents (Table 1). It is likely that the longer service and better pay are consequences of the fact that people who refused tended to be older. We lack a direct measure of injury severity, but benefit payments suggest that respondents may have been more seriously injured than others. Medical benefits were higher for respondents than for the other two groups. If we measure income benefits in terms of weeks of pre-injury earnings, respondents were paid benefits equivalent to an average of 55 weeks of earnings, while the other two groups were paid an amount equal to 45 weeks of earnings. Income benefits were highest in the group that refused to be interviewed, but this reflects their higher earnings. Those who refused appeared to work somewhat more frequently in the agriculture, construction, or manufacturing sectors. Approximately one third of workers in each group were represented by attorneys, indicating similar levels of dispute in the three groups.

RESULTS AND DISCUSSION

Economic Costs

Return to Work after Injury

With support from the Workers' Compensation Research Institute, Prof. Boden and Dr. Monica Galizzi prepared a study of return to work in Wisconsin (Galizzi and Boden 1996). This study found that the most important factors shaping return to work are:

- Returning to work for the preinjury employer
- Preinjury employment history
- Firm size
- Economic incentives facing workers

This study also showed that longer durations off work decreased employment rates after return to work, after using statistical methods (instrumental variables) to take injury severity into account. For workers who go back within six months after injury, we expect 6 to 7 percent to be unemployed one year after they return to work. Unemployment for workers who remain off after six months jumps to 14 percent or more.

Injury-related Lost Earnings

Following that, we have completed a study of lost earnings resulting from workplace injuries and illnesses in Wisconsin, and Prof. Boden is currently writing up a study of lost earnings in Florida, which will also compare the Florida and Wisconsin results. These are the first non-ecological studies of earnings lost because of workplace injuries that look at a wide range of injuries, from those involving only 4 days off work to those involving permanent and total disability and death.[3] A reprint of a paper presenting measures of losses and benefits in Wisconsin is included with this report.
Using conservative estimates, these studies show that workplace injuries often lead to substantial costs for workers. For men in Wisconsin who lost at least 7 days of work during 1989 or 1990, projected pre-tax lost earnings average $10,806 (in 1994 dollars, discounted at 3 percent annually). For women, projected losses average $9,733 (Table 1). Within these overall averages, workers receiving temporary disability benefits for at least six weeks, those receiving PPD benefits, those receiving compromise[4] settlements, and those with permanent total disability or death claims have the largest average and total losses.

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[3] A substantial but unknown number of all workers with occupational injuries never enter the workers' compensation system (Biddle, Roberts, Rosenman, and Welch 1998; Morse, Dillon, Warren, Levenstein, and Warren 1998), and there are many injuries involving less than 4 days off work.

[4] Compromise settlements settle all issues related to the claim with a payment to the injured worker. Most compromise cases involve disagreements about the degree of permanent disability. Therefore, they often are classified as a subgroup of PPD claims.

Table 1. Pretax Losses per Injury and Annualized Total Losses by Benefit Category, Workers Injured in Wisconsin, 1989-1990

	Men		Women	
	Losses per injury	Total Losses	Losses per Injury	Total Losses
TTD benefits only:				
8-10 days	$621	$3,538,044	$426	$1,013,880
11-14 days	$908	$3,776,675	$715	$1,290,813
2.1-3 weeks	$1,288	$5,996,069	$729	$1,491,534
3.1-4 weeks	$1,928	$5,056,501	$1,215	$1,461,240
4.1-6 weeks	$2,302	$7,832,939	$1,561	$2,489,275
6.1-8 weeks	$7,683	$17,107,480	$5,185	$5,361,290
8.1-12 weeks	$12,016	$23,094,752	$13,353	$14,715,006
12.1-16 weeks	$27,585	$21,773,760	$20,166	$11,118,188
16..1+ weeks	$34,653	$37,517,648	$21,801	$19,649,968
PPD benefits	$20,328	$129,408,048	$21,179	$53,272,245
Compromise benefits	$62,908	$94,403,939	$49,659	$42,243,256
Permanent total and death	$351,500	$23,199,000	$209,577	$1,536,898
All claims	$10,806	$372,704,855	$9,733	$155,643,593
Total, men and women				$528,348,447

Note: Does not include fringe benefit losses. For groups below the dashed line, losses are projected for 10 years. Permanent total and death cases are projected 30 years or until age 75, whichever is sooner. This table differs from the parallel table in the paper enclosed in the Appendix because claims with 4-7 days of lost time are omitted here.

Using the same methods as for Wisconsin, estimates of lost earnings for workers injured in Florida appear to be much higher than for similar groups in Wisconsin (Table 2). For workers in Florida, we have data on injuries with lost time lasting at least 8 days. Comparing workers injured in Florida with those with at least 8 days' lost time in Wisconsin, we find that average projected losses per injury in Florida average 80 to 100 percent higher than those in Wisconsin. Compared to Wisconsin, Florida had average injury-related lost earnings that were 160 percent higher. The most striking difference between the two states is the difference in losses for the most costly category of claims – permanent total disability and death. In Wisconsin, these claims comprise less than two percent of losses, but in Florida they account for 20 percent of losses. The difference is almost entirely caused by the difference in the proportion of permanent total disability claims in Florida –over 13 times that in Wisconsin.

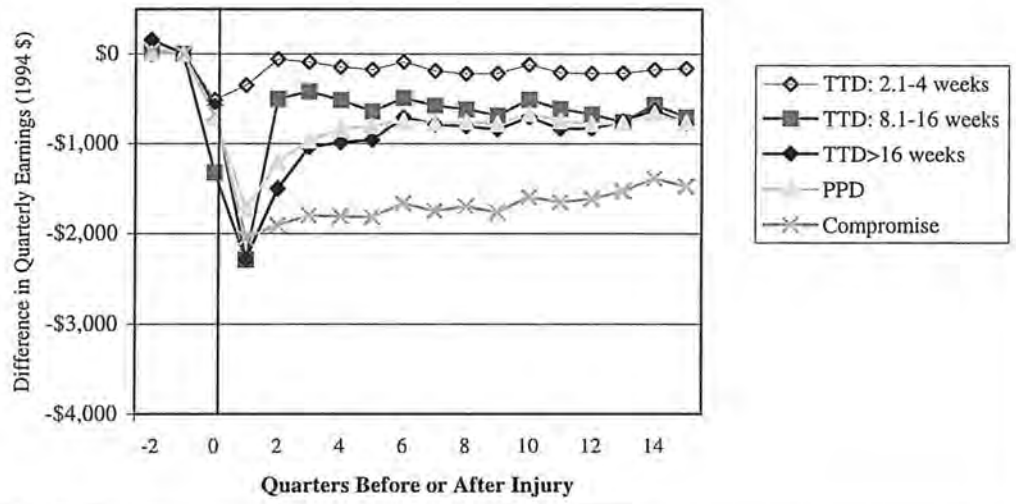
Table 2. Pretax Losses per Injury and Annualized Total Losses by Benefit Category, Workers Injured in Florida, 1990-1991

	Men		Women	
	Losses per Injury	Total Losses	Losses per Injury	Total Losses
8-10 days	$544	$2,151,609	$367	$680,800
11-14 days	$490	$2,317,055	$481	$1,033,218
2.1-3 weeks	$959	$4,460,160	$636	$1,420,642
3.1-4 weeks	$1,152	$5,688,430	$833	$1,905,746
4.1-6 weeks	$1,597	$7,202,090	$1,291	$2,554,904
6.1-8 weeks	$4,285	$14,383,807	$3,383	$4,613,296
8.1-12 weeks	$8,947	$31,469,486	$5,848	$9,319,244
12.1-16 weeks	$11,927	$20,598,400	$12,325	$10,251,023
16..1+ weeks	$25,941	$91,621,469	$21,319	$43,103,564
PPD benefits	$47,883	$141,864,118	$43,305	$67,350,534
Compromise benefits	$51,360	$506,968,505	$43,678	$185,480,199
Permanent Total and Death	$235,311	$211,781,430	$163,974	$73,180,284
All claims	$21,388	$1,040,506,558	$17,786	$400,893,456
Total, men and				$1,441,400,014

Note: Does not include fringe benefit losses. For groups below the dashed line, losses are projected for 10 years. Permanent total and death cases are projected 30 years or until age 75, whichever is sooner.

A large proportion of injured workers suffer losses that continue at least four years into the future -- and perhaps over their entire working lives. This includes many who are classified by workers' compensation as having "temporary disabilities." Figure 1 shows average changes in quarterly earnings for groups of male workers injured in Wisconsin with different levels of workers' compensation benefits. From these changes, we have subtracted the average change for workers with injuries involving 8 to 10 days of lost time. (By construction, we begin at zero in the quarter of injury). This provides a rough measure of injury-related changes in earnings. Workers with 10 to 14 days of temporary disability benefits suffer small and short-term losses. However, groups with PPD benefits or receiving temporary disability benefits for more than 8 weeks (but no PPD benefits) appear to suffer substantial losses even 4 years post-injury. This also applies to male workers in Florida and to female workers in both states. In Wisconsin, about 1/3 of workers with more than one week of lost time are in groups that suffer significant long-term lost earnings. In Florida, over 45 percent of workers fall into these groups. These initial findings emphasize the importance of measuring losses and understanding factors that can affect the overall economic impact of workplace injuries.

Figure 1
Changes in Quarterly Earnings Relative to Comparison Group, Men Injured in Wisconsin 1989-90



The Relationship of Lost Earnings and Income Benefits

To be useful as a tool to focus prevention efforts, workers' compensation benefits should have a consistent and predictable relationship to injury and illness costs. This requires both that all injuries and illnesses be equally reported as workers' compensation claims and that benefits have a consistent relationship to losses for all claims. This research focus on the second relationship. Other studies have begun to analyze the propensity to file claims, suggesting that many injuries eligible for workers' compensation benefits go uncompensated (Biddle, Roberts, Rosenman, and Welch 1998; Morse, Dillon, Warren, Levenstein, and Warren 1998).

Our research shows that, overall, Wisconsin workers' compensation income benefits average 47 percent of projected[5] pre-tax lost earnings of injured men and 38 percent of projected losses incurred by women (Table 3). These averages conceal striking differences among groups of workers categorized by their benefit status. Among people who received temporary disability benefits for more than 6 weeks but did not receive PPD or compromise payments, income benefits averaged only from 14 to 28 percent of pre-tax losses. For PPD and compromise cases, income benefits averaged between 43 and 57 percent of projected pretax losses.

[5] Unless otherwise noted, projected losses refer to losses projected 10 years past the observed period

Table 3. Average Replacement of Losses by Benefit Category, Workers Injured in Wisconsin, 1989-1990

	Benefits as a Percent of Pretax Projected Losses:	
	Men	Women
TTD Benefits Only:		
4-7 days	31%	33%
8-10 days	62%	63%
11-14 days	60%	51%
2.1-3 weeks	58%	71%
3.1-4 weeks	55%	60%
4.1-6 weeks	65%	64%
6.1-8 weeks	27%	28%
8.1-12 weeks	24%	15%
12.1-16 weeks	15%	14%
16.1+ weeks	25%	25%
PPD Benefits	58%	47%
Compromise Benefits	54%	44%
All Claims	47%	38%

Note: Loss estimates do not include fringe benefit losses, and benefits are net of attorney fees.

Florida shows a different relationship between workers' compensation benefits and losses (Table 4). Overall, despite average losses that are much higher than in Wisconsin, Florida's workers' compensation system replaces a higher proportion of those losses. The main reason for Florida's higher overall replacement rate is that 26 percent of workers with lost-time claims receive PPD or compromise benefits in addition to TTD (temporary total disability) benefits, and that 20 percent receive relatively generous compromise benefits. In Wisconsin, 22 percent receive PPD or compromise benefits, and compromise benefits do not cover as large a proportion of lost earnings as in Florida.

Table 4. Average Replacement of Losses by Benefit Category, Workers Injured in Florida, 1990-1991.

	Benefits as a Percent of Pretax Projected Losses:	
	Men	Women
TTD Benefits Only:		
8-10 days	15%	18%
11-14 days	43%	36%
2.1-3 weeks	40%	47%
3.1-4 weeks	66%	71%
4.1-6 weeks	77%	78%
6.1-8 weeks	39%	38%
8.1-12 weeks	27%	32%
12.1-16 weeks	29%	28%
16.1+ weeks	32%	33%
PPD Benefits	45%	44%
Compromise Benefits	66%	65%
All Claims	55%	52%

Note: Loss estimates do not include fringe benefit losses, and benefits are net of attorney fees. The PPD benefits group includes people who received wage loss benefits, impairment benefits, or both.

Most states determine permanent disability benefits according to a percentage disability rating that varies between 0 and 100. Within this important category, for workers' compensation benefits to be a good index of lost earnings, we would expect to see a constant ratio between the two. . It is clear that awards and losses are not closely related in California for 2/3 of workers with PPD benefits – those with less than a 20 percent disability rating (Table 5). From them, workers with similar losses receive very different awards (Reville 1999), suggesting substantial inequities in the California system. In addition, private or public prevention decisions based on the distribution of workers' compensation benefits could be badly misdirected.

Table 5. Lost Earnings in Relation to Benefits, 1991 PPD Injuries in California , by Disability Rating Category

Disability Rating	Lost Earnings, 5 Years after Injury	Income Benefits	Benefits/Lost Earnings	Percent of Workers
1-5%	$29,788	$3,461	12%	21%
6-10%	$31,308	$6,619	21%	19%
11-20%	$39,188	$13,816	35%	26%
21-35%	$56,560	$28,606	51%	20%
36-99%	$90,793	$43,877	48%	13%

Table from (Peterson, Reville, Stern, and Barth 1997).

However, in Wisconsin we have seen a much better match between benefits and losses for PPD injuries. Losses (on the vertical axis) and the PPD rating (on the horizontal axis) increase together, over a wide range of PPD ratings. Wisconsin clearly was doing a better job than California of tying PPD benefits to lost earnings.

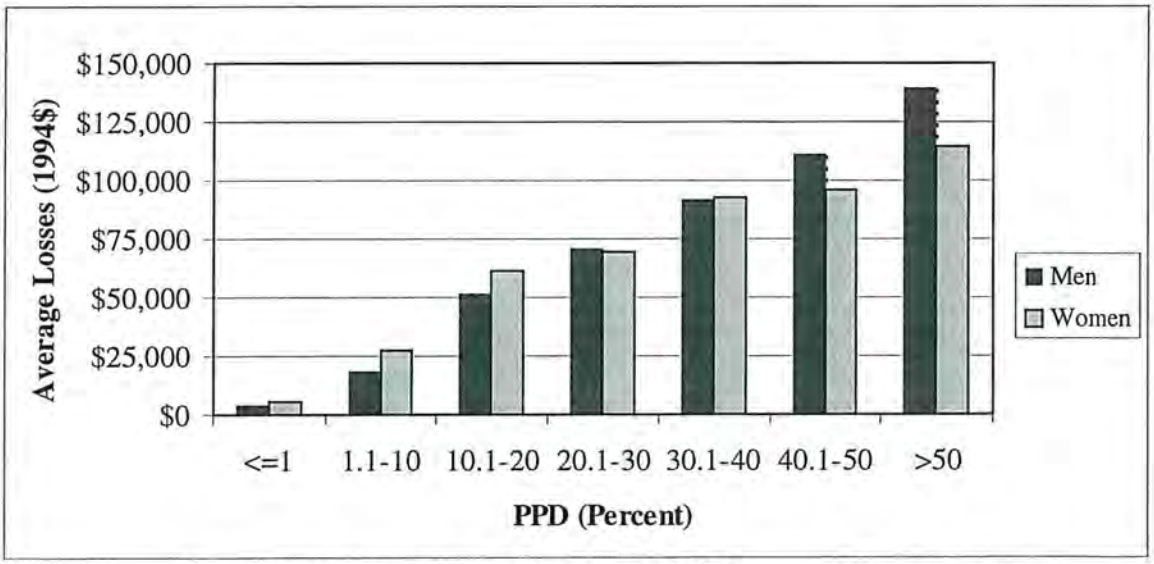


Figure 2. Ten-Year Wage Losses and PPD Percent: Wisconsin

In Florida, permanent partial disability is paid in a more complex fashion, not easily translated into percentages. So, instead of a percentage rating, we measure benefits here by the dollar value of benefits divided by weekly preinjury earnings. In Florida, as in Wisconsin, average losses rise with weeks of PPD paid, and in both cases average losses rise more slowly than weeks paid. One difference between the two states is that PPD benefits appear to track losses equally for men and women in Wisconsin, but track losses less well for women in Florida. (In both states, however, women's benefits are a smaller proportion of losses than are men's benefits.)

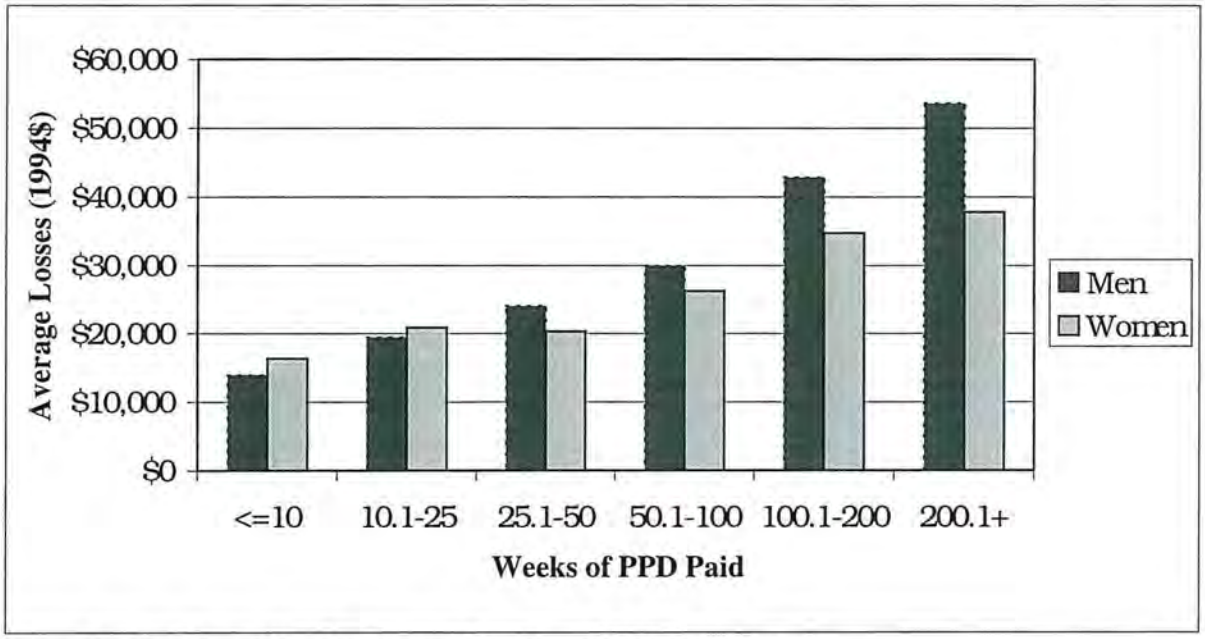
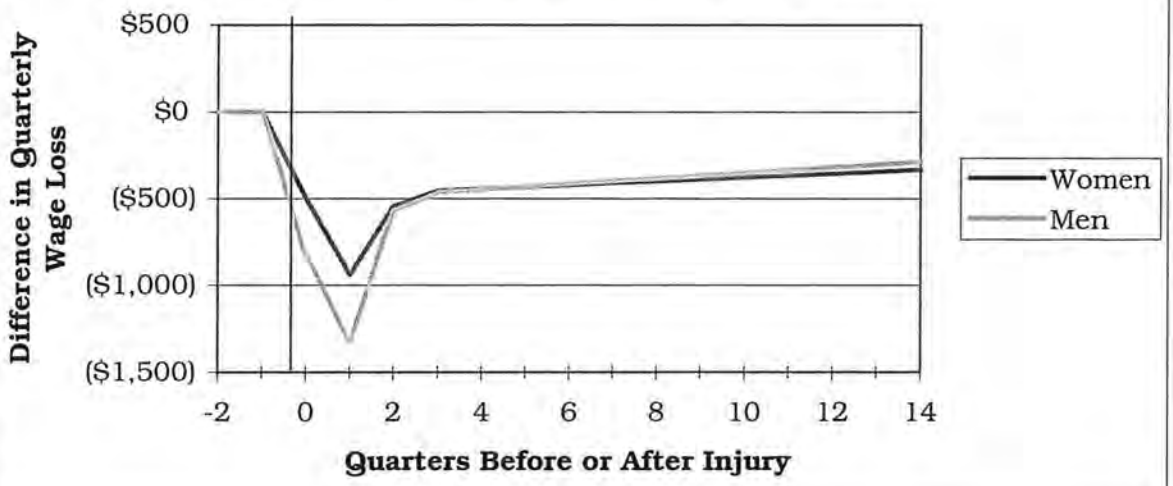


Figure 3. Ten-Year Wage Losses and Weeks of PPD Paid: Florida

Differences in Losses by Gender

Women injured at work in Wisconsin during 1989 or 1990 had average earnings in the preinjury quarter that were 66 percent of men's earnings. Women's losses in the quarter of injury were 65 percent of men's losses, and proportionate losses were 23 and 22 percent respectively. However, in subsequent quarters, women's losses became as large as men's (Figure 4), so their proportionate losses became much larger than those of men. In the three years after the post-injury quarter, women lost an average of 7.2 percent of preinjury earnings, while men lost 4.1 percent.

Figure 4
Estimated Changes in Wages Relative to Comparison Group, Workers Injured in Wisconsin, 1989-1990



Using a variant of the Oaxaca-Blinder composition, we find that accounting for covariates increases the gender disparity in losses. Evidence provides at best weak support for several explanations of these disparities that do not rely on discrimination. Overall, this study suggests that there may be substantial gender discrimination in the reemployment of injured workers.
In both Wisconsin and Florida, women appear to lose a greater proportion of their earnings than men. Overall, despite the fact that men's earnings are about 50 percent higher than women's, average losses of men are only 9 percent and 13 percent higher than average losses for women in Wisconsin and Florida respectively. The principal investigator has written a paper with Monica Galizzi on gender differences in losses in Wisconsin. It will be submitted shortly.

The Experiences of Injured Workers and their Families

Impact of the Injury

The study of the human costs of occupational injuries as described by injured workers includes the impact on their abilities to carry out job-related and non-job-related "work." Understanding workers' post-injury experience is critical to a full appreciation of their losses and in addition it promotes an understanding of factors that contribute to these losses, thus enabling us to design policies that reduce both economic and non-economic losses.

Threat to Masculinity and Sense of Independence: Males

Males in Wisconsin and Florida reported the injury as threatening their sense of self, of loss of masculinity. For some males this was expressed in terms of loss of independence while for others the threat was expressed in terms of disability. The loss of independence was viewed as feeling helpless as well as imposing on others. In Florida, White, Black and Hispanic males reported these threats although there were differences in emphasis among the groups.

For workers in both Wisconsin and Florida the workplace back injuries had three non-work limitations: (1) role limitations, (2) self worth limitations, and (3) family limitations. These limitations were manifested differently for males and females but were manifested similarly across the two states. In Florida, White and Black males were more likely than Hispanic males to talk about the injury as a threat to their sense of self and to their masculinity, remarking: "You don't feel like a man," "I'm a man and I should be doing this stuff." The threat to sense of self and masculinity was also reflected when talking about how they felt emotionally after the injury, of being "upset," "mad," and "depressed."

Threat to Identity and Sense of Worth: Females

Among the women in both Wisconsin and Florida, the injury also seemed to threaten their sense of self but was explained in terms of a threat to their sense of worth. Among females in Florida, these issues of loss of sense of worth and of feeling helpless and worthless was mentioned by White, Black and Hispanic females. These feelings of loss of self and worthlessness were echoed by females when they talked about how they felt emotionally after the injury. Over half the females said they felt depressed, angry or both.

Spouse/Significant Other

Many of the respondents talked about the effects of the injury on their relationship with their spouse or significant other. Overall both men and women talked about the support they received from their spouses but for some the injury caused displeasure regarding gender role responsibility reversals with women more likely than men to talk about their spouses dislike of the change. Both men and women also talked about a lessening of sympathy from their spouses over time.

Sexual Relations. Although the interviewer did not probe this issue with respondents in Wisconsin, over one quarter (27%) of both men and women talked about the effect of the injury on their sexual relations. A majority of Florida respondents reported that their back injury had negative effects on their sex life. Among males 16/24 White, 18/24 Black, and 15/24 Hispanic males and among females 15/24 White, 18/24 Black, and 11/17 Hispanic females reported that the injury affected their sex life. For many their back injury continues to negatively affect their sexual relations.

Relations with Children

As heard in these discussions many of the injured workers received help from their spouses/significant others and children. When asked about their children reactions to having to take over chores a number of women talked about their childrens' assistance. other women talked about the resentment their children displayed at having to take over household responsibilities. Men also talked about the effect of the injury on their relations with children and its effect on the family unit.

Return-to-work Conditions: White, Black, and Hispanic Workers

The interviewees were asked about the conditions they encountered when they returned to work including whether or not they returned to light duty work, the number of hours they worked when they returned, whether or not they required special equipment in order to return-to-work and who provided the equipment. Questions were also asked about current working conditions including limitations on working capabilities, any special accommodations needed in order to perform their work, and the flexibility of the job to meet their injury-related needs.

Among White, Black and Hispanic males and females in Florida, White males were the most likely to say they returned to a light duty job (Table 6). Half of the White females who said they returned

to a light duty job remarked sarcastically that "their light duty was not really light duty." Similar statements were heard from other workers including a Black male who said, "Well they put me on light duty but there's no such thing as light duty," and two Black female that it was "supposedly" light duty and "Well, they called it light duty." Three Hispanic males explained that although their doctors told them to do light duty work their supervisors would not allow it. One of them who was told by his doctor not to return to his job as a tractor driver reported about his supervisor's response, "He told me no matter what, get on the tractor and work slow, but work;" another that, "Well they put light duty on it but then nobody took care of that so I had to do my own job," and Carlos was told to return to a light duty job "but he say he no have it."

Other workers complained that their employers made no attempt to accommodate their needs. A White male recounted that his doctor had recommended he sit more often, "but they didn't go along with that, they didn't even take that into consideration." Two Black males explained that they did not return to light duty work because "there's no light duty job," as did a White female who said "there's no light duty in cafeteria work," and similarly a Hispanic female who said about her return-to-work, "they send you for light duty but there is no light duty whatsoever. I told the doctor 'of what light duty are you talking about, there is no light duty standing on a production line eight hours.'"

Needs and Capacities of Workers. When asked whether they were provided with special equipment in order to return-to-work White males were most likely to report needing and receiving such equipment from their employers (Table 1). Two White males reported that they did not require any accommodations but received special equipment as a precaution against further injury. Female workers were most likely to say they required special equipment but that it was not provided. Although a chiropractor told Rosa she needed a neck brace she was not provided one and, since she could not afford to purchase one, she used a rolled towel around her neck. Black and Hispanic workers were most likely to report that their current job is not flexible to their back needs and both Black and Hispanic males reported that they had not told anyone at their current job about their back problems because they feared losing their jobs if their employer knew they had a back injury. Charles said he requires special equipment but has not asked for any because "I don't want them to know I have a problem with my back." Female workers were the most likely to say the injury had resulted in limiting their capabilities in their jobs and that they require special accommodations in their current jobs.

Overall, White males were more likely than other males or females to return to employers who enable them to continue working by providing light-duty work and special accommodations needed as a consequence of their work-related injury.

Beliefs About Work and Racial and/or Ethnic Discrimination: Black and Hispanic Workers

Although not specifically asked about racial or ethnic discriminatory practices experienced at work either before or after the injury, when workers were asked how they were treated compared to other workers who had been injured on the job a number of Black and Hispanic workers responded that they believed they were treated differently because of their race or ethnic background. Three Black males believed they were laid off because they were Black. One of them, Charles, said, "I know that's an easy thing for somebody to say but in my case I think it's true." Charles gave examples of other people who had back injuries and who had returned to light duty jobs and although he said that another Black coworker had been given a light duty job after a back injury, he elaborated that "we only had a certain number on the job so you had to have somebody in a position where they could say that they was being fair with the, you know, the positioning of the crew leaders or whatever." A second Black male said about one of his supervisors "he wasn't nice -- prejudiced -- and at times he gave me a hard time." After returning to work he was laid off, "they told me they had nothing for me to do. So then, that's when I know it was more than what they told me they had a job on the board but they didn't want me to have it." And the third Black male who was a city maintenance worker said about his job, "Well I really feel I'm

entitled to more money what they could have given me. I had a hard time to get it and I really believe I'm not the only one ever had it like that. There's a lot of discrimination in the world today."

Table 6. Florida Workers' Post-injury Needs and Capacities, Total (at time of injury 1991)

	White		Black		Hispanic	
	Male	Female	Male	Female	Male	Female
Return-to-work	n=28	n=32	n=28	n=26	n=26	n=19
Light duty work when returned	21	15	12	11	9	11
Light duty for 1-2 weeks	2	0	0	0	4	1
"Light duty" when returned	2	4	2	4	2	1
Worked fewer hours when returned	10	18	6	3	4	6
Required special equipment to return-to-work	11	9	8	8	11	13
Employer provided equipment	8	2	5	6	6	2
Worker provided equipment	0	4	0	0	0	1
Medical provider provided equipment	1	0	0	1	1	3

Among the Hispanic males, Carlos explained that when he returned to work, "I feel discrimination...I was disappointed after I was so honest to the company after so many years." A second Hispanic male remarked that at his job "there were all types of people and nationalities and everyone got along well. Some supervisors they went beyond and abused their position, see, even though that never happened with me." And a third Hispanic male said that he worried about applying to Worker's Compensation because it would affect his job, "because I don't know, because I didn't understand English well, much less to read it or anything like that I think later on it would affect me." Language issues were also of concern to Rosa who explained that, "I feel that I'm one of those people that they love to humiliate because I'm a Mexican or because I don't speak English. Because other people they do help, and with me they did what they wanted." Another Hispanic female said about her hospital cleaning job "it was the only thing that I could work in, that was in cleaning, because they didn't care if I didn't speak English."

Interestingly, a few Hispanic workers referred to their non-Hispanic supervisors as helping them because they were Hispanic. One male said about his former supervisor "when he find out I was looking for a job he called me right away 'cause he like Latin people that work." And the female hospital cleaner talked about the assistance she received from "the American boy, if it hadn't been for him I would gone several months without the help of the Worker's Compensation. If it wasn't for his good advice, I'm always grateful to him, I wouldn't have had the early medical treatment that by law I had to have."

Beliefs about Work and Gender Discrimination: White, Black and Hispanic Females

Although female workers were not asked about gender issues and experiences at work before or after the injury, a number of females believed that they were treated differently because of their gender. White, Black and Hispanic females talked about issues of gender discrimination. Patty said that because she was a woman she was not treated in the same way as other people injured on the job, "Well one, because I'm a woman, that had a lot to do with it. Other than cashiers there weren't any women workers. I was treated rather shabby." Elizabeth thought that her gender was the reason she was laid off, "You know, sometimes they just hire ladies just 'cause they have to. But they don't want you back once you get hurt." Two Hispanic females commented that they were expected to do work that was inappropriate for women. One worked in the rug department of a department store remarked, "It was heavy, most of the ladies, they get problems and I mean they should have given us some kind of belt or something while we were working." The second worked in the bakery of a supermarket said although her doctor told her to return to light duty work she was put to work in a strenuous job "that was what the men did there."

Relations With Spouse/Significant Other

A majority of White, Black and Hispanic males and females reported that their back injury had negative effects on their sex life. Among males 16/24 White, 18/24 Black, and 15/24 Hispanic males and among females 15/24 White, 18/24 Black, and 11/17 Hispanic females reported that the injury affected their sex life. For many their back injury continues to negatively affect their sexual relations.

Use of Drugs: Over-the Counter and Prescription Drugs

Males and females in all groups talked about being on medications for pain, but only White workers talked about seeking professional help for depression. A White female explained that "I see a psychologist, and I take a lot of medication, and I pray a lot." Similarly a White male said, "I got pretty depressed. I did end up seeing a shrink." Two White males and two White females, three Black males and five Hispanic females said they used medications for depression and/or "to calm me down."

The use of pain medications, both prescription and over-the-counter pain medications and anti-inflammatory medications was widely reported with approximately half of all those who were prescribed pain medication after the injury continuing to use some form of pain medication on a regular basis. More Black and Hispanic than White males and females initially used and currently use pain medications. Among eight White males who said they had used pain medications three continue to use them; of twenty Black males who had used pain medications ten continue to do so, and of 16 Hispanic males who used such medication six are currently using them. Reasons for continued use included "I have spasms and my back hurts for a couple of days and I have to take a muscle relaxer," and "I went through medication, I went through pain shots, I went through the whole nine yards. I'm on medication and I take it three times a day." Among females six of 14 White females who had initially used pain medications continue to use them; nine of 19 Black females who used such medications continue to use them, and seven of 12 Hispanic females continue to use them. The reasons for continued use were similar to reasons heard from males, "I end up on my back or I end up having to take medications."

Returning to the Workplace after a Work-Related Injury

When workers reenter the workplace after an injury, they or their employers control the path of reentry. Self-controlled paths of reentry are governed by whether the worker wants to return either to the pre-injury job or place of work. These paths include returning to the pre-injury job, deciding not to return because of concern about being unable to perform the work, deciding not to return for family or educational reasons, wanting different employment, or moving from the area. Over 90 percent of workers in our study chose to return to their pre-injury job or place of work (Table 2), and on attempting to return

they encountered paths of reentry governed by decisions made by the employer. Four employer-controlled paths of reentry to the pre-injury workplace were described by workers and included "welcome back," "business as usual," "no alternative," or "you're out." One in ten workers who wanted to return to the pre-injury workplace were never reemployed by the pre-injury employer (Table 2), encountering the employer-controlled path of "stay away."

Our ethnographic interview study in Florida suggests that workers from different racial and/or ethnic groups may experience different return-to-work conditions following an injury and that older workers are less likely to return-to-work after an injury or to be employed five years after an injury. The data also suggest that Black and Hispanic workers may be more likely than White workers to be employed in occupations in which they are less likely to be able to either return to their original job or to other employment. This could be the result of many factors, including more strenuous employment, lower education levels, more severe injuries, and employment discrimination. Still, some Black, Hispanic, and female workers describe perceived discriminatory behavior by their pre-injury employers.

SUMMARY OF SPECIFIC AIMS OF THE GRANT AND SUCCESS IN MEETING THEM

(1) Develop a semi-structured open-ended interview guide that allows workers to describe the important issues they faced after their workplace injuries.
COMPLETED

(2) Administer semi-structured open-ended interviews to 198 of the more severely injured workers in Wisconsin and 216 in a second state to elicit from them descriptions of the noneconomic effects of their injuries and their experience of the workers' compensation system. These workers will be chosen as a stratified random sample of the closed-ended survey population, with equal numbers of men and women and equal numbers of workers in three age groups. We will choose a second state where the minority population is larger, and we will include strata for non-Hispanic Blacks, non-Hispanic Whites, and Hispanics. We also will include strata for litigated and nonlitigated claims, but, in Wisconsin, litigation is rare enough that we cannot make these strata equal in number.
WISCONSIN: COMPLETED (182 interviews).
FLORIDA: COMPLETED

(3) Analyze the interviews using established coding methods and criteria to characterize important themes shared by all groups and differences in the relative importance of these themes in subgroups.
WISCONSIN: COMPLETED
FLORIDA: COMPLETED

One paper, describing return-to-work patterns and problems among injured workers, has been submitted for publication.

Another paper, describing role impacts and impacts on family relationships, will be submitted for publication in January 2000.

(4) Analyze detailed injury and income data from the two states, covering all compensable injuries and illnesses, using a repeated measures/random effects regressions to estimate the time-profile of incomes of injured workers. Workers with very minor injuries will be used as a comparison group against which to measure income losses of workers with injuries involving at least one month's lost time or permanent disability payments.
WISCONSIN: COMPLETED
FLORIDA: COMPLETED

(5) Use supplemental data from a closed-ended survey of 1500 workers who experienced back injuries in each of the two states studied to determine whether unobserved information significantly affected estimates of income losses and to provide additional insights into the monetary impacts of injuries and illnesses. These workers are a stratified random sample of the population of injured workers, with three strata by injury severity and two gender strata.
WISCONSIN: COMPLETED
FLORIDA: CANCELED. See copy of letter to Roy Fleming, dated March 11, 1997.

(6) Provide direct estimates of income losses from workplace fatalities and for workers with minor injuries and illnesses
WISCONSIN: COMPLETED
FLORIDA: COMPLETED

(7) Use data from the Bureau of Labor Statistics injury and illness datasets and the Current Population Survey to explore methods to extrapolate income-loss estimates to other states.
In our proposal, we noted that this extrapolation may not be supportable. We believe that this is correct and have not included such extrapolations in our publications.

(8) Work with NIOSH to disseminate information generated by this study and to develop follow-on research
WISCONSIN: Lost earnings study published, attached. First ethnographic study submitted, second study in draft. Study of gender differences in earnings submitted.
FLORIDA: Lost earnings study expected submission date 4/2000.
One follow-on proposal submitted to NIOSH and funded.
We submitted a second proposal in 1999, and have not yet heard about funding.
Our work was cited in several of the background papers for the NORA HSR/SEC conference of 6/99.

Ethnographic open-ended interviews

FIRST STATE: WISCONSIN

The interview subcontractor, Northeast Research, completed 182 of the planned 198 interviews, which have been entered, coded, and analyzed.

SECOND STATE: FLORIDA

Interviews have been entered, coded, and analyzed.

Economic loss estimates

FIRST STATE: WISCONSIN

We developed estimates of losses in Wisconsin from administrative data, and we have compared these estimates with those derived from the structured survey data. Estimates from both sources are consistent. One concern was that there would be more voluntary job change / unemployment among the injured workers, biasing our estimates of losses. This is not the case. The analysis of sources of income and losses of fringe benefits has been completed. We also have completed an analysis of differences in losses among subgroups of workers and have submitted a paper for publication.

Using Bureau of Labor Statistics data, we have explored whether our data meet the conditions necessary for extrapolating to other states. Our examination of this option suggests that extrapolation would be problematic. For example, median injury durations for specific industries and occupations differ from state to state. If the underlying distribution of injury durations (and therefore economic losses) differs for workers in similar occupations and industries, the foundation for extrapolation from one state to another may be quite shaky. We have not been able to come up with a method of extrapolation to other states about which we can feel comfortable at this point.

SECOND STATE: FLORIDA

Our plans to develop measures of lost earnings in Florida were delayed by the very slow response of the state unemployment compensation agency to our data requests. We have resolved these problems and currently have in hand all the administrative data we need. We have completed most of the data analysis and expect to complete the remaining analysis by November 1998. We will write this up and expect to submit a paper within 1-2 months of that date. As described in our letter to Roy Fleming of March 11, 1997, delays in this phase of the project were caused by the decision of the Workers' Compensation Research Institute (WCRI) not to undertake a second study (in Florida) of the economic consequences of workplace injuries. This has forced us to conduct the analysis of Florida administrative data with "donated labor." We are doing this, but it has delayed the study timetable.

Also, as described in the March 11, 1997 letter, the decision of the WCRI to withdraw from doing a study in Florida has meant that we could not conduct the 30-minute closed-ended survey of 1,500 Florida workers, would have had out-of-pocket costs well in excess of $100,000. These costs were not part of the NIOSH proposal, but were part of an understanding with the WCRI.

We requested and received approval to drop the closed-ended interviews of injured workers in Florida. NIOSH did not supply the funding for these interviews, and the organization that was to have funded them (the Workers Compensation Research Institute) decided not to do so. Aside from timing, we have made no other changes in the plans of the funded proposal and requested no funding changes.

Literature Cited

Agar, M. A. 1986 *Speaking of Ethnography*. Sage Publications. Beverly Hills, CA.

Antonakes, JA 1981. Claims cost of back pain. *Best's Review*, September.

Biddle J, K Roberts, DD Rosenman, and EM Welch. 1998. What percentage of workers with work-related illnesses receive workers' compensation benefits? J Occup & Environmental Med. 40(4):325-31.

Boden LI and M Galizzi. Economic Consequences of Workplace Injuries and Illnesses: Lost Earnings and Benefit Adequacy. *American Journal of Industrial Medicine.* 36(5):487-503.

Boden, LI and Galizzi, M. (1999) Income losses of women and men injured at work. In review.

Galizzi, M and Boden, LI. (1996) *What are the most important factors shaping return to work? Evidence from Wisconsin*. WC-96-6. Workers Compensation Research Institute. Cambridge, MA.

Galizzi, M, Boden, L. I. and Liu, T. (1998) *The worker's story: Results of a survey of workers injured in Wisconsin* WC-98-5. Workers Compensation Research Institute. Cambridge, MA.

Klein, BP, RC Jensen, and LM Sanderson. 1984. Assessment of workers' compensation claims for back strains/sprains. *Journal of Occupational Medicine* 26:443-448.

Kleinman A.1978. What Kind of Model for the Anthropology of Medical Systems? *American Anthropologist*. 80(3):661-665.

Morse T, C Dillon, N Warren, C Levenstein and A Warren. 1998. The Economic and social consequences of work-related musculoskeletal disorders: The Connecticut Upper-Extremity Surveillance Project (CUSP). Int J Occup Env Health 4:209-216.

Reid J, Ewan C and Lowy E. (1991) Pilgrimage of pain: the illness experiences of women with repetition strain injury and the search for credibility. *Social Science and Medicine,* 32: 601-612.

Spradley J. P. (1979) *The Ethnographic Interview*. Holt, Rinehart & Winston. New York.

Strunin L. (1997) The Human Costs of Occupational Injuries. Paper Presented at the National Occupational Injury Research Symposium '97. Morgantown, WV.

Strunin L and Boden L. (1999a) Paths of reentry: Employment experiences of injured workers. *American Journal of Industrial Medicine* (in review).

Strunin, L. and Boden L. (1999b) The human costs of occupational injuries. Working Paper, Boston University.

PUBLICATIONS

Boden LI and M Galizzi. Economic Consequences of Workplace Injuries and Illnesses: Lost Earnings and Benefit Adequacy. *American Journal of Industrial Medicine.* 36(5):487-503, 1999.

Future Publications

Boden LI and M Galizzi. Income Losses of Women And Men Injured At Work. Journal of Human Resources (in review), 2000.

Boden, LI. Disparities in Losses from Workplace Injuries: A Two-State Comparison. To be submitted, 2000.

Strunin, L. and Boden L. The Human Costs of Occupational Injuries. Working Paper, Boston University, 1999. To be submitted, 2000.

Strunin L and Boden L. Paths of Reentry: Employment Experiences of Injured Workers. *American Journal of Industrial Medicine* (in review), 2000.

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Economic Consequences of Workplace Injuries and Illnesses: Lost Earnings and Benefit Adequacy

Leslie I. Boden, PhD,[1]* and Monica Galizzi, PhD[2]

Background *This is the first study based on individual data to estimate earnings lost from virtually all reported workplace injuries and illnesses in a state.*
Methods *We estimated lost earnings from workplace injuries and illnesses occurring in Wisconsin in 1989–90, using workers' compensation data and 6 years of unemployment insurance wage data. We used regression techniques to estimate losses relative to a comparison group.*
Results *The average present value of losses projected 10 years past the observed period is over $8,000 per injury. Women lose a greater proportion of their preinjury earnings than do men. Replacement of after-tax projected losses averages 64% for men and 50% for women.*
Conclusions *Overall, workers with compensated injuries and illnesses experienced discounted pre-tax losses projected to total over $530,000,000 (1994 dollars), with about 60% of after-tax losses replaced by workers' compensation. Generally, groups losing over eight weeks' work received workers' compensation benefits covering less than 40% of their losses.* Am. J. Ind. Med. 36:487–503, 1999. © *1999 Wiley-Liss, Inc.*

KEY WORDS: occupational injuries; occupational diseases; workers' compensation; cost of illness; disability; employment; economics

INTRODUCTION

Background

In 1996, employers in the United States reported 6.2 million workplace injuries and illnesses, of which 2.8 million involved restricted work activity or at least one day lost from work [Bureau of Labor Statistics, 1997]. Although the importance of the impact of workplace injuries and illnesses on employment and earnings is well-understood [National Institute for Occupational Safety and Health, 1996], no statistical studies based on individual data have estimated these impacts for the full range of lost-time injuries and illnesses. These impacts have two components: a physical component caused by reduced work capacity and a labor-market component caused by the long-term impact of work absence during the recovery period. The labor-market component may be caused by a loss of seniority, by a change from a unionized job to a nonunion job, by stigma attached to people who have been injured at work, or simply because injured workers miss valuable labor market experience while off work.

In Wisconsin, workers who miss more than three days of work because of a work-related injury or disease can receive temporary total disability (TTD) benefits. TTD benefits are paid at a rate of two-thirds of the worker's preinjury weekly wage, subject a maximum benefit. Some workers never fully recover from their occupational injuries. When this occurs, Wisconsin requires payment of perma-

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nent partial disability (PPD) benefits related to this lasting physical impairment. PPD benefits are paid based on PPD ratings between 0–100%. A rating of zero would mean no permanent disability, while a rating of 100% would mean total disability. Four percent of workers' compensation claims in this study involve legal dispute and are resolved with compromise agreements, which settle all issues (including income and medical benefits) related to the claim with a payment to the injured worker. Most compromised cases involve disagreements about the degree of permanent disability. Therefore, compromised claims are largely a subgroup of PPD claims.

Previous Studies of Lost Earnings

Several studies of income losses have been published based on statistical analyses of data on claims filed in various workers' compensation systems. All these studies measure losses by subtracting a measure of expected earnings from actual post-injury earnings. However, all published studies to date have focused exclusively on injuries and illnesses involving permanent disability benefits [Cheit, 1961; Johnson et al., 1978; Ginnold, 1979; Berkowitz and Burton, 1987; Reville, 1999].[1] Among the 50 states, PPD claims comprise about one quarter of injuries involving time lost from work and average about three quarters of income benefit payments [Burton and Schmidle, 1994]. Still, many lost-time injuries fall outside the PPD category. Because these studies do not include them in the analysis, important impacts may be lost from view, and estimates of losses are likely to be biased. Also, comparisons of losses across states will be misleading if the probability of receiving PPD benefits varies by state.

Leigh et al. [1997] recently published a study that calculated lost earnings for workplace injuries in the U.S. However, they did not statistically estimate lost earnings. Rather, the authors calculated income losses by assuming specific ratios between income benefit payments and losses. They assumed this ratio was 60% for temporary disability claims, 50% for permanent partial, and 40% for permanent total disability claims. Except for our study, there are no recent empirical analyses to support or refute these assumptions for both the permanent partial and temporary disability groups.

DATA AND METHODS

Data

This study is based on lost-time injury data from workers' compensation records for injuries in the State of Wisconsin between April 1, 1989 and September 30, 1990. We matched over 97% of the injured workers to their unemployment insurance wage records. These wage records provide us with quarterly earnings of workers employed in Wisconsin, excluding the self-employed, from the beginning of 1988 through the end of 1993.[2] From them, we created a data set with 24 quarterly records for each worker, including quarterly earnings as well as personal, injury, and employer characteristics. For injuries and illnesses in April 1989, we have income data for 5 quarters before and 18 quarters after the injury date; for injuries in September 1990, we have income data for 10 quarters before and 13 quarters after the injury date. Therefore, our data are an unbalanced panel.

We estimated losses only for injured workers with matched earnings records who had temporary total disability benefits of eight days or more or PPD benefits or compromise benefits, for a total of 47,910 men and 22,467 women. We excluded from this part of our analysis 110 workers who received permanent total disability payments or who suffered fatal injuries. We further excluded 4,138 workers otherwise eligible for the comparison group but who had more than one injury in the observed period. This leaves 44,899 men and 21,340 women with temporary disability greater than 7 days or PPD or compromise benefits. Of these, our estimates use 36,283 men and 18,026 women. The difference of 16–19% is attributable to missing values — most frequently on the tenure or age of the injured workers — and removing 158 outliers from our estimates of losses. Table I presents descriptive statistics for the administrative data analyzed in this study, including median values where distributions are skewed. On average, the workers studied were 37 years old and had 6 years of tenure with the preinjury employer. Almost half were unskilled blue-collar workers. Only 24% were employed in firms with fewer than 50 employees and 10% were employed in the public sector. The most frequent injuries were back injuries (29%). Finally, 17% did not return to the preinjury employer.

To calculate marginal tax rates, we impute marital status and number of dependents using data from a telephone survey of a stratified random sample of 1,473 people with workers' compensation claims in Wisconsin for back injuries in 1989 or 1990. The survey sample is stratified by gender and by the type and duration of workers' compensation income benefits payments. We randomly impute marital status and number of dependents from records in the survey data with the same age, gender, and type of claim, using the Bayesian bootstrap [Rubin, 1992]. We assume that the missing data are drawn from the same distribution as the observed data.

[1] From this point forward, as a matter of style, we will use the term "injuries" to refer to both injuries and illnesses.

[2] Unobservability of out-of-state earnings is a limitation of this study. However, among the survey subpopulation described in the data section, only 4.2% held an out-of-state job in the 5–6 years between their injuries and the interviews. This percentage was equal for the comparison group and the other groups studied.

TABLE I. Summary Statistics for Wisconsin 1989–1990 Injuries with 1+ Weeks of Lost Time (Standard Deviations in Parentheses)

	All claims	Men	Women
Individual characteristics			
Age in years	36.71 (11.66)	36.32 (11.51)	37.47 (11.91)
Tenure in years	5.87 (7.72)	6.29 (8.25)	5.01 (6.41)
Median	2	2	2
Occupation type (proportion)			
Skilled blue collar	0.22 (0.41)	0.29 (0.46)	0.08 (0.26)
Unskilled blue collar	0.49 (0.50)	0.54 (0.50)	0.39 (0.49)
Agricultural, military, or other	0.02 (0.13)	0.02 (0.15)	0.01 (0.09)
Employer characteristics			
Number of employees	1,169 (2,324)	989 (2,105)	1,531 (2,675)
Median	237	162	421
Proportion of employees in firms with 50 or fewer employees	0.24 (0.43)	0.30 (0.46)	0.12 (0.32)
Proportion in public sector	0.10 (0.29)	0.08 (0.28)	0.12 (0.33)
Part of body injured			
Head, neck, or back	0.32 (0.46)	0.32 (0.46)	0.32 (0.47)
Back only	0.29 (0.45)	0.29 (0.45)	0.29 (0.45)
Upper extremities	0.28 (0.45)	0.25 (0.43)	0.33 (0.47)
Carpal tunnel syndrome	0.04 (0.20)	0.02 (0.15)	0.08 (0.27)
Trunk, multiple, or different injuries	0.23 (0.42)	0.23 (0.42)	0.23 (0.42)
Lower extremities	0.18 (0.38)	0.21 (0.40)	0.13 (0.33)
Claim characteristics			
Proportion with permanent partial disability	0.18 (0.39)	0.19 (0.39)	0.17 (0.37)
Proportion with only temporary total disability	0.78 (0.41)	0.78 (0.42)	0.79 (0.41)
Proportion of claims compromised	0.04 (0.19)	0.03 (0.18)	0.05 (0.21)
Earnings and employment			
Pretax earnings one quarter before injury	$5,499 ($3,420)	$6,179 ($3,547)	$4,129 ($2,666)
Median	$5,112	$6,015	$3,736
Frequency of preinjury employer change	0.09 (0.15)	0.09 (0.16)	0.08 (0.15)
Proportion changing employer after injury	0.17 (0.44)	0.18 (0.45)	0.16 (0.43)
Total number of observations	54,309	36,283	18,026

Note: Regression estimates are based on these data

METHODS

Conceptual Basis

Let y_{i1} represent earnings when person i is injured, and y_{i0} earnings when person i is uninjured. Either of y_{i0} or y_{i1}—but not both—can be observed for any person, since we cannot observe the same person at the same moment both injured and uninjured. Let I_i be an indicator of injury ($=1$, if injured; $=0$, otherwise). Then the observed outcome for person i is $y_i = I_i y_{i1} + (1-I_i) y_{i0}$. The injury effect or loss for person i is:

$$\lambda_i = y_{i1} - y_{i0}, \tag{1}$$

where time relative to injury is implicit in the specification. We can rewrite the impact of injuries on the injured population as:

$$\lambda|_{I=1} = E(y_{i1}|I_i = 1) - E(y_{i0}|I_i = 1) \quad (2)$$

This cannot be estimated directly since we do not observe y_{i0}, post-injury earnings if the injured workers had not been injured.

Statistical methods developed in the nonexperimental evaluation literature allow estimation of a change in earnings relative to a counterfactual, in this case relative to what the worker would have received if the injury had not occurred. Typically, nonexperimental evaluation involves comparing a treatment group with a nonexperimental comparison group, which may have different characteristics than the treatment group. We assume selection on observable covariates [Rubin, 1974], that is $\{y_{i1}, y_{i0} \perp\!\!\!\perp I_I\}|X_i$ (where $\perp\!\!\!\perp$ indicates independence).

In the context of estimating the impact of a workplace injury, injured workers are analogous to the treatment group. The comparison group could be uninjured workers or workers with very minor injuries. The assumption of selection on observables implies that, conditional on the observable covariates, X_i, there is no systematic preinjury difference between the groups assigned to treatment and control. This allows us to identify the effect of injuries on earnings for the injured:

$$\lambda|_{I=1} = E[E(y_i|X_i, I_i = 1) - E(y_i|X_i, I_i = 0)|I_i = 1], \quad (3)$$

where the overall expectation is over the distribution of $X_i|I_i = 1$, the distribution of preinjury variables in the injured population.

In this study, we compare actual post-injury income between a comparison group and other groups of injured workers, using regression methods to control for observed and unobserved worker and employer characteristics and labor-market conditions. The treatment groups are chosen, with the administrative data at hand, to reflect the type of income benefits received and, within the temporary disability group, the duration of income benefits. These groups reflect administrative decisions about injury-related losses, but they do not necessarily reflect actual losses or injury severity.

The comparison group

We choose as our comparison group workers with short-duration injuries or illnesses. These are defined by the receipt of workers' compensation temporary disability benefits for 7–10 days. Our estimates of losses are based on the assumption that losses in the comparison group are limited to the period of their temporary disability benefits. Estimates may be biased downward if some workers in the comparison group experience injury-related losses that extend past this period.

Estimates based on workers with short duration injuries and illnesses will also be biased if unobserved factors affect both workers' earnings and injury-related time off work. For example, a poor employer–employee relationship could lead both to lower earnings growth and a longer duration of time lost from work following injury. If the unobserved factors are unchanging over the study period, fixed-effects or first-differences estimates may eliminate the bias (or at least its linear component).

Because workers' compensation data provide information on several important personal characteristics, including gender, age, occupation, and job tenure, if we use workers with short duration injuries and illnesses as a comparison group, we can condition our estimates on these covariates. Using matched unemployment insurance data, we also can control for other factors, including industry, employer size, and workers' preinjury employment patterns.

The comparison group consists of workers who meet three criteria: (1) they had a single workplace injury from April 1, 1989 through September 30, 1990 and no subsequent injuries through 1993, (2) they lost eight to ten days from work and then returned, and (3) they received no permanent disability or compromise payments.

To derive our estimate of losses for each individual in the sample, we first estimate the difference in changes in post-injury earnings between the comparison group and other injured workers. We then add imputed losses of that individual for a 9 day injury (the average time off work for the comparison group).[3]

One test of appropriateness of a comparison group is whether, controlling for observed covariates, the outcome variable of the group with longer-term injuries tracks the outcome variable of the comparison group in the pre-injury period. We indicate below (p. 15) that this appears to be the case for the comparison group we use. It is possible that some members of the comparison group suffer continuing losses from their injuries. If that is the case, our estimates will be biased downward.

We also considered using uninjured workers as a comparison group, using unemployment compensation

[3] Wisconsin compensates (and keeps records on) injuries with more than 3 days' lost time and lacks data on workers with medical-only claims. Some other states only track injuries with at least 8 days' lost time. For comparability with future studies in other states, we use injuries with 8–10 days' lost time for the comparison group. We compared estimates of losses of workers with more than 10 days of lost time by using 4–7 days comparison group and found that using the 4–7 days comparison group produced small (under $50 on average) and statistically insignificant differences in our estimates of losses for the longer-term injuries. Note that using 4–7 days or 8–10 days claims as the comparison group does not imply that we ignore the losses from either group. See, for example, Tables II–VI.

earnings data. If we used a random sample of all employed workers as a comparison group, our only source of data would be unemployment insurance wage records, which lack data on gender, age, occupation, and job tenure. But such factors have been proven to be very important determinants of earnings. For this reason, using uninjured workers as a comparison group would not have permitted us to use these covariates to control for important differences between injured workers and workers in the comparison group.

Other injury groups

In principle, temporary and permanent disability benefits are designed to provide replacement of injury-related lost earnings. The duration of temporary disability benefits should span the period of physical recovery and associated income losses. The existence and level of PPD benefits reflect the existence and degree of permanent impairment and related losses. The duration of workers' compensation temporary disability benefits and the permanent partial disability percentage (zero to 100) provide useful tools for creating groups of workers whose losses should be similar within a group, but are likely to differ among groups. Because most claims resolved with compromise settlements are litigated, they may differ from other claims. Thus, we analyze them as a separate group. To some degree, the duration of temporary disability, the existence and level of PPD benefits, and the use of compromise agreements are endogenous, depending on personal and employer behavior and incentives. Still, we believe that they are useful for organizing our results. We group injured workers as follows:

- Temporary disability benefits only for:
  8–10 days (comparison group), 11 days to 2 weeks, more than 2 weeks to 3 weeks, more than 3 weeks to 4 weeks, more than 4 weeks to 6 weeks, more than 6 weeks to 8 weeks, more than 8 weeks to 12 weeks, more than 12 weeks to 16 weeks, and more than 16 weeks
- PPD benefits (with or without TTD benefits)
- Compromise settlements
- Permanent total disability and death.

Specification of a model of post-injury earnings

We observe each person in our data for three to four years after injury. Figures 1 through 4 reflect average changes in earnings of injured workers compared with changes in earnings of the comparison group (those with temporary disability benefits lasting 8–10 days) and are not adjusted for covariates. We impute zero quarterly earnings in quarters for which no employer reports earnings for a person in our sample.

To construct Figures 1 through 4, we first subtracted each person's earnings in the preinjury quarter from earnings in every observed quarter and calculated the average of this value for each group in every quarter. This measures the mean change in earnings between the preinjury quarter and all other quarters. We then calculated

Changes in Quarterly Earnings Relative to Comparison Group, Men Injured in Wisconsin 1989-90

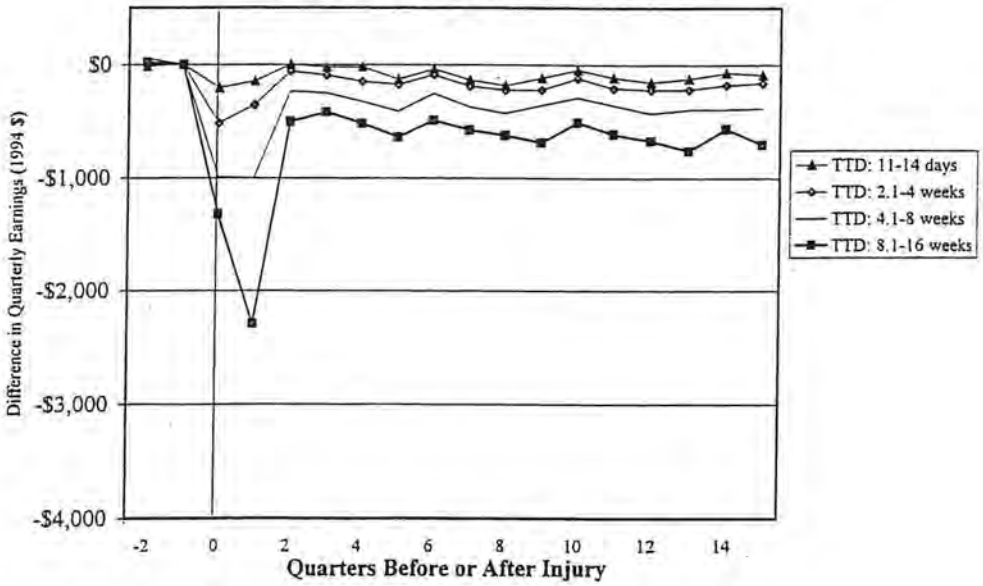


FIGURE 1.

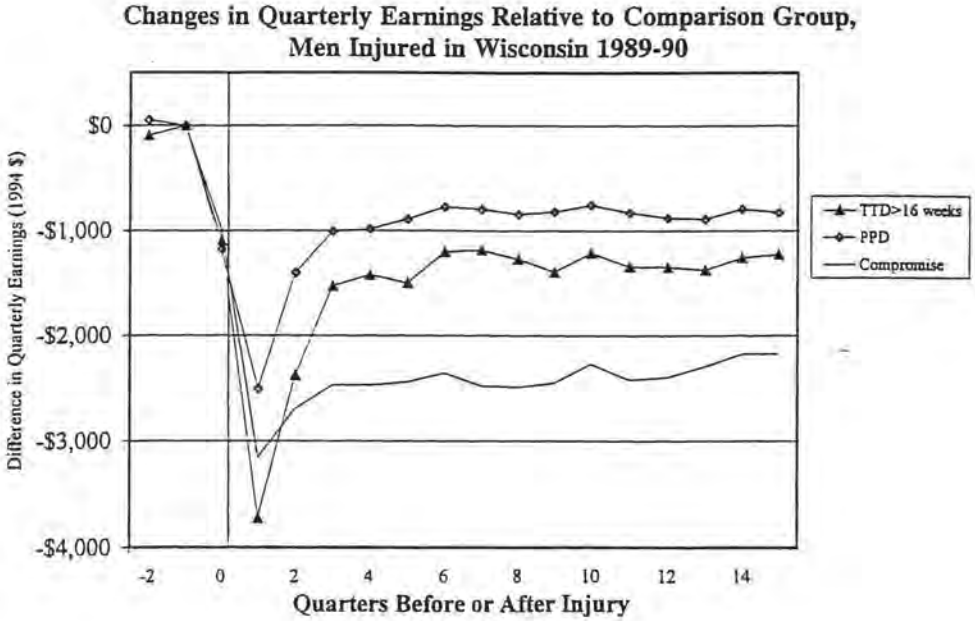


FIGURE 2.

the difference between these values for each injury group and the parallel value for the comparison group. The resulting values measure differences in average quarterly changes in earnings between people in injury groups and those in the same-gender comparison group. The preinjury quarter is marked by a vertical line.

Three and one half years after the injury, the overall average changes in earnings for men who received at most four weeks of temporary disability benefits are similar to the average changes for the 8–10 day group. However, they are substantially lower for workers with more than 4 weeks' temporary disability. Figure 2 shows that the average drop in annual earnings is largest for men with at least 16 weeks' temporary disability, PPD, or compromise payments. Average post-injury earnings of women display a similar pattern. Figures 3 and 4 show that, after their initial losses, women with 8 weeks or less of temporary disability appear to rebound to a point similar to those of the comparison group. However, those with longer temporary disability, PPD, or compromise payments continue to experience substantial losses long after the date of injury. Because Figures 1 through 4 are based on mean earnings unadjusted for covariates, part of what we observe in these graphs could be caused by differences in covariates among the groups. The estimates below account for a wide range of such covariates.

To estimate losses due to injury, we first estimated what injured workers' earnings would have been had these workers been in the comparison group, given personal and job characteristics, employer characteristics, and labor-market conditions. Then, we compared actual post-injury earnings of injured workers to these expected earnings. The difference is our measure of lost earnings. Our method resembles very closely estimation techniques used to measure the income losses of displaced workers [Jacobson et al., 1993; Stevens, 1997].

The model of earnings rests on the assumption that all workers in our study with the same (observed and unobserved) personal and employer characteristics in the same labor-market setting would have the same earnings if they had not been injured.[4] Based on this assumption, we developed a statistical model to estimate post-injury earnings. It consists of two primary elements. The first is the component of earnings that is unaffected by the injury. The second is the impact of the injury on earnings. Because in general the earnings and employment of men and women differ considerably, we estimated their earnings separately.

Noninjury-related earnings. The specification of the component of earnings unrelated to injury includes: (1) fixed calendar time effects, reflecting broad economic factors affecting all workers in each observed calendar quarter, (2) a fixed effect and a time trend to capture the impacts of unobserved characteristics common to workers in the comparison group, (3) fixed effects for periods before and after the injury quarter, and (4) a vector of characteristics of

[4] In our data, the estimated changes in preinjury earnings in the comparison group do not differ significantly from those of workers with longer-term injuries (p. 15).

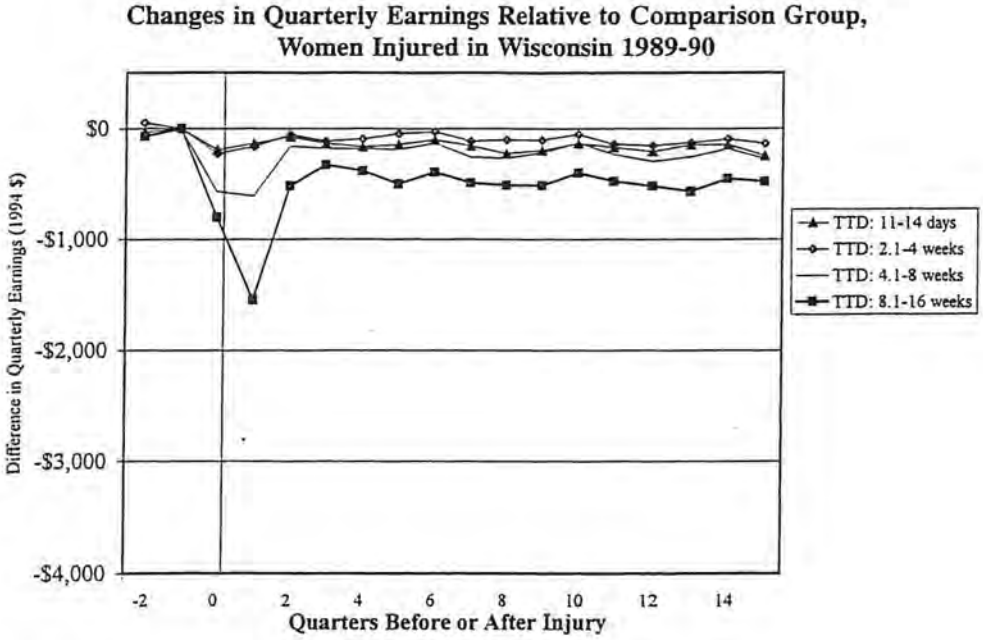


FIGURE 3.

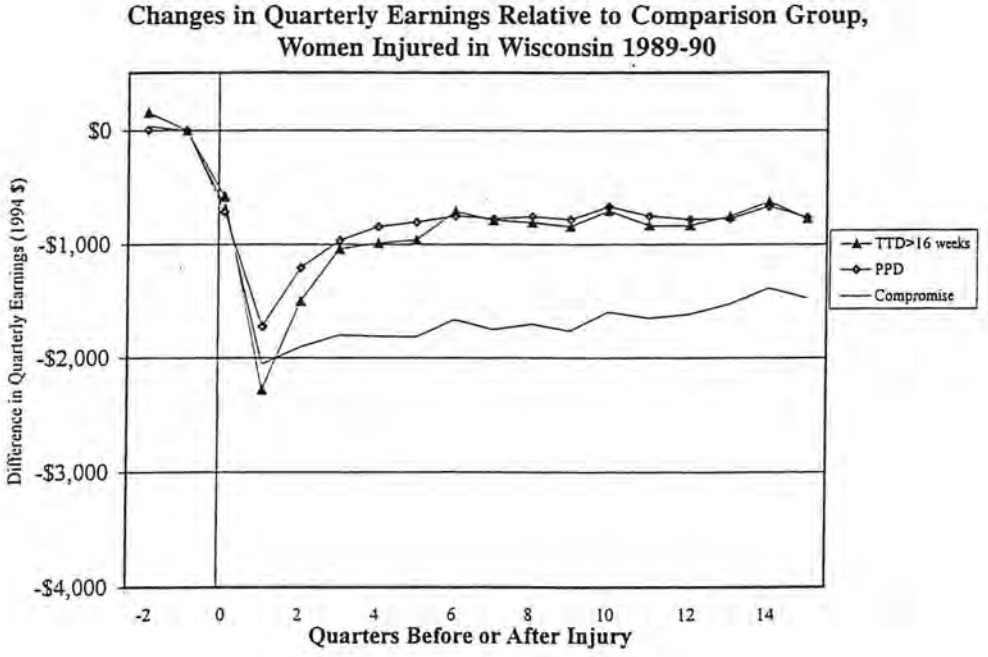


FIGURE 4.

individual workers and their employers. This vector is composed of:

- age, age^2, age^3, age^4
- Four groups representing job tenure at the time of the injury; also preinjury and post-injury earnings trends for the four tenure groups
- 2-digit industry group dummies (SIC) and time trends for each group
- 1-digit Census occupational categories and time trends for each category
- Private or public sector dummy
- Log (number of the employees of the firm at the time of the injury)

- Stability of preinjury earnings (coefficient of variation of quarterly earnings) and preinjury and post-injury trend interactions
- A measure of frequency of preinjury change of employer (number of changes divided by total changes possible) and preinjury and post-injury trend interactions.

The impact of the injury on earnings. The second part of the estimated model accounts for the impact of the injury on earnings, reflecting the patterns in the overall raw data shown in Figures 1 through 4. The changes in earnings observed in the raw data suggest a model that allows post-injury changes in earnings to differ among injury groups and vary in size and direction for each of the four post-injury

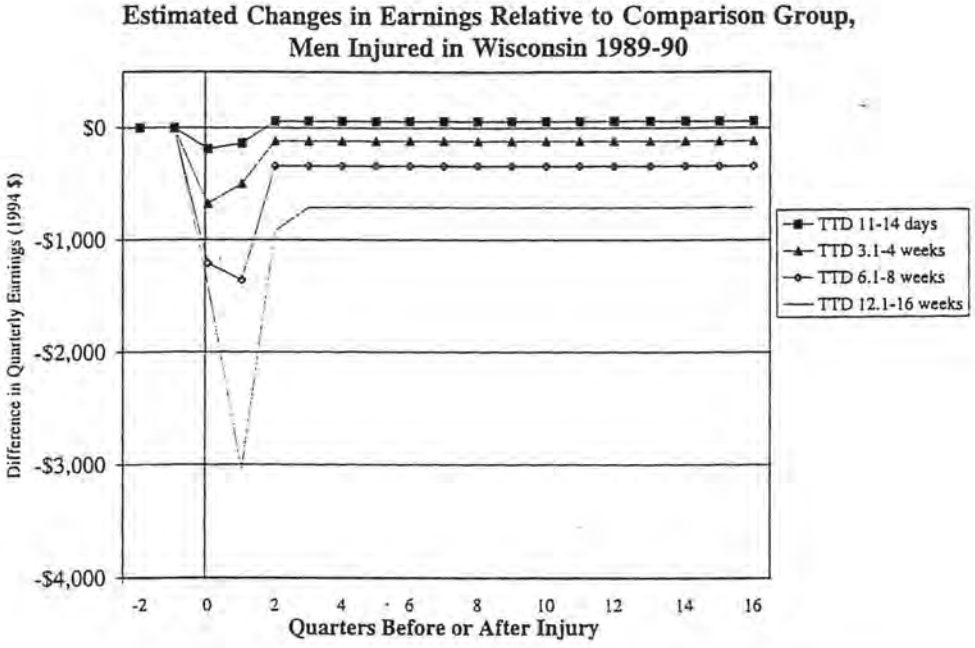
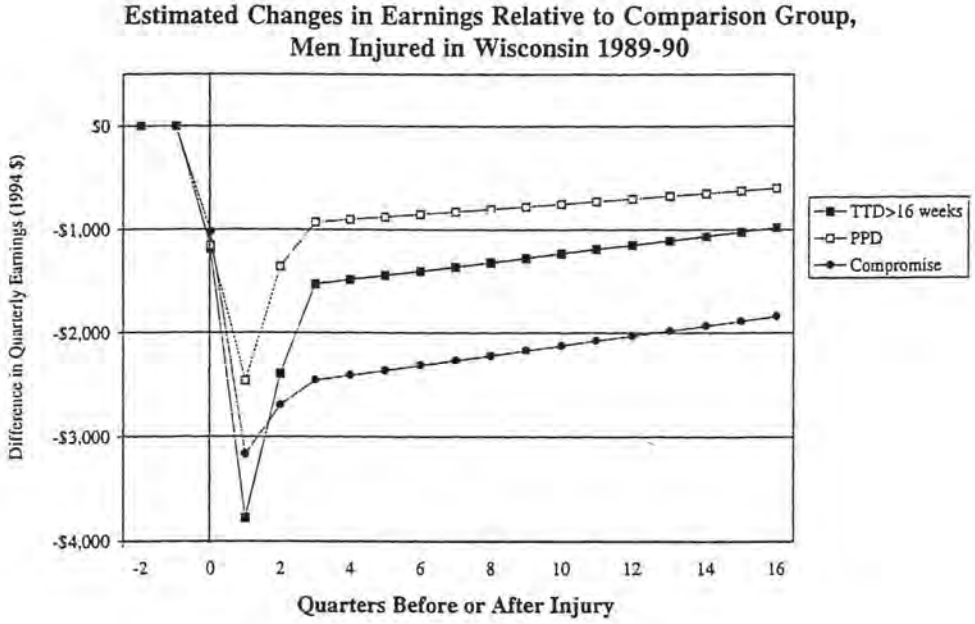


FIGURE 5.



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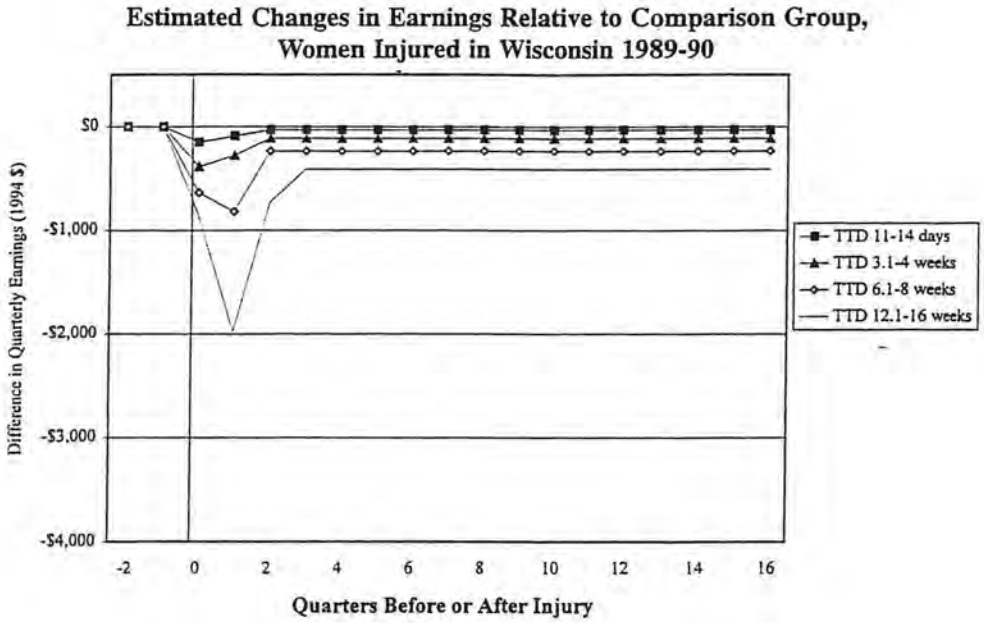

FIGURE 7.

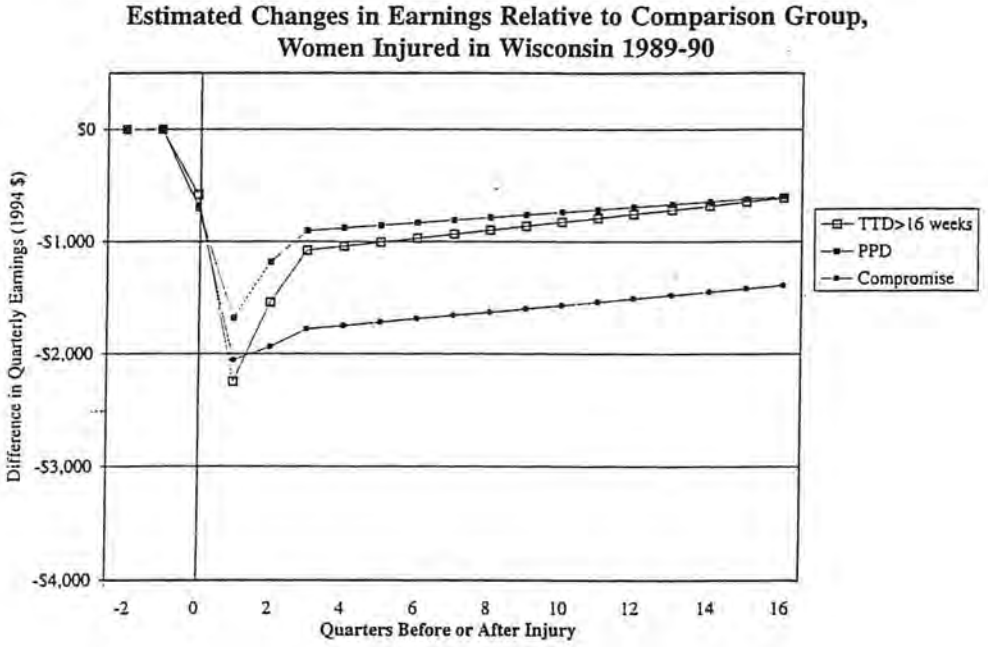

FIGURE 8.

quarters. For workers in some groups, earnings begin to rise in the second quarter after injury and level off after that. For other groups, earnings may continue to fall in the second quarter and rise in the third and fourth quarters. After the fourth post-injury quarter, each group appears to have a stable linear trend in earnings relative to the comparison group.

To capture these changes, we include interactions between post-injury periods and injury groups in our regression. These interactions allow for changes in each of the four post-injury quarters and a trend relative to the comparison group after then. For the PPD and compromise groups, we also allow these relative changes that vary according to the size of the PPD rating (which is between 0 and 100).[5]

[5] We tried different specifications including more period dummies before the linear trend and allowing for both a linear and squared trend component. None appreciably improved the fit.

Finally, about 30% of workers in our sample had more than one injury during the study period (that is, by the end of 1993). The model we use also accounts for the effects of injuries subsequent to the initial one. We tested to see if including information for a third injury changed our estimates of the impact of the first injury. It did not. Also, we did not interact the second injury term with the benefit groups because our results showed that the second injury played almost no role in determining income losses from the first injury and additional interaction terms would have further complicated our estimation.

Given our model accounting for both non-injury and injury related factors, we use two methods to estimate earnings. The first generates linear regression estimates based on first differences. The second method uses a repeated-measures model that allows for first-order autocorrelation of the errors (AR(1)), allowing for correlation of each period's error term with that of the period before it. The second method generates large and significant estimates of the degree of first order autocorrelation ($\rho = 0.75$ for men and $\rho = 0.78$ for women, $P < 0.001$). Both methods have their limitations. The first-differences estimator tends to aggravate bias from measurement error, and the AR(1) estimator is biased in short panels. However, estimates of post-injury changes in earnings (results available from the authors) are very similar for both methods and, indeed, for fixed-effects estimates. This suggests that these biases on measures of the impact of injuries and illnesses are small, although it is possible that they are large and equal. The estimated impacts of workplace injuries and illnesses on earnings are displayed in Figures 5 through 8.

We also tested the null hypothesis that the average trend in pre-injury earnings is equal in the comparison group and the treatment groups, controlling for observed covariates. The null hypothesis cannot be rejected. In the first-differences specification for men, the time trend for the comparison group is \$8 per quarter less than that for other injured workers ($P > 0.31$). For women, the equivalent estimate is \$2 per quarter more ($P > 0.82$).

The value of losses

Next, we calculated losses, that is, actual earnings minus expected earnings absent injury for all people in the sample. We estimated for injured workers their expected post-injury income if they had been in the comparison group. We then added losses imputed to each individual for a 9 day injury, based on workers' preinjury average weekly wage.[6] For injuries with less than 11 days of lost time, we multiplied by the number of days lost. We use the results from our first-differences estimates. The AR(1) and first differences estimates produced very similar expected losses, and we chose this method because it eliminates the linear component of the impact of unmeasured unchanging differences (like intelligence and motivation) between people in the sample.[7]

The injury has an impact only in the quarter of the accident and in future quarters. Our estimates of losses therefore began with losses equal to zero in the preinjury quarter. Losses are calculated from our estimates for subsequent observed quarters and predicted outside the observed period.

RESULTS

Losses in the Observed Period

We calculated expected losses over the period during which average quarterly losses remain significantly different from zero. Table II shows estimates of the average present discounted value of after-tax losses for men and women during the observed period. Throughout, we express these in 1994 dollars and discounted at 3%.

Several facts are notable. First, men who received more than 12 weeks of temporary disability benefits but did not receive PPD or compromise payments have higher average

TABLE II. After-tax Average Losses During the Observed Period by Benefit Category, Workers Injured in Wisconsin, 1989–1990

	After-tax loss estimates	
	Men (dollars)	Women (dollars)
TTD benefits only		
4–7 days	263	189
8–10 days	377	252
11–14 days	567	464
2.1–3 weeks	844	478
3.1–4 weeks	1,293	819
4.1–6 weeks	1,516	1,037
6.1–8 weeks	4,632	3,409
8.1–12 weeks	6,183	5,472
12.1–16 weeks	11,067	8,654
16.1+weeks	17,434	11,365
PPD benefits	10,431	9,702
Compromise benefits	28,597	20,970
All claims except permanent total and death	4,156	3,616

Note: Does not include lost fringe benefits

[6] Because we estimated losses in comparison to workers who experienced injuries where they lost 8–10 calendar days from work, our method does not account for losses in the initial 8–10 days off work. To account for these losses, we added to the estimated losses each injured worker's average preinjury daily wage multiplied by 9 days, the average duration of temporary disability benefits in the comparison group.

[7] We use the first-differences model to generate losses after two additional preliminary step. We first remove outliers, eliminating men with a residual greater \$30,000 in quarterly earnings and women with a residual greater than \$20,000.

losses than those who received PPD payments. This also is the case for women who had more than 16 weeks of temporary disability but lacked PPD or compromise benefits. Second, overall average losses of women are almost as large as those of men, despite the fact that women's earnings average only two-thirds those of men and that women's losses are smaller than men's within every benefit group. This reflects the smaller proportion of women who have injuries and illnesses with 4 weeks of temporary disability or less (46.6% vs. 49.9% for men) and the larger proportion of women in the two groups with the greatest total losses: those with more than 16 weeks of temporary disability and those with compromise benefits (which together comprise 10.8% of women and 7.4% of men).

Projected Losses

Where average losses at the end of the observed period differ significantly from zero, we projected losses into the future. (The insignificant losses generally are positive, so projecting them would generally produce higher projected losses). To avoid substantially understating the losses, for most groups with continuing losses we projected losses 10 years past the observed period or to age 75, whichever comes first. Our projection assumes that losses continue to decline (or increase) for two years past the observed period at the same rate as we estimated for the end of the observed period; afterward, we assume that losses remain fixed until the end of the projection period.

A 10-year projection provides conservative estimates of losses for people whose average age at injury is about 37 years. Losses may continue indefinitely for many workers who, four years after their injuries, continue to experience substantial losses. However, we were uncertain about how average earnings would change after the observed period. Although we were willing to project earnings 10 years past the observed period, we were uncomfortable with longer projections. Thus, we present relatively short projections on the understanding that these probably present the lower-bound estimates of actual lifetime losses. On the other hand, earnings of workers with permanent total disability and fatal injuries and illnesses declined virtually to zero, so we were comfortable that we could project their earnings and therefore their losses 30 years past the observed period or to age 75 (whichever comes first).

Although losses at the end of the observed period are statistically significant, we did not project losses for the group with 6.1–8 weeks of temporary disability. We treated this group as a transition group between those with at most six weeks of temporary disability (for which we calculated losses only for the first two post-injury quarters because the calculated average quarterly losses after those quarters do not significantly differ form zero at $P = 0.15$) and those with longer temporary disability, PPD, or compromise benefits (for which we project losses past the observed period). Since we were uncertain about when injured workers begin to incur long-term losses, we chose to present losses for the 6.1–8 week group as losses during the observed period only. None of our findings would change qualitatively if we projected losses for this group.

In projecting losses, we also took into account the fact that employment rates of uninjured workers vary by age over the period over which we project earnings, affecting the size of projected losses relative to losses during the observed period. For example, after the age at which somebody would have retired even absent injury, their injury-related losses should be zero. Morbidity, mortality, labor-force participation rates, and unemployment rates—all affect expected earnings and vary by age.

To take this variation into account, we used the administrative data to estimate how the probability of employment (that is, a positive reported wage) in each quarter varies by age. As noted above, we assumed that workers were not employed in any quarter for which no employer reported earnings for them. We estimated separate logistic regressions for men and women (results available from the authors). To account for within-person correlations, we used the White–Huber adjustment for the standard errors. This allowed us to adjust projected losses for increasing participation (for younger people) and declining participation (for older people). For each quarter in the projection period, we multiplied projected losses by the ratio of the expected probability of employment at that age to the expected probability of employment at the end of the observed period.

Table III presents the after-tax projected losses, which add losses during the observed period and losses projected 10 years after the observed period, discounting by 3% annually. As just discussed, we did not project losses for groups with less than 8 weeks of temporary disability benefits, and we projected losses for permanent total disability and death claims for 30 years or until the age of 75, whichever is sooner. The first and third columns show the average present value of losses per injury for men and women in Wisconsin who had at least 4 days' lost time because of workplace injuries and illnesses during 1989–1990. The other two columns show total annualized after-tax losses for each of these groups. As is the case for losses calculated only during the observed period, the projected losses indicate that women, whose earnings average only two-thirds those of men, have relatively larger losses. When we project losses, women's losses per injury average almost as much as men's despite the fact that projected losses are lower in all but two benefit categories (8.1–12 weeks of temporary disability and the PPD category).[8] On average, men injured in Wisconsin with at least seven days' lost time

[8] The difference in mean losses for these groups is not statistically from zero at $P < 0.40$.

TABLE III. After-Tax Average Losses and Annualized Total Losses by Benefit Category, Workers Injured in Wisconsin, 1989–1990, 10-Year Projections (Standard Errors in Parentheses)

	Men		Women	
	Losses per injury (dollars)	Total losses (dollars)	Losses per injury (dollars)	Total losses (dollars)
TTD benefits only				
4–7 days	263 (11)	2,227,961	189 (10)	654,570
8–10 days	377 (58)	2,147,895	252 (59)	599,760
11–14 days	567 (59)	2,358,342	464 (57)	837,675
2.1–3 weeks	844 (56)	3,929,101	478 (57)	977,988
3.1–4 weeks	1,293 (81)	3,391,108	819 (74)	984,984
4.1–6 weeks	1,516 (68)	5,158,443	1,037 (67)	1,653,669
6.1–8 weeks	4,632 (573)	10,313,920	3,409 (598)	3,524,906
8.1–12 weeks	7,876 (1,772)	15,137,672	9,771 (1,780)	10,767,642
12.1–16 weeks	20,021 (2,754)	15,803,243	15,305 (2,310)	8,438,157
16.1+ weeks	25,313 (2,746)	27,405,541	16,078 (2,103)	14,491,637
PPD benefits	14,022 (1,059)	89,264,052	15,565 (1,247)	39,151,163
Compromise benefits	47,406 (2,627)	71,140,604	38,488 (2,283)	32,740,459
Permanent total and death	276,639 (20,282)	18,258,174	164,528 (49,607)	1,206,539
All claims	6,203 (212)	266,536,055	5,964 (283)	116,029,149

Note: Does not include lost fringe benefits. For groups with more than 8 weeks of TTD, PPD, or compromise benefits, losses are projected for 10 years or until age 75, whichever is sooner. Permanent total and death cases are projected 30 years or until age 75, whichever is sooner

lose about 4.8 months' earnings, while women lose about 7.2 months' earnings.

Overall, we found that less than one fifth of workers injured in Wisconsin experience more than three-quarters of the losses. These are workers with temporary disability longer than 16 weeks, PPD benefits, compromise settlements, permanent total disability, and fatal injuries and illnesses. On the other side of the coin are about 60% of injured workers with lost time lasting longer than three days but no more than four weeks. These workers incur about 8% of losses among men and 5% among women.

Although after-tax losses measure the costs to workers of workplace injuries and illnesses, pretax losses are a better measure of the social costs related to lost earnings. Pretax losses are about 40% higher than the after-tax losses, and have a similar distribution among benefit groups (Table IV).[9] We estimated that pretax losses of men and women total $532,363,276.

We did a sensitivity analysis, changing the discount rate and the projection period. Changing the discount rate to 2 or 4% changed a group's average after-tax projected losses by at most 6%. Extending the projection to 30 years past the observed period increases overall projected pretax losses by 26% and projected losses per injury by $1,931 for men and $2,943 for women, or 22 and 37%, respectively (Table V).

[9] Of course, after-tax losses do not measure the full costs of injuries for several other reasons. They exclude medical costs, nonpecuniary costs, lost fringe benefits, and employer/insurer legal and administrative costs. We also have not calculated losses related to injuries lasting a week or less.

TABLE IV. Pretax Average Losses and Annualized Total Losses by Benefit Category, Workers Injured in Wisconsin, 1989–1990, 10-Year Projections (Standard Errors in Parentheses)

	Men		Women	
	Losses per injury (dollars)	Total losses (dollars)	Losses per injury (dollars)	Total losses (dollars)
TTD benefits only				
4–7 days	366 (12)	3,100,508	264 (11)	914,320
8–10 days	621 (82)	3,538,044	426 (85)	1,013,880
11–14 days	908 (83)	3,776,675	715 (82)	1,290,813
2.1–3 weeks	1,288 (79)	5,996,069	729 (78)	1,491,534
3.1–4 weeks	1,928 (116)	5,056,501	1,215 (106)	1,461,240
4.1–6 weeks	2,302 (98)	7,832,939	1,561 (99)	2,489,275
6.1–8 weeks	7,683 (819)	17,107,480	5,185 (867)	5,361,290
8.1–12 weeks	12,016 (2,339)	23,094,752	13,353 (2,291)	14,715,006
12.1–16 weeks	27,585 (3,587)	21,773,760	20,166 (2,999)	11,118,188
16.1+weeks	34,653 (3,529)	37,517,648	21,801 (2,717)	19,649,968
PPD benefits	20,328 (1,397)	129,408,048	21,179 (1,646)	53,272,245
Compromise benefits	62,908 (3,384)	94,403,939	49,659 (2,930)	42,243,256
Permanent total and death	351,500 (25,771)	23,199,000	209,577 (55,219)	1,536,898
All claims	8,747 (299)	375,805,363	8,048 (368)	156,557,913

Note: Does not include lost fringe benefits. For groups with more than 8 weeks of TTD, PPD, or compromise benefits, losses are projected for 10 years or until age 75, whichever is sooner. Permanent total and death cases are projected 30 years or until age 75, whichever is sooner.

Workers' Compensation Replacement of Losses

We measured the replacement of lost earnings as the ratio of workers' compensation benefits net of attorney fees to after-tax losses.[10] We compared benefits to after-tax losses because workers' compensation benefits are exempt from state and federal income taxes. Thus, after-tax losses minus workers' compensation benefits measure net lost earnings. Ideally, we should include in losses the value of lost fringe benefits. Practically, we lack a good measure of lost fringe benefits so we do not include them, thus understating losses and overstating replacement rates. We do not measure the replacement rate for permanent total disability and death claims, because these often are paid out over an extended period, so our measures of benefits could be substantially understated.

Overall, excluding the permanent total disability and death claims, our estimates indicate that Wisconsin replaces 89% of after-tax earnings lost during the observed period for injured men and 84% for women. Using projected after-tax losses, we find replacement rates of 64% for men and 50% for women. As we show in Table VI, these averages conceal some striking differences among groups of workers categorized by their benefit status. This table shows that workers' compensation in Wisconsin provides substantial income replacement for workers with less than six weeks of temporary disability benefits and replaces about half of the

[10] Attorney fees average about 10% of compromise settlements, but less than 1% of income benefits in other categories.

TABLE V. Pretax Average Losses and Annualized Total Losses by Benefit Category, Workers Injured in Wisconsin, 1989–1990, 30-Year Projections (Standard Errors in Parentheses)

	Men		Women	
	Losses per injury (dollars)	Total losses (dollars)	Losses per injury (dollars)	Total losses (dollars)
TTD benefits only				
4–7 days	366 (12)	3,100,508	264 (11)	914,320
8–10 days	621 (82)	3,538,044	426 (85)	1,013,880
11–14 days	908 (83)	3,776,675	715 (82)	1,290,813
2.1–3 weeks	1,288 (79)	5,996,069	729 (78)	1,491,534
3.1–4 weeks	1,928 (116)	5,056,501	1,215 (106)	1,461,240
4.1–6 weeks	2.302 (98)	7,832,939	1,561 (99)	2,489,275
6.1–8 weeks	7,683 (819)	17,107,480	5,185 (867)	5,361,290
8.1–12 weeks	13,584 (3874)	26,108448	19,844 (3986)	21,868,088
12.1–16 weeks	39,214 (5905)	30,952,917	28,681 (5048)	15,812,791
16.1+weeks	44,531 (5740)	48,212,229	29,528 (4,818)	26,614,571
PPD benefits	24,450 (2315)	155,648,700	28,788 (2,790)	72,411,416
Compromise benefits	84,865 (5440)	127,354,077	72,365 (4,924)	61,558,493
Permanent total and death	351,500 (25,771)	23,199,000	209,577 (55,219)	1,536,898
All claims	10,658 (669)	457,883,587	10,991 (578)	213,824,609

Note: Does not include lost fringe benefits. For groups with more than 8 weeks of TTD, PPD, or compromise benefits, as well as permanent total and death cases, losses are projected for 30 years or until age 75, whichever is sooner.

after-tax losses for those with PPD and compromise payments. The PPD and compromise cases have substantial continuing losses, and payments in these cases cover between 54 and 83% of projected losses.

By contrast, injured workers with more than eight weeks of temporary total disability who do not collect PPD or compromise payments receive benefits that are a smaller proportion of their losses. For them, benefits replace between 37 and 56% of losses during the observed period and between 19 and 37% of projected losses.

Finally, we should note that the replacement rates we present do not measure the full replacement of lost earnings, as workers may receive other benefits, like social security disability benefits, payments from private and state disability systems, and welfare benefits. On the other hand, a payment in lieu of future medical benefits may be included in compromise benefits, so that our calculated replacement rate may be overstated for this group.

DISCUSSION AND CONCLUSIONS

In this study, we have estimated lost earnings and compared them with benefits for workers injured in Wisconsin in 1989 and 1990. Our estimates are conservative for several reasons. First, several studies suggested that a substantial number of workers with occupational injuries and illnesses never enter the workers' compensation system [Biddle et al., 1998; Morse et al., 1998]. We do not know the

TABLE VI. Average Replacement of Losses by Benefit Category, Workers Injured in Wisconsin, 1989–1990

	Benefits as a percent of			
	After-tax losses in the observed period		After-tax losses projected 10 years	
	Men (%)	Women (%)	Men (%)	Women (%)
TTD benefits only				
4–7 days	44	48	43	48
8–10 days	102	106	102	106
11–14 days	94	79	94	79
2.1–3 weeks	89	108	89	108
3.1–4 weeks	82	89	82	89
4.1–6 weeks	99	97	99	97
6.1–8 weeks	45	42	45	42
8.1–12 weeks	52	40	37	20
12.1–16 weeks	40	37	20	19
16.1+ weeks	56	54	35	34
PPD benefits	124	113	83	63
Compromise benefits	116	87	63	54
All claims	89	84	64	50

Note: Loss estimates do not include lost fringe benefits, and benefits are net of attorney fees. Average losses used to calculate percentages in this table come from Tables III and IV.

magnitude of the undercount for all injuries and illnesses, but, for example, the National Traumatic Occupational Fatality System [National Institute for Occupational Safety and Health, 1993] provides estimates for fatal injuries in 1989 and 1990. That source identifies 203 fatal occupational injuries that occurred in Wisconsin in 1989 and 1990. Workers' compensation data for the same period identify only 115 claims involving death benefits—an undercount of 43%. If compensated and uncompensated deaths involved the same losses, taking into account this discrepancy alone would add about 3% to the estimated losses. Second, for most groups, we projected long-term losses only 10 years past the observed period. Projecting losses 30 years ahead would increase the overall estimated losses by 17% for men and 28% for women. Finally, our estimates exclude other injury costs, like medical costs, nonpecuniary costs, lost fringe benefits, employer/insurer legal and administrative costs, and other employer costs attributable to workplace injuries and illnesses. Third, we assumed that losses of workers with TTD benefits lasting less than 11 days do not extend past the period of TTD benefit payment. Fourth, we assumed that the very large number of workers who receive workers' compensation medical benefits but not TTD benefits had no lost earnings. We did not know whether losses from these injuries are substantial, and we certainly could not rule out this possibility.

Using conservative estimates, we have shown that workplace injuries and illnesses often lead to substantial lost earnings. For men in Wisconsin who lost at least 4 days' work during 1989 or 1990, the projected after-tax lost earnings average $6,203. For women, the projected losses average $5,964 (Table III). Pretax losses are $8,747 and $8,048, respectively (Table IV). Within these overall averages, the groups with temporary disability longer than eight weeks, the PPD group, and the compromise group have the largest average losses.

Our data show that a substantial number of people in the longer temporary disability groups suffer losses that continue well after their benefits have ceased. These losses may have been incurred because of labor-market effects that persist after recovery from injury. For example, workers who stay off work for several months may lose their preinjury jobs and their investments in skill and seniority at those jobs. Earnings and employment after return could be affected, even if they fully recover from the effects of the injury. Such impacts have been noted in our 1996 study of return to work in Wisconsin [Galizzi and Boden, 1996]. This study, which accounts for the endogeneity of injury severity, finds that workers with longer durations off work experience higher rates of unemployment after they return to work.

Another possibility is that workers with longer-term disabilities may have weaker labor-market attachment.

However, our model attempts to take this into account by controlling for the frequency of preinjury job changes and instability of earnings. Finally, some of the long-term losses may be attributable to employers' unwillingness to hire people with the stigma of past workers' compensation injuries and illnesses. Employers may believe that long spells of work absence mark someone as unreliable or otherwise unacceptable for employment, thus limiting employment opportunities and reducing future earnings for this group.

We also have measured the replacement of lost earnings by workers' compensation income benefits. Overall, Wisconsin replaces 64% of after-tax projected losses of injured men and 50% of losses incurred by women. The pretax percentages are 47 and 38%, respectively. The average pretax replacement rate for PPD and compromise claims is 53%, lower than the 81% replacement (85% for uncontested PPD claims and 58% for contested PPD claims) reported by Berkowitz and Burton [1987] in their study of workers who received these types of benefits and were injured in Wisconsin in 1968. Probably the main reason for this is that we projected losses and they did not. Our estimated pretax replacement rate for PPD and compromise claims, considering losses only during the 4 observed years after injury, is 83%. Their estimate covered two more years of losses than did ours. Still, the replacement rates are remarkably similar, considering that the injuries occurred over 20 years apart.

To calculate lost earnings, Leigh et al. [1987] assumed replacement of 50% of pretax earnings for permanent partial disabilities and 60% for temporary disabilities; our estimated average pretax replacement is 53 and 29% respectively. Applying their assumptions to our data would lead to estimates of losses that are 15% lower than our estimates. While replacement rates based on losses estimated at the individual level may differ for other states [Reville, 1999], our estimates of overall losses are not very different from those of Leigh and his coauthors.

To conclude, we found that work-related injuries and illnesses can have lasting effects on the earnings of workers and that these losses can be substantial. For injuries occurring in Wisconsin in 1989 or 1990, our conservative estimate of annual pretax losses totalled $532,363,276. We also found that, compared with men, injured women suffer larger effects on their earnings than we would expect given the gender disparity in preinjury earnings.

These results leave us with important unresolved questions: Why do we find such high losses for groups of injured workers who do not receive PPD benefits? Why do women have higher proportionate losses than do men? To what extent are we observing injury-related losses that are caused by the disabling effect of the injury? To what extent are these losses caused by labor-market impacts of time lost from work, injury-related job loss, or stigma attached to workers with long-term injuries and illnesses? What is the magnitude of losses related to unreported injuries and illnesses and to injuries without workers' compensation income benefit payments? Answers to these questions await further study.

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REFERENCES

Berkowitz M, Burton JF Jr. 1987. Permanent disability benefits in workers' compensation. Kalamazoo: W.E. Upjohn Institute for Employment Research.

Biddle J, Roberts K, Rosenman DD, Welch EM. 1998. What percentage of workers with work-related illnesses receive workers' compensation benefits? J Occup Environ Med 40(4):325–331.

Bureau of Labor Statistics, U.S. Department of Labor. 1997. Workplace injuries and illnesses in 1996. USDL 97-453. Washington, DC: US Department of Labor.

Burton JF Jr, Schmidle TP. 1994. Permanent disability benefits data: frequency and cost trends. John Burton's Workers' Compensation Monitor. 7(2):1–21,24.

Cheit E. 1961. Injury and recovery in the course of employment. New York: John Wiley & Sons.

Galizzi M, Boden LI. 1996. What are the most important factors shaping return to work? Evidence from Wisconsin. WC-96-6. Cambridge, MA: Workers Compensation Research Institute.

Ginnold R. 1979. A followup study of permanent disability cases under Wisconsin workers' compensation. In: Research report of the Interdepartmental Workers' Compensation Task Force, Volume 6. Washington, DC: US Government Printing Office.

Jacobson LS, LaLonde RJ, Sullivan DG. 1993. Earnings losses of displaced workers. Amer Econ Rev 83:685–709.

Johnson WG, Cullinan PR, Curington WP. 1978. The adequacy of workers' compensation benefits. In: Research report of the Interdepartmental Workers' Compensation Task Force 6:95–121.

Leigh JP, Markowitz SB, Fahs M, Shin C, Landrigan PJ. 1997. Occupational injury and illness in the United States: Estimates of costs, morbidity, and mortality. Arch Intern Med 157:1557–1568.

Morse T, Dillon C, Warren N, Levenstein C, Warren A. 1998. The economic and social consequences of work-related musculoskeletal disorders: The Connecticut Upper-Extremity Surveillance Project (CUSP). Int J Occup Env Health 4:209–216.

National Institute for Occupational Safety and Health. 1993. Fatal injuries to workers in the US, 1980–1989: A decade of surveillance. Cincinnati: NIOSH.

National Institute for Occupational Safety and Health. 1996. National Occupational Research Agenda. Cincinnati: NIOSH.

Reville RT. 1999. The impact of a disabling workplace injury on earnings and labor force participation. In: Lane J, editor. The creation and analysis of linked employer–employee data, contributions to economic analysis. New York: Elsevier Science, North-Holland. In press.

Rubin D. 1974. Estimating causal effects of treatments in randomized and non-randomized studies. J Educ Psych 66(1):688–701.

Rubin D. 1992. Multiple imputations for nonresponse in surveys. New York: John Wiley.

Ruhm C. 1991. Are workers permanently scarred by job displacement? Amer Econ Rev 81(1):319–324.

Stevens AH. 1997. Persistent effects of job displacement: The importance of multiple job losses. J Labor Econ 15(1):165–188.

White H. 1980. A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. Econometrica 48: 817–830.

DEPARTMENT OF HEALTH AND HUMAN SERVICES

Public Health Service
Centers for Disease Control
and Prevention (CDC)

Memorandum

Date: May 31, 2001

From: Roy M. Fleming, Sc.D., Director, Research Grants Program RMF
Office of Extramural Programs, NIOSH, D30

Subject: Final Report Submitted for Entry into NTIS for Grant 5 R01 CC112141-03.

To: William D. Bennett
Data Systems Team, Information Resources Branch, EID, NIOSH, P03/C18

The attached final report has been received from the principal investigator on the subject NIOSH grant. If this document is forwarded to the National Technical Information Service, please let us know when a document number is known so that we can inform anyone who inquires about this final report.

Any publications that are included with this report are highlighted on the list below.

Attachment
cc: Sherri Diana, EID, P03/C13

List of Publications None

Title: Impact of Workplace Injuries: Human and Economic Costs
Investigator: Leslie Boden, Ph.D.
Affiliation: Boston University
City & State: Boston, MA
Telephone: (617) 638-4620
Award Number: 5 R01 CC112141-03
Start & End Date: 9/30/1995–9/29/1999
Total Project Cost: $679,889
Program Area: Social and Economic Consequences of Occupational Injury & Disease
Key Words:

Abstract:
This study measures lost earnings by comparing the earnings of all other injured workers with a comparison group, controlling for differences that could account for different earnings. The comparison group consists of workers who lost 7-9 days from work and then returned to their jobs. We studied lost-time injuries reported to workers' compensation systems in Wisconsin and Florida. The method is a linear-regression version of a difference-in-differences approach. The analyzed data are for 54,309 cases in Wisconsin and 71,189 cases in Florida. Workers' compensation administrative databases supplied injury and personal characteristics. To obtain earnings and employer characteristics, we matched the workers' compensation data with data collected by state unemployment insurance and labor market information agencies.

We also conducted two ethnographic interviews of workers with back injuries, including (a) 198 workers from Wisconsin stratified by gender and age (20-29, 30-54, 55 and older), and (b) 216 workers from a Florida telephone survey stratified by gender, age, and racial and/or ethnic background (Black non-Hispanic, White non-Hispanic, and Hispanic). Interviews conducted about six years after injury explored the workers' beliefs and attitudes about themselves as workers including their pre and post injury relationship to employment, their experience of the work injury, encounters with the medical and legal systems, and the effects of the injury on self-image and family relationships.

In Wisconsin, injuries involving permanent disability payments or temporary of more than one week caused about $530 million in lost earnings, with average lost earnings per injury of about $10,000. In Florida, lost earnings for the same group were over $1.4 billion, and average losses were about twice Wisconsin's.

A large proportion of injured workers suffer losses that continue at least four years into the future, and perhaps over their entire working lives. This includes workers classified as having permanent disabilities, but also many who are classified by workers' compensation as having "temporary disabilities." Workers with 10 to 14 days of temporary disability benefits suffer small and short-term losses. However, in both Wisconsin and Florida, groups with permanent partial disability (PPD) benefits or receiving temporary disability benefits for more than 8 weeks (but no PPD benefits) appear to suffer substantial losses even 4 years post-injury. In Wisconsin, over 30

percent of workers with more than one week of lost time are in groups that suffer significant long-term lost earnings. In Florida, over 45 percent of workers fall into these groups.

In both Wisconsin and Florida, women appear to lose a greater proportion of their earnings than men. Overall, despite the fact that men's earnings are about 50 percent higher than women's, average losses of men compared with women are only 9 percent and 13 percent higher in Wisconsin and Florida, respectively. This raises a question about whether employers discriminate against women who were injured at work.

Our research shows that, overall, Wisconsin workers' compensation income benefits average 47 percent of projected pre-tax lost earnings of injured men and 38 percent of projected losses incurred by women. These averages conceal striking differences among groups of workers categorized by their benefit status. Among people who received temporary disability benefits for more than 6 weeks but did not receive PPD or compromise payments, income benefits averaged only from 14 to 28 percent of pre-tax losses. For PPD and compromise cases, income benefits averaged between 43 and 57 percent of projected pretax losses. Florida shows a different relationship between workers' compensation benefits and losses. Overall, despite average losses that are much higher than in Wisconsin, Florida's workers' compensation system replaces a higher proportion of those losses. In Florida as in Wisconsin, workers with only long temporary total disability (TTD) had the lowest replacement rates.

Those who want to return to the pre-injury employer face an array of employer responses, ranging from "welcome back" to "stay away." The "welcome back" path provided workers with a sense of being valued by their pre-injury employers. This positive affect remained, even for those who were unable to continue working because of limitations imposed by their injuries. Other paths of re-entry caused workers to feel undervalued, as discarded or damaged goods, and generated hostility and resentment. In this study, female workers in all groups were less likely than males to have their injury-related needs met in the workplace and to be currently working. White males were more likely than other groups to be employed in skilled jobs and were also the most likely to remain in their pre-injury jobs over time.

In Florida, workers from different racial and/or ethnic groups appear to experience different return-to-work conditions following an injury. The data also suggest that Black and Hispanic workers may be more likely than White workers to be employed in occupations in which they are less likely to be able to either return to their original job or to other employment. This could be the result of many factors, including more strenuous employment, lower education levels, more severe injuries, and employment discrimination. Still, some Black, Hispanic, and female workers describe perceived discriminatory behavior by their pre-injury employers.

Although not specifically asked about racial or ethnic discriminatory practices experienced at work either before or after the injury, when workers were asked how they were treated compared to other workers who had been injured on the job, a number of

Black and Hispanic workers in Florida responded that they believed they were treated differently because of their race or ethnic background. Although female workers were not asked about gender issues and experiences at work before or after the injury, a number of females in Florida believed that they were treated differently because of their gender. White, Black and Hispanic females talked about issues of gender discrimination.

When asked how they see themselves or feel about themselves, White, Black and Hispanic males and females in Florida discussed the injury as a threat to their sense of self. For males this was expressed in terms of a threat to their sense of masculinity and for females it was expressed in terms of a threat to their sense of self-worth. When asked how they felt emotionally after the injury many workers talked about feeling depressed, angry, afraid, and many talked about using medications to overcome these feelings. Interviewees also talked about the effect of the back injury on relations with their spouse and partner, in particular the effect on their sex life.

Among workers with back injuries in Wisconsin, about 80 percent of men and 40 percent of women reported problems doing outdoor chores such as mowing the lawn, shoveling snow, and yard work. Two thirds of men and women reported some difficulty performing other household chores including cleaning, shopping, taking out the garbage, vacuuming, and carrying laundry. Approximately three quarters of the men and half the women could not engage in vigorous recreational activities. Twenty percent reported difficulty in having sex, and approximately one-third could not lift their children or play with them. A majority of White, Black and Hispanic males and females in Florida reported that their back injury had negative effects on their sex life.

The use of pain medications, both prescription and over-the-counter pain medications and anti-inflammatory medications was widely reported among injured workers in Florida, with approximately half of all those who were prescribed pain medication after the injury continuing to use some form of pain medication on a regular basis. More Black and Hispanic than White males and females initially used and currently use pain medications.

The findings provide a new knowledge base on economic losses from injuries, how workers conceive of their injury and how social norms, personal beliefs, and the illness environment influence their behavior. This information is important for advancing research knowledge about occupational injuries and illnesses.

Publications

No publications to date.