CPWR TECHNICAL REPORT

Construction Injury Surveillance In Illinois

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Key Findings

- There were 4,058 First Reports of Injury filed in 2005, and 19,734 Claims filed between 2000 and 2005 with the Illinois Workers Compensation Commission for construction injuries. “Claims filed” only pertains to compensation not settled between the worker and employer, which is sent to arbitration for a decision.

- The majority of injuries were for males between 25 and 54 years of age; sprains/strains, open wounds and fractures were the most common injuries, and overexertion, falls and struck by the most common causes.

- The cumulative cost of claims for construction injuries from 2000-2005 was $580,405,416. The mean cost of a claim was $35,834; the median level of financial compensation of decided claims (N=15,898), which excluded claims in progress and dismissed claims, was $16,705.

- Workers filing a claim with attorney representation received $1,210 higher compensation than those representing themselves when controlling for other covariates. This finding contrasts significantly with previous models published in the literature.

- The system for submitting First Reports in Illinois must be changed to make this a useful source for occupational injury and illness surveillance.

- To be useful for occupational surveillance, Claims data would need to require NAICS/SIC codes.

- Extensive paper Claims files are kept and could be useful for more detailed research than is possible using the database alone.

- Legal fees don’t drive the high costs of paying workers’ compensation claims. It’s the severity of the injury and the assessed level of impairment that have the most effect on the payout to the worker.

Abstract

Construction is one of the most hazardous economic sectors in the U.S. Although the federal government collects data on occupational injuries, there is growing evidence that the Bureau of Labor Statistics substantially underreports injuries and illnesses. There is a need for alternative data sources to help provide a better picture of the pre-event and event factors, as well as the magnitude and trend of injuries in the construction industry. We conducted a study of workers compensation data to determine the magnitude and nature of injuries among construction workers in the State of Illinois. The specific aims were to: 1) establish a dataset of construction injuries that were reported to the Illinois Workers Compensation Commission in 2005 via First Reports of Injury; 2) establish a dataset of construction injuries between 2000-2005 from the IWCC "Claims" database; 3) assess the quality of IWCC datasets; 4) increase knowledge about occupational construction injuries in Illinois. For 2005, we found 4058 First Reports; approximately 40% were submitted on paper. We found that many did not need to be filed and there was much missing data. The majority of First Reports were for males between 25 and 54 years of age, with sprains/strains, open wounds and fractures the most common injuries. There were 19,734 Claims between 2000 and 2005. The cumulative cost of Claims was $580,405,416. The cost of compensation for construction injuries represented approximately 4.5% of the total payments for workers compensation Claims, whereas construction injuries represented 5.0% of all Claims during the same period. The mean cost of a construction Claim was $35,834. In a robust regression model, we found that Claims involving legal counsel retained by the worker cost approximately $1200 in increased payment to the worker; this is in contrast to other studies that used lost time as a proxy of severity. The system for submitting First Reports needs to be changed in Illinois in order to make it a good source of occupational injury surveillance. Claims data should have SIC (NAICS) codes entered for each case. Construction claims made up 5% of total claims, but only 4.5% of the total workers compensation payments. More complex regression models for research using workers compensation data are necessary in order to fully exploit the value of workers compensation data for surveillance.

Background

The construction industry has continuously been one of the most hazardous industries in the U.S. Each year several hundred thousand construction workers become ill or are injured as a result of on-the-job hazards. The estimated rates for injuries, illnesses and fatalities among construction workers are consistently among the highest of any economic sector (NIOSH, 2004). In 2007, the most recent year of reported national data, the estimated incidence rate for recordable injuries and illnesses among construction workers was the second highest, only slightly lower than the manufacturing industry (BLS, 2007).

Although the federal government collects data on occupational injuries, there is growing evidence that the Bureau of Labor Statistics data substantially underreports injuries and illnesses primarily as a result of reporting inconsistencies by employers and changes to OSHA's recordkeeping standard (Rosenman, 2006; Friedman, 2007; CPWR, 2002); this problem limits the value of BLS data in describing injuries in the Construction sector. Also, there is a dearth of data on the workplaces, working conditions, and mechanisms that lead to injuries in construction. There is a need for alternative data sources to help provide a better picture of the pre-event and event factors, as well as the magnitude and trend of injuries in the construction industry.

State-based data repositories can be used to fill in the gaps left by Federal surveillance programs. Currently, BLS data is the primary source of occupational surveillance data for Illinois. However, there are several alternative surveillance resources that can be used to help better describe construction injuries in the State. These include the Illinois Workers Compensation Commission (IWCC) First Reports of Injury and Claims data, and the Illinois Trauma Registry (ITR). These databases have been underutilized for occupational surveillance. A pilot study is needed to evaluate these alternative sources of surveillance data for construction injuries and to determine methods for linking them.

During the past year, we conducted a study to better understand the magnitude and nature of injuries among construction workers in the State of Illinois. The work was based on workers compensation data for the years 2000-2005. Two datasets were used in this analysis: (1) a database of electronic filings of First Reports of Injury and (2) a database of administratively active and inactive benefit Claims. The workers compensation data files provide unique information on a broad spectrum of injuries, including minor injuries; these include data on exposure circumstances, as well as detailed data on disability and level of medical and financial compensation. The specific aims of this small study were to:

1. Establish a dataset of construction injuries that have been reported to the Illinois Workers Compensation Commission via First Reports of Injury
2. Establish a dataset of construction injuries from the IWCC "Claims" database (both administratively active and inactive files).
3. Assess the quality of IWCC datasets.
4. Increase knowledge about occupational construction injuries in Illinois by describing cause of injury, types of injuries, injury severity, work location at the time of injury, employer data, level of disability, and level of financial compensation.
5. Establish a statistical linkage key to facilitate linkage between the IWCC datasets and the ITR.

We completed this work on March 31, 2009. Our methods and findings are presented below.

Aim#1. Illinois Workers Compensation Commission (IWCC) Data—First Reports of Injury

The Illinois Workers Compensation Commission accepts the Employer's First Report of Injury (IL Form 45) in both hard copy (55%) and electronic formats (45%). Hard copy reports are not entered into a database. The variables in Form 45 that are available for this project include: 1)*lost work day?, 2) doing business as, 3) nature of business or service,4) SIC Code, 5) name of WC carrier, 6) self-insured?,7) gender, 8) marital status, 9) #dependents, average weekly wage,10) job title or occupation, 11) date hired, 12) date and time of accident, 13) time employee began work, 14) last day employee worked, 15)*

death?, 16) on employer's premises?, 17) what employee was doing, 18) how did it occur,19) what was the injury or illness, 20) what body part, 21) what object or substance harmed employee, 22) treating health care professional, 23) employee treated in ER, 24) employee hospitalized overnight.

The Illinois Workers Compensation Commission (IWCC) receives approximately 100,000 First Reports of Injury (Illinois Form 45) each year. An employer is obligated to report an injury if it resulted in three or more lost workdays. Forty five percent of the forms are transmitted electronically, and the remainder are mailed in as single pieces of paper. The paper forms are copied for use in administrative matters only in contested cases, and then filed in boxes; the paper-report data is not extracted and is, therefore, not readily available for surveillance. The Co-PIs (Forst and Friedman) and UIC have recently signed an agreement with the Illinois Workers Compensation Commission to receive all of the First Reports of Injury (Form 45) from the year 2000-2011. Currently, UIC has received and stored all the First Reports of Injury through 2008.

For the analysis of the First Reports of Injury, we identified construction worker injuries in the year 2005 through two methods, (1) for the First Reports filed by paper we hired several graduate students to go through every paper First Report of Injury to look for company names and/or SIC codes that indicated a construction company, (2) for the First Reports filed electronically we filtered the data by industrial classification coded "construction". The number of paper based First Reports identified manually was 1,339 and the number identified electronically was 2,719. The data analysis of the First Reports may be found in Appendix A of this document.

The First Reports of injury suffer from several major limitations. First, most employers filed First Reports of injury incorrectly. Although, the law stipulates that only injuries resulting in three or more days away from work are to be reported, the majority of First Reports of Injury involve minor injuries that do not result in any lost work time. Second, the reporting forms we encountered were not uniform. Employers have the option to report online or by mailing in a paper form. Those that use the paper form submit a variety of different forms from insurance agencies and older First Reports of Injury forms, rather than the most updated form that is disseminated by the IWCC. Third, it is highly likely that the First Reports of Injury are not filed for every injury resulting in three or more lost work days. There is no clear data to help us determine the level of underreporting. Although First Reports of Injury do include narratives on the cause of injury, in most cases the employer does not provide enough detail or simply omits the information. We have provided recommendations to IWCC as to how to improve the First Reports of Injury data system that include mandating web-based reporting that forces completion of every field. Finally, Race/ethnicity variables are not collected in this database, and therefore it is impossible to determine injury characteristics for Hispanic workers. Analysis of the First Reports can be found in Appendix A of this document.

Aim #2. Illinois Workers Compensation Commission Claims Data

There are approximately 70,000 Claims filed with IWCC for financial compensation each year. The Claims are filed when the employee and employer are unable to resolve compensation for an injury. Workers compensation Claims are initially heard by an arbitrator. The arbitrator's decision can subsequently be appealed before a panel of three commissioners. At any point, the injured worker and employer can settle the claim independently of the Workers Compensation system.

We obtained a dataset of all Claims in the Illinois Workers Compensation Commission, which included information on both active and closed Claims. The dataset contained an array of information including employer information, employee characteristics, body part affected, percent of functional lost (impairment), and compensation for costs associated with the injury including medical fees, lost wages, attorney costs and death and dependent benefits. For this study we include only Claims filed between January 1, 2000 and December 31, 2005. However, the data for filed Claims included cumulative compensation costs paid through 2007, and these costs include decisions made in follow-up appeals or settlements. Compensation costs were not adjusted for inflation. The minimum age in this study group was 16 years. Illinois law prohibits persons under the age of 16 to work in construction.

The IWCC Claims data did not contain information about industrial classification (SIC codes, NAICS codes or descriptive data); however, it did have company names. Therefore, we purchased a list of all construction companies in Illinois that have operated in the State since 2000 from Manufacturers News, a corporation that publishes state manufacturers directories and databases, dating back to 1912 (Manufacturers' News, 2009). We modified the list to allow for different variations in the spelling of company names (abbreviations, shortened names, acronyms), and we filtered the Claims data using this list. Because of the possibility that the list we purchased was incomplete, we analyzed the list of company names using a text analyzer looking for patterns in word usage. The analyzer produced a list of most frequently used words in the names of construction companies (e.g., 'construction', 'contractors', 'paving', and 'roofing'). We then filtered the Claims file again using the high frequency words to produce a second list. We merged the two lists of potential construction industry Claims. The final merged list was then manually reviewed to identify non-construction companies and remove them. The original list contained over 50,000 Claims of potential construction workers for the six-year period, but was reduced to 19,734 after cleaning.

Our assessment of the Claims dataset is that it represents a clearly defined and useful "universe" of Claims handled through the Illinois Workers' Compensation Commission. The current Claims data system could be enhanced by adding SIC codes and improving the coding of injuries. Race/ethnicity are not collected in this database, and therefore it is impossible to determine injury characteristics for Hispanic workers. In the current dataset, more than half of the Claims filed did not have adequate injury information. However, overall the Claims dataset is a useful tool for occupational injury surveillance in Illinois, in particular as a tool to help quantify the cost associated with a workplace injury or illness (see Data Analysis section, below).

Aim #3. Data Quality

We evaluated the quality of the IWCC data by checking the proportion of missing data for key variables and the internal consistency across common variables. The proportion of missing data for key variables was as follows: date of birth (N=196, 1.0%), filing date (N=0, 0%), date of accident (N=29, 0.1%), gender (N=18, 0.1%), and city of residence (N=411, 2.1%). The internal consistency check showed that the data was highly consistent across similar variables. For example, when comparing nature of injury and body part affected (e.g. hearing loss and ears), the internal consistency ranged between 97% and 100%.

Aim #4. Data Analysis

We used SAS software for all statistical analyses (v.9.1; Cary, NC). Frequencies of occupational injuries, overall, and distributions by age, gender, weekly salary and industry were determined. We also described type of injuries and disparities between groups in terms of external cause of injury, body part affected, and type of injury. Appropriate parametric (Pearson's chi-square) and non-parametric tests (Wilcoxon Rank Sum) were used to evaluate bivariate relationships. For all statistical tests, a two-sided p-value less than 0.05 was considered statistically significant.

To calculate rates, we used data regarding employment in the construction sector from the Current Employment Statistics (CES) survey (USBLS, 2009). The CES surveys approximately 150,000 private and public sector employers per month, however it does not include farm payrolls. The survey focuses on estimating the number of employed, hours worked and earnings. The data is abstracted from employer payroll records. The CES survey counts full time, part time, temporary, and intermittent employees, in addition, the survey counts employees on sick leave, vacation or on strike / work slow down. Final rates did not include workers who reported their place of residence to be outside Illinois. The rate of Claims per 100 construction employees was calculated and the 95% confidence intervals were estimated using Fisher's exact method.

For the multivariable regression analysis, we used robust M-estimation as implemented in SAS Version 9 (PROC ROBUSTREG; SAS Institute, Inc., Cary, NC) using bisquare weights. The parameter estimates derived from robust regression are less influenced by outliers. This is generally achieved by weighting observations whose residuals are large.

The principal findings from the analysis of the Claims data is as follows: The cumulative cost of Claims between 2000 and 2005 for injured construction workers in Illinois was $580,405,416. The cost of compensation for construction injuries represented approximately 4.5% of the total payments for workers compensation Claims made in Illinois between 2000 and 2005, whereas construction injuries represented 5.0% of all Claims during the same period. In this study, the mean cost of a construction Claim was $35,834 compared to a mean cost of $10,084 for construction injuries in Oregon (Horowitz, 2004).

In the literature there have been studies showing that use of attorneys by injured workers is associated with higher compensation costs (Bernacki, 2007; Bernacki, 2008). These studies have explained the higher costs associated with attorneys in that they delay the process and incur higher processing fees. These arguments focus solely on the legal counsel retained by the worker, however, nearly all the employers and insurers use attorneys. These studies controlled for lost time as a proxy of severity. In addition, these studies used logistic models so that they were unable to directly quantify the cost of using attorneys by an injured worker. In our analysis, before we added percent disability into the multivariable model during the stepwise model selection process, Claims involving legal counsel retained by the worker resulted in $10,032 higher costs. Once controlling for percent disability, the increased cost of retaining legal counsel by the claimant was a little over $1200. This illustrates how spurious conclusions can be drawn when a model does not adequately control for important covariates. In fact, only a small fraction of the variance of cost (0.3%) was explained by the use of attorneys by the claimant. It appears that the most important determinant of cost of compensation is not the attorney, but the severity of injury and the impairment rating (or the medical professional who defines the impairment that determines the scheduled payout).

We found no other published study that quantifies the cost of compensation using an appropriate regression model for skewed data. The model used in this study clearly indicates that percent disability is the most important determinant of cost, though the method and uniformity of percent impairment allocation could be better elucidated. Retention of legal counsel by the worker is associated with a modest increase in cost when controlling for important covariates. There is a need to integrate analytical methods that are suitable for skewed data when analyzing claim costs. Both robust regression and nonparametric tests should be further used in this field. The field of econometrics has developed a wide array of analytical tools that address heavy right-tailed data similar to claim costs. Further research is needed that evaluates the determinants of compensation costs for other industries, in order to determine whether the predictors identified in this study are relevant to other economic sectors. We have drafted a paper for publication, included as Appendix B to this document.

Aim #5. Statistical Linkage Key

In the last month, we have signed a contract with the Illinois Department of Public Health to obtain the Illinois Trauma Registry, the EMS Prehospital (ambulance run) Database, and Hospital Discharge data. Under this agreement, we will receive complete datasets, including identifiers. Prior to submitting the proposal for this Small Grant, we had an agreement with the Illinois Workers Compensation Commission that gives us access to identifiers. We no longer have a need to establish a statistical linkage key because we can now conduct deterministic linkage (match on identifiers, such as name, date of birth, date of injury) across the two workers compensation and three public health databases. There are variables in the public health database that may, surprisingly, make it easier to identify construction related injuries than it has been in the workers compensation databases. Therefore we have made no attempt to establish a statistical linkage key in this project.

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APPENDIX A

Analysis of the Illinois Workers' Compensation First Reports of Injury Data

Analysis of First Reports of Injury

For the analysis of the First Reports of injury, we identified construction worker injuries in the year 2005 through two methods, (1) for the First Reports filed by paper we hired several graduate students to go through every paper First Report of Injury to look for company names and/or SIC codes that indicated a construction company, (2) for the First Reports filed electronically we filtered the data by industrial classification coded "construction". The number of paper based First Reports identified manually was 1,339 and the number identified electronically was 2,719.

There were major differences between the reports of injuries filed electronically and by paper. It is unclear if the observed differences result from differences in missing information or whether the differences reflect distinguishing characteristics of companies filing by paper vs. those filing electronically. Companies filing by paper were more likely to omit information as seen in the table below. An important finding is that the mean interval from the time an employer is notified until the time the First Report of Injury was filed was extensive (37 days for paper filings and 55 for electronic filings). The large proportion of injuries occurred during standard business hours of 600am and 600pm. In addition the largest proportion of construction workers injured were between the ages of 25 and 54 years.

The distribution of injuries by body part were nearly identical for paper and electronic filings of First Reports of injury. However, there were more injuries coded as internal in the electronic filings. In both datasets, injuries to the upper and lower extremities predominated. The electronic filings showed a greater proportion of concussions, contusions, sprains and strains than reported in the paper filings, but the paper filings also had substantially more unspecified types of injuries. The three most common types of injuries reported both electronically and by paper were sprains/strains, open wounds and fractures. The most frequent causes of accidents were overexertion/movement related, falls and slips and being struck by an object.

The First Reports of injury, on the other hand, suffer from several major limitations. First, most employers filed First Reports of injury incorrectly. Although, the law stipulates that only injuries resulting in 3 or more days away from work are to be reported, the majority of First Reports of injury involve minor injuries that do not result in any lost work. Second, there is no uniform reporting form or tool. Employers have the option to report online or by paper form. Those that use the paper form submit a variety of different forms from insurance agencies and older First Reports of injury forms. Third, it is very likely that the First Reports of injury are not filed for every injury resulting in three or more lost work days. There is no clear data to help us determine the level of underreporting. Although First Reports of injury do include narratives on the cause of injury, in most cases the employer does not provide enough detail or simply omits the information. We have provided guidelines to IWCC as to how to improve the First Reports of injury data system.

Table
Demographic Characteristics of Injured Construction Workers
First Reports of Injury Filings

	Electronic Filings (N=2719)	Paper Filings (N=1339)
Gender		
Male	2612 (96.06%)	1246 (93.05%)
Female	106 (3.90%)	80 (5.97%)
Unspecified	1 (0.04%)	13 (0.97%)
Marital Status		
Single	433 (15.92%)	424 (31.67%)
Married	1512 (55.61%)	689 (51.46%)
Unspecified	774 (28.47%)	226 (16.88%)
Number of Dependents under 18		
0	1638 (60.24%)	290 (21.66%)
1	255 (9.38%)	103 (7.69%)
2	236 (8.68%)	116 (8.66%)
3	129 (4.74%)	85 (6.35%)
4	59 (2.17%)	34 (2.54%)
5 or more	29 (1.07%)	23 (1.72%)
Missing Frequency	373 (13.72%)	688 (51.38%)
Age Category		
16 to 24 years	245 (9.01%)	140 (10.46%)
25 to 34 years	719 (26.44%)	289 (21.58%)
35 to 44 years	763 (28.06%)	341 (25.47%)
45 to 54 years	590 (21.70%)	249 (18.60%)
55 to 64 years	197 (7.25%)	97 (7.24%)
65 and older	43 (1.58%)	14 (1.05%)
Unspecified	162 (5.96%)	209 (15.61%)
Time of Accident		
000 - 559	332 (12.21%)	15 (1.12%)
600-1159	1263 (46.45%)	415 (30.99%)
1200-1759	961 (35.34%)	277 (20.69%)
1800-2359	163 (5.99%)	54 (4.03%)
Missing Frequency	0 (0.00%)	578 (43.17%)
Mean interval from accident to employer notification (Days)	8	NA
Mean interval from employer notification to filing / (IC45) (Days)	55	36.52
Average Weekly Salary	$900.78	$1,096.29

Table
Body Part, Nature of Injury and Cause of Injury Among Injured Construction Workers
First Reports of Injury Filings

	Electronic Filings (N=2719)	Paper Filings (N=1339)
Body Part		
Head and Neck	226 (8.31%)	139 (10.38%)
Back and Spine	477 (17.54%)	201 (15.01%)
Upper Extremities	871 (32.03%)	408 (30.47%)
Torso	105 (3.86%)	100 (7.47%)
Lower Extremities	656 (24.13%)	262 (19.57%)
Internal	104 (3.82%)	2 (0.15%)
Multiple Extremeties Unspecified	202 (7.43%)	120 (8.96%)
Unclassified	78 (2.87%)	107 (7.99%)
Nature of Injury		
Amputation	20 (0.74%)	9 (0.67%)
Burn	34 (1.25%)	20 (1.49%)
Concussion/ Contusion	253 (9.30%)	0 (0.00%)
Crush	20 (0.74%)	25 (1.87%)
Disclocation	23 (0.85%)	14 (1.05%)
fracture	304 (11.18%)	126 (9.41%)
Internal	101 (3.71%)	35 (2.61%)
Nerve Damage	32 (1.18%)	7 (0.52%)
Open wound	312 (11.47%)	212 (15.83%)
Sprain / Strain	1020 (37.51%)	359 (26.81%)
Superficial	56 (2.06%)	69 (5.15%)
Unspecified/Other	498 (18.32%)	463 (34.58%)
Cause of Injury		
Absorbtion/ingestion/inhalation	19 (0.70%)	na
Animal or Insect	29 (1.07%)	na
Chemical	17 (0.63%)	na
Collisions/ struck by object	91 (3.35%)	na
Electrocution	12 (0.44%)	na
Falls/ slips	452 (16.62%)	na
Fire/Flames/Heat	42 (1.54%)	na
Homicide / Assault	62 (2.28%)	na
Machinery	133 (4.89%)	na
Overexertion/Movement Related	1024 (37.66%)	na
Road Accidents/ vehicle related	76 (2.80%)	na
Struck by Object	241 (8.86%)	na
Sharp Objects/ Cuts	56 (2.06%)	na
Other	465 (17.10%)	na

APPENDIX B

Analysis of the Illinois Workers' Compensation Claims Data

***Note: The data are presented in a format ready for publication. We plan on submitting these findings to a peer-reviewed scientific journal during the next 30 days. Please do not share or publish these findings until the embargo is lifted. Thank you.**

Introduction

The construction industry has continuously been one of the most hazardous industries in the U.S. Each year several hundred thousand construction workers become ill or are injured as a result of on-the-job hazards (BLS, 2007). The estimated rates for injuries, illnesses and fatalities among construction workers are consistently among the highest of any economic sector (BLS, 2007). In 2007, the most recent year of reported national data, the estimated incidence rate for recordable injuries and illnesses among construction workers was the second highest, only slightly lower than the manufacturing industry (BLS, 2007).

As a result of the large number of injuries and illnesses, the cost of construction injuries and illnesses is immense. Several studies have estimated the annual comprehensive cost due to injuries and illnesses among construction workers in the U.S. to be as high as $12.7 billion dollars (Waehrer, 2007a; Waehrer, 2007b; Leigh, 2004). The comprehensive cost for non-fatal injuries in the construction industry is estimated to be nearly twice as high as all other industries (Waehrer, 2007a). These are comprehensive cost estimates, which provide macro-level estimates of the total cost of injuries and illnesses.

Workers compensation data, in contrast, provide detailed direct costs paid for Claims that are not based on estimates. Workers compensation data has the potential to be used to identify factors associated with increasing or reducing compensation costs. Workers compensation was first introduced in the U.S. in the State of Maryland in 1902. By the year 2000, the national average of covered employees under workers compensation was 87.5% (NASI, 2002). Workers' compensation is a no-fault system except in extreme cases of employer negligence. The workers' compensation system was designed primarily to protect employers from excessive damage awards and to provide a more reliable system of compensation for injured workers. Most employers are required by law to purchase workers' compensation policies. During the 1980s, workers' compensation costs incurred by employers rose dramatically, but later decreased during the 1990s. In 1984, workers' compensation costs comprised 1.66% of total payroll costs, but had risen to 2.16% by 1991. By 1998, the program costs dropped to 1.35% of total employee payroll costs (Burton, 2001). The cost of maintaining workers compensation systems has fueled numerous studies evaluating compensation costs (Horwitz, 2004; Bernacki, 2007; Bernacki, 2008; Shah, 2003; Lipscomb, 2003; Foley, 2007; Hoffmann, 2006; Horwitz, 2005).

Workers compensation data are useful for occupational surveillance because most workers compensation datasets provide information about the employee, employer, level of impairment following an injury or illness, and the direct costs associated with an injury/illness. Studies evaluating workers compensation data have reported that industry (Waehrer, 2007a; Leigh, 2004), occupation (Horwitz, 2004; Waehrer, 2007a; Shah, 2003; Lipscomb, 2003), legal counsel (Bernacki, 2007; Bernacki, 2008), union membership (Lipscomb, 2003), and health care costs (Appel, 1993) are associated with claim costs. However, none have used regression models to directly quantify the predictors of cost. The majority of past studies have relied solely on descriptive analyses and stratification. A few studies have used logistic regression models. None of these methods provides direct estimates of costs associated with predictors while simultaneously controlling for confounding.

In this study, we describe the characteristics of injured construction workers filing Claims with the Illinois Worker Compensation Commission (IWCC) between 2000 and 2005. We also identify factors associated with compensation costs using a robust regression model.

Methods

In existence since 1913, the IWCC operates the administrative court system for workers' compensation cases. There are approximately 70,000 Claims filed with IWCC for financial compensation each year. The Claims are filed when the employee and employer are unable to resolve compensation for an injury. Workers compensation Claims are initially heard by an

arbitrator. The arbitrator's decision can subsequently be appealed before a panel of three commissioners. At any point, the injured worker and employer can settle the claim independently of the Workers Compensation system.

We obtained a dataset of all Claims in the Illinois Workers Compensation Commission, which included information on both active and closed Claims. The dataset contained an array of information including employer information, employee characteristics, body part affected, percent of functional lost (impairment), and compensation for costs associated with the injury including medical fees, lost wages, attorney costs and death and dependent benefits. For this study we include only Claims filed between January 1, 2000 and December 31, 2005. However, the data for filed Claims included cumulative compensation costs paid through 2007, and these costs include decisions made in follow-up appeals or settlements. Compensation costs were not adjusted for inflation. The minimum age in this study group was 16 years. Illinois law prohibits persons under the age of 16 to work in construction.

The IWCC Claims data did not contain information about industrial classification (SIC codes, NAICS codes or descriptive data), however, it did have company names. Therefore, we purchased a list of all construction companies in Illinois that have operated in the State since 2000 from Manufacturers News, a corporation that publishes state manufacturers directories and databases, dating back to 1912 (Manufacturers' News, 2007). We modified the list to allow for different variations in the spelling of company names (abbreviations, shortened names, acronyms), and we filtered the Claims data using this list. Because of the possibility that the list we purchased was incomplete, we analyzed the list of company names using a text analyzer looking for patterns in word usage. The analyzer produced a list of most frequently used words in the names of construction companies such as 'construction', 'contractors', 'paving', and 'roofing'. We then filtered the Claims file again using the high frequency words to produce a second list. We merged the two lists of potential construction industry Claims. The final merged list was then manually reviewed to identify non-construction companies and remove them. The original list contained over 50,000 Claims of potential construction workers for the six-year period, but was reduced to 19,734 after cleaning.

We evaluated the quality of the IWCC data by checking the proportion of missing data for key variables and the internal consistency across common variables. The proportion of missing data for key variables was as follows: date of birth (N=196, 1.0%), filing date (N=0, 0%), date of accident (N=29, 0.1%), gender (N=18, 0.1%), and city of residence (N=411, 2.1%). The internal consistency check showed that the data was highly consistent across similar variables. For example, when comparing nature of injury and body part affected (e.g. hearing loss and ears), the internal consistency ranged between 97% and 100%.

We calculated cumulative percent temporary and permanent disability for this study. Temporary disability results when a physician indicates that the injured worker is unable to return to work or is placed on restricted work activity (i.e. light work duty). Permanent disability involves partial or complete loss of body function at the point of maximal medical improvement. We used the statutory formula to calculate cumulative percent disability when more than one body part was injured and limited in function. An example of the statutory formula for computing cumulative disability is $A + (1-A)*B$, where A is the percent disability indicated by a physician for a specific injury involving a specific body part and B is the percent disability for a second specific injury involving a specific body part. Percent temporary and permanent disability were calculated separately. An injured worker could receive both temporary and permanent disability.

We used population density estimates calculated by the Census Bureau (US Census Bureau, 2009), based on the American Community Survey rather than the 2000 Census because it was conducted between 2005 and 2007. We matched ZIP codes of the place of an accident with the population density data. Only ZIP codes within Illinois were matched. Unmatched cases were manually reviewed (N=2134). For most unmatched cases, the ZIP codes were not in the Census Bureau's file, but were valid ZIP codes. Therefore, we used the US Postal Service ZIP code

search utility (US Postal Service, 2009) to identify the city for the unmatched ZIP codes for place of accident. We matched the identified city where the accident occurred with a second population density file using cities. At the end of the matching procedure, 306 (1.6%) Claims remained unmatched, of which the majority were outside Illinois.

To calculate rates, we used data regarding employment in the construction sector from the Current Employment Statistics (CES) survey (USBLS, 2009b). The CES surveys approximately 150,000 private and public sector employers per month, however it does not include farm payrolls. The survey focuses on estimating the number of employed, hours worked and earnings. The data is abstracted from employer payroll records. The CES survey counts full time, part time, temporary, and intermittent employees, in addition, the survey counts employees on sick leave, vacation or on strike / work slow down. Final rates did not include workers who reported their place of residence to be outside Illinois.

Statistical Analysis

We used SAS software for all statistical analyses (v.9.1; Cary, NC). The rate of Claims per 100 construction employees was calculated and the 95% confidence intervals were estimated using Fisher's exact method. For all statistical test, a two-sided p-value less than 0.05 was considered statistically significant.

For the regression analysis, the dependent variable (compensation cost) was heavily skewed to the right in a fashion similar to income (skewness = 52.7). In scenarios with extreme or many outliers causing the data to be skewed, ordinary least squares (OLS) regression will produce biased parameter estimates. This is because in OLS the parameter estimates will be weighted towards the outliers, which also inflates the variance. However, we did not transform the dependent variable because back transformation of log transformed data leads to biased estimates (Parkhurst, 1998; Huybrechts, 2002). While the log transformation makes the data less skewed, it changes the relationship between the dependent and independent variables (Parkhurst, 1998; Huybrechts, 2002).

Therefore, for the multivariable regression analysis, we used robust M-estimation as implemented in SAS Version 9 (PROC ROBUSTREG; SAS Institute, Inc., Cary, NC) using bisquare weights. (Huber, 1973; Huber, 1981; Hampel, 1986). The parameter estimates derived from robust regression are less influenced by outliers. This is generally achieved by weighting observations whose residuals are large.

The multivariable model included demographic variables, wage, injury outcome, and attorney representation. The outcome variable was total financial compensation of decided Claims, excluding Claims in progress and dismissed Claims. Total financial compensation included medical costs, dependent benefits, death benefits, settlement payments, attorney fees, and other miscellaneous costs. We used a stepwise selection method to identify the best model fit for the predictors. Akaike (AIC) criterion and Schwarz information criteria (BIC) were also used for model selection and to identify the best weighting function. For this study, the bisquare weighting function performed best in the final fitted model. In the final model, gender, number of dependents, interval from day of accident to day of filing, and population density were not significant, and therefore were excluded. In addition, although the age was curvilinear in unadjusted regression models, in the multivariable models the polynomial not significant. The final model included the following variables: martial status (dichotomous), age at time of accident (continuous), employee's weekly wage (continuous), fatality (dichotomous), attorney representation (dichotomous), number of body parts injured, and percent temporary and permanent disability (continuous).

Results

Between 2000 and 2005, we identified a total of 19,734 Claims filed with the Illinois Workers Compensation Commission by workers employed by construction companies. Table 1 shows the demographic information of the workers filing Claims. Nearly all of the injuries involved male workers (95.5%). The majority of injured workers were married (61.0%) and without any children (52.3%). The mean age of the workers on the date of injury was 39.5 years. The average reported weekly wage of the injured workers was $926.30 (sd=$368.50).

Nearly all of the workers filing Claims were injured while working in Illinois (98.6%; N=19454) and 94.2% (N=18599) reported their place of residence at the time of filing a claim to be in Illinois. Only 29 construction workers filing Claims with the IWCC reported being injured outside of Illinois and living outside of Illinois.

The proportion of construction injury Claims declined between 2000 and 2005. The number of Claims by year was as follows: 2000, 3443 (17.4%); 2001, 3679 (18.5%); 2002, 3533 (17.9%); 2003, 3205 (16.2%), 2004, 3100 (15.7%), 2005, 2774 (14.1%). The overall rate of construction Claims per 100 Illinois construction workers was 1.21 (CI95%: 1.19, 1.22). The rate was highest in 2001 and lowest in 2005 (Figure 1). The average interval between the date of injury and the date a claim was filed was approximately nine months (276.6 days; sd=296.6 days). The longest interval was 14.8 years and interval for the upper quartile was approximately 13 months (391 days). The proportion of construction injuries was highest between June and October, with the highest proportion of injuries occurring during August and lowest proportion occurring in February.

Injuries to the extremities (N=11,397; 58.8%) and back/spine (N=3,981; 20.5%) were the most frequent body parts affected (Table 2). The majority of injuries among the construction workers filing Claims involved only one body region (N=14,770; 74.9%). A total of 103 Claims for work related deaths were filed between 2000 and 2005 (6.3 fatality Claims per 100,000 construction workers; CI95%: 5.1, 7.6 per 100,000).

Among the 19,734 Claims filed by construction workers, a decision had been finalized regarding the level of compensation for 15,922 (80.7%) of the Claims, 2230 (11.3%) had been dismissed, and 1582 (8.0%) were still in progress with no final decision. Mean annual total cost of construction Claims for the period of 2000-2005 was $96,734,252. The median level of financial compensation of decided Claims (N=15,898) – excluding Claims in progress and dismissed Claims – was $16,705 and the 95th percentile was $150,786. Of the Claims filed for work-related deaths, the median total compensation was $60,039 compared to $16,642 among non-fatal injuries. Twenty-five (24.3%) of the Claims filed for work related deaths were dismissed and 10 (9.7%) had not been decided. Median compensation was higher among male workers and married persons (Table 1). Total compensation also increased with age until the age of 65 years and older, at which point we observed a small decline in median compensation (Table 1). Cost of compensation was higher among those suffering back and spine injuries compared to persons injuring other body parts, and increased with the number of body parts injured (Table 2). Among the decided Claims, 74.7% (N=11880) involved attorney representation by the injured workers. The median cost of Claims involving workers with attorney representation was $18,606 compared to $13,504 among workers who chose to represent themselves.

In the final multivariable robust regression model (Table 3), compensation was $63,329 higher for workers killed on the job when controlling for other covariates. Workers filing a claim with attorney representation received $1,210 higher compensation than those representing themselves when controlling for other covariates. In addition, compensation increased by $800 for each additional body part injured. 41.9% of the variance of compensation costs was explained by the variables in the final model. The cumulative percent temporary and permanent disability – measures of severity of injury – explained 38.7% of the variance of cost. Attorney costs explained only 0.3% of the variance of the dependent variable.

Discussion

The cumulative cost of Claims between 2000 and 2005 for injured construction workers in Illinois was $580,405,416. The cost of compensation for construction injuries represented approximately 4.5% of the total payments for workers compensation Claims made in Illinois between 2000 and 2005 (IWCC, 2007), whereas construction injuries represented 5.0% of all Claims during the same period. In this study, the mean cost of a construction claim was $35,834 compared to a mean cost of $10,084 for construction injuries in Oregon. (Horowitz, 2004).

Claims data are not comprehensive in nature, but reflect most of the direct costs associated with an injury or illness. Workers compensation costs include the cost of medical treatment and lost wages, in addition to costs associated with long-term rehabilitation; they do not account for nonmonetary costs related to the reduction in the quality of life of the affected worker, increased workers compensation insurance premiums, and cost of retraining or replacing an injured worker. Studies that have evaluated comprehensive costs have reported that 15% of private industry injury costs are from the construction industry, while the construction industry employs only 5% of all workers in the U.S. (Waehrer, 2007a; Waehrer, 2007b).

In the literature there have been studies showing that use of attorneys by injured workers is associated with higher compensation costs (Bernacki, 2007; Bernacki, 2008). These studies have explained the higher costs associated with attorneys in that they delay the process and incur higher processing fees. It is strange that these arguments focus solely on the legal counsel retained by the worker, when nearly all the employers and insurers use attorneys. These studies controlled for lost time as a proxy of severity. In addition, these studies used logistic models so they were unable to directly quantify the cost of using attorneys by an injured worker. In our analysis, before we added percent disability into the multivariable model during the stepwise model selection process, Claims involving legal counsel retained by the worker resulted in $10,032 higher costs. Once controlling for percent disability, the increased cost of retaining legal counsel by the claimant was a little over $1200. This clearly illustrates how spurious conclusions can be drawn when a model does not adequately control for important covariates. In fact, only a small fraction of the variance of cost (0.3%) was explained by the use of attorneys by the claimant. It appears that the most important determinant of cost of compensation is not the attorney, but the severity of injury and the medical professional who defines the impairment that determines the scheduled payout.

In the final multivariable regression model, age was positively associated with level of compensation. The relationship was linear in the final model, rather than curvilinear as suggested by the crude data. The model indicates that there was an increase in compensation of $520 for every 10-year increase in age. Compensation was significantly higher for workers killed on the job, but this is to be expected since the IWCC has a schedule of minimum payments for fatalities, which is substantially higher than the minimum for nonfatal injuries.

It is unclear if the decline in the number of Claims represents a safer working environment for Illinois construction workers between 2000 and 2005 or whether employers and employees are moving towards external settlements not involving the IWCC. Furthermore, Claims for fatal injuries showed a near steady linear decline of 57.1% during the study period (N=21 in 2000 to N=9 in 2005), but the decline was not as clear when looking at the CFOI data for Illinois. Illinois CFOI data shows that fatalities rose and fell erratically between 2000 and 2005. As the number of Claims decreased between 2000-2005, the median compensation for an injured construction worker increased (Figure 1). Financially, it makes sense to avoid injury disclosures and settle Claims independently of the IWCC in order to minimize the impact on the employer's insurance premiums, particularly for less severe (i.e. less costly) injuries. The observation that the median cost of the claim increased over time may indicate that smaller Claims for less severe injuries are being settled independently of the IWCC.

Limitations

Our method for identifying construction cases may have missed companies that were not on the company list we purchased or had names that did not include one of the construction keywords. Based on the 2002 Economic Census (US Census Bureau, 2006), there were approximately 30,655 construction companies in Illinois. In the final Claims dataset, we identified 6,087 construction companies that had Claims filed for compensation through the IWCC. Using 2002 data only, because the Economic Census was conducted in 2002, we would have expected approximately 1950 companies to have Claims filed by their employees if the distribution of Claims was even across all employers (Claim rate of 1.272 Claims/100 employees; median employees per company was approx 5 per firm; 30655 companies). In 2002, we identified 1891 companies with Claims filed by their workers.

As a measure of severity we used percent temporary and permanent disability. This is not a perfect measure of severity, but it is the best available measure when using Illinois workers compensation data. Percent disability is assigned by the IWCC, based on the physician's assessment of short term and long term disability. It is an independent party (i.e. the physician) that is the primary determinant of disability. In contrast, days away from work may have nothing to do with disability, since a worker can be working but transferred to "light" work or a job that can be accomplished despite a disability. For example, a serious foot injury resulting in 25% temporary partial disability may not prevent a worker from completing his tasks on an assembly line if the worker can use a stool/chair at his work station.

However, Impairment and disability ratings for occupational injuries and illnesses have been the subject of much controversy. The AMA Guides to the Evaluation of Impairment is the major resource for the disability examination in the US (AMA, 2008). Spieler et al provided a careful critique of the AMA Guides based on a review of studies through the Fourth Edition (Spieler, 2000). Their criticisms include lack of a comprehensive system that is reliable, unbiased, and evidence-based. In brief, the Guides (1) are not comprehensive in that they leave out many conditions that can cause impairment; (2) lack consistency across organ systems; (3) assess functional loss at 0% for some conditions that are diagnosable, blurring the distinction between impairment and disability; (4) dismiss much of the time-honored physical examination as “subjective,” eliminating an important diagnostic modality; (5) treat pain inconsistently, especially in different organ systems; (6) rely on pre-treatment diagnoses for some conditions, rather than functional status at maximal medical improvement; (7) do not uncouple impairment (anatomical loss and functional impairment) from disability (impairment that diminishes functional ability at work and at home). In addition, in some cases, they seem to disregard functional limitations to prevent excessive costs.

The RAND Institute for Civil Justice conducted a study of workers compensation permanent disability benefits in the State of California, which has required use of the AMA Guides since 2004 (Fifth Edition). They found that there were large differences in impairment ratings between physicians and that these discrepancies “appeared substantial enough to provide parties with incentives to litigate.” (Reville, 2005). The reported inconsistencies in impairment ratings may make it difficult to duplicate findings when using different State datasets.

For this study, we used Current Employment Survey (CES) to calculate the claim rates. The CES counts jobs, whereas the Current Population Survey counts people. A person with two construction jobs is counted twice in the CES survey. Furthermore, employees not listed on payrolls (e.g. informal sector and underground economy) are not counted in the CES, which are not uncommon employment arrangements in the construction sector. Other workers not included in the CES are the self-employed, volunteers, domestic laborers and family members. It is unclear if the CES would lead to an over- or underestimation of the rates. In addition, workers’ compensation data underestimate the actual incidence of occupational injuries because most

injuries are not reported to an employer or are settled between the employer and employee external of the workers compensation system.

Conclusion

We found no other published study that quantifies the cost of compensation using a regression model that is appropriate for skewed data. The model used in this study clearly indicates that percent disability is the most important determinant of cost, though the method and uniformity of percent impairment allocation could be better elucidated. Retention of legal counsel by the worker is associated with a modest increase in cost when controlling for important covariates. There is a need to integrate analytical methods that are suitable for skewed data when analyzing claim costs. Both robust regression and nonparametric tests should be further used in this field. The field of econometrics has developed a wide array of analytical tools that address heavy right tailed data similar to claim costs. Further research is needed that evaluates the determinants of compensation costs for other industries, in order to determine whether the predictors identified in this study are relevant to other economic sectors.

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Trend in Number of Workers Compensation Claims and Median Compensation of Settled Claims for Illinois Construction Workers by Year , Illinois 2000-2005

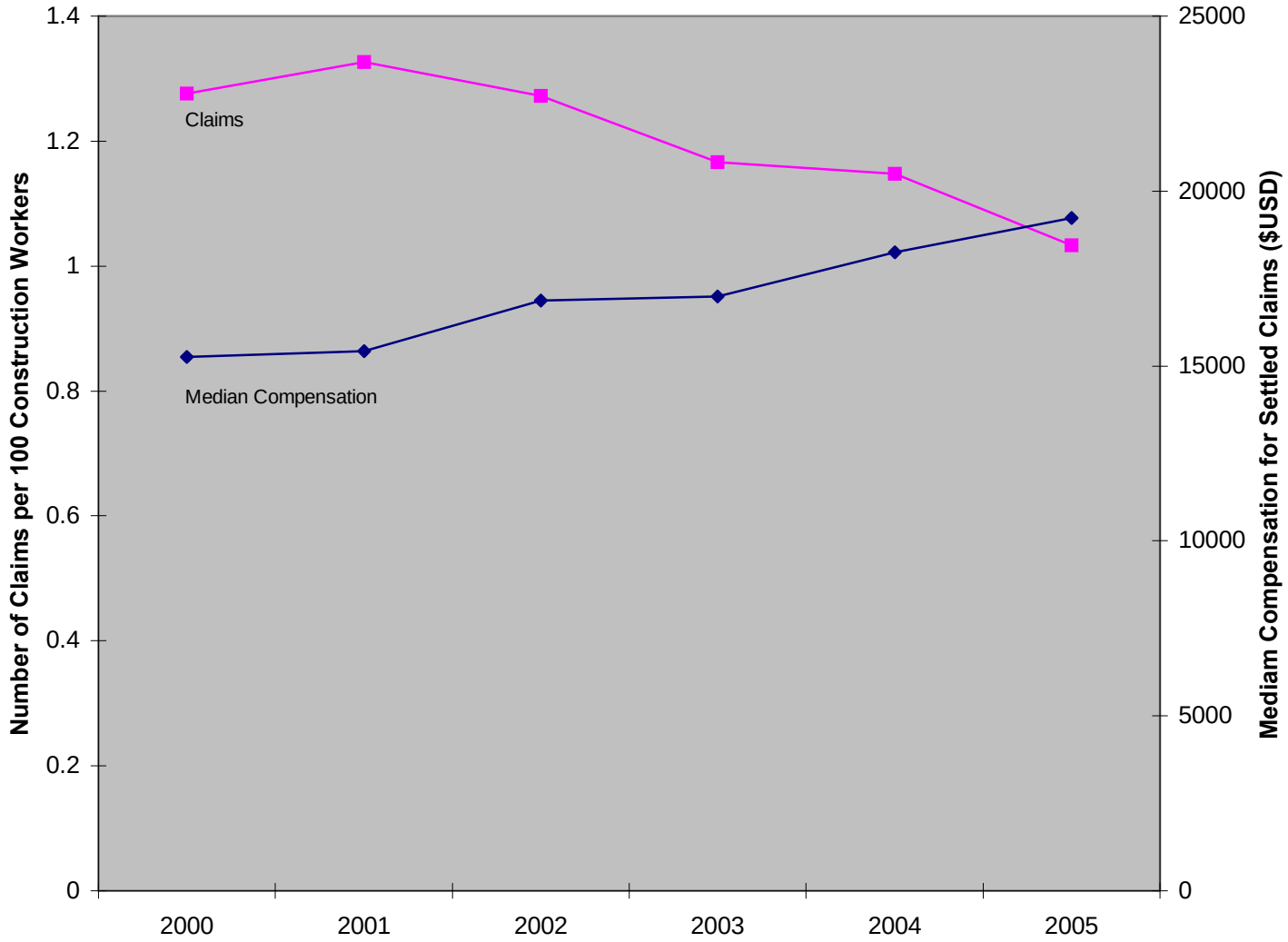

Table 1
Demographic Data for Construction Workers
Illinois Workers Compensation Claims Data, 2000-2005

		Compensation (USD$)*	
	N= (%)	Mean (SD)	Median
Gender			
Male	18848 (95.5%)	36157 (108821)	16952
Female	868 (4.4%)	28561 (60375)	12251
Unspecified	18 (0.1%)	17202 (15347)	15257
Marital Status			
Single	7419 (37.6%)	28908 (52010)	13351
Married	12029 (61.0%)	40212 (130681)	18964
Widowed/Divorced	41 (0.2%)	28204 (36419)	8800
Unspecified	245 (1.2%)	30871 (47801)	16025
Number of Dependents			
0	10318 (52.3%)	33980 (121166)	15860
1	3196 (16.2%)	38047 (72353)	17768
2	3442 (17.4%)	37553 (65395)	18188
3	1790 (9.1%)	36072 (56876)	17282
4	641 (3.2%)	49370 (246084)	17659
5 or more	343 (1.7%)	30709 (51017)	16182
Unspecified	4 (<0.1%)	8500 (~)	8500
Mean Age (SD)	39.5 (sd=10.5)	~	
16 to 24 years	1667 (8.5%)	17558 (34518)	8760
25 to 34 years	5187 (26.3%)	30834 (53027)	14697
35 to 44 years	6812 (34.5%)	37931 (100916)	18056
45 to 54 years	4161 (21.1%)	41091 (66948)	20264
55 to 64 years	1492 (7.6%)	53125 (284524)	22431
65 and older	112 (0.6%)	31618 (33997)	19535
Unspecified	303 (1.5%)	24561 (40485)	12043
Population Density: Place of Accident (persons/sq.mi)			
Rural (0-499)	595 (3.0%)	31829 (45728)	16474
Mid range (500-999)	838 (4.2%)	49922 (382791)	16630
Urban ($\geq$1000)	17995 (91.2%)	35526 (79443)	16761
Out of State or Unspecified	306 (1.6%)	32579 (52638)	15454

*Compensation costs for only cases with a decision. New filings and dismissed cases are excluded

Table 2
Body Part Injured
Illinois Workers Compensation Claims Data, 2000-2005

Variable N=		%	Compensation (USD$)* Mean (SD)	Median
Body Part[a]				
Head and Neck	1277	6.6%	33953 (54297)	11613
Back and Spine	3981	20.5%	49161 (79048)	22251
Upper Extremities	6505	33.6%	29697 (85472)	15152
Torso	443	2.3%	11777 (25160)	6871
Lower Extremities	4892	25.3%	33492 (162743)	17338
Internal	85	0.4%	31366 (101225)	7500
Multiple Extremeties Unspecified	3898	20.1%	45426 (69398)	20658
Unclassified	212	1.1%	43213 (62074)	16662
Number of Body Parts Affected				
0	85	0.4%	28723 (52326)	11293
1	18259	92.5%	35044 (1097656)	16327
2	1221	6.2%	47428 (66738)	23006
3 or more	169	0.9%	46712 (59730)	25527
Percent Temporary Disability				
No Disability	14697	74.5%	36165 (124131)	16177
1 to 25 Percent	4332	22.0%	22933 (35573)	14297
26 to 50 Percent	527	2.7%	91190 (79805)	83297
51 to 100 Percent	178	0.9%	169406 (68684)	175760
Percent Permanent Disability				
No Disability	10694	54.2%	52442 (144345)	16599
1 to 25 Percent	6081	30.8%	15997 (27066)	12553
26 to 50 Percent	2441	12.4%	34184 (107848)	30810
51 to 100 Percent	518	2.6%	54510 (62169)	47549

*Mean compensation for only cases with a decision. New filings and dismissed cases are excluded
[a]Body part: the sum exceeds the sample size because a worker could have suffered injuries to more than one body part

Table 3
Cost Associated with Predictors of Compensation Cost ($USD) for Decided Claims
Multivariable Robust Regression Modela
Illinois Workers Compensation Claims Data, 2000-2005

Variable	Parameter Estimate	95% Confidence Interval	P-value
Marital Status: Married	332	96, 569	0.006
Age at Accident	52	40, 63	<0.001
Weekly wage	10	9, 10	<0.001
Fatality	63329	61610, 65049	<0.001
Attorney Representation	1210	949, 1470	<0.001
Number of Body Parts Injured	800	428, 1172	<0.001
Cumulative Temporary Disability	2462	2451, 2473	<0.001
Cumulative Permanent Disabiltiy	883	876, 890	<0.001

[a]Global Robust M-Estimation Regression Model: R2=41.9%; age, wage, body parts, and percent disability are continuous variables; Marital status, fatality, attorney representation are dichotomous variables. Regression model does not include Claims in progress or dismissed Claims.