Reliability of the AMA Guides to the Evaluation of Permanent Impairment

Linda Forst, MD, MPH, Lee Friedman, PhD, UIC-SPH, EOHS, and Abraham Chukwu, MD, MPH, UIC-SPH, EOHS

Background: AMA's Guides to the Evaluation of Permanent Impairment is used to rate loss of function and determine compensation and ability to work after injury or illness; however, there are few studies that evaluate reliability or construct validity. **Objectives:** To evaluate the reliability of the fifth and sixth editions for back injury; to determine best methods for further study. **Results:** Intra-class correlation coefficients within and between raters were relatively high. There was wider variability for individual cases. Impairment ratings were lower and correlated less well for the sixth edition, though confidence intervals overlapped. **Conclusions:** The sixth edition may not be an improvement over the fifth. A research agenda should include investigations of reliability and construct validity for different body sites and organ systems along the entire rating scale and among different categories of raters.

Impairment ratings are used to describe physical or functional loss of a body part or an organ following an occupational injury or illness. The rating fixes the diagnosis and the percentage of physical and functional loss at the point of "maximal medical improvement." This percentage is frequently translated into a monetary award, and is also used as the first step in the evaluation of disability.

The Guides to the Evaluation of Permanent Impairment, developed by the American Medical Association, is the most frequently used tool in the United States to assign a permanent impairment rating. Some 40 jurisdictions use it in workers compensation systems, in personal injury litigation, and in automobile insurance systems.[1,2]

First published in 1958 and revised through the sixth edition in 2008,[3,4] *The Guides* has been criticized for following reasons: inconsistency and ambiguity in definitions; poor reliability and reproducibility; lack of content validity; failure of ratings to reflect true or perceived functional loss; lack of consistency across organ systems; poor predictive capability; an inadequate basis in scientific evidence; development by a narrow consensus of practitioners, with exclusion of other stakeholders, like attorneys and policy makers; wide variability of assigned ratings among practitioners; complexity of the system that requires many hours of study and training; a bias toward the worker; a bias toward the employer; and a marked departure in the rating protocol from prior versions.[1,2,5–9] Because of these concerns, many states have elected not to adopt the new version (Impairment Resources, 2010 http://impairment.com/PressRelease/index.htm, accessed August 5, 2010).

Despite several impassioned testimonies before workers compensation commissions and legal writings,[10–12] there is a dearth of evidence to either justify or refute claims that the fifth or sixth edition of *The Guides* is superior to the other in terms of precision, accuracy, validity, or reliability. We conducted a pilot test to determine the reliability of the fifth and of the sixth editions for low back injury; to compare ratings for individual low back cases between the fifth and sixth editions; and to sort out methodological issues for a larger, more definitive study.

From the University of Illinois at Chicago, School of Public Health, Environmental and Occupational Health Sciences, Chicago, Ill.

Address correspondence to: Linda Forst, MD, MPH, University of Illinois at Chicago, School of Public Health, Environmental and Occupational Health Sciences, 2121 W. Taylor, MC 922, Chicago, IL 60612; E-mail: ForstL@uic.edu.

DOI: 10.1097/JOM.0b013e3181fd2782

METHODS

Cases

We chose low back injuries as the study's health outcome because of the high prevalence and exorbitant costs associated with occupationally related low back disorders, and because of the lack of definitive clinical tests to aid in determining the degree of impairment of this body site. We developed 20 case histories of low back pain from summaries that we found on the Internet and in medical texts. These case summaries described the injury event, the acute findings, the laboratory tests, the medical interventions, the clinical course, and the history and physical examination at the time of "maximal medical improvement." They ranged from very mild injuries with complete resolution of signs and symptoms to severe injuries with invasive interventions and continued pain and functional impairment.

Participants

Six occupational medicine residents and two fourth-year medical students were recruited to participate. Participants were divided into two groups of three residents and one student. One group was trained to render an opinion regarding degree of impairment using the fifth edition, and one group the sixth edition. Two of the investigators (Chukwu and Forst) prepared and conducted an hour presentation and case discussion from a template they designed to assure equivalence of the training sessions. There had been 3 hours of presentations to these participants of *The Guides*, in general (the purpose, goals, development), and for body parts other than the low back prior to this study. A naïve group was chosen to avoid the influence of prior experience in conducting impairment examinations or using either version of *The Guides*. After the groups were trained, a third party, not affiliated with residency training, obtained informed consent, as approved by the IRB (Protocol #2010-0180).

Rating Impairment

Each person who agreed to participate was scheduled to sit in a room for up to 3 hours with a folder containing the 20 case descriptions and with the actual book of *The Guides*, fifth or sixth edition, depending on their assignment and training. They filled in a single impairment rating for each case on a data collection sheet.

Data Entry and Analysis

Participant code number, book edition number, and impairment ratings were entered into a MS Excel file and analyzed using Statistical Package for the Social Sciences for intra- and inter-class agreement within/between the fifth and sixth editions using nonparametric testing. We used the Shrout and Fleiss (1979)[13] formula to estimate intraclass correlations (ICC). This method assumes that all subjects are rated by the same raters who are the entire population of raters rather than a subset of raters or randomly assigned

to patients. We also tried Winer's calculations[14] for ICC and found almost no difference, so we report the former, here.

RESULTS

The average score across all raters using the fifth edition versus the average score using the sixth edition yielded a Pearson correlation coefficient of 0.88. The Pearson correlation coefficient for each rater of a given edition against the average for that edition ranged between 0.72 and 0.97 with 14 out of the 16 raters having coefficients above 0.85. In comparing the ICC for each individual rater against all other raters, the ICCs range between 0.478 and 0.85 and are all statistically significant. Table 1 shows the ICCs for comparisons within and between groups rating low back injury cases using the fifth versus the sixth edition. These range between 0.629 and 0.770.

DISCUSSION

Each state and territory in the United States has developed its own workers compensation system with the goal of protecting employers against civil law suits and exorbitant payments while providing expeditious and fair compensation to employees who have been injured or become ill at work. The impairment rating of those that have been injured in the workplace occurs within a milieu of contentiousness among employers, insurance companies, and employees, as well as attorneys who represent all three. *The Guides* has been developed in an attempt to lend objectivity to this process and to provide a logical, systematic, and fair basis for compensating those injured at work. The major changes between the fifth and the sixth editions claim to improve reliability and reproducibility. In addition, the sixth edition purportedly takes into account a broader model of disability and impairment put forth by the World Health Organization,[10] where physical impairment is only one of many determinants of participation in the workforce and in society, in general.

As each edition of *The Guides* has been published, there has been a mixture of acceptance and resistance to the recommended methodology for determining impairment citing the following: lack of a scientific basis for relating impairment to functionality; extremely limited testing of reliability, reproducibility, precision, and validity of *The Guides*; lack of inclusion of stakeholders, including attorneys, unions, legislators, along with an adequate array of clinical specialists, when writing *The Guides*; and inappropriate, or inadequately debated, acceptance of the World Health Organization model.[1,2,5,6–12,15,16] Despite the fact that there is a hot legal debate and great resistance among policy makers in state workers compensation systems to accept the sixth edition, we found no publications that compare the fifth and sixth editions of *The Guides*, and very few research publications that evaluate or compare any other versions.[2]

In this study, we found that the correlation of impairment ratings for low back injuries across raters–using the fifth edition alone, using the sixth edition alone, and comparing those using the fifth with those using the sixth–was relatively high and consistently so. This demonstrates fairly high inter-rater reliability for each edition and inter-rater reliability between the two editions.

The mean impairment ratings were somewhat lower using the sixth edition compared to the fifth. This suggests a more conservative approach to rating impairment in the newer version. Although this finding was not statistically significant, it is consistent with Colledge et al's account in 2009.[17] If accurate, injured employees stand to get less compensation when providers use the sixth edition, vs. the fifth.

There were two large outlier ratings among the raters in this study. Removing these numbers from the analysis did not alter the overall results. Furthermore, real life impairment rating is expected to yield occasional wide differences in the percentages assigned for individual cases.

There are several limitations to this study. First, we used mock cases on paper rather than real, face-to-face assessments; results might be different following an actual clinical encounter. Also, our case summaries provided information that would allow the rater to use the Diagnosis Related Evaluation, rather than the Range of Motion model in the fifth edition or the Diagnosis Based Impairment model in the sixth edition. Rater training on evaluating the back lasted only 1 hour in each edition and the participants had been introduced to the sixth edition of *The Guides* in 3 hour-long sessions, prior to being trained for this study. Results may be different if they had more extensive training, though this is probably representative of actual practice; in most states there is no formal training or certification of physicians that conduct Independent Medical Evaluations or rate impairment. We chose naïve raters and trained them to avoid study participants with a large amount of experience that might influence whether they actually followed the designated edition of *The Guides* vs. whether they were influenced by prior experience. In addition to a potential difference with experienced raters, it also is possible that different medical specialists (e.g., orthopedists, physiatrists, primary care, and occupational medicine physicians) assess impairment differently, even if they use *The Guides*.

CONCLUSIONS/RECOMMENDATIONS

The Guides fifth and sixth editions of the AMA are relatively reliable and consistent tools for rating impairment of low back injuries. The impairment ratings using the sixth edition of the AMA Guides are somewhat lower than the fifth and do not meet the claims made of improvement in reliability. Given the impact that impairment ratings, monetary settlements, and disability have on employers, employees, and society, it is critical to promote rigorous research to evaluate and refine these rating guidelines. An urgent research agenda should be implemented to answer the following questions:

1. What is the reliability and reproducibility of the rating guide for each organ system?
2. What is the "construct validity" of the ratings in terms of reflecting true functional impairment, ability to return to the same job and with the same pay, ability to return to work at all, quality of work life, and quality of life, in general? This would take a number of studies that include long-term follow-up of cases vis-à-vis quality of life and work life.
3. Does *The Guides* work well across the entire spectrum of ratings, from 0 to 100%? The construct validity for 50% to 100% is complex, given that many states judge that parties are "totally disabled" at less than 100%.

TABLE 1. Intra-Class Correlation Coefficients Comparing Impairment Raters Using the Fifth Versus Sixth Editions of AMA's Guides to the Evaluation of Permanent Impairment. Fleiss & Shrout Formulae Were Used

Comparisons	Correlation Coefficient (95% CI)
Among all raters, not controlling for version	0.629 (95% CI = 0.465, 0.795)
Among fifth edition raters, only	0.724 (95% CI = 0.56, 0.863)
Among sixth edition raters, only	0.650 (95% CI = 0.450, 0.820)
Average ratings of fifth vs. average ratings of sixth	0.770 (95% CI = 0.506, 0.902)

4. Is there a difference in ratings among physicians of the same specialty, among physicians of different specialties, or of treating physicians vs. independent medical examiners?
5. How does certification of examiners impact ratings, monetary settlements, and outcomes?
6. Do experienced physicians rigorously follow *The Guides* when evaluating patients or are they influenced by prior experience? if so, how much are they influenced and in which direction? This type of study could assess the objectivity of the rating process and evaluate, for example, whether subjective factors play a role (eg, experience, social/political view of occupational injury, etc).

REFERENCES

1. Chase K, Brigham RC, Ensalda LH, Talmage JB. *Evaluation of Impairment.* Clinics in Occupational and Environmental Medicine; 2001.
2. Brigham RC. *Study of the Impact on Changing from the American Medical Association (AMA) Guides to the Evaluation of Permanent Impairment.* Third Edition Revised to the Fourth or Fifth Editions in Determining Workers' Compensation Impairment Ratings. Performed at the request of the Labor and Employment The State of Colorado; 2002.
3. Haralson RH, III. Evaluation of the spine utilizing the AMA guides to the evaluation of permanent Impairment. 4th ed. *Instr Course Lect.* 1999;48:451–461.
4. Rondinelli RD, ed. *American Medical Association's Guides to the Evaluation of Permanent Impairment.* Chicago: American Medical Association; 2008.
5. Rondinelli RD, Changes for the new AMA guides to impairment ratings. 6th ed.: Implications and applications for physician disability evaluations. *PMR.* 2009;1:643–656.
6. McCarthy ML, McAndrew MP, MacKenzie EJ, et al. Correlation between the measures of impairment, according to the modified system of the American Medical Association, and function. *J Bone Joint Surv Am.* 1998;80:1034–1042.
7. Nitschke JE, Nattrass CL, Disler PB, Chou MJ, Ooi KT. Reliability of the AMA guide's model for measuring spinal range of motion. Its implication for whole-person impairment rating. *Spine (Phila Pa 1976).* 1999;24:262–268
8. Patel B, Buschbacher R, Crawford J. National variability in permanent partial impairment ratings. *Am J Phys Med Rehabil.* 2003;82:302–306.
9. Rondinelli RD, Katz RT. Merits and shortcomings of the AMA guides. 5th ed. a physiatric perspective. *Phys Med Rehabil Clin N Am.* 2002;13:355–370.
10. World Health Organization. International Classification of functioning, Disability, and Health (ICF). Geneva; 2001.
11. Spieler EA, Barth PS, Burton JF Jr, Himmelstein J, Rudolph L. Recommendations to guide revision of the guides to the evaluation of permanent impairment. American Medical Association. *JAMA.* 2000;283:519–523.
12. Dake M. *In Iowa Workers Compensation Commission Task Force on the AMA Guides Task Force.* Appendix D. Report of [a] Member. 2009. http://www.iowaworkforce.org/wc/amataskforce/2008amataskforcetoc.pdf, http://www.iowaworkforce.org/wc/amataskforce/dakereport.pdf. Accessed July 31, 2010.
13. Shrout PE, Fleiss JL. "Intraclass correlations: uses in assessing rater reliability." *Psychol Bull.* 1979;86:420–428.
14. Winer BJ. *Statistical Principles in Experimental Design.* New York: McGraw Hill;1971.
15. Kentucky workers compensation commissioner report [on the AMA guides. 6th ed]. 2009. Available at: http://www.labor.ky.gov/NR/rdonlyres/DC046C16-F0FF-4BB5-98B8-7C1CE7E92D02/0/CommissionerReportonAMAGuides.pdf. Accessed July 31, 2010.
16. Robinson JP, Turk DC, Loeser JD. Pain, impairment, and disability in the AMA guides. *J Law Med Ethics.* 2004;32:315–26, 191.
17. Colledge A, Hunter B, Bunkali LD, Holmes EB. Impairment rating ambiguity in The United States: the Utah impairment guides for calculating workers compensation impairments. *J Korean Med Sci.* 2009;24:S232–S241.

Workers' Compensation Costs Among Construction Workers: A Robust Regression Analysis

Lee S. Friedman, PhD
Linda S. Forst, MD, MPH

Background: *Workers' compensation data are an important source for evaluating costs associated with construction injuries.* ***Methods:*** *We describe the characteristics of injured construction workers filing claims in Illinois between 2000 and 2005 and the factors associated with compensation costs using a robust regression model.* ***Results:*** *In the final multivariable 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 model used in this study clearly indicated that percent disability was the most important determinant of cost, although the method and uniformity of percent impairment allocation could be better elucidated. There is a need to integrate analytical methods that are suitable for skewed data when analyzing claim costs.* (J Occup Environ Med. *2009;51:1306–1313*)

The construction industry has continuously been one of the most hazardous industries in the United States. Each year several hundred thousand construction workers become ill or are injured as a result of on-the-job hazards.[1] The estimated rates for injuries, illnesses, and fatalities among construction workers are consistently among the highest of any economic sector.[1] 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.[1]

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 United States to be as high as $12.7 billion dollars.[2–4] The comprehensive cost for nonfatal injuries in the construction industry is estimated to be nearly twice as high as all other industries.[2] These are comprehensive cost estimates, which provide macrolevel estimates of the total cost of injuries and illnesses.

Workers' compensation data, in contrast, provide information on the 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

From the Division of Environmental and Occupational Health Sciences, School of Public Health, University of Illinois, Chicago, Ill.

IRB approval was made by the University of Illinois at Chicago, Office for the Protection of Research Subjects. IRB approval number: #2008-0039.

Address correspondence to: Lee Friedman, PhD, The Social Policy Research Institute, 4001 Emerson Street, Skokie, Chicago, IL 60612-7260; E-mail: lfriedman@tspri.org, www.tspri.org.

DOI: 10.1097/JOM.0b013e3181ba46bb

state of Maryland, United States, in 1902. By the year 2000, the national average of covered employees under workers' compensation was 87.5%.[5] 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 and expeditious system of compensation for injured workers. Most employers are required by law to purchase workers' compensation insurance policies. During the 1980s, workers' compensation costs incurred by employers rose markedly 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.[6] The cost of maintaining workers' compensation systems has fueled numerous studies evaluating compensation costs.[7–14]

Workers' compensation data are useful for occupational surveillance because most workers' compensation data sets provide information about the employee, employer, level of impairment after an injury or illness, and the direct costs associated with an injury/illness. Studies evaluating workers' compensation data have reported that industry,[2,4] occupation,[2,9,11,12] legal counsel,[13,14] union membership,[12] and health care costs[15] are associated with claim costs. Nevertheless, none have used regression models to directly quantify the predictors of cost. Most past studies have relied solely on descriptive analyses and stratification. A few studies have used logistic regression models. None of these methods provide 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 Workers' 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 in Illinois. There are ~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. An arbitrator initially hears a workers' compensation claim. 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 IWCC.

We obtained a data set of all claims in the IWCC, which included information on both active and closed claims. The data set contained an array of information including employer information, employee characteristics, body part affected, percent of functional loss (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. Nevertheless, 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 younger than 16 years from working in construction.

The IWCC claims data did not contain information about industrial classification (Standard Industrial Classification codes, North American Industry Classification System 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.[16] We modified the list to allow for 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 claims from nonconstruction companies and remove them. The original list contained >50,000 claims of potential construction workers for the 6-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 the nature of injury and body part affected (eg, 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 either that the injured worker is unable to return to work or should be placed on restricted work activity (ie,

light-work duty). Permanent disability involves partial or complete loss of body function at the point of maximum 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 $A + (1 - A) \times B$, where A is the percent disability 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 disabilities were calculated separately. An injured worker could receive both temporary and permanent disabilities.

We hypothesized that there might be differences in levels of compensation between workers from rural and urban areas. To determine this, we used population density estimates calculated by the Census Bureau,[17] 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 to identify the city for the unmatched ZIP codes for place of accident.[18] 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.[19] The CES surveys ~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 are 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 or 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; SAS Institute, Inc., Cary, NC). The rate of claims per 100 construction employees was calculated, and the 95% CIs were estimated using Fisher's exact method. For all statistical tests, a two-sided P value <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 regression will produce biased parameter estimates. This is because in ordinary least squares the parameter estimates will be weighted toward the outliers, which also inflates the variance. Nevertheless, we did not transform the dependent variable because back transformation of log transformed data leads to biased estimates.[20,21] While the log transformation makes the data less skewed, it changes the relationship between the dependent and independent variables.[20,21]

Therefore, for the multivariable regression analysis, we used robust M-estimation as implemented in SAS Version 9 (PROC ROBUSTREG; SAS Institute, Inc.) using bisquare weights.[22–24] The parameter estimates derived from robust regression are less influenced by outliers. This is generally achieved by weighting observations whose residuals are large and does not remove them.

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. An Information Criterion of Akaike (AIC) and Bayesian Information Criterion of Schwarz (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 age was curvilinear in unadjusted regression models, in the multivariable models the polynomial was not significant. The final model included the following variables: marital status (dichotomous), age at the time of accident (continuous), employee's weekly wage (continuous), fatality (dichotomous), attorney representation (dichotomous), number of body parts injured, and percent temporary and permanent disabilities (continuous). Temporary disability represents wage replacement. It is 66.7% of salary, tax free, in the state of Illinois.

Results

Between 2000 and 2005, we identified a total of 19,734 claims filed with the IWCC by workers employed by construction companies. Table 1 shows the demographic information of the workers filing claims. Nearly all the injuries involved male workers (95.5%). Most 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

TABLE 1
Demographic Data for Construction Workers

		Compensation (USD$)*	
	N (%)	Mean (SD)	Median
Gender			
Male	18,848 (95.5)	36,157 (108,821)	16,952
Female	868 (4.4)	28,561 (60,375)	12,251
Unspecified	18 (0.1)	17,202 (15,347)	15,257
Marital status			
Single	7,419 (37.6)	28,908 (52,010)	13,351
Married	12,029 (61.0)	40,212 (130,681)	18,964
Widowed/Divorced	41 (0.2)	28,204 (36,419)	8,800
Unspecified	245 (1.2)	30,871 (47,801)	16,025
No. dependents			
0	10,318 (52.3)	33,980 (121,166)	15,860
1	3,196 (16.2)	38,047 (72,353)	17,768
2	3,442 (17.4)	37,553 (65,395)	18,188
3	1,790 (9.1)	36,072 (56,876)	17,282
4	641 (3.2)	49,370 (246,084)	17,659
5 or more	343 (1.7)	30,709 (51,017)	16,182
Unspecified	4 (<0.1)	8,500 (–)	8,500
Mean age (SD), yr	39.5 (10.5)	–	
16–24	1,667 (8.5)	17,558 (34,518)	8,760
25–34	5187 (26.3)	30,834 (53,027)	14,697
35–44	6,812 (34.5)	37,931 (100,916)	18,056
45–54	4,161 (21.1)	41,091 (66,948)	20,264
55–64	1,492 (7.6)	53,125 (284,524)	22,431
65 and older	112 (0.6)	31,618 (33,997)	19,535
Unspecified	303 (1.5)	24,561 (40,485)	12,043
Population density: place of accident (persons/sq.mi.)			
Rural (0–499)	595 (3.0)	31,829 (45,728)	16,474
Mid range (500–999)	838 (4.2)	49,922 (382,791)	16,630
Urban (≥1,000)	17,995 (91.2)	35,526 (79,443)	16,761
Out of state or unspecified	306 (1.6)	32,579 (52,638)	15,454

Illinois Workers' Compensation Claims Data, 2000–2005.
*Compensation costs for only cases with a decision. New filings and dismissed cases are excluded.

wage of the injured workers was $926.30 (SD = $368.50).

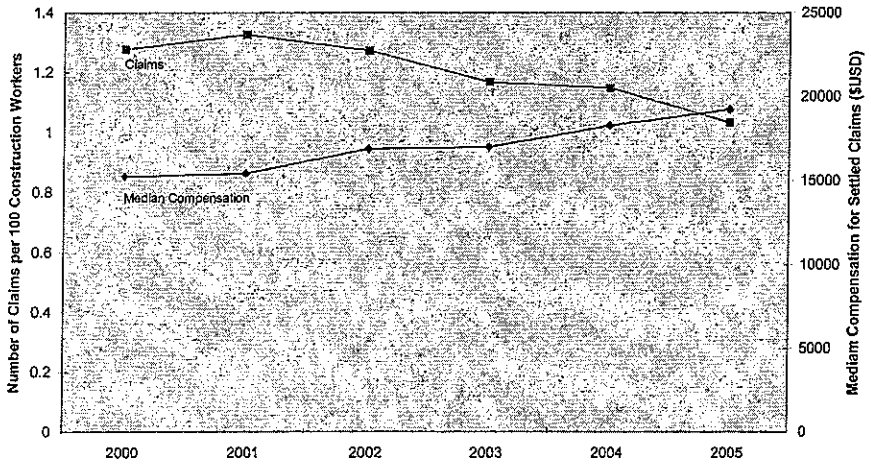
Nearly all the workers filing claims were injured while working in Illinois (98.6%; N = 19,454) and 94.2% (N = 18,599) reported their place of residence at the time of filing a claim to be in Illinois. Only 29 construction workers filing claims with the IWCC reported being injured outside of Illinois and living outside of Illinois.

The proportion of construction injury claims declined between 2000 and 2005. The number of claims filed 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%); and 2005, 2774 (14.1%). The overall rate of construction claims per 100 Illinois construction workers was 1.21 (95% CI: 1.19–1.22). The rate was highest in 2001 and lowest in 2005 (Fig. 1). The average interval between the date of injury and the date a claim was filed was ~9 months (276.6 days; SD = 296.6 days). The interval for the upper quartile was ~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 = 3981; 20.5%) were the most frequently affected body parts (Table 2). Most 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; 95% CI: 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 to 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 with $16,642 among nonfatal 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 with persons injuring other body parts, and increased with the number of body parts injured (Table 2). Among the decided claims, 74.7% (N = 11,880) involved attorney representation by the injured workers. The median cost of claims involving workers with attorney representation was $18,606 compared with $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 who died while working when controlling for other covariates compared



*Median compensation adjusted for inflation according to Consumer Price Index, year 2000 dollars. Inflation rate reported in the annual Statistical Abstracts of the United States

Fig. 1. Trend in number of workers compensation claims and median compensation of settled claims for Illinois construction workers by year, Illinois 2000–2005.

TABLE 2
Body Part Injured and Disability Ratings

Variable	*N*	Percent	Compensation (USD$)* Mean (SD)	Median
Body part†				
Head and neck	1,277	6.6	33,953 (54,297)	11,613
Back and spine	3,981	20.5	49,161 (79,048)	22,251
Upper extremities	6,505	33.6	29,697 (85,472)	15,152
Torso	443	2.3	11,777 (25,160)	6,871
Lower extremities	4,892	25.3	33,492 (162,743)	17,338
Internal	85	0.4	31,366 (101,225)	7,500
Multiple extremities unspecified	3,898	20.1	45,426 (69,398)	20,658
Unclassified	212	1.1	43,213 (62,074)	16,662
No. body parts affected				
0	85	0.4	28,723 (52,326)	11,293
1	18,259	92.5	35,044 (1,097,656)	16,327
2	1,221	6.2	47,428 (66,738)	23,006
3 or more	169	0.9	46,712 (59,730)	25,527
Percent temporary disability				
No disability	14,697	74.5	36,165 (124,131)	16,177
1%–25%	4,332	22.0	22,933 (35,573)	14,297
26%–50%	527	2.7	91,190 (79,805)	83,297
51%–100%	178	0.9	169,406 (68,684)	175,760
Percent permanent disability				
No disability	10,694	54.2	52,442 (144,345)	16,599
1%–25%	6,081	30.8	15,997 (27,066)	12,553
26%–50%	2,441	12.4	34,184 (107,848)	30,810
51%–100%	518	2.6	54,510 (62,169)	47,549

Illinois workers' compensation claims data, 2000–2005.
*Mean compensation for only cases with a decision. New filings and dismissed cases are excluded.
† Body part: the sum exceeds the sample size because a worker could have suffered injuries to more than one body part.

with workers suffering nonfatal injuries. Workers filing a claim with attorney representation received $1210 higher compensation than those representing themselves when controlling for other covariates. In addition, compensation increased by $800 for each additional body part injured. The variables in the final model explained 41.9% of the variance of compensation costs. The cumulative percent temporary and permanent disabilities—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 filed between 2000 and 2005 for injured construction workers in Illinois was $580,405,416. Nevertheless, in Illinois, information is not collected if an insurer or employer makes a payment independent of the commission. Because, the IWCC data does not capture external settlements, the true direct costs are likely much higher.

The cost of compensation for construction injuries represented ~4.5% of the total payments for workers' compensation claims made in Illinois between 2000 and 2005,[25] 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 with a mean cost of $10,084 for construction injuries in Oregon occurring in the early and mid-1990s.[9]

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, whereas the construction industry employs only 5% of all workers in the United States.[2,3]

TABLE 3
Cost Associated With Predictors of Compensation Cost ($USD) for Decided Claims Multivariable Robust Regression Model*

Variable	Parameter Estimate ($)	95% CI	P
Marital status: married	332	96–569	0.006
Age at accident	52	40–63	<0.001
Weekly wage	10	9–10	<0.001
Fatality	63,329	61,610–65,049	<0.001
Attorney representation	1,210	949–1,470	<0.001
No. body parts injured	800	428–1,172	<0.001
Cumulative temporary disability	2,462	2,451–2,473	<0.001
Cumulative permanent disability	883	876–890	<0.001

Illinois workers' compensation claims data, 2000–2005.
*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.

In the literature, there have been studies showing that use of attorneys by injured workers is associated with higher compensation costs.[13,14] One explanation for the association provided by the authors was that attorney involvement delayed the settlement of claims resulting in higher processing fees, although some have discussed alternative explanations for these findings.[26] 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 >$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 seems that the most important determinant of cost of compensation is not the cost associated with retaining an attorney but the severity of injury and the impairment rating.

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 who died while working, but this is to be expected because 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 toward 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 Census of Fatal Occupational Injuries data for Illinois.[27] Illinois Census of Fatal Occupational Injuries data showed that fatalities rose and fell erratically between 2000 and 2005. As the number of claims decreased between 2000 and 2005, the median compensation for an injured construction worker increased (Fig. 1). Financially, it makes sense to avoid injury disclosures and settle claims independently of the IWCC and insurance companies to minimize the impact on the employer's insurance premiums, particularly for less severe (ie, 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 (Fig. 1).

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. The purchased list seemed to contain all the largest employers ($N > 50$ employees) in the state when we cross-checked the list with alternative business sites such as Hoover's business directory. Based on the 2002 Economic Census,[28] there were ~30,555 construction companies in Illinois. In the final claims data set, we identified 6087 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 ~1943 companies to have claims filed by their employees if the distribution of claims was even across all employers (claim rate of 1.272 claims per 100 employees; median employees per company was ~5 per firm; 30,555 companies). In 2002, we identified 1891 companies with claims filed by their workers. This capture estimate is likely a best-case scenario. Our assumption that the rate of claims across employers is constant is unlikely. Nevertheless, it is unclear to what degree this would impact our capture estimate.

As a measure of severity, we used percent temporary and permanent

disabilities. This is not a perfect measure of severity, but it is the best available measure when using Illinois workers' compensation data. In Illinois, the attorneys and arbitrator are the ones that assign the final percent disability for a worker's injury that determines the level of compensation. The percent loss of function is based on the physician's assessment of short-term and long-term impairments. In contrast, days away from work may have nothing to do with impairment, because a worker can be working but transferred to "light" work or a job that can be accomplished despite impairment. 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 or chair at his workstation.

For this study, we used 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 (eg, 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 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 was the most important determinant of cost, although the method and uniformity of percent impairment allocation could be better elucidated. Retention of legal counsel by the worker was associated with a small 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, to determine whether the predictors identified in this study are relevant to other economic sectors.

Acknowledgment

The authors thank Sue Piha and Ray Gladych from the Illinois Workers' Compensation Commission for providing them with the data to complete this project.

Supported by a small study grant from the Center to Protect Workers' Rights. #08-1-PS. This work was also supported, in part, by the National Institute for Occupational Safety and Health (5 T42-OH008672).

References

1. Bureau of Labor Statistics. US Department of Labor. Survey of Occupational Injuries and Illnesses. 2007. Available at: http://www.bls.gov/news.release/osh.nr0.htm. Accessed March, 25. 2009.
2. Waehrer G, Dong XS, Miller TR, Haile E, Men Y. Costs of occupational injuries in construction in the United States. *Accid Anal Prev.* 2007;39:1258–1266.
3. Waehrer G, Dong XS, Miller TR, Men Y, Haile E. Occupational injury costs and alternative employment in construction trades. *J Occup Environ Med.* 2007;49:1218–1227.
4. Leigh JP, Waehrer GM, Miller TR, Keenan C. Costs of occupational injury and illness across industries. *Scan J Work Environ Health.* 2004;30:199–205.
5. National Academy of Social Insurance (NASI). *Workers' Compensation Data Fact Sheet: Workers' Compensation Coverage by State. Prepared for the International Association of Industrial Accident Boards and Commissions.* Number 1. Washington, DC: National Academy of Social Insurance (NASI): 2002.
6. Burton JF, Spieler E. *Workers' Compensation and Older Workers. Health and Income Security for an Aging Workforce.* Washington, DC: National Academy of Social Insurance; 2001.
7. Foley M, Silverstein B, Polissar N. The economic burden of carpal tunnel syndrome: long-term earnings of CTS claimants in Washington State. *Am J Ind Med.* 2007;50:155–172.
8. Hofmann J, Snyder K, Keifer M. A descriptive study of workers' compensation claims in Washington State orchards. *Occup Med.* 2006;56:251–257.
9. Horwitz IB, McCall BP. Disabling and fatal occupational claim rates, risks, and costs in the Oregon construction industry 1990–1997. *J Occ Environ Hyg.* 2004;1:688–698.
10. Horwitz IB, McCall BP. Occupational Injury among Rhode island adolescents: an analysis of workers' compensation claims, 1998 to 2002. *J Occ Environ Med.* 2005;47:473–481.
11. Shah SM, Bonauto D, Silverstein B, Foley M, Kalat J. Injuries and illnesses from wood framing in residential construction, Washington State, 1993–1999. *J Occup Environ Med.* 2003;45:1171–1182.
12. Lipscomb HJ, Dement JM, Behlman R. direct costs and patterns of injuries among residential carpenters, 1995–2000. *J Occup Environ Med.* 2003;45:875–880.
13. Bernacki EJ, Yuspeh L, Tao X. Determinants of escalating costs in low risk workers' compensation claims. *J Occup Environ Med.* 2007;49:780–790.
14. Bernacki EJ, Tao XG. The relationship between attorney involvement, claim duration, and workers' compensation costs. *J Occup Environ Med.* 2008;50:1013–1018.
15. Appel DA. Health care costs in workers' compensation. *Benefits Q 4th Quarter.* 1993;9:6–8.
16. Manufacturers' News, Inc. Evanston, Illinois. State Manufacturers Database of the Construction Industry: Illinois. 2007. Available at: http://www.manufacturersnews.com/. Accessed November 11, 2008.
17. US Census Bureau. 2005–2007 American Community Survey 3-Year Estimates. Available at: http://factfinder.census.gov/servlet/ADPTable?_bm=y&-geo_id=04000US17&-qr_name=ACS_2007_3YR_G00_DP3YR5&-ds_name=ACS_2007_3YR_G00_&-_lang=en&-_sse=on. Accessed March 2009.

18. US Postal Service. ZIP Code Lookup Tool. Available at: http://zip4.usps. com/zip4/welcome.jsp. Accessed March 2009.
19. Bureau of Labor Statistics. US Department of Labor. Current Employment Survey. State and Area Employment, Hours and Earnings. Available at: http://data.bls.gov/PDQ/outside.jsp?survey=sm. Accessed March 2009.
20. Parkhurst DF. Arithmetic versus geometric means for environmental concentration data. *Environ Sci Technol.* 1998;32:92A–98A.
21. Huybrechts T, Thas O, Dewulf J, Van Langenhove H. How to estimate moments and quantiles of environmental data sets with non-detected observations? A case study on volatile organic compounds in marine water samples. 2002;975:123–133.
22. Huber PJ. Robust regression: asymptotics, conjectures and the Monte Carlo. *Ann Stat.* 1973;1:799–821.
23. Huber PJ. *The Basic Types of Estimates, Robust Statistics.* New York: John Wiley & Sons; 1981:43–55.
24. Hampel FR, Ronchett EM, Rousseeuw PJ, Stahel WA. *Linear Models: Robust Estimation, Robust Statistics: The Approach Based on Influence Functions.* New York: John Wiley & Sons; 1986:315–328.
25. Illinois Workers' compensation Commission (IWCC). *FY 2007 Annual Report.* Chicago, IL: Illinois Government Printing Office; 2007.
26. Welch LS, Boden LI. Letter to the Editor. Re: Attorney involvement, claim duration, and workers' compensation costs. *J Occup Environ Med.* 2009;51:1–2.
27. Illinois Department of Public Health. Census of Fatal Occupational Injuries and Illnesses: Illinois, 2000, 2001, 2002, 2003, 2004, and 2005. Epidemiologic Report Series. Springfield, Illinois. Available at: http://www.idph.state.il.us/about/epi/cfoirpt.htm. Accessed March 2009.
28. US Census Bureau. *Economics and Statistics Administration. 2002 Economic Census. Survey of Business Owners: Company Statistics Series. SB02–00CS-COSUM.* Washington, DC: US Census Bureau; 2006.