

RISK FACTORS FOR INJURIES IN SMALL AND MEDIUM SIZED
CONSTRUCTION COMPANIES

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KATHERINE ELIZABETH SCHOFIELD

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BRUCE H. ALEXANDER, ADVISOR

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Dedication

This work is dedicated to my parents who taught me that anything is possible with belief in oneself, desire, dedication, and a bit of luck. To my husband, Derek; our lives have changed so much over the course of the past five years and I have never been happier. I am so blessed to have you. And to my baby boy, Jackson, my greatest gift, my greatest accomplishment.

Abstract

Background

Construction work is hazardous and often physically demanding and strenuous. The industry has a high rate of fatal injuries and contributes a high number of severe and non-fatal injuries. Small construction firms dominate the industry but published data pertaining to health and safety are limited. Those employed in the construction industry consistently rank in the top of all occupations and industries for illicit drug and heavy alcohol use. Additionally, hazards in the industry may be modified by human and organizational elements, as well as contact with a safety and health professional. In this study we examined risk factors for injury and increased injury severity in small-and-medium sized construction companies.

Methods

Workers' compensation claims data were evaluated covering 1,360 construction companies from 2004-2009. Four different hypotheses were tested.

For the first hypothesis our goal was to determine the associations between active company drug testing programs, injury rate, and severity; presence of a testing program was obtained from the compensation carrier. Hours at-risk and injury claims were used to determine injury rates. Drug testing programs were classified into two categories: pre-employment and post-accident, or pre-employment, post-accident, random, and suspicion testing. Rate ratios (RR) and 95% confidence intervals (CI) were estimated as a function of injury rate using a Poisson regression model and accounting for time-dependent factors. Generalized estimating equations were used to account for correlated observations within companies over time. Models include confounding covariates of company size, union status, and trade.

For the second hypothesis our goal was to determine the association of safety professionals' evaluations of management attitude and commitment to safety on injury rate and severity. Employee hours at-risk and claims were used to determine injury rates.

Rating of management attitude was done by safety professionals, employed by the insurance carrier, upon initial visit to member companies. A company had no rating until the initial visit. Based on an evaluation process to characterize hazard control practices of a company, and interactions between the company and safety professional, an attitude and commitment rating was assigned. Rate ratios (RR) and 95% confidence intervals (CI) were estimated as a function of injury rate using a Poisson regression model. Generalized estimating equations were used to account for correlated observations within companies. Models included confounding covariates of company size, union status, and trade.

For the third hypothesis, our goal was to determine the association of medical claims on risk of incidence of lost-time claim. The date of indemnity and medical claims were obtained from the compensation carrier. Time intervals were created based upon data of entrance into the study until date of lost-time claim. If a company had repeated lost time events, a new interval began after the date of the last lost-time claim. Incidence and frequency of medical claims during the intervals was calculated. Proportional hazards regression was used to model the time to lost-time claim event intervals. The effect of medical claims on risk of lost-time injury was evaluated by estimating hazard ratios (HR) and 95% confidence intervals (CI) as a function of injury rate. Each claim was considered to be independent of prior claims. The sandwich estimate was used to account for within company correlation and for its more robust estimates. The models included potentially confounding covariates of union status, company size, and hours worked.

For the fourth and final hypothesis, our goal was to determine the association of safety and health professional contact on risk of incidence of lost-time claim. The date of indemnity claims and safety and health (S &H) professional contact with the company were obtained from the compensation carrier. Time intervals were created based upon date of entrance into the study until the date of a lost-time claim. If a company had repeated lost-time events, a new interval began after the date of the last lost-time claim. Incidence and frequency of S&H professional contact with the member during the intervals was calculated. Proportional hazards regression was used to model the time to

lost-time claim event intervals. The effect of S&H professional contact on risk of lost-time injury were evaluated by estimating hazard ratios (HR) and 95% confidence intervals (CI) as a function of injury rate. Each claim was considered to be independent of prior claims. The sandwich estimate was used to account for within company correlation and for its more robust estimates. The models included potentially confounding covariates of union status, company size, and hours worked.

Results

Hypothesis One illustrated a lower rate of injury for those companies using a drug testing program. Compared to no testing, results respectively were RR=0.85 (CI=0.72-1.0) and RR=0.97 (CI=0.86-1.10) for overall injuries, and RR=0.78 (CI=0.60-1.03) and RR=1.01 (CI=0.86-1.19) for lost-time injuries. Analysis by specific trades revealed significant reductions, as great as 60% for some trades. Significantly lower rates were seen in both union and non-union companies with testing programs. Major injury event and injury type categories also had lower rates when testing programs were used.

For Hypothesis Two, companies were categorized as having a bad attitude or were not yet rated. Compared to good, results for these categories, respectively, were RR=0.94 (CI=0.74-1.19) and RR=1.11 (CI=1.03-1.21) for overall injuries, and RR=1.15 (CI=0.85-1.55) and RR=1.13 (CI=0.99-1.28) for lost-time injuries. In all categories of claims, we observed increased rate of injury claims for companies during the time that they had not been evaluated by a safety professional. Analysis by specific trades revealed some very significant increases in rate, for both categories of companies that had not yet been rated and companies with a poor rating. Prior to contact with a safety professional, we also observed increased injury rates for many injury mechanism, injury type, and claim dollar value categories.

Hypothesis Three revealed that, compared to experiencing 0-1 claims, increased risk occurred with experiencing 2-3 claims (HR=1.25, CI=1.32- 1.75), 4-6 claims (HR=1.36, CI=1.19- 1.56), and 7 or more claims (HR=1.52, CI=1.12- 1.39). Companies with a higher premium size were associated with greater risk of a loss time claim, as were union companies

With Hypothesis Four, compared to experiencing no contact, reduced risk occurred with experiencing one contact (HR=0.77, CI=0.67-0.88) and two contacts (HR=0.63, CI=0.55-0.74). Once companies reached the highest category of contacts, three or more, there was no longer a significant reduction in risk (HR= 1.06, CI= 0.92-1.22). Companies with a higher premium size were associated with greater risk of a loss time claim, as were union companies

Conclusions

The results indicate drug-testing programs may reduce injury rates in this population; however variations in a drug testing program's effect and magnitude must be considered. Results indicate subjective rating of attitude and commitment from a single visit may not be indicative of injury risk when examining basic injury trends, but may be more predictive when broken down by trade. However, workers were at increased risk of overall injuries, lost-time injuries, and medical injuries during the period prior to the contact with the health and safety professional. The contact of a S & H professional with a company is associated with decreased risk of severe injury claim, compared to no contact. There appears to be an association between frequency of minor injuries and incidence of severe injury.

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Organization

The organization of this thesis provides initial chapters including an introduction, comprehensive literature review, and comprehensive presentation of the research design and methods. These chapters are followed by four major papers (Chapters 3-6) that report the findings for the study; because these papers are prepared for publication in peer-reviewed journals, there is some redundancy in the first chapters pertaining to the literature cited and methods presented.

Chapter One

Background and Significance

Injuries in Construction

The construction industry is uniquely difficult and challenging to study due to the pace and organization of work and projects. Many physical hazards are present under normal conditions, and the work is often physically demanding and strenuous. Natural conditions and weather also can greatly affect the worksite as well as employee working conditions. This industry has a high rate of fatalities, annually; while it employs about 8% of the workforce, it experiences 22% of the fatalities (National Institute of Occupational Safety and Health (NIOSH), 2009). The construction sector also contributes to a high number of severe and non-fatal injuries (Courtney, Matz, & Webster, 2002; Dement & Lipscomb, 1999). Compared to other industries, employment in the construction industry has also been associated with a higher probability of disability should an injury occur on the job (Stover, Wickizer, Zimmerman, Fulton-Kehoe, & Franklin, 2007). In addition to the direct cost of injuries, there is an emotional and financial toll on injured workers and their families, along with their co-workers, places of employment, and the public (Waehrer, Dong, Miller, Haile, & Men, 2007). Workers' compensation claims cost does not take into account the indirect cost that add additional social and economic burden to the impact of the injury. These indirect costs include pain and suffering of the injured employee and their family, costs to the employer such as rehiring and retraining employees, loss of productivity, absenteeism, low morale, and burden on the community (Dong, Entzel, Men, Chowdhury, & Scott, 2004).

Small construction firms dominate the industry but published data pertaining to health and safety are limited. Nationally, small firms of fewer than 10 employees make up one fourth of the construction industry; yet, they experience one half of the fatal injuries (NIOSH, 2009). Small- and medium-sized companies have been shown to be at increased risk for fatal and non-fatal injuries, compared to larger companies (Lowery, et al., 1998). However, in most studies, one hundred employees or less is considered small, which is significantly larger than the average size firm. The US Census in 2007 reported that there were 15,863 employer construction establishments in the state of Minnesota and, in that same year, there were 134,584 employed in this sector (United States Census

Bureau, 2007). This is an average of approximately nine employees per establishment, with slightly less in recent years, indicating that the vast majority of establishments are small businesses, a trend that has not changed. The hazards encountered by small business, non-union and residential sectors are difficult to characterize due to limited information on work, hours, and injury occurrence (Lipscomb, Dement, & Behlman, 2003). Moreover, safety training and education is inconsistent and less likely to be categorized or documented. Non-union contractors lack some of the resources available to large and union contractors, and also do not receive the same amount of health and safety attention on their jobsites (Gillen, Baltz, Gassel, Kirsch, & Vaccaro, 2002). There are few published studies or reports that address both the residential sector and small- and medium-sized construction firms.

Substance Abuse in Construction

In addition to the already high risks posed by the work, pace, and environment, those employed in construction consistently rank in the top of all occupations and industries for illicit drug use and heavy alcohol use, a trend that has not changed in the last ten years, in addition to high reported prevalence of illicit drug (15.1%) and alcohol (17.8%) use within the last month. (Larson, Eyerman, Foster, & Gfroerer, 2007). The Worker Substance Use and Workplace Policy Report found that prevalence of drug and heavy alcohol use increased as the size of the company decreased (Larson, et al, 2007). Companies with fewer than ten employees had the highest past month prevalence of illicit drug use (9.9%) and were followed by establishments of 25 to 99 employees with a prevalence of 8.2% (Substance Abuse and Mental Health Administration (SAMHSA, 2008). The consequences of drug and alcohol use, especially while working in this high-risk occupation, can be costly and severe. Formalized occupational drug testing programs offer a potential mechanism to reduce the impacts of drug and alcohol in this industry. These have gained increasing exposure and acceptance in recent years; yet, many companies still have not adopted drug-free workplace policies, and construction companies rank near the bottom for testing employees (Gerber & Yacoubian Jr, 2002). Moreover, small companies are also least likely to have drug testing programs (Gerber & Yacoubian Jr, 2002). There has, however, been little consistent research that evaluates

the efficacy of these programs on preventing work-related injuries; specifically, in smaller construction companies and in regard to company and injury characteristics.

Management Role in the Prevention of Injuries

An important component of worker injury risk control, though difficult to characterize, is the human and organizational element; often referred to as a safety culture or climate which includes the dynamic attitudes, beliefs, and safety-related actions of company and its employees (Choudhry, Fang, & Mohamed, 2007; Cooper, 2000; Flin, Mearns, O'Connor, & Bryden, 2000; Guldenmund, 2000 ; Shannon, Mayr, & Haines, 1997). Management that is committed, and strongly supports, participates in, promotes, and enforces the safety culture and safety programs across all levels of an organization, have been shown to be the most effective (Choudhry, et al., 2007; Flin, et al., 2000; Lehtola, et al., 2008; Wirth & Sigurdsson, 2008; Zohar, 1980) While studies tend to highlight the effects of employee training (Dong, et al., 2004, Lowery, et al., 1998) or employee perception of company safety climate, little research has evaluated the opinions of trained outside entities, e.g. loss control specialists, on client's safety climate, control over hazards, and with respect to injury experience. The identification of this link, and enhancement of the ability to detect it, can have major ramifications both in proactive injury prevention, safety culture coaching, and reduction in insurance costs.

Safety and Health Professionals and Prevention of Injury

Numerous studies have researched the factors that influence the safety performance of construction companies. These include written safety programs, pre-job planning on sites, proper protective equipment, safety training and education, safety accountability, and jobsite inspections and monitoring (Liska & Goodloe, 1993; Lowery, et al., 1998; Glazner, Borgerding, Bondy, Lowery, Lezotte & Kreiss, 1999; Dement, Lipscomb, Li, Epling & Desai, 2003; Dong, Entzel, Men, Chowdhury & Scott, 2004; Geldart, Shannon & Lohfeld, 2005; Hoonakker, Loushine, Carayon, Kallman, Kapp & Smith, 2005; McDonald, Lipscomb, & Glazner, 2009; Mikkelsen, Spangenberg & Kines 2010), as well as safety climate and management commitment (Choudhry, Fang, & Mohamed, 2007; Flin, Mearns, O'Connor, & Bryden, 2000; Lehtola, et al., 2008; Wirth & Sigurdsson, 2008; Zohar, 1980). All of these factors usually are the direct responsibility

or under the direction and influence of a company safety representative, but the majority of small and medium sized construction establishments do not have the resources to employ a full-time safety director. Thus, the responsibilities and tasks must be distributed amongst other employees, management, or outside safety resources, if at all. Outside safety resources may take the form of OSHA enforcement or consultation (Haviland, Burns, Gray, Ruder & Mendeloff, 2010; Baggs, Silverstein, & Foley, 2003), hired consultants or trainers, resources from trade or professional organizations, or professionals from insurance carriers, to name a few, and there have been few studies on their effect on the workplaces with which they come in contact.

When focusing strictly on insurance carriers, studies have identified factors that lead to, and escalate the cost of, workers' compensation claims (Bernacki, Yuspeh, & Xuguang, 2007; Stover, et. al, 2007) Some have indicated the use of a team, including loss prevention and safety professionals, provided by the workers' compensation carrier, can reduce the rate of injury and lower the cost of existing claims once they occur (Green-McKenzie, Parkerson & Bernacki 1997; Bernacki, & Tsai, 2003; Davis, Badii, Yassi, 2004;)

Association of Minor Injuries and Severe Injuries

It is a commonly held belief in the workplace that a pattern of minor injuries will lead to higher likelihood of a severe injury. Hinze, J., J.N. Devenport, and G. Giang (2006) conducted research that focused on the hypothesis that the trends leading to minor injuries are not the same as the trends leading to more severe injuries and fatalities, thus they should be examined and targeted in different manners. A study of contracts during the building of the Denver International Airport also reported that having occurrences of minor, non-lost time injuries during the course of a contract increased the risk of having more severe, lost time injuries on that same contract (Lowery, et al., 1998). The presence of minor injuries may warrant more attention to prevent the occurrence of major injuries.

Injury Severity Classification

The most common breakdown of measures of claim severity in the workers' compensation industry are medical-only (non-compensable) and indemnity (lost time)

claims, and their respective dollar amount totals. In the event of a medical-only claim, an employee's full medical costs are covered, no wage loss is recovered by the employee for missing days, and the employee returns back to work within the non-compensable time frame set by each state. The standard non-compensable timeframe in Minnesota is three calendar days. If an employee does not return back to work within these three days, the claim turns into a compensable indemnity claim. This time frame is unique to each state and may range from 3-10 days. In addition to medical vs. indemnity classification, the type of injury, mechanism of injury, and cost of injury may also be analyzed as different ways to illustrate claim severity.

Workers' Compensation System, Employee Benefits, and Claim Reporting

In the United States, the worker's compensation system is organized and governed at the state level, often with many differences among states (Courtney, et al., 2002). When an employee is injured on the job in Minnesota, they are entitled to certain benefits paid through the workers' compensation system. The benefit levels paid to an injured employee are set by statute unique to Minnesota. Benefits include medical care for the injury, including physical rehabilitation, wage-loss benefits for part of lost income, payment for permanent damage of loss of function in a body part, benefits to spouse and/or dependents in the result of employee death, and/or, vocational rehabilitation if the employee cannot return to their pre-injury job or pre-injury employer. Minnesota state statutes classify lost-time/indemnity claims as those involving injuries or illnesses that result in more than three consecutive calendar days of lost work time and include payment of medical and wage loss costs. Medical-only claims involve injured or ill workers who receive care but have not missed more than three consecutive days of lost work time and only medical costs are incurred.

In the state of Minnesota, employees are required to report all injuries immediately to their supervisors and/or employers, and employers must report claims to their insurance provider within 10 calendar days. Non-reporting of injuries and/or self-payment of claims by employers are punishable by up to a \$10,000 fine, per occurrence.

Chapter 2

Research Design and Methods

Population Data and Collection

TBG is a self-insured workers' compensation fund that insures mainly small- and medium-sized construction and construction-related businesses within the state of Minnesota. Criteria for acceptance into TBG are based mainly on the company's established financial stability. The study included all companies insured by TBG during the time period 2004-2009. Employees working for these companies are predominantly Caucasian males, living and employed within the state of Minnesota.

Calculating Hours Worked for Time At-Risk

Person-time at risk for the population was based upon hours at-risk for each company by month, the unit of time used for analysis. Hours at-risk were estimated from monthly payroll reports submitted to TBG by each company for each employee. The person-time at risk data were also further broken down on a monthly basis by trade (risk class) within a company. Company level data were classified by union status and premium size.

Injury Ascertainment

Claims data captured all injury and illness submitted to TBG for compensation. First reports of injury are completed by office personnel or management within an insured company and then submitted to TBG where it is further processed and categorized by a claim manager. The injury is coded based upon the American Standard Method of Measuring and Recording Injury Experience of the American National Standards Institute (ANSI). Claims were classified as medical-only or lost-time/indemnity and also included information on mechanism of injury, type of injury, and cost of injury claim.

Drug Testing Program Classification

Presence of a drug-testing program was obtained from the compensation carrier, as reported by the insured, and verified by the carrier and internal carrier loss control department. Drug testing programs included: pre-employment; post-accident; random;

and reasonable suspicion. Pre-employment testing occurs prior to a prospective employee starting the job. Post-accident testing occurs after an employee is injured, injures another employee, or sometimes even after a pre-set value of equipment or materials are damaged in a workplace incident. Random testing occurs in pre-set intervals (monthly, quarterly, etc.) with a pre-set percentage of the safety-sensitive population of a company. Reasonable suspicion testing may occur if a trained supervisor is a first-hand witness or detects evidence of drug or alcohol use or suspects the employee is under the influence. Those companies participating in testing programs were categorized as pre-employment/post-accident programs, only (n=11,649,512 hours, 5,842 FTE) or participation in all four testing programs combined (n=25,673,201 hours, 12,836 FTE) versus no testing program (n=148,486,239 hours, 74,243 FTE). A distinction was made among testing programs because participation in all four types of testing is usually more management-intensive, higher in cost, and also associated with targeting a wider spectrum of potential drug users within the company. The majority of companies that contributed hours at-risk to the drug testing program categories started the study in the no testing program category.

Management Attitude and Commitment Classification and Loss Control Contacts

The Builders Group has a comprehensive loss control (LC) division which is designed to evaluate safety culture and potential risk of member companies, and then aid the companies in lowering the risk of injury to their employees, thus preventing workers' compensation claims, through evaluation, intervention, and training. The evaluations are conducted when a company enrolls in the program and then periodically thereafter, at the request of the company, when major changes in safety and/or operations have occurred, or in response to serious injury events. The LC evaluations capture a profile of companies that characterize level and frequency of employee training, presence or absence of safety programs, employee hazards and controls, and management attitude and commitment. Additional services and training programs that promote injury prevention and hazard controls are offered at no cost on a regular basis, but are adopted by the companies at varying levels.

The LC representatives are professionals with advanced degrees in their field and receive training to standardize the TBG evaluations. A standardized form is used when performing company evaluations (see attached). The form enables recording of major hazard categories, employee exposures, presence of safety programs, and what procedures and controls are in place. Additionally, there is a subjective summary measure of the LC representative's perception of attitude and commitment of management toward company safety. This rating is based upon the opinion of the LC representative after examining the safety information of the company and their interaction with company representatives. The mere presence of injury risk factors may not cause a poor rating if management is deemed to be open to assistance and desiring to improve. A company may be enrolled in the insurance program, but some time may pass before an initial evaluation occurs. The company will have no rating until this initial visit occurred. This provides an opportunity to evaluate the claims experience prior to the influence of the loss control activities. Ratings of management attitude and commitment are categorized as: poor/needs improvement (n=363 claims, n=7,195,780 hours, 3,597 FTE) or not yet rated (n=1,935 claims, n=33,730,250 hours, 16,865 FTE) vs. good (n=7,688 claims, 144,882,922 hours, 72,441 FTE).

In addition to evaluations, the LC department also provides a wide array of services and engages in contact with the member company. All contacts with the member are recorded. A contact with an insured may comprise any of the following activities: training; safety program development; evaluations; jobsite audits; claim reviews; recommendation follow-ups; or calls, emails, or other correspondence. These contacts may be based upon member request, premium size, claim activity, and/or internal LC directives, but there is no systematic system for contact with members.

Confounding Covariate Selection and Control

Careful selection of covariates will decrease the number of confounding factors and degree of bias (Greenland, Pearl, & Robins, 1999). Confounders were selected with a priori assumptions. Three covariates were selected as potential confounders for the models as identified in the following:

Industry work classification. Employees are categorized by job classifications based on National Council of Compensation Insurance (NCCI) codes. The NCCI codes are referred to as class codes, and describe the work activities each employee performs during the day. Codes of trades and activities with higher risks, such as iron work, will have much higher cost than low risk codes, such as office and clerical work. Class codes of the employees within a company were considered because they reflect the type of work and hazards encountered by the employee. Class codes were combined with other like class codes and condensed into 21 groups of trade.

Company Size. Company size was shown to be an important predictor of escalating workers' compensation claim cost (Bernacki, et al., 2007) as well as injury rate (NIOSH, 2009), injury reporting (Fan, Bonauto, Foley, & Silverstein), and severity of injuries (Kines & Mikkelsen, 2003). Smaller companies were at greater risk. Another study also illustrated that risk of worksite injury is heightened for contacts involving small-and-medium sized companies (Lowery, et al., 1998). One study showed an interesting trend regarding company size and injury rate. Results determine that the smallest companies had the highest relative rate of serious injuries, while larger companies had the highest rates of minor injuries. (Kines & Mikkelsen, 2003). Company size may affect the type of work the company does, regulatory enforcement focus, ability to return injured employees to work, the magnitude and sophistication of safety programs, along with the funds and personnel to manage these programs. Stratification by company size allowed evaluation of possible confounding by company size, and also more accurate results. Company insurance premium was used as a surrogate for company size. Companies were divided into three premium bands, \$0-15K \$15,001-75K, and \$>75,001, based on natural division and insurance practices for this population.

Union Status. Union status was another important factor to consider. A study on predicative factors of disability in workers' compensation claims indicated that companies whose employees belong to a labor union may be more likely to file workers' compensation claims (Fan, et al.; Stover, et al., 2007), and that the claims that are filed are less severe (Stover, et al., 2007). This could be due, in part to more support from the labor unions to injured employees and less anxiety about job loss or ramifications from filing a claim for injured employees who are union (Stover, et al., 2007). In one study,

union members were more likely to perceive working in a more supportive and responsive safety environment in which they were made more aware of dangerous conditions than non-union workers. They also reported receiving more training and instruction (Gillen, et al., 2002). Union support also appeared to increase safety cooperation and support of behavior safety measures among its members (Wirth & Sigurdsson, 2008). Stratification by union status allowed evaluation of possible confounding by union status, and also more accurate results.

Human Subjects Protection

The research and design methods of the project have undergone review by the University of Minnesota Institutional Review Board and Human Subjects Committee #1004P80574. It was determined that the study was exempt from review under federal guidelines 45 CFR Part 46.101(b) category #4 EXISTING DATA; RECORDS REVIEW; PATHOLOGICAL SPECIMENS. The study was granted permission to commence under the outlined study methods. Statistics on gender and race were not available for the overall population of this study. There were no exclusions on the basis of either gender or race in the study; the inclusion of children was not relevant in this study that involved a working population with an expected age range between 18 and 75 years of age. All companies, and their employees, insured by TBG were included in this study

Chapter Three

Effect of Drug Testing Programs on Injury Rate and Severity in Small and Medium Sized
Construction Companies

Abstract

Objective: Construction work is hazardous and workers consistently rank in the top of all occupations and industries for illicit drug and heavy alcohol use. The goal of the study was to determine the associations between active company drug testing programs, injury rate, and severity.

Methods: Workers' compensation claims data were evaluated covering 1,360 construction companies from 2004-2009. Presence of a drug testing program was obtained from the compensation carrier. Hours at-risk and injury claims were used to determine injury rates. Rate ratios (RR) and 95% confidence intervals (CI) were estimated as a function of injury rate using a Poisson regression model and accounting for time dependent factors. Generalized estimating equations were used to account for correlated observations within companies over time. Models included confounding covariates of company size, union status, and trade. Drug testing programs were classified into two categories: pre-employment and post-accident, or pre-employment, post-accident, random, and suspicion testing.

Results: Compared to no testing, results respectively were RR=0.85 (CI=0.72-1.0) and RR=0.97 (CI=0.86-1.10) for overall injuries, and RR=0.78 (CI=0.60-1.03) and RR=1.01 (CI=0.86-1.19) for lost-time injuries. Analysis by specific trades revealed significant reductions, as great as 60% for some trades. Significantly lower rates were seen in both union and non-union companies with testing programs. Major injury event and injury type categories also had lower rates when testing programs were used.

Conclusion: The results indicate drug-testing programs may reduce injury rates in this population; however variations in a drug testing program's effect and magnitude must be considered.

Introduction

The construction industry is uniquely difficult and challenging to study due to the pace and organization of work and projects. Many physical hazards are present under normal conditions, and the work is often physically demanding and strenuous. Natural conditions and weather also can greatly affect the worksite as well as employee working conditions. This industry has a high rate of fatalities, annually; while it employs about 8% of the workforce, it experiences 22% of the fatalities (National Institute of Occupational Safety and Health (NIOSH), 2009). The construction sector also contributes to a high number of severe and non-fatal injuries (Courtney, Matz, & Webster, 2002; Dement & Lipscomb, 1999). Compared to other industries, employment in the construction industry has also been associated with a higher probability of disability should an injury occur on the job (Stover, Wickizer, Zimmerman, Fulton-Kehoe, & Franklin, 2007). In addition to the direct cost of injuries, there is an emotional and financial toll on injured workers and their families, along with their co-workers, places of employment, and the public (Waehrer, Dong, Miller, Haile, & Men, 2007). This comprehensive cost has been shown to be disproportionately high in construction, almost double the cost, compared to other industries (Waehrer, et al., 2007).

Small construction firms dominate the industry but published data pertaining to health and safety are limited. Nationally, small firms of fewer than 10 employees make up one fourth of the construction industry; yet, they experience one half of the fatal injuries (NIOSH, 2009). Small- and medium-sized companies have been shown to be at increased risk, compared to larger companies (Lowery, et al., 1998). However, in most studies, one hundred employees or less is considered small, which is significantly larger than the average size firm. The US Census in 2007 reported that there were 15,863 employer construction establishments in the state of Minnesota and, in that same year, there were 134,584 employed in this sector (United States Census Bureau, 2007). This is an average of approximately nine employees per establishment, with slightly less in recent years, indicating that the vast majority of establishments are small businesses, a trend that has not changed. The hazards encountered by small business, non-union and residential sectors are difficult to characterize due to limited information on work, hours,

and injury occurrence (Lipscomb, Dement, & Behlman, 2003). Moreover, safety training and education is inconsistent and less likely to be categorized or documented. Non-union contractors lack some of the resources available to large and union contractors, and also do not receive the same amount of health and safety attention on their jobsites (Gillen, Baltz, Gassel, Kirsch, & Vaccaro, 2002). There are few published studies or reports that address both the residential sector and small- and medium-sized construction firms.

In addition to the already high risks posed by the work, pace, and environment, those employed in construction consistently rank in the top of all occupations and industries for illicit drug use and heavy alcohol use, a trend that has not changed in the last ten years (Larson, Eyerman, Foster, & Gfroerer, 2007). The Worker Substance Use and Workplace Policy Report found that prevalence of drug and heavy alcohol use increased as the size of the company decreased (Larson, et al, 2007). Companies with fewer than ten employees had the highest past month prevalence of illicit drug use (9.9%), followed by establishments of 25 to 99 employees with a prevalence of 8.2% (Substance Abuse and Mental Health Administration (SAMHSA, 2008). The consequences of drug and alcohol use, especially while working in this high-risk occupation, can be costly and severe. Formalized occupational drug testing programs offer a potential mechanism to reduce the impacts of drug and alcohol in this industry. These have gained increasing exposure and acceptance in recent years; yet, many companies still have not adopted drug-free workplace policies, and construction companies rank near the bottom for testing employees (Gerber & Yacoubian Jr, 2002). Moreover, small companies are also least likely to have drug testing programs (Gerber & Yacoubian Jr, 2002). There has, however, been little research that evaluates the efficacy of these programs on preventing work-related injuries, specifically, in smaller construction companies and in regard to company and injury characteristics.

The objective of this study was to evaluate the impact of active company drug testing programs on the rates and severity of injuries sustained by workers in small-and-medium sized construction firms.

Materials and Methods

Population Data and Collection

Workers' compensation claims were used to examine injuries in employees of construction companies who obtained workers' compensation insurance from The Builders Group (TBG). TBG is a self-insured workers' compensation fund that insures mainly small- and medium-sized construction and construction-related businesses within the state of Minnesota. Criteria for acceptance into TBG are based mainly on the company's established financial stability. The study included all companies insured by TBG during the time period 2004-2009.

Person-time at risk for the population was based upon hours at-risk for each company by month. Hours at-risk were estimated from monthly payroll reports submitted to TBG by each company for each employee. The person-time at risk data were also further broken down on a monthly basis by trade (risk class) within a company. Company level data were classified by union status and premium size. Payroll data were audited internally at TBG, and externally, for accuracy. Payroll and trade are the main factors that determine a company's premium size. The premium size, in general, correlates with the number of employees at a company, what type of work those employees are doing, and past claims' experience. To help control for potential confounding, companies were divided into three premium bands, \$0-15K \$15,001-75K, and \$>75,001.

Claims Data, Collection, and Outcomes

Claims data captured all injury and illness events submitted to TBG for compensation. First reports of injury are completed by office personnel or management within an insured company and then submitted to TBG where they are further processed and categorized by a claim manager. Claims data included information on mechanism of injury, type of injury, cost of injury claim, and amount of lost work time. Claims were classified as medical-only or lost-time/indemnity. Minnesota state statutes classify lost-time/indemnity claims as those involving injuries or illnesses that result in more than three consecutive calendar days of lost work time and include payment of medical and

wage loss costs. Medical-only claims involve injured or ill workers who receive care but have not missed more than three consecutive days of lost work time and only medical costs are incurred. In addition to this initial classification, claims were grouped by alternative injury outcomes and severity metrics. This included total claims, lost-time claims, medical claims, mechanisms of injury, types of injury, and cost of injury claim. The mechanism of injury, type of injury, and cost of injury claim were collapsed from the original data into fewer categories containing similar groups and descriptions for more robust analyses.

Drug Testing Program Classification

Presence of a drug-testing program was obtained from the compensation carrier, as reported by the insured, and verified by the carrier and internal carrier loss control department. Drug testing programs included: pre-employment; post-accident; random; and reasonable suspicion. Pre-employment testing occurs prior to a prospective employee starting the job. Post-accident testing occurs after an employee is injured, injures another employee, or sometimes even after a pre-set value of equipment or materials are damaged in a workplace incident. Random testing occurs in pre-set intervals (monthly, quarterly, etc.) with a pre-set percentage of the safety-sensitive population of a company. Reasonable suspicion testing may occur if a trained supervisor is a first-hand witness or detects evidence of drug or alcohol use or suspects the employee is under the influence. Those companies participating in testing programs were categorized as pre-employment/post-accident programs, only (n=11,649,512 hours, 5,842 FTE) or participation in all four testing programs combined (n=25,673,201 hours, 12,836 FTE) versus no testing program (n=148,486,239 hours, 74,243 FTE). A distinction was made among testing programs because participation in all four types of testing is usually more management-intensive, higher in cost, and also associated with targeting a wider spectrum of potential drug users within the company. The majority of companies that contributed hours at-risk to the drug-testing program categories started the study in the no testing program category.

Analysis

The claims and payroll data were used to estimate rates for overall injuries, lost-time injuries, medical-only injuries, and by mechanism of injury, type of injury, and cost of injury. Overall, lost-time, and medical claims analyses were further stratified by trade and union status. The effects of the different drug testing programs were evaluated by estimating rate ratios (RR) and 95% confidence intervals (CI) as a function of injury rate, using a Poisson regression model and accounting for time-dependent factors (Haenszel, Loveland, & Sirken, 1962). The hours at-risk of companies that transitioned from no testing to a drug-testing program during the study time period were changed at month of the switch to the new categorization. Generalized estimating equations were used to account for correlated observations within companies over time (Liang & Zeger, 1986). Overall claims, lost-time, and medical claims models included confounding covariates of company premium size, union status, and trade. Mechanism of injury, type of injury, and total claim dollar models included confounding covariates of company premium size and union status. All analyses were done using SAS (2011).

Results

During the study period, 1,360 companies compiled 185,808,952 hours of employee time at risk, representing approximately 92,882 full time equivalent employees (FTE) and 9,986 workers' compensation claims for an average claim rate of 10.54 per 100 FTE. Total incurred cost of claims during this period was \$90,416,073. Claim rates varied among trade categories, and union companies and companies of larger premium size had higher injury rates (Table 1).

Compared to no testing, results for pre-employment/post-accident only or all four testing types of testing combined were, respectively: RR=0.85 (CI=0.72- 1.0) and RR=0.97 (CI=0.86-1.10) for overall claims; RR=0.79 (CI=0.60-1.03) and RR=1.02 (CI=0.87-1.19) for lost time claims; RR=0.86 (CI=0.73-1.02) and RR=0.96 (CI=0.84-1.10) for medical-only claims. In all categories of claims, lower injury rates were observed with the pre-employment/post-accident testing programs (Table 2).

Analysis by specific trades revealed significantly lower rates of injury, some as great as 60%. For the following trades, lower rates in injuries were associated with drug testing programs: interior carpentry; heating/ventilation/air-conditioning (HVAC) and plumbing; flooring installation and flatwork; painting; concrete and masonry; roadwork and equipment operators; and garbage and recycling. With the exception of flooring installation and flatwork, which had lower rates with both pre-employment/post-accident and all four types of testing programs, all trade-specific reductions in overall injury rates occurred only in one testing category or the other, not both (Table 3). Supervisors, however, had a higher injury rate when their companies participated in testing programs. Further exploring injury rates by trade and lost time injuries, only flooring installation and flatwork and concrete and masonry continued to show lower rates with testing programs (Table 4).

Upon stratification by union status, union companies had an overall claim rate $RR=0.86$ ($CI=0.72-1.02$) and lost time injury $RR=0.80$ ($CI=0.63-1.01$) reductions with the all four-type Pre/Post/Random/Reason program combination. Non-union companies had an overall lower injury rate with the pre-employment/post-accident testing programs ($RR=0.85$, $CI=0.69-1.03$), but not with lost-time injuries. Neither union nor non-union companies illustrated significantly lower injury rates in medical-only claims with either type of testing program (Table 5).

The significant results of the mechanism of injury categories for this population are detailed in this paragraph. The use of pre-employment/post-accident drug testing programs were associated with lower risk for straining ($RR=0.62$, $CI=0.47-0.81$), general slips, trips, and falls ($RR=0.70$, $CI=0.5-0.96$), struck by/flying objects ($RR=0.63$, $CI=0.42-0.97$), cumulative/repetitive trauma ($RR=0.32$, $CI=0.19-0.53$), and slips, trips, and falls from the same level ($RR=0.24$, $CI=0.07-0.89$). Use of all four types of drug testing programs was associated with lower risk for strains, not otherwise classified ($RR=0.79$, $CI=0.62-1.00$), powered and hand tools ($RR=0.65$, $CI=0.47-0.88$), and falls from ladders and scaffolding ($RR=0.49$, $CI=0.31-0.76$).

Drug testing programs illustrated lower rates in most of the major injury types experienced by this population and significant results are highlighted in this paragraph. Pre-employment/post-accident testing was associated with lower risk for following injury

types: strains/sprains (RR=0.73, CI=0.59-0.91); bruises and contusions (RR= 0.45, CI= 0.27-0.75); foreign object in eye (RR= 0.69, CI=0.45-1.04); penetration injuries (RR=0.57, CI=0.37-0.88); and dislocations (RR=0.56, CI=0.34-0.91). The combination of all four types of testing programs was also associated with reduced risk, although to a lesser degree: of strains/sprains (RR=0.91, CI=0.79-1.05); bruises and contusions (RR= 0.74, CI= 0.59-0.94); and penetration injuries (RR=0.61, CI=0.40-0.93).

Drug testing in the pre-employment/post-accident category was associated with lower injury rates within the lower total claim dollar amount categories, with significant results described in this paragraph. Lower injury rates occurred with claims \geq \$0 to $<$ \$1,000 (RR=0.71, CI=0.58-0.85), \geq \$1,000 to $<$ \$5,000 (RR=0.69, CI=0.54-0.88), and \geq \$10,000 to $<$ \$25,000 (RR=0.68, CI=0.45-1.03). No difference was seen for either category of drug testing involving claims of \geq \$5,000 to $<$ \$10,000, \geq \$25,000 to $<$ \$50,000, \geq \$50,000 and $<$ \$100,000 and \geq \$100,000.

Discussion

This analysis indicates that drug testing programs may lower injury rates in this population; however, effects vary by trade, union status, and type of testing program. Results also vary based upon the mechanism of injury, the type of injury, and the total dollar amount incurred on the injury claim. Although the effects of the testing programs varied, there was a general consistency of lower rates of claims following implementations of drug testing programs.

Several potential limitations should be considered when interpreting the data. It is possible that not all injuries incurred during employment are captured by worker compensation systems. The effect of this underreporting, however, is likely lower in TBG companies because TBG collects information on all claims filed, including incident-only claims, and not just claims paid or with time loss. This aids a more complete capture of injury events. Moreover, TBG actively trains company owners and employees on the importance of reporting all injuries, as well as describing the consequences of non-reporting. It is conceivable that the effect of drug testing programs reduced injury claims reporting and not actual injuries. Underreporting in the claims data

for this reason would be more likely with less severe injuries, which are easier to conceal and cover out of pocket. Our results did show drug testing was associated with reductions in the less and the more costly injuries. Moreover, it is important to note that the reporting of claims is not conditional on a drug-testing program. The employees' perceptions of possible consequences from being injured and potentially testing positive for drug or alcohol use may negatively influence injury reporting in companies with drug testing programs-- theoretically, a problem when post-accident testing is used. However, Minnesota drug testing statutes (Minnesota Reliability and Fairness Safeguards, 2010) states that an employee cannot be fired nor can their workers' compensation claim be denied based on a positive drug test. An employer must offer the employee the chance to seek evaluation and treatment if they test positive while on the job. Only if an employee refuses, or does not follow and complete the prescribed treatment, can they then be terminated. Never the less, it is still possible that this could reduce reporting of claims in companies with drug testing programs because employees are not aware of the state statutes or still fear discipline and termination regardless of the statutes. Generalizability of our results is also a consideration. This analysis is limited to one workers' compensation insurer in one state. TBG is the largest insurer of construction companies in Minnesota and covers a substantial proportion of the small- and medium-sized construction firms that work in the full spectrum of construction trades and types of building projects. While construction practices may vary regionally, overall the work methods and procedures done by this cohort of companies are very similar to operations nationwide.

The limitations of this analysis were offset by several unique strengths of this study. The data used for this study provide a more complete picture than workers' compensation data alone, with comprehensive information on the population at risk, injury and illness claims, and company policies pertaining to drug testing as a risk-reduction method. This data resource is unique in that data are available that characterize company practices prior to the injury events, and also through time, to track changes. The data capture small- and medium-sized construction companies, including all companies insured by TBG so no survey or response methods are needed, and are detailed enough to be able to break down types of drug testing programs into distinct

groups. The availability of company characteristics such as trade, union status, premium size, and additional injury descriptors provided a robust analysis.

There are multiple considerations when examining the effectiveness of a program or type of testing. The timeframe from implementation of a drug-testing program to the achievement of desired results may be highly varied, plus quality and consistency of testing could vary from company to company. For some companies, there may be multiple issues creating injury problems; thus, a drug testing program may be just one option in a multifaceted approach to mitigate or reduce injuries, and may not solve all injury problems. If the program is implemented specifically to target certain employees or groups of employees, the program may have inadequate ability to access target employees if they are already hired. This could happen when a problem individual is never picked at random for a test, does not act in a suspicious enough manner to be called out for testing, and/or escapes involvement in an accident/incident that triggers testing, yet continues to work under the influence.

Of note, the observed lower injury rates associated with drug testing were inconsistent across the types of testing programs. Lower rates were more often associated with the pre-employment and post-accident testing combination only, but not as frequently with all four types of testing. It would seem counterintuitive that fewer types of testing (pre-employment/post-accident only programs versus using all four types of testing programs) would result in lower rates of injury more often. A possible explanation for some of these situations could be that an employer having a high amount of injuries, personnel, and/or safety issues may be more likely to implement all four types of testing to try to solve the issues; however, the drug testing alone may not be enough to sufficiently combat or address all the underlying issues. Or perhaps, since using all four types of drug testing for a program within a company requires higher levels of company management, organization, and oversight, those companies conducting all four types of testing simply are more organized or sophisticated and have lower risks of injury and, thus, acquire less direct benefit from testing.

Lower risk of injury with some type of drug testing program occurred for most of the major mechanism of injury categories and injury type categories for this population—those that occurred with the most frequency. This was especially notable for the

mechanism of injury categories of strains, general slips, trips, and falls, cumulative/repetitive trauma injury, slips, trips, and falls from the same level, and falls from ladders and scaffolding. Besides occurring frequently in the population, all of these have the potential for severe or disabling injury, lost work time, and high claim costs. Falls are of particular concern in the construction industry, and strain and cumulative trauma injuries are a major issue for an aging American workforce.

When examining total claim value, drug-testing programs were associated with lower rates of injury (around 30%) in three of the lower dollar value categories. Lower rates were illustrated in the very high value claims that are generally indicative of more severe or catastrophic claims. Ideally, these are the types of claims that are the most important to prevent or reduce, but are also the claims that tend to occur much less frequently and have multiple, often complex variables that determine total cost and far beyond the control of a drug testing program.

There were some instances where a testing program was associated with higher rates of injury. This included the supervisor trade; possible explanations for an increased injury rate for this trade include higher injury reporting within this trade, compared to other trades, older and aging employees who incurred more injuries moving to this classification, or that employers purposely misclassify employees into this trade for insurance purposes in order to receive lower premium rates when, in reality, work being done is of a higher risk category. However, reasons why any of these possible scenarios would occur more frequently in companies with testing than without testing programs are not clear.

Overall findings are consistent with reports of others in that drug-testing programs appeared to be associated with reduced injury rates and/or risk. A study that showed a particularly strong association between drug testing programs and injury reduction examined only the construction industry; experience modification rates of companies' pre-drug testing implementation and post-implementation injuries were compared, and it showed the average company dropped its injury incidence rate by 51% within two years of implementation of drug testing (Gerber & Yacoubian Jr, 2002). In a study of workers' compensation data from Washington State, injury rates were monitored over a seven-year period between firms enrolled in a drug-testing program and those not

enrolled in a drug testing program. The results showed a significant decrease in injury rates for three industry groups, including construction. Construction had the largest observed change in the injury rates, a difference of 4.78 injuries per 100 person-years (Wickizer, Kopjar, Franklin & Joesch, 2004).

Summary

Drug testing programs may result in lower injury rates in small-and-medium construction firms, including those with severe, lost-time claims, in high-risk trades, and are frequent and major contributors to injury. Variations in a drug testing program's effect and magnitude are based upon multiple factors and must be considered.

Impact on Industry

Identifying practical methods to prevent injuries in an underrepresented population is an important goal in construction safety research. Focusing on modifiable characteristics, such as a drug-testing program, is key to translating research findings into actionable practices in the construction industry for both small and large contractors. Drug testing programs are not difficult to implement, are relatively low in cost, and present little to no risk for employees. In a population at high risk of injury, drug-testing programs appear to be one feasible method of reducing injury burden to workers. The results may also provide evidence for the companies already using drug-testing programs that the programs are of value and worth continuing.

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Table 1 Overall, Lost-Time, and Medical Claims and Claim Rates[†] by Trade, Union Status, and Premium Size

Exposed	Overall Claims (n)	Overall Rates	Lost-Time Claims (n)	Lost-Time Rates	Medical Claims (n)	Medical Rates
<i>Total Population</i>	9,986	10.54	2,292	2.46	7,693	8.15
<i>Trade</i>						
Rough Carpentry	1,835	24.32	452	600.00	1,382	18.32
Interior Carpentry	336	20.53	77	4.79	259	15.92
Supervisors	259	5.31	60	1.24	199	4.09
Crane Operators	33	9.75	11	3.26	22	6.50
Sales and Retail	158	0.54	22	0.08	136	0.47
Shop, Yard, and Deliveries	1,240	7.56	238	1.46	1,002	6.11
Drywall	601	16.71	173	4.81	428	11.90
HVAC and Plumbing	1,304	26.22	259	5.21	1,045	21.02
Auto Repair	50	13.49	11	2.97	39	10.52
Roofing	94	31.12	27	8.95	67	22.21
Manufacturing	606	19.00	85	2.67	521	16.35
Flooring Installation and Flatwork	441	24.05	123	6.72	318	17.35
Trucking	19	7.82	5	2.06	14	5.76
Electric Installation	271	14.22	48	2.52	223	11.70
Painting	437	14.61	104	3.48	333	11.14
Concrete and Masonry	1,107	14.39	334	4.38	773	10.07
Iron and Steel	274	82.79	58	17.62	216	65.34
Roadwork and Equipment Operators	310	11.22	89	3.24	221	8.01
Garbage and Recycling	155	12.42	33	2.65	122	9.79
Nursery and Landscaping	287	23.96	54	4.53	233	19.46
Equipment Installation and Assembly	169	21.11	29	3.66	140	17.56
<i>Union Status</i>						
Non-Union	5,920	9.83	1,272	2.13	4,647	7.73
Union	4,066	11.86	1,020	3.07	3,046	8.94
<i>Premium Size Classification</i>						
\$0-15K	788	7.23	198	1.83	590	5.42
\$15,001-75K	4,226	9.49	940	2.13	3,285	7.40
\$>75,001	4,972	12.76	1,154	3.02	3,818	9.83

[†] Rate per 100 FTE (200,000 hours)

Table 2 Risk of Injury by Claim Type and Drug Testing Program

	Testing Program	Hours	Claims	RR[†]	95% CI
Total	No Program	148,486,239	8,035	1.00	.
	Pre-Employment/Post-Accident	11,649,512	531	0.85	0.72-1.0
	Pre/Post/Random/Reasonable	25,673,201	1,420	0.97	0.86-1.10
Lost Time	No Program	148,486,239	1,844	1.00	.
	Pre-Employment/Post-Accident	11,649,512	118	0.79	0.60-1.03
	Pre/Post/Random/Reasonable	25,673,201	330	1.02	0.87-1.19
Medical	No Program	148,486,239	6,190	1.00	.
	Pre-Employment/Post-Accident	11,649,512	413	0.86	0.73-1.02
	Pre/Post/Random/Reasonable	25,673,201	1,090	0.96	0.84-1.10

[†] Controlling for Trade, Union Status, and Premium Size

Table 3 Risk of Total Injuries by Drug Testing Program and Trade

Trade	Testing Program	Hours	Claims (n)	RR [†]	95% CI
Rough Carpentry	No Program	13,375,077	1,624	1.00	.
	Pre-Employment/Post-Accident	507,843	63	0.96	0.70-1.33
	Pre/Post/Random/Reason	1,193,401	148	0.94	0.65-1.36
Interior Carpentry	No Program	2,519,330	277	1.00	.
	Pre-Employment/Post-Accident	335,753	19	0.51	0.28-0.95
	Pre/Post/Random/Reason	357,853	40	1.00	0.66-1.52
Supervisors	No Program	7,725,836	176	1.00	.
	Pre-Employment/Post-Accident	421,446	18	1.83	0.96-3.46
	Pre/Post/Random/Reason	1,542,853	65	1.98	1.29-3.03
*Crane Operators	No Program	346,022	21	1.00	.
	Pre-Employment/Post-Accident	182	0	1.00	.
	Pre/Post/Random/Reason	329,711	12	1.00	.
Sales and Retail	No Program	46,944,257	137	1.00	.
	Pre-Employment/Post-Accident	3,717,600	6	0.58	0.23-1.41
	Pre/Post/Random/Reason	7,156,884	15	0.79	0.45-1.38
Shop, yard, and Deliveries	No Program	26,226,549	976	1.00	.
	Pre-Employment/Post-Accident	1,667,846	57	0.93	0.53-1.61
	Pre/Post/Random/Reason	4,814,739	207	1.09	0.83-1.43
Drywall	No Program	6,044,573	516	1.00	.
	Pre-Employment/Post-Accident	610,836	47	0.77	0.54-1.10
	Pre/Post/Random/Reason	535,778	38	0.87	0.56-1.35
HVAC and Plumbing	No Program	8,079,458	1,089	1.00	.
	Pre-Employment/Post-Accident	560,109	92	1.21	0.99-1.48
	Pre/Post/Random/Reason	1,302,241	123	0.69	0.53-0.90
Auto Repair	No Program	464,159	34	1.00	.
	Pre-Employment/Post-Accident	100,023	4	0.85	0.50-1.43
	Pre/Post/Random/Reason	175,654	12	0.98	0.41-2.33
Roofing	No Program	544,192	81	1.00	.
	Pre-Employment/Post-Accident	20,634	9	1.00	.
	Pre/Post/Random/Reason	38,423	4	1.00	.
Manufacturing	No Program	4,744,171	412	1.00	.
	Pre-Employment/Post-Accident	133,399	9	0.79	0.31-2.05
	Pre/Post/Random/Reason	1,478,566	185	1.23	0.78-1.95
Flooring Installation and Flatwork	No Program	2,765,899	361	1.00	.
	Pre-Employment/Post-Accident	131,273	9	0.40	0.22-0.72
	Pre/Post/Random/Reason	762,373	71	0.46	0.27-0.77
*Trucking	No Program	311,875	6	1.00	.
	Pre-Employment/Post-Accident	.	.	.	.
	Pre/Post/Random/Reason	174,537	13	7.23	0.86-5.27
Electric Installation	No Program	3,242,309	234	1.00	.
	Pre-Employment/Post-Accident	228,718	15	1.08	0.80-1.46
	Pre/Post/Random/Reason	337,082	22	0.95	0.54-1.69
Painting	No Program	4,757,715	354	1.00	.
	Pre-Employment/Post-Accident	629,966	36	0.73	0.59-0.90
	Pre/Post/Random/Reason	592,976	47	1.01	0.66-1.55
Concrete and Masonry	No Program	11,640,161	897	1.00	.
	Pre-Employment/Post-Accident	1,510,854	73	0.59	0.40-0.86
	Pre/Post/Random/Reason	2,093,159	137	0.84	0.62-1.14
*Iron and Steel	No Program	536,480	169	1.00	.
	Pre-Employment/Post-Accident	.	.	.	.
	Pre/Post/Random/Reason	121,692	105	0.63	0.19-2.05
Roadwork and Equipment Operators	No Program	3,604,441	212	1.00	.
	Pre-Employment/Post-Accident	760,879	32	0.59	0.35-1.01
	Pre/Post/Random/Reason	1,133,121	66	1.00	0.65-1.55
Garbage and Recycling	No Program	1,787,875	116	1.00	.
	Pre-Employment/Post-Accident	92,600	6	0.67	0.43-1.04
	Pre/Post/Random/Reason	606,078	33	0.88	0.56-1.39

Nursery and Landscaping	No Program	1,942,568	242	1.00	.
	Pre-Employment/Post-Accident	24,237	2	0.89	0.26-3.05
	Pre/Post/Random/Reason	419,060	43	0.91	0.47-1.76
Equipment installation and Assembly	No Program	883,292	101	1.00	.
	Pre-Employment/Post-Accident	195,315	34	1.39	0.70-2.78
	Pre/Post/Random/Reason	507,022	34	0.63	0.29-1.36

†Controlling for company premium size and union status,

*All hours at-risk in No Program or All Four Drug Testing Programs

Table4 Risk of Lost Time Injuries by Drug Testing Program and Trade

Trade	Testing Program	Hours	Claims (n)	RR [†]	95% CI
Rough Carpentry	No Program	13,375,077	402	1.00	.
	Pre-Employment/Post-Accident	507,843	15	0.97	0.59-1.58
	Pre/Post/Random/Reason	1,193,401	35	0.87	0.51-1.49
Interior Carpentry	No Program	2,519,330	63	1.00	.
	Pre-Employment/Post-Accident	335,753	5	0.53	0.22-1.27
	Pre/Post/Random/Reason	357,853	9	1.06	0.47-2.38
Supervisors	No Program	7,725,836	41	1.00	.
	Pre-Employment/Post-Accident	421,446	4	1.65	0.59-4.59
	Pre/Post/Random/Reason	1,542,853	15	1.89	0.92-3.86
*Crane Operators	No Program	346,022	7	1.00	.
	Pre-Employment/Post-Accident	182	0	1.00	.
	Pre/Post/Random/Reason	329,711	4	1.00	.
*Sales and Retail	No Program	46,944,257	19	1.00	.
	Pre-Employment/Post-Accident	3,717,600	0	1.00	.
	Pre/Post/Random/Reason	7,156,884	3	1.00	.
Shop, yard, and Deliveries	No Program	26,226,549	186	1.00	.
	Pre-Employment/Post-Accident	1,667,846	13	1.14	0.58-2.25
	Pre/Post/Random/Reason	4,814,739	39	1.10	0.70-1.74
Drywall	No Program	6,044,573	143	1.00	.
	Pre-Employment/Post-Accident	610,836	16	0.90	0.49-1.65
	Pre/Post/Random/Reason	535,778	14	1.16	0.43-3.15
HVAC and Plumbing	No Program	8,079,458	210	1.00	.
	Pre-Employment/Post-Accident	560,109	18	1.26	0.66-2.40
	Pre/Post/Random/Reason	1,302,241	31	0.91	0.57-1.45
*Auto Repair	No Program	464,159	8	1.00	.
	Pre-Employment/Post-Accident	100,023	0	1.00	.
	Pre/Post/Random/Reason	175,654	3	1.00	.
*Roofing	No Program	544,192	23	1.00	.
	Pre-Employment/Post-Accident	20,634	2	1.00	.
	Pre/Post/Random/Reason	38,423	2	1.00	.
*Manufacturing	No Program	4,744,171	58	1.00	.
	Pre-Employment/Post-Accident	133,399	0	1.00	.
	Pre/Post/Random/Reason	1,478,566	27	1.00	.
Flooring Installation and Flatwork	No Program	2,765,899	94	1.00	.
	Pre-Employment/Post-Accident	131,273	3	0.59	0.42-0.83
	Pre/Post/Random/Reason	762,373	26	0.81	0.56-1.18
*Trucking	No Program	311,875	1	1.00	.
	Pre-Employment/Post-Accident	.	.	.	.
	Pre/Post/Random/Reason	174,537	4	1.00	.
Electric Installation	No Program	3,242,309	44	1.00	.
	Pre-Employment/Post-Accident	228,718	1	0.41	0.04-4.12
	Pre/Post/Random/Reason	337,082	3	0.70	0.39-1.25
Painting	No Program	4,757,715	83	1.00	.
	Pre-Employment/Post-Accident	629,966	6	0.62	0.29-1.30
	Pre/Post/Random/Reason	592,976	15	1.38	0.91-2.08
Concrete and Masonry	No Program	11,640,161	283	1.00	.
	Pre-Employment/Post-Accident	1,510,854	20	0.30	0.10-0.90
	Pre/Post/Random/Reason	2,093,159	31	0.60	0.37-0.97
*Iron and Steel	No Program	536,480	38	1.00	.
	Pre-Employment/Post-Accident	.	.	.	.
	Pre/Post/Random/Reason	121,692	20	1.00	.
Roadwork and Equipment Operators	No Program	3,604,441	61	1.00	.
	Pre-Employment/Post-Accident	760,879	9	0.60	0.24-1.54
	Pre/Post/Random/Reason	1,133,121	19	1.01	0.50-2.03
Garbage and Recycling	No Program	1,787,875	22	1.00	.
	Pre-Employment/Post-Accident	92,600	1	0.55	0.11-2.84
	Pre/Post/Random/Reason	606,078	10	1.41	0.80-2.51

*Nursery and Landscaping	No Program	1,942,568	42	1.00	.
	Pre-Employment/Post-Accident	24,237	0	1.00	.
	Pre/Post/Random/Reason	419,060	12	1.00	.
Equipment installation and Assembly	No Program	883,292	16	1.00	.
	Pre-Employment/Post-Accident	195,315	5	1.74	0.65-4.69
	Pre/Post/Random/Reason	507,022	8	0.96	0.26-3.49

†Controlling for company premium size and union status

*Not enough data for analysis

Table 5 Risk of Injury Claims by Drug Testing Program and Union Status

Claim Type	Union Status	Testing Program	Hours	Claim (n)	RR†	95% CI
Total	Non-Union	No Program	99,121,824	4,933	1.00	.
		Pre-Employment/Post-Accident	6,569,471	285	0.85	0.69-1.03
		Pre/Post/Random/Reasonable	13,689,150	702	0.99	0.86-1.14
	Union	No Program	49,364,415	3,102	1.00	.
		Pre-Employment/Post-Accident	5,080,041	246	0.82	0.64-1.06
		Pre/Post/Random/Reasonable	11,984,051	718	0.86	0.72-1.02
Lost-Time	Non-Union	No Program	99,121,824	1,043	1.00	.
		Pre-Employment/Post-Accident	6,569,471	58	0.85	0.63-1.14
		Pre/Post/Random/Reasonable	13,689,150	171	1.21	0.97-1.5
	Union	No Program	49,364,415	801	1.00	.
		Pre-Employment/Post-Accident	5,080,041	60	0.69	0.44-1.07
		Pre/Post/Random/Reasonable	11,984,051	159	0.80	0.63-1.01
Medical	Non-Union	No Program	99,121,824	3889	1.00	.
		Pre-Employment/Post-Accident	6,569,471	227	0.87	0.70-1.07
		Pre/Post/Random/Reasonable	13,689,150	531	0.95	0.82-1.09
	Union	No Program	49,364,415	2301	1.00	.
		Pre-Employment/Post-Accident	5,080,041	186	0.88	0.70-1.11
		Pre/Post/Random/Reasonable	11,984,051	559	0.87	0.71-1.07

†Controlling for trade and company premium size

Chapter Four

Effect of Rating of Management Attitude and Commitment on Injury Rate and Severity in Small and Medium-Sized Construction Companies

Abstract

Background: Hazards in the construction industry can be modified by human and organizational elements. **Objective:** Determine the association of safety professionals' evaluations of management attitude and commitment to safety on injury rate and severity.

Methods: We evaluated workers' compensation claims data covering 1,360 construction companies from 2004-2009. Employee hours at-risk and claims were used to determine injury rates. Rating of management attitude was done by safety professionals, employed by the insurance carrier, upon initial visit to member companies. A company had no rating until the initial visit. Based on an evaluation process to characterize hazard control practices of a company, and interactions between the company and safety professional, an attitude and commitment rating was assigned. Rate ratios (RR) and 95% confidence intervals (CI) were estimated as a function of injury rate using a Poisson regression model. Generalized estimating equations were used to account for correlated observations within companies. Models included confounding covariates of company size, union status, and trade.

Results: Ratings were categorized as: good; poor; and not yet rated. Compared to good, results for these categories, respectively, were RR=0.94 (CI=0.74-1.19) and RR=1.11 (CI=1.03-1.21) for overall injuries, and RR=1.15 (CI=0.85-1.55) and RR=1.13 (CI=0.99-1.28) for lost-time injuries.

Conclusions/Significance/Contributions: Our results indicate subjective rating of attitude and commitment from a single visit may not be indicative of injury risk. However, workers were at increased risk of injuries prior to contact with the safety professional. Initial contact by a safety professional may allow for improved procedures to control risk of injury.

Introduction

The construction industry is uniquely difficult and challenging to study due to the pace and organization of work and projects. Many physical hazards are present under normal conditions, and the work is often physically demanding and strenuous. Natural conditions and weather also can greatly affect the worksite as well as employee working conditions. This industry has a high rate of fatalities, annually; while it employs about 8% of the workforce, it experiences 22% of the fatalities (National Institute of Occupational Safety and Health (NIOSH), 2009). The construction sector also contributes to a high number of severe and non-fatal injuries (Courtney, Matz, & Webster, 2002; Dement & Lipscomb, 1999). Compared to other industries, employment in the construction industry has also been associated with a higher probability of disability should an injury occur on the job (Stover, Wickizer, Zimmerman, Fulton-Kehoe, & Franklin, 2007). In addition to the direct cost of injuries, there is an emotional and financial toll on injured workers and their families, along with their co-workers, places of employment, and the public (Waehrer, Dong, Miller, Haile, & Men, 2007). This comprehensive cost has been shown to be disproportionately high in construction, almost double the cost, compared to other industries (Waehrer, et al., 2007).

Small construction firms dominate the industry but published data pertaining to health and safety are limited. Nationally, small firms of fewer than 10 employees make up one fourth of the construction industry; yet, they experience one half of the fatal injuries (NIOSH, 2009). Small- and medium-sized companies have been shown to be at increased risk, compared to larger companies (Lowery et al., 1998). However, in most studies, one hundred employees or less is considered small, which is significantly larger than the average size firm. The US Census in 2007 reported that there were 15,863 employer construction establishments in the state of Minnesota and, in that same year, there were with 134,584 employed in this sector (United States Census Bureau, 2007). This is an average of approximately nine employees per establishment, with slightly less in recent years, indicating that the vast majority of establishments are small businesses, a trend that has not changed. The hazards encountered by small business, non-union and residential sectors are difficult to characterize due to limited information on work, hours,

and injury occurrence (Lipscomb, Dement, & Behlman, 2003). Moreover, safety training and education is inconsistent and less likely to be categorized or documented. Non-union contractors lack some of the resources available to large and union contractors, and also do not receive the same amount of health and safety attention on their jobsites (Gillen, Baltz, Gassel, Kirsch, & Vaccaro, 2002). There are few published studies or reports that address both the residential sector and small- and medium-sized construction firms.

An important component of worker injury risk control, though difficult to characterize, is the human and organizational element; often referred to as a safety culture or climate which includes the dynamic attitudes, beliefs, and safety-related actions of company and its employees (Choudhry, Fang, & Mohamed, 2007; Cooper, 2000; Flin, Mearns, O'Connor, & Bryden, 2000; Guldenmund, 2000; Shannon, Mayr, & Haines, 1997). Management that is committed, and strongly supports, participates in, promotes, and enforces the safety culture and safety programs across all levels of an organization, have been shown to be the most effective (Choudhry, et al., 2007; Flin, et al., 2000; Lehtola, et al., 2008; Wirth & Sigurdsson, 2008; Zohar, 1980). While studies tend to highlight the effects of employee training (Dong, Entzel, Men, Chowdhury & Scott, 2004; Lowery, et al., 1998) or employee perception of company safety climate, little research has evaluated the opinions of trained outside entities, e.g. loss control specialists, on client's safety climate, control over hazards, and with respect to injury experience. The identification of this link, and enhancement of the ability to detect it, can have major ramifications both in proactive injury prevention, safety culture coaching, and reduction in insurance costs.

The goal of this study is to measure if a positive evaluation of company management attitude and commitment by a health and safety professional is associated with lower injury rates and decreased injury severity.

Materials and Methods

Population Data and Collection

Workers' compensation claims were used to examine injuries in employees of construction companies who obtain workers' compensation insurance from The Builders

Group (TBG). TBG is a self-insured workers' compensation fund that insures mainly small- and medium-sized construction and construction-related businesses within the state of Minnesota. Criteria for acceptance into TBG are based mainly on the company's established financial stability. The study included all companies insured by TBG during the time period 2004-2009.

Person-time at risk for the population was based upon hours at-risk for each company by month, the unit of time used for analysis. Hours at-risk were estimated from monthly payroll reports submitted to TBG by each company for each employee. The person-time at risk data were also further broken down on a monthly basis by trade (risk class) within a company. Company level data were classified by union status and premium size. Payroll data were audited internally at TBG, and externally, for accuracy. Payroll and trade are the main factors that determine a company's premium size. The premium size, in general, correlates with the number of employees at a company, attention of the carrier's Loss Control Department, and factors relating to safety. To help control for potential confounding, companies were divided into three premium bands, \$0-15K, \$15,001-75K, and \$>75,001, based on insurance practices for this population.

Claims Data, Collection, and Outcomes

Claims data captured all injury and illness submitted to TBG for compensation. First reports of injury are completed by office personnel or management within an insured company and then turned into TBG where it is further processed and categorized by a claim manager. Claims data included information on mechanism of injury, type of injury, cost of injury claim, and amount of lost work time. Claims were initially classified as medical-only or lost-time/indemnity. Minnesota state statutes classify lost-time/indemnity claims as those involving injuries or illnesses that result in more than three consecutive calendar days of lost work time and include payment of medical and wage loss costs. Medical-only claims involve injured or ill workers who receive care but have not missed more than three consecutive days of lost work time and only medical costs are incurred. In addition to this initial classification, claims were grouped by alternative injury outcomes and severity metrics. This included total claims, lost-time claims, medical claims, mechanisms of injury, types of injury, and cost of injury claim.

The mechanism of injury, type of injury, and cost of injury claim were collapsed from the original data into fewer categories of similar groups and descriptions for more robust analysis.

Loss Control, Management Attitude and Commitment Rating, and Classification

TBG has a comprehensive loss control (LC) division that evaluates safety practices and culture to identify modifiable risk factors to reduce injury risk and compensation costs for its insured member companies. Evaluations are done after a member enters, and, periodically, thereafter. Loss control professionals meet with company representatives in person and go through a standardized evaluation interview process. The evaluations ascertain the company's safety efforts, programs, hazard controls, and management attitude, and any changes over time. Frequencies of contacts following initial evaluation are primarily based on company management requests. Occasionally, companies are contacted to follow-up on frequent and/or high cost claims, but there is no systematic review based on injury rate.

The LC representatives are professionals with advanced degrees in their field and they receive training to standardize the TBG evaluations. A standardized form is used when performing company evaluations (see attached). The form enables recording of major hazard categories, employee exposures, presence of safety programs, and procedures and controls that are in place. Additionally, there is a subjective summary measure of the LC representative's perception of attitude and commitment of management toward company safety. This rating is based upon the opinion of the LC representative after examining the safety information of the company and their interaction with company representatives. The mere presence of injury risk factors may not cause a poor rating if management is deemed to be open to assistance and desiring to improve. A company may be enrolled in the insurance program, but some time may pass before an initial evaluation occurs. The company will have no rating until this initial visit occurs. This provides an opportunity to evaluate the claims experience prior to the influence of the loss control activities. Ratings of management attitude and commitment are categorized as: poor/needs improvement (n=363 claims, n=7,195,780 hours, 3,597

FTE) or not yet rated (n=1,935 claims, n=33,730,250 hours, 16,865 FTE) vs. good (n=7,688 claims, 144,882,922 hours, 72,441 FTE).

Analysis

The claims and payroll data were used to estimate rates for overall injuries, lost-time injuries, medical-only injuries, and by mechanism of injury, type of injury, and cost of injury. Overall, lost-time, and medical claim analysis were further stratified by trade and union status. The effect of attitude and commitment ratings were evaluated by estimating rate ratios (RR) and 95% confidence intervals (CI) as a function of injury rate, using a Poisson regression model and accounting for time-dependent factors (Haenszel, Loveland, & Sirken, 1962). The hours at-risk of companies that transitioned from different rating categories over the study time period were changed at month of the switch to the new categorization. Generalized estimating equations were used to account for correlated observations within companies over time (Liang & Zeger, 1986). Overall claims, lost-time, and medical claim models included confounding covariates of company premium size, union status, and trade. Mechanism of injury, type of injury, and total claim dollar models include confounding covariates of company premium size and union status. All analyses were done using SAS (2011).

Results

During the study period, 1,360 companies compiled 185,766,467 hours of employee time at risk, representing approximately 92,882 full time equivalent employees (FTE) and 9,986 workers' compensation claims for an average claim rate of 10.75 per 100 FTE. The total claims count was comprised of 7,693 medical claims (8.28 per 100 FTE) and 2,292 lost-time claims (2.47 per 100 FTE). The total incurred cost of claims during this period was \$90,416,073. Claim rates varied among trade categories, and union companies and companies of larger premium size had higher injury rates (**Table 1**).

When examining the association between the rating of management attitude and commitment and overall injury claims, compared to a good rating, results for poor/needs improvement and not yet rated were, respectively: RR=0.94 (CI=0.74-1.19) and RR=1.11 (CI=1.03-1.21). For lost-time claims, compared to good rating, results for poor/needs improvement and not yet rated were, respectively: RR=1.15 (CI=0.85-1.55) and RR=1.13

(CI=0.99-1.28); for medical only claims, respective results were: RR=0.88 (CI=0.67-1.15) and RR=1.11 (CI=1.01-1.22). In all categories of claims, we observed increased rate of injury claims for companies during the time that they had not been evaluated by a safety professional (**Table 2**).

Analysis by specific trades revealed several significant increases in rate, for both categories of companies that had not yet been rated and companies with a poor rating. The following demonstrated increases in overall injuries: interior carpentry (no rating); drywall (poor rating), flooring installation and flatwork (no rating and poor rating), iron and steel (no rating and poor rating), and nursery and landscaping (no rating) (**Table 3**). Examination of lost time injuries by trade and lost time injuries revealed significant increases for not yet rated and poor rated categories, including the following: drywall (poor rating), flooring installation and flatwork (poor rating), electric installation (poor rating), roadwork and equipment operators (poor rating), nursery and landscaping (no rating) (**Table 4**).

Upon stratification by union status, there were moderate increases in total injury rates for non-union companies with no rating (RR=1.08, CI=0.96-1.21). When examining lost-time injuries, moderate increases were revealed in both non-union (RR=1.10, CI=0.92-1.31) and union (RR=1.21, CI=0.98-1.50) companies with no rating (**Table 5**).

In mechanism of injury categories for this population, companies with no rating had notable increases in claims involving general slips, trips, and falls (RR=1.32, CI=1.11-1.58), contact with objects and equipment (RR=1.56, CI=1.27-1.91), powered and hand tools (RR=1.38, CI=1.07-1.79), and cumulative/repetitive trauma (RR= 1.31, CI=0.95-1.82). Companies with a poor rating had a significant increase in strains (RR=1.31, CI=1.05-1.67), but also a significant reduction in injuries from sharp objects (RR=0.59, CI=0.41-0.85).

When examining major injury types experienced by this population, all notable increases in injury rates occurred in companies that had not been rated. Significant increases included the following: strains/sprains (RR=1.15, CI=1.02-1.29); bruises and contusions (RR= 1.25, CI= 1.03-1.51); penetration injuries (RR=1.38, CI=1.01-1.87); fractures/dislocations (RR=1.22, CI=0.95-1.56), and hernias (RR=1.7, CI=1.02-2.83).

Companies that had not yet been rated showed increased injury rates in lower total claim dollar amount categories, but did not show notable reductions in injury rates for total claim values over \$5,000. Increased injury rates prior to visits occurred with $\geq \$0$ to $< \$1,000$ (RR=1.14, CI=1.01-1.28) and $\geq \$1,000$ to $< \$5,000$ (RR=1.21, CI=1.03-1.41). Companies with poor ratings did not show any notable differences in any categories.

Discussion

Our results indicate subjective rating of attitude and commitment from a single visit may not be indicative of injury risk when examining basic injury trends, but may be more predictive when broken down by trade. However, workers were at increased risk of overall injuries, lost-time injuries, and medical injuries during the period prior to the contact with the health and safety professional.

Several potential limitations should be considered when interpreting the data. Potential limitations include underreporting of claims. The complete and systematic reporting of all injury claims by all companies is vital for accurate calculations of injury rates. The effect of this, however, is likely lower in TBG companies as information is collected on all claims reported, including incident-only claims, and not just claims paid, or those with time loss. This aids a more complete capture of injury events. Moreover, TBG continuously trains and educates company owners and employees on the importance of reporting all injuries, as well as describing the consequences of non-reporting. Non-reporting of injuries, resulting in potentially inaccurate injury reduction results would be more likely with less severe, easier to conceal, and easier to pay for claims. The data show increase in these types of injury categories prior to loss control contact, but also in the more severe lost-time claims, leading one to believe that the data contain non-biased reporting of injuries. Generalizability of our results is also a consideration. This analysis is limited to one workers' compensation insurer in one state. TBG is the largest insurer of construction companies in Minnesota and covers a substantial proportion of the small- and medium-sized construction firms that work in the full spectrum of construction trades and types of building projects. While construction

practices may vary regionally, the work methods and procedures used by this cohort of companies are very similar to operations nationwide.

The loss control survey was not created for the purpose of scientific study and data analysis. It was made for insurance loss control and pricing purposes, and had not been validated prior to data collection. Loss control representatives work with companies based upon geographic territory. Once member clients are assigned, there is little interaction with other TBG loss control representatives, thus, limiting the ability to test the inter-rater reliability of the evaluations.

The limitations of this analysis were offset by several unique strengths of this study. The data used for this study provide a more complete picture than workers' compensation data alone, with comprehensive information on the population at risk, injury and illness claims, and company loss control contact as a risk reduction method. This data resource is unique in that data are available that characterize company practices prior to the injury events, and also through time, to track safety changes. The data capture small- and medium-sized construction companies, including all companies insured by TBG so no survey or response methods are needed. All companies in the study commenced with some amount of time prior to loss control evaluation, thus allowing for before and after comparisons and analysis of loss control contact. The availability of company characteristics such as trade, union status, premium size, and additional injury descriptors facilitated a robust analysis.

Generally, there were no differences between good and poor rating of management attitude and commitment, except when the analysis was broken down by trade. These trade specific associations were especially noted when examining lost time injures, where four of the five trades with significant increased risk of injury were from companies with a poor rating. Trades that had significantly higher rates associated with either the poor rating or the not yet rated status tended to have very large increases in risk, some as great as 100% or more. It could be that trades that work under more inherently dangerous conditions, like iron and steel workers, may be more easily affected by poor management attitude and safety commitment.

The absence of notable differences injury rates between good and poor management ratings in all other categories besides trade is somewhat surprising and

prompts some deeper examination. The baseline risk of companies was not necessarily reflected in the rating of management attitude and commitment. This rating was based upon the company's willingness to work with loss control and to adopt or enhance safety and loss control measures. This means that a company with a great deal of uncontrolled hazards or safety deficits in the workplace, but that were very willing to work with loss control and enthusiastic about learning how to make the workplace more safe, could be rated as having a good attitude and commitment. Whereas, a company with basic control over their hazards, but unwillingness to work with loss control or lack of desire to improve, could be rated as having a poor attitude and commitment. This may limit the ability to pinpoint true risk of injury. However, it is more likely that companies with higher risk of injury would be misclassified into the good attitude category, thus, reducing discernible injury reduction associations between good and poor ratings. Additionally, increased attention or education from a loss control representative, while working with a company with a good attitude and desire to improve, may lead to improved reporting practices, thus a seeming increase in number of claims after loss control attention. A similar finding was noted in a study on OSHA consultation activity (Baggs, Silverstein, & Foley, 2003). This could create some potential issues in reverse causality, reducing illustration of effects.

Given that the perception of management attitude and commitment by the safety professional is true, it would follow that this perception underlies company procedures and policies in regard to safety and that employees know and follow these procedures and policies. Although rating of management attitude and commitment may be good, and the measurement valid, if there is any form of disconnect between management and employee and between implementation and compliance with policies, the benefit of reduced incidence of injury may not be observed.

An association was noted between occurrence of an increased injury rate and when the initial evaluation was delayed. These same results also were illustrated when the data were analyzed by injury mechanism and injury types, with significant differences in some of the categories of most concern for this field: slips trips, and falls; being struck by objects and equipment; cumulative/repetitive injuries; and strains. Some of the

injuries that had elevated rates, including sprains and strains, fractures, and hernias have the potential to be quite severe or disabling.

Reasons for delay in the initial meetings and evaluations are varied. It may be that delay in initial contact could be associated with companies that have unmeasured variables or characteristics that put them at more risk of employee injury. Reductions of injury rates post-evaluation could be associated just with visiting the companies and applying these ratings to assist loss control in a further plan of action towards the company; companies with no rating of any kind remain largely unknown and uncharacterized. Similar results were demonstrated in a study of Washington State OSHA activity. Accounts with non-fixed sites (construction) that had any kind of contact from OSHA had significant decreases (12.8%) in rates of workers' compensation claims, compared to accounts with no OSHA activity (7.4% reduction) (Baggs).

Identifying practical methods to prevent injuries in an underrepresented population in construction safety research is an important goal. Focusing on modifiable characteristics, such as contact with a safety and health professional, is key to translating research findings into actionable practices in the construction industry for both small and large contractors. Identification of an optimal number or type of contacts from a safety professional to establish an injury reduction trend would be highly valuable knowledge for industry stakeholders. Further refinement on determining the components of safety culture and assessment tools to measure it are valuable to researchers and businesses.

Conclusions

There were limited, yet potentially very important, instances when there were significant associations between loss control professionals assessment of management attitude and commitment and risk of injury based upon the single subjective survey tool. The ability of the rating to determine specific trades that are at the most risk may help to reduce injuries. But, a loss control professional's rating may be too superficial to accurately pinpoint all of the complex and diverse variables that go into a good company's safety culture or climate. However, contact with a loss control professional does appear to reduce injury rate, so further examination of the interaction between loss control and the company should be considered as a prevention strategy.

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Table 1 Overall, Lost-Time, and Medical Claim Rates[†] by Trade, Union Status, and Premium Size

Exposed	Overall Claims (n)	Overall Rates	Lost-Time Claims (n)	Lost-Time Rates	Medical Claims (n)	Medical Rates
Total Population	9,986	10.54	2,292	2.46	7,693	8.15
Trade						
Rough Carpentry	1,835	24.32	452	600.00	1,382	18.32
Interior Carpentry	336	20.53	77	4.79	259	15.92
Supervisors	259	5.31	60	1.24	199	4.09
Crane Operators	33	9.75	11	3.26	22	6.50
Sales and Retail	158	0.54	22	0.08	136	0.47
Shop, Yard, and Deliveries	1,240	7.56	238	1.46	1,002	6.11
Drywall	601	16.71	173	4.81	428	11.90
HVAC and Plumbing	1,304	26.22	259	5.21	1,045	21.02
Auto Repair	50	13.49	11	2.97	39	10.52
Roofing	94	31.12	27	8.95	67	22.21
Manufacturing	606	19.00	85	2.67	521	16.35
Flooring Installation and Flatwork	441	24.05	123	6.72	318	17.35
Trucking	19	7.82	5	2.06	14	5.76
Electric Installation	271	14.22	48	2.52	223	11.70
Painting	437	14.61	104	3.48	333	11.14
Concrete and Masonry	1,107	14.39	334	4.38	773	10.07
Iron and Steel	274	82.79	58	17.62	216	65.34
Roadwork and Equipment Operators	310	11.22	89	3.24	221	8.01
Garbage and Recycling	155	12.42	33	2.65	122	9.79
Nursery and Landscaping	287	23.96	54	4.53	233	19.46
Equipment Installation and Assembly	169	21.11	29	3.66	140	17.56
Union Status						
Non-Union	5,920	9.83	1,272	2.13	4,647	7.73
Union	4,066	11.86	1,020	3.07	3,046	8.94
Premium Size Classification						
\$0-15K	788	7.23	198	1.83	590	5.42
\$15,001-75K	4,226	9.49	940	2.13	3,285	7.40
\$>75,001	4,972	12.76	1,154	3.02	3,818	9.83

[†] Rate per 100 FTE (200,000 hours)

Table 2 Risk of Injury by Management Attitude Rating and Claim Type

Claim Type	Attitude Rating	Claims	RR	95% CI
Total	No Rating	1935	1.11	1.03-1.21
	Good Attitude	7688	1.0	.
	Poor Attitude	363	0.94	0.74-1.19
Lost Time	No Rating	449	1.13	0.99-1.28
	Good Attitude	1742	1.0	.
	Poor Attitude	101	1.15	0.85-1.55
Medical	No Rating	1485	1.11	1.01-1.22
	Good Attitude	5946	1.0	.
	Poor Attitude	262	0.88	0.67-1.15

† Controlling for Trade, Union Status, and Premium Size

Table 3 Risk of Total Injuries by Management Attitude Rating and Trade

Trade	Attitude Rating	Hours	Claims (n)	RR [†]	95% CI
Rough Carpentry	No Rating	3,558,937	477	1.07	0.89-1.27
	Good Attitude	11,060,553	1,322	1.00	.
	Poor Attitude	456,830	36	0.77	0.51-1.16
Interior Carpentry	No Rating	484,361	73	1.54	1.05-2.27
	Good Attitude	2,685,508	262	1.00	.
	Poor Attitude	43,067	1	0.25	0.06-1.04
Supervisors	No Rating	2,057,294	35	0.56	0.37-0.83
	Good Attitude	7,356,793	218	1.00	.
	Poor Attitude	276,048	6	0.83	0.30-2.28
*Crane Operators	No Rating	258,309	9	.	.
	Good Attitude	417,587	24	.	.
	Poor Attitude	19	0	.	.
Sales and Retail	No Rating	10,327,160	40	1.43	0.91-2.25
	Good Attitude	45,022,025	113	1.00	.
	Poor Attitude	2,469,555	5	0.83	0.30-2.28
Shop, yard, and Deliveries	No Rating	6,367,580	246	1.06	0.82-1.37
	Good Attitude	25,542,973	964	1.00	.
	Poor Attitude	798,580	30	1.01	0.52-1.94
Drywall	No Rating	768,560	61	0.99	0.69-1.40
	Good Attitude	5,998,989	484	1.00	.
	Poor Attitude	423,638	56	1.82	1.15-2.88
HVAC and Plumbing	No Rating	1,808,676	238	0.98	0.76-1.28
	Good Attitude	7,332,633	985	1.00	.
	Poor Attitude	800,499	81	0.73	0.47-1.15
*Auto Repair	No Rating	194,559	17	.	.
	Good Attitude	522,468	33	.	.
	Poor Attitude	22,809	0	.	.
*Roofing	No Rating	47,570	6	.	.
	Good Attitude	551,597	88	.	.
	Poor Attitude	4,081	0	.	.
Manufacturing	No Rating	944,867	90	1.09	0.71-1.66
	Good Attitude	5,287,659	513	1.00	.
	Poor Attitude	123,609	3	0.28	0.08-1.03
Flooring Installation and Flatwork	No Rating	589,751	97	1.64	1.17-2.32
	Good Attitude	3,010,355	330	1.00	.
	Poor Attitude	59,439	14	2.06	1.28-3.29
*Trucking	No Rating	49,035	1	.	.
	Good Attitude	437,361	18	.	.
	Poor Attitude	16	0	.	.
Electric Installation	No Rating	444,783	31	0.84	0.56-1.27
	Good Attitude	3,040,217	226	1.00	.
	Poor Attitude	323,109	14	0.61	0.33-1.11
Painting	No Rating	625,324	58	1.42	0.91-2.22
	Good Attitude	5,332,139	377	1.00	.
	Poor Attitude	23,193	2	1.62	0.35-7.50
Concrete and Masonry	No Rating	2,935,000	231	1.07	0.84-1.37
	Good Attitude	11,540,199	831	1.00	.
	Poor Attitude	768,975	45	0.81	0.41-1.58
Iron and Steel	No Rating	97,828	43	1.85	1.19-2.90
	Good Attitude	557,839	190	1.00	.
	Poor Attitude	2,505	41	5.74	1.96-16.82
Roadwork and Equipment Operators	No Rating	732,059	42	1.19	0.75-1.89
	Good Attitude	4,542,281	253	1.00	.
	Poor Attitude	224,101	15	1.48	0.75-2.90
Garbage and Recycling	No Rating	688,621	42	0.95	0.64-1.43
	Good Attitude	1,482,622	101	1.00	.
	Poor Attitude	315,311	12	0.59	0.40-0.86

Nursery and Landscaping	No Rating	432,110	78	1.72	1.07-2.75
	Good Attitude	1,932,086	208	1.00	.
	Poor Attitude	21,670	1	0.55	0.07-4.51
Equipment installation and Assembly	No Rating	317,866	20	0.66	0.42-1.05
	Good Attitude	1,229,038	148	1.00	.
	Poor Attitude	38,724	1	0.17	0.10-0.28

†Controlling for company premium size and union status,

*Not enough data available for analysis

Table 4 Risk of Lost Time Injuries by Management Attitude Rating and Trade

Trade	Attitude Rating	Hours	Claims (n)	RR [†]	95% CI
Rough Carpentry	No Rating	3,558,937	117	1.07	0.81-1.41
	Good Attitude	11,060,553	324	1.0	.
	Poor Attitude	456,830	11	0.91	0.48-1.70
*Interior Carpentry	No Rating	484,361	16	.	.
	Good Attitude	2,685,508	61	.	.
	Poor Attitude	43,067	0	.	.
Supervisors	No Rating	2,057,294	10	0.76	0.36-1.60
	Good Attitude	7,356,793	47	1.0	.
	Poor Attitude	276,048	3	1.92	0.48-7.62
*Crane Operators	No Rating	258,309	3	.	.
	Good Attitude	417,587	8	.	.
	Poor Attitude	19	0	.	.
*Sales and Retail	No Rating	10,327,160	6	.	.
	Good Attitude	45,022,025	16	.	.
	Poor Attitude	2,469,555	0	.	.
Shop, yard, and Deliveries	No Rating	6,367,580	52	1.18	0.83-1.68
	Good Attitude	25,542,973	180	1.0	.
	Poor Attitude	798,580	6	1.09	0.48-2.48
Drywall	No Rating	768,560	13	0.76	0.39-1.48
	Good Attitude	5,998,989	139	1.0	.
	Poor Attitude	423,638	21	2.32	1.02-5.26
HVAC and Plumbing	No Rating	1,808,676	44	0.91	0.62-1.32
	Good Attitude	7,332,633	197	1.0	.
	Poor Attitude	800,499	18	0.85	0.51-1.42
*Auto Repair	No Rating	194,559	7	.	.
	Good Attitude	522,468	4	.	.
	Poor Attitude	22,809	0	.	.
*Roofing	No Rating	47,570	3	.	.
	Good Attitude	551,597	24	.	.
	Poor Attitude	4,081	0	.	.
Manufacturing	No Rating	944,867	12	1.0	0.51-1.97
	Good Attitude	5,287,659	72	1.0	.
	Poor Attitude	123,609	1	0.67	0.13-3.54
Flooring Installation and Flatwork	No Rating	589,751	23	1.21	0.72-2.04
	Good Attitude	3,010,355	96	1.0	.
	Poor Attitude	59,439	4	2.39	1.12-5.12
*Trucking	No Rating	49,035	0	.	.
	Good Attitude	437,361	5	.	.
	Poor Attitude	16	0	.	.
Electric Installation	No Rating	444,783	6	0.98	0.43-2.25
	Good Attitude	3,040,217	35	1.0	.
	Poor Attitude	323,109	7	2.03	1.04-3.95
Painting	No Rating	625,324	11	1.01	0.54-1.89
	Good Attitude	5,332,139	92	1.0	.
	Poor Attitude	23,193	1	1.65	0.52-5.28
Concrete and Masonry	No Rating	2,935,000	77	1.34	0.92-1.96
	Good Attitude	11,540,199	246	1.0	.
	Poor Attitude	768,975	11	0.66	0.24-1.78
*Iron and Steel	No Rating	97,828	7	.	.
	Good Attitude	557,839	42	.	.
	Poor Attitude	2,505	9	.	.
Roadwork and Equipment Operators	No Rating	732,059	11	1.11	0.54-2.25
	Good Attitude	4,542,281	71	1.0	.
	Poor Attitude	224,101	7	2.44	1.23-4.84
*Garbage and Recycling	No Rating	688,621	9	.	.
	Good Attitude	1,482,622	24	.	.
	Poor Attitude	315,311	0	.	.

Nursery and Landscaping	No Rating	432,110	17	2.19	1.30-3.70
	Good Attitude	1,932,086	36	1.0	.
	Poor Attitude	21,670	1	3.24	0.38-27.86
Equipment installation and Assembly	No Rating	317,866	5	0.92	0.44-1.92
	Good Attitude	1,229,038	23	1.0	.
	Poor Attitude	38,724	1	0.79	0.44-1.39

†Controlling for company premium size and union status

*Not enough data for analysis

Table 5 Risk of Injury Claims by Management Attitude Rating and Union Status

Claim Type	Union Status	Attitude Rating	Hours	Claim (n)	RR	95% CI
Total	Non-Union	No Rating	24,120,190	1,237	1.08	0.96-1.21
		Good Attitude	91,547,052	4,536	1.00	.
		Poor Attitude	3,713,203	147	0.86	0.65-1.14
	Union	No Rating	9,610,061	698	0.95	0.58-1.57
		Good Attitude	53,335,870	3,152	1.00	.
		Poor Attitude	3,482,577	216	0.98	0.73-1.31
Lost Time	Non-Union	No Rating	24,120,190	274	1.10	0.92-1.31
		Good Attitude	91,547,052	965	1.00	.
		Poor Attitude	3,713,203	33	0.89	0.55-1.44
	Union	No Rating	9,610,061	175	1.21	0.98-1.50
		Good Attitude	53,335,870	777	1.00	.
		Poor Attitude	3,482,577	68	1.31	0.82-2.08
Medical	Non-Union	No Rating	24,120,190	274	1.06	0.94-1.20
		Good Attitude	91,547,052	965	1.00	.
		Poor Attitude	3,713,203	33	0.85	0.65-1.12
	Union	No Rating	9,610,061	175	0.95	0.59-1.53
		Good Attitude	53,335,870	777	1.00	.
		Poor Attitude	3,482,577	68	0.86	0.62-1.20

†Controlling for company premium size

Chapter Five

Minor Injury Experience and Risk of Lost-Time Injury in Construction Companies Using
Survival Analysis

Abstract

Objective: The construction industry experiences a high rate of injuries and a pattern of minor injuries may increase risk of severe injuries within a company. The goal of the study was to determine the associations between non-lost-time injuries and risk of lost-time injury.

Methods: Workers' compensation claims data were evaluated covering 1,360 construction companies from 2004-2009. Hazard Ratios (HR) and 95% confidence intervals (CI) were estimated using a proportional hazards regression model and accounting for repeated events and time-varying covariates. Non-lost-time claim experience was categorized into the following groups: 0-1 claim, 2-3 claims, 4-6 claims, 7 or more claims. A model based variance estimate was used to account for correlated observations within companies over time. Models included confounding covariates of company premium size and union status.

Results: Compared to experiencing 0-1 claims, increased risk occurred with experiencing 2-3 claims (HR=1.25, CI=1.32- 1.75), 4-6 claims (HR=1.36, CI=1.19- 1.56), and 7 or more claims (HR=1.52, CI=1.12- 1.39). Companies with a higher premium size were associated with greater risks of lost-time claims, as were union companies

Conclusion: The results indicate increasing non-lost-time claims experience is associated with increasing risk of lost-time injury.

Introduction

The construction industry is uniquely difficult and challenging to study due to the pace and organization of work and projects. Many physical hazards are present under normal conditions, and the work is often physically demanding and strenuous. Natural conditions and weather also can greatly affect the worksite as well as employee working conditions. This industry has a high rate of fatalities, annually; while it employs about 8% of the workforce, it experiences 22% of the fatalities (National Institute of Occupational Safety and Health (NIOSH), 2009). The construction sector also contributes to a high number of severe and non-fatal injuries (Courtney, Matz, & Webster, 2002; Dement & Lipscomb, 1999). Compared to other industries, employment in the construction industry has also been associated with a higher probability of disability should an injury occur on the job (Stover, Wickizer, Zimmerman, Fulton-Kehoe, & Franklin, 2007). In addition to the direct cost of injuries, there is an emotional and financial toll on injured workers and their families, along with their co-workers, places of employment, and the public (Waehrer, Dong, Miller, Haile, & Men, 2007). This comprehensive cost has been shown to be disproportionately high in construction, almost double the cost, compared to other industries (Waehrer, et al., 2007).

Small construction firms dominate the industry but published data pertaining to health and safety are limited. Nationally, small firms of fewer than 10 employees make up one fourth of the construction industry; yet, they experience one half of the fatal injuries (NIOSH, 2009). Small- and medium-sized companies have been shown to be at increased risk, compared to larger companies (Lowery, et al., 1998). However, in most studies, one hundred employees or less is considered small, which is significantly larger than the average size firm. The US Census in 2007 reported that there were 15,863 employer construction establishments in the state of Minnesota and, in that same year, there were 134,584 employed in this sector (United States Census Bureau, 2007). This is an average of approximately nine employees per establishment, with slightly less in recent years, indicating that the vast majority of establishments are small businesses, a trend that has not changed. The hazards encountered by small business, non-union and residential sectors are difficult to characterize due to limited information on work, hours, and injury occurrence (Lipscomb, Dement, & Behlman, 2003). Moreover, safety

training and education is inconsistent and less likely to be categorized or documented. Non-union contractors lack some of the resources available to large and union contractors, and also do not receive the same amount of health and safety attention on their jobsites (Gillen, Baltz, Gassel, Kirsch, & Vaccaro, 2002). There are few published studies or reports that address both the residential sector and small- and medium-sized construction firms.

The background on the relation between minor and severe injuries has existed since 1931 when Hebert Heinrich wrote a book about workplace injury reduction with theories stating that near miss events, minor injuries, and severe injuries have similar causal pathways, which continue to be supported by some research (Wright and van der Schaaf, 2004). Other research has varied results on this topic; some noted no similar factors between the types of injuries (Smith, Smith, Hogg-Johnson, Mustard, Chen, & Tompa, 2012), while others noted factors that are associated for only certain types of injuries, such as musculoskeletal (Alamgir, Yu, Goreman, Ngan, & Guzman, 2009). A study examining just the construction industry and work for the Denver International Airport found increased risk for severe injury when companies experienced minor injuries (Lowery, et al., 1998). An association between non-lost time and lost-time injuries in construction could help pinpoint those companies at greatest risk of a severe injury and more accurately enable development of preventive measures.

The objective of this study was to evaluate the association of minor injuries on risk of lost-time injuries in small- and medium-sized construction firms.

Materials and Methods

Population Data and Collection

Workers' compensation claims were used to examine injuries in employees of construction companies who obtained workers' compensation insurance from The Builders Group (TBG). TBG is a self-insured workers' compensation fund that insures mainly small- and medium-sized construction and construction-related businesses within the state of Minnesota. Criteria for acceptance into TBG are based mainly on the company's established financial stability. The study included all companies insured by TBG during a 2192-day time-period from January 1st, 2004 until December 31st, 2009.

Company-level data were classified by union status and premium size. Payroll and trade are the main factors that determine a company's premium size. The premium size, in general, correlates with the number of employees at a company, attention of the carrier's safety and health professionals, as well as other underlying factors relating to safety. To control for potential confounding, companies were divided into three premium bands, \$0-15K \$15,001-75K, and \$>75,001, based on insurance practices for this population and to approximate number of employees.

Claims Data, Collection, and Outcomes

Claims data captured all injury and illness submitted to TBG for compensation. First reports of injury are completed by office personnel or management within an insured company and then turned into TBG where it is further processed and categorized by a claim manager. Claims data included information on calendar date of injury, mechanism of injury, type of injury, and cost of injury claim. Claims were classified as medical-only or lost-time. Minnesota state statutes classify lost-time claims as those involving injuries or illnesses that result in more than three consecutive calendar days of lost work time and include payment of medical and wage loss (indemnity) costs. Non-lost time claims involve injured or ill workers who receive care but have not missed more than three consecutive days of lost work time and only medical costs are incurred.

Modeling Repeated Events

We examined the effect of non-lost time claims on the rate of lost-time injury claims. Time intervals were constructed from a company's entrance into the study to the date of a lost-time injury event, exit from the study, or end of the study. Following a lost-time injury, a new interval would begin. The number of non-lost time claims during the time intervals was also tabulated.

Proportional hazards regression was used to model the time to lost-time injury intervals. Because companies could have multiple lost-time injuries over the course of the study period, a repeated events model was used. Data were compiled in the counting process format, meaning that for any company with multiple lost-time injury events, each such record represented one interval for the company. Each record was in the form of

($time_1$, $time_2$, $I_{event} \dots$), where $time_1$ represented the day (1-2192) at which the interval started, $time_2$ the day at which the interval ended, and I_{event} , was an indicator variable showing the end status of the interval (Ake & Carpetner, 2002). A lost-time injury was indicated by a (1) and the end of the interval with no lost-time injury event, exit from the study, or end of study was indicated by a (0). If a company had multiple intervals, $time_1$ of the new interval would begin the day after the lost-time injury event of the previous interval.

Modeling Time-Varying Non-lost time Claim Covariate within Repeated Event Intervals

The exposure variable of interest, non-lost time claims, was included in the model as a time-varying covariate. The time varying nature of the exposure meant that within a lost-time interval, a company could experience multiple non-lost time claims. The non-lost time claim accumulation experience within a lost-time interval, and how it varied from company to company, needed to be measured and accounted for to maintain the proportional hazards assumption. Non-lost time claim experience was categorized into four groups; 0-1 non-lost time claim, 2-3 non-lost time claims, 4-6 non-lost time claims, and 7 or more non-lost time claims. The counting process format was used again, and the duration, in days, that a company occupied each non-lost time claim experience category within lost-time injury interval was accounted for, forming intervals within intervals. Each record of non-lost time claim experience category was in the form of ($time_1$, $time_2$, $I_{event} \dots$), where $time_1$ represents the day at which the non-lost time claim injury experience category observation started, $time_2$ the day at which the observation ended, and I_{event} , was an indicator variable showing the status of the observation interval (Ake & Carpetner, 2002). Thus, one lost-time interval could have up to four non-lost time claim experience category observations or “rows” of data. If non-lost time claims experience necessitated multiple intervals, $time_1$ of the new interval would begin the day the non-lost time claim occurred that pushed the experience to the higher category. Time independent (static) indicators of union status and premium size repeated for the rows of code whereas exit status variables changed across the rows. The end of a non-lost time claims

experience category interval with a lost-time injury event was indicated by a (1) and the end of an interval with no lost-time injury event was indicated by a (0).

Analysis

Cox proportional hazards regression was conducted using the SAS PHREG procedure (Allison, 2010). The effects of non-lost time claims on risk of lost-time injury were evaluated by estimating hazard ratios (HR) and 95% confidence intervals (CI) as a function of injury rate. Each claim was considered to be independent of prior claims. A model based variance estimate was used to account for within company correlation. The models included potentially confounding covariates of union status, company premium size, and hours worked. All analyses were done using SAS Version 9.2 (2011).

Results

During the study period, 1,360 companies compiled 185,766,467 hours of employee time at risk, representing approximately 92,882 full time equivalent employees (FTE) and 9,986 workers' compensation claims for an average claim rate of 10.75 per 100 FTE. The total claims count was comprised of 7,693 non-lost time claims (8.28 per 100 FTE) and 2,292 lost-time claims (2.47 per 100 FTE). Total incurred cost of claims during this period was \$90,416,073 with lost-time claims comprising \$84,654,708 of this cost, or about 93.6%. Claim rates varied among trade categories, union companies, and companies of larger premium size had higher injury rates (**Table 1**).

Cox proportional hazards was used for the unadjusted and adjusted model analysis. The crude model revealed significantly higher rates of lost-time injury for those companies with non-lost time injuries. The adjusted model continued to illustrate that a company was significantly more likely to experience a lost-time injury event as they accumulated more non-lost time injury claims. Compared to experiencing 0-1 claims, increased risk occurred with experiencing 2-3 claims (HR=1.25, CI=1.32- 1.75), 4-6 claims (HR=1.36, CI=1.19- 1.56), and 7 or more claims (HR=1.52, CI=1.12- 1.39). Companies with a higher premium size were associated with greater risks of lost-time claims, as were union companies (**Table 2**).

Discussion

This analysis indicates increasing non-lost time claims incidence is associated with increasing risk of experiencing lost-time injuries, and this varies with company size and with union status.

Several potential limitations should be considered when interpreting the data. Control for the trade/type of work being done was not explicitly calculated for this analysis. While all of the hours at-risk involved construction or construction-related activities, the separation of work by those trades that may be more inherently at risk was not possible. Additionally, the exact number of employees per company was not captured in the data, but was estimated by the surrogate variable of premium size. Insurance premium is a composite covariate that estimates employee payroll and hours at-risk, along with variables related to trade and loss history, so has some ability to control for factors that were not directly captured. It is possible that not all injuries incurred during employment are captured by workers' compensation systems.

Underreporting in the claims data would be more likely with less severe injuries, which are easier to conceal and cover out of pocket. The effect of this underreporting, however, is likely lower in TBG companies as TBG collects information on all claims filed, including incident-only claims, and not just claims paid, or those with time loss. This aids a more complete capture of injury events. TBG actively trains company owners and employees on the importance of reporting all injuries, as well as describing the consequence of non-reporting. Moreover, the results of the association of non-lost time claims incidence on risk of lost-time injury were significant in all categories. The effect of one lost-time claim on future lost-time claims must also be considered. A company may be affected in ways that cannot be measured in the data by the experience of a lost-time claim. The analysis treated each subsequent lost-time claim interval as independent from previous lost-time intervals. Generalizability of our results is also a consideration. This analysis is limited to one workers' compensation insurer in one state. TBG is the largest insurer of construction companies in Minnesota and covers a substantial proportion of the small- and medium-sized construction firms that work in the full spectrum of construction trades and types of building projects. While construction

practices may vary regionally, the work methods and procedures done by this cohort of companies are very similar to operations nationwide.

The limitations of this analysis were offset by several unique strengths of this study. The data used for this study provide a more complete picture than workers' compensation data alone, with comprehensive information on the population at risk that can be used to prospectively evaluate injury and illness claims. This data resource is unique in that data are available that characterize non-lost time claim experience prior to the lost-time injury events, and also through time, to track changes. The data capture small- and medium-sized construction companies, including all companies insured by TBG, so no survey or response methods are needed. The availability of company characteristics such as union status, premium size, and claim cost facilitated a robust analysis.

Companies with larger premium sizes were associated with increased risk of lost-time injury claims. The premium size is primarily a function of the size of the payroll of a company, but also accounts for underlying risk and claims history. That a larger company is at higher risk is somewhat surprising, as it is often assumed that larger companies have more attention, time, and resources available to be dedicated to injury prevention. Yet, larger companies tend to work on larger, more complex projects with more employees and other companies present, and this may lend itself to a larger number of factors that could increase risk of injuries. However, even the companies deemed "large" in this population are still almost entirely below 100 employees, which is a size that is generally considered small in the majority of other published research.

Union companies were also at significantly higher risk for injury than companies that were non-union. This could be, in part, because they tend to be larger in size, and larger companies are subject to a number of factors described above. Employees who are union members may also report injuries more consistently, as they feel they have the support and backing of their union and feel less fear of retaliation. Still, union members usually have large amounts of safety and health training in their programs and increased focus and enforcement of injury prevention on the projects they work on, so one would generally expect union companies to have lower rates of lost-time injuries.

Overall findings are consistent with reports of others that show that minor injuries are associated with incidence of major injury, most notably, Lowery et. al (2008) who researched contractors involved in the building of the Denver International Airport. They reported contractors experiencing one more minor injuries were four times more likely to experience a major injury (OR= 4.0, CI = 2.5-5.5). A review of evidence and testing of data from United Kingdom railway studies provided support for the theory of underlying causes between near miss, injuries, and fatalities (Wright and van der Schaaf, 2004). The results of our study have some similarities to research of non-lost time and lost-time claims in a health care setting that determined that one type of injury, musculoskeletal, had similar factors in both non-lost time and lost-time events (Alamgir, Yu, Goreman, Ngan, & Guzman, 2009). Our results differed from Hinze, Devenport & Giang (2006) who focused on minor injuries, noting their high frequency in the construction industry. They reported that younger workers were more likely to experience lacerations and eye injuries and older workers were more likely to have knee, upper extremity, and lumbar spine injuries. Also, a study that looked at independent demographic factors, such as age, gender and industry did not find any significantly common factors between non-lost time and lost-time claims (Smith, Smith, Hogg-Johnson, Mustard, Chen, & Tompa, 2012), thus seemingly providing limited support for common factors between the two types of claims.

There are several considerations when examining minor injuries as predictors of lost-time injuries. The mechanisms and underlying causes of the minor injuries may be very similar or very different than the cause of the lost-time injury. It can be presumed that the more similar the underlying mechanisms (mechanical, environmental, human, etc.) between the types of claims, the more accurate the minor claims can be in predicting risk of a lost-time injury, and the more targeted, efficient, and significant the prevention strategies can be with the intent to prevent the severe claims.

Summary

Companies with increasing minor claim frequency were at increasing risk for lost-time injuries. The presence of minor injuries may warrant more attention to prevent the occurrence of major injuries. They may serve as a useful trigger for an assessment of safety practices or an indicator of where to most appropriately devote limited resources for injury prevention in a population at high risk of severe injury.

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Table 1 Overall, Lost-Time, and Non-Lost Time Injury Claims and Rates[†] by Trade, Union Status, and Premium Size

Exposed	Overall Claims (n)	Overall Rates	Lost-Time Claims (n)	Lost-Time Rates	Non-lost time Claims (n)	Non-lost time Rates
<i>Total Population</i>	9,986	10.54	2,292	2.46	7,693	8.15
<i>Trade</i>						
Rough Carpentry	1,835	24.32	452	600.00	1,382	18.32
Interior Carpentry	336	20.53	77	4.79	259	15.92
Supervisors	259	5.31	60	1.24	199	4.09
Crane Operators	33	9.75	11	3.26	22	6.50
Sales and Retail	158	0.54	22	0.08	136	0.47
Shop, Yard, and Deliveries	1,240	7.56	238	1.46	1,002	6.11
Drywall	601	16.71	173	4.81	428	11.90
HVAC and Plumbing	1,304	26.22	259	5.21	1,045	21.02
Auto Repair	50	13.49	11	2.97	39	10.52
Roofing	94	31.12	27	8.95	67	22.21
Manufacturing	606	19.00	85	2.67	521	16.35
Flooring Installation and Flatwork	441	24.05	123	6.72	318	17.35
Trucking	19	7.82	5	2.06	14	5.76
Electric Installation	271	14.22	48	2.52	223	11.70
Painting	437	14.61	104	3.48	333	11.14
Concrete and Masonry	1,107	14.39	334	4.38	773	10.07
Iron and Steel	274	82.79	58	17.62	216	65.34
Roadwork and Equipment Operators	310	11.22	89	3.24	221	8.01
Garbage and Recycling	155	12.42	33	2.65	122	9.79
Nursery and Landscaping	287	23.96	54	4.53	233	19.46
Equipment Installation and Assembly	169	21.11	29	3.66	140	17.56
<i>Union Status</i>						
Non-Union	5,920	9.83	1,272	2.13	4,647	7.73
Union	4,066	11.86	1,020	3.07	3,046	8.94
<i>Premium Size Classification</i>						
\$0-15K	788	7.23	198	1.83	590	5.42
\$15,001-75K	4,226	9.49	940	2.13	3,285	7.40
\$>75,001	4,972	12.76	1,154	3.02	3,818	9.83

[†] Rate per 100 FTE (200,000 hours)

Table 2 Risk of Lost-Time Claim Associated with Non-Lost Time Claim Experience

Variable	Crude HR	95% CI	Adjusted[†] HR	95% CI
<i>Non-Lost Time Claim Experience</i>				
7+ claims	3.62	3.15- 4.16	1.52	1.32- 1.75
4-6 claims	2.51	2.20- 2.86	1.36	1.19- 1.56
2-3 claims	2.01	1.81- 2.24	1.25	1.12- 1.39
0-1 claim (referent)	1.00	.	1.00	.
<i>Premium Size</i>				
>\$75,000	.	.	13.56	11.48- 16.02
\$15,000-\$75,000	.	.	3.97	3.38- 4.65
<\$15,000 (referent)	.	.	1.00	.
<i>Union Status</i>				
Union	.	.	1.21	1.11- 1.33
Non-Union (referent)	.	.	1.00	.

[†] Adjusted for premium size and union status

Chapter Six

Safety and Health Professional Contact and Risk of Lost-Time Injury in Construction

Companies Using Survival Analysis

Abstract

Objective: Written safety programs, jobsite planning, and training are some factors that have been associated with reduced risk of injury in the construction industry. These are responsibilities of company safety directors or staff, but smaller companies may need to turn to outside resources for safety assistance. The goal of the study was to determine the associations between company contact with an external safety and health professional and risk of lost-time injury.

Methods: Workers' compensation claims data were evaluated covering 1,360 construction companies from 2004-2009. Hazard Ratios (HR) and 95% confidence intervals (CI) were estimated using a proportional hazards regression model and accounting for repeated events and time-varying covariates. Safety and health professional contact was categorized into the following groups: 0 contacts, 1 contact, 2 contacts, and 3 or more contacts. A model based variance estimate was used to account for correlated observations within companies over time. Models included confounding covariates of company premium size and union status.

Results: Compared to experiencing no contact, reduced risk occurred with experiencing 1 contact (HR=0.77, CI=0.67-0.88) and 2 contacts (HR=0.63, CI=0.55-0.74). Once companies reached the highest category of contacts, three or more, there was no longer and significant reduction in risk (HR= 1.06, CI= 0.92-1.22). Companies with a higher premium size were associated with greater risk of a loss time claim, as were union companies.

Conclusion: The results indicate contact of some type with a safety and health professional may reduce the risk of lost-time injury.

Introduction

The construction industry is uniquely difficult and challenging to study due to the pace and organization of work and projects. Many physical hazards are present under normal conditions, and the work is often physically demanding and strenuous. Natural conditions and weather also can greatly affect the worksite as well as employee working conditions. This industry has a high rate of fatalities, annually; while it employs about 8% of the workforce, it experiences 22% of the fatalities (National Institute of Occupational Safety and Health (NIOSH), 2009). The construction sector also contributes to a high number of severe and non-fatal injuries (Courtney, Matz, & Webster, 2002; Dement & Lipscomb, 1999). Compared to other industries, employment in the construction industry has also been associated with a higher probability of disability should an injury occur on the job (Stover, Wickizer, Zimmerman, Fulton-Kehoe, & Franklin, 2007). In addition to the direct cost of injuries, there is an emotional and financial toll on injured workers and their families, along with their co-workers, places of employment, and the public (Waehrer, Dong, Miller, Haile, & Men, 2007). This comprehensive cost has been shown to be disproportionately high in construction, almost double the cost, compared to other industries (Waehrer, et al., 2007).

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training and education is inconsistent and less likely to be categorized or documented. Non-union contractors lack some of the resources available to large and union contractors, and also do not receive the same amount of health and safety attention on their jobsites (Gillen, Baltz, Gassel, Kirsch, & Vaccaro, 2002). There are few published studies or reports that address both the residential sector and small- and medium-sized construction firms.

Numerous studies have researched the factors that influence the safety performance of construction companies. These include written safety programs, pre-job planning on sites, proper protective equipment, safety training and education, safety accountability, and jobsite inspections and monitoring (Liska & Goodloe, 1993; Lowery, et al., 1998; Glazner, Borgerding, Bondy, Lowery, Lezotte & Kreiss, 1999; Dement, Lipscomb, Li, Epling & Desai, 2003; Dong, Entzel, Men, Chowdhury & Scott, 2004; Geldart, Shannon & Lohfeld, 2005; Hoonakker, Loushine, Carayon, Kallman, Kapp & Smith, 2005; McDonald, Lipscomb, & Glazner, 2009; Mikkelsen, Spangenberg & Kines 2010), as well as safety climate and management commitment (Choudhry, Fang, & Mohamed, 2007; Flin, Mearns, O'Connor, & Bryden, 2000; Lehtola, et al., 2008; Wirth & Sigurdsson, 2008; Zohar, 1980). All of these factors usually are the direct responsibility or under the direction and influence of a company safety representative, but the majority of small and medium sized construction establishments do not have the resources to employ a full-time safety director. Thus, the responsibilities and tasks must be distributed amongst other employees, management, or outside safety resources, if at all. Outside safety resources may take the form of OSHA enforcement or consultation (Haviland, Burns, Gray, Ruder & Mendeloff, 2010; Baggs, Silverstein, & Foley, 2003), hired consultants or trainers, resources from trade or professional organizations, or professionals from insurance carriers, to name a few, and there have been few studies on safety and health (S & H) professional effect on the workplaces with which they come in contact. When focusing strictly on insurance carriers, studies have identified factors that lead to, and escalate the cost of, workers' compensation claims (Bernacki, Yuspeh, & Xuguang, 2007; Stover, et. al, 2007) Some have indicated the use of a team, including loss prevention and safety professionals, provided by the workers' compensation carrier, can reduce the rate of injury and lower the cost of existing claims once they occur

(Green-McKenzie, Parkerson & Bernacki 1997; Bernacki, & Tsai, 2003; Davis, Badii, Yassi, 2004;)

The objective of this study was to evaluate the association of contact and assistance from a S& H professional, provided by the workers' compensation carrier, on reduction of risk for lost-time injuries in small and medium sized construction firms.

Materials and Methods

Population Data and Collection

Workers' compensation claims were used to examine injuries in employees of construction companies who obtained workers' compensation insurance from The Builders Group (TBG). TBG is a self-insured workers' compensation fund that insures mainly small- and medium-sized construction and construction-related businesses within the state of Minnesota. Criteria for acceptance into TBG are based mainly on the company's established financial stability. The study included all companies insured by TBG during a 2192-day time-period from January 1st, 2004 until December 31st, 2009.

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Claims Data, Collection, and Outcomes

Claims data captured all injury and illness events submitted to TBG for compensation. First reports of injury are completed by office personnel or management within an insured company and then submitted to TBG where they are further processed and categorized by a claims manager. Claims data included information on calendar date of injury, mechanism of injury, type of injury, and cost of injury claim. Claims were classified as medical-only or lost-time. Minnesota state statutes classify lost-time claims as those involving injuries or illnesses that result in more than three consecutive calendar

days of lost work time and include payment of medical and wage loss (indemnity) costs. Medical claims involve injured or ill workers who receive care but have not missed more than three consecutive days of lost work time and only medical costs are incurred.

Loss Control and Contact with Companies

TBG has a comprehensive loss control (LC) division that evaluates safety practices and culture to identify modifiable risk factors to reduce injury risk and compensation costs for its insured member companies. An initial evaluation of the company is conducted after a member enters and, periodically thereafter. Loss control professionals meet with company representatives and go through a standardized evaluation interview process. The evaluations ascertain the company's safety efforts, programs, hazard controls, and management attitude, and any changes over time. The initial evaluation and meeting help characterize the company risk and identify areas for improvement, intervention, or future contact by the loss control representative, as well as company safety goals. Occasionally companies are contacted to follow-up on frequent and/or high cost claims, but there is no systematic review based on injury rate.

The LC representatives are S & H professionals with advanced degrees in their field. They may perform a wide variety of services for the companies they work with, including safety awareness training and education, technical equipment training, safety program development, jobsite visit and audits, jobsite hazard evaluations, ergonomic evaluations, safety coaching and goal setting. The goal of the LC representatives is to be a safety resource for the companies with which they work with and fill the void when a company does not have full-time, or part-time, safety personnel.

Modeling Repeated Events

We examined the effect of S & H professional contact on the rate of lost-time injury claims. Time intervals were constructed from a company's entrance into the study to the date of a lost-time injury event, exit from the study, or end of the study. Following a lost-time injury, a new interval would begin. The number of S & H professional contacts with a company during the time intervals was also tabulated.

Proportional hazards regression was used to model the time to lost-time injury intervals. Because companies could have multiple lost-time injuries over the course of the study period, a repeated events model was used. Data were compiled in the counting process format, meaning that for any company with multiple lost-time injury events, each such record represented one interval for the company. Each record was in the form of $(\text{time}_1, \text{time}_2, I_{\text{event}} \dots)$, where time_1 represented the time at which the interval started, time_2 the time at which the interval ended, and I_{event} was an indicator variable showing the end status of the interval. A lost-time injury was indicated by a (1) and the end of the interval with no lost-time injury event, exit from the study, or end of study was indicated by a (0). If a company had multiple intervals, time_1 of the new interval would begin the day after the lost-time injury event of the previous interval.

Modeling Time-Varying S & H Professional Contact Covariate within Repeated Event Intervals

The exposure variable of interest, S &H professional contacts, was included in the model as a time-varying covariate. The time varying nature of the exposure meant that within a lost-time interval, a company could experience multiple contacts. The S & H contact accumulation experience within a lost-time interval, and how it varied from company to company, needed to be measured and accounted for to maintain the proportional hazards assumption. S & H professional contacts were categorized into four groups; 0 contacts, 1 contact, 2 contacts, and 3 or more contacts. The model counted the duration, in days, that a company occupied each category within lost-time injury interval. Each record of a S & H professional contact category was in the form of $(\text{time}_1, \text{time}_2, I_{\text{event}} \dots)$, where time_1 represents the time at which the contact experience category observation started, time_2 the time at which the observation ended, and I_{event} was an indicator variable showing the status of the observation interval. Thus, one lost-time interval could have up to four S & H professional contact category observations. If contact experience necessitated multiple intervals, time_1 of the new interval would begin the day contact occurred that pushed the count to the higher category. Time independent (static) indicators of union status and premium size repeated for the rows of code whereas exit status variables changed across the rows. The end of a S &H professional contact

category interval with a lost-time injury event was indicated by a (1) and the end of an interval with no lost-time injury event was indicated by a (0).

Analysis

Cox proportional hazards regression was conducted using the SAS PHREG procedure (Allison, 2010). The effect of S & H contacts on risk of lost-time injury were evaluated by estimating hazard ratios (HR) and 95% confidence intervals (CI) as a function of injury rate. Each claim was considered to be independent of prior claims. A model-based variance estimate was used to account for within company correlation. The models included potentially confounding covariates of union status, company premium size, and hours worked. All analyses were conducted using proc phreg in SAS (2011).

Results

During the study period, 1,360 companies compiled 185,766,467 hours of employee time at risk, representing approximately 92,882 full time equivalent employees (FTE) and 9,986 workers' compensation claims for an average claim rate of 10.75 per 100 FTE. The total claims count was comprised of 7,693 medical claims (8.28 per 100 FTE) and 2,292 lost-time claims (2.47 per 100 FTE). Of the lost-time claims, 602 were over \$25,000 in value. Total incurred cost of claims during this period was \$90,416,073. Claim rates varied among trade categories, and union companies and companies of larger premium size had higher injury rates (**Table 1**).

Cox proportional hazards was used for the unadjusted and adjusted model analysis. The crude model revealed significantly lower rates of lost-time injury for those companies with S & H professional contact. The adjusted model continued to illustrate that a company was significantly less likely to experience a lost-time injury event as they received more S & H professional contact. Compared to experiencing no contact, reduced risk occurred with experiencing 1 contact (HR=0.77, CI=0.67-0.88) and 2 contacts (HR=0.63, CI=0.55-0.74). Once companies reached the highest category of contacts, three or more, there was no longer and significant reduction in risk (HR= 1.06, CI= 0.92-1.22). Companies with a higher premium size were associated with greater risk of a loss time claim, as were union companies (**Table 2**)

Discussion

This analysis indicates that increased contact with a loss control representative is associated with a reduced risk of experiencing a lost-time injury, and this varies with company size and with union status.

Several potential limitations should be considered when interpreting the data. Control for the trade/type of work being done was not explicitly calculated for this analysis. While all of the hours at-risk involved construction or construction related activities, the separation of work by those trades that may be more inherently at risk was not possible. Additionally, the exact number of employees per company was not captured in the data, but was estimated by the surrogate variable of premium size. It is possible that not all injuries incurred during employment are captured by workers' compensation systems. Underreporting in the claims data would be more likely with less severe injuries, which are easier to conceal and covered out of pocket. The effect of this underreporting, however, is likely lower in TBG companies as TBG collects information on all claims filed, including incident-only claims, and not just claims paid, or those with time loss. This aids a more complete capture of injury events. TBG actively trains company owners and employees on the importance of reporting all injuries, as well as describing the consequence of non-reporting. The effect of one lost-time claim on future lost-time claims must also be considered. A company may be affected in ways that cannot be measured in the data by the experience of a lost-time claim. The analysis treated each subsequent lost-time claim interval in the same manner as the first. Generalizability of our results is also a consideration. This analysis is limited to one workers' compensation insurer in one state. TBG is the largest insurer of construction companies in Minnesota and covers a substantial proportion of the small- and medium-sized construction firms that work in the full spectrum of construction trades and types of building projects. While construction practices may vary regionally, overall the work methods and procedures done by this cohort of companies are very similar to operations nationwide.

The limitations of this analysis were offset by several unique strengths of this study. The data used for this study provide a more complete picture than workers' compensation data alone, with comprehensive information on the population at risk that

can be used to prospectively evaluate injury and illness claims. This data resource is unique in that data are available that characterize safety and health professional experience prior to the lost-time injury events, and also through time, to track changes. The data capture small- and medium-sized construction companies, including all companies insured by TBG so no survey or response methods are needed.

Companies with larger premium sizes were associated with increased risk of lost-time injury claim. The premium size is primarily a function of the size of the payroll of a company, but also accounts for underlying risk and claims history. That a larger company is at higher risk is somewhat surprising, as it is often assumed that larger companies have more attention, time, and resources available to be dedicated to injury prevention. Yet, larger companies tend to work on larger, more complex projects with more employees and other companies present, and this may lend itself to a larger number of factors that could increase risk of injuries. However, even the companies deemed “large” in this population are still almost entirely below 100 employees, which is a size that is generally considered small in the majority of other published research.

Union companies were also at significantly higher risk for injury than companies that were non-union. This could be, in part, because they tend to be larger in size, and larger companies are subject to a number of factors described above. Employees who are union members may also report injuries more consistently, as they feel they have the support and backing of their union and feel less fear of retaliation. Still, union members usually have large amounts of safety and health training in their trade training programs, and increased focus and enforcement of injury prevention on the projects they work on, so one would generally expect union companies to have lower rates of lost-time injuries.

Results of the study were similar to results demonstrated in a study of Washington State OSHA activity. Construction accounts that had any kind of contact from OSHA enforcement had significant decreases (12.8%) in rates of workers’ compensation claims, compared to accounts with no OSHA activity (7.4% reduction). However, OSHA consultation did not cause any significant decrease in claim rates (Baggs, et al, 2003). It would appear that safety and health attention with more of a consequence has more of an effect. Another recent study, although focusing more on the manufacturing sector, also found that OSHA enforcement reduced injury rates (4.1-7.2%) (Haviland, et al, 2010).

Previous research that suggested that workers' compensation team approach models, that included safety and health professionals, and reduced injury claims and costs also coincided with the results of this study. A ten-year study using a managed care team approach realized a 73% decrease in lost time claims, a 77% decrease of paid temporary or total disability days away from work, and a 54% overall decrease in workers' compensation costs (Bernacki & Tsai, 2003), with a number of different studies of the same cohort providing similar results throughout the time period (Green-McKenzie, et al., 1997; Davis et al., 2004) did not see a reduction in incidence, but some categories of employees were transitioned back to work more promptly, which has a major implication for workers' compensation savings.

There are several considerations when examining involvement of a S&H professional to reduce the risk of severe injury within a company. The type of activity the safety and health professional is doing during their contact with the company is not measured. It is possible that some activities, such as jobsite visits or training, could have more of an effect on the risk for injury than other activities, such as writing a safety program. On the other hand, it could be that just the attention or perhaps threat of increased insurance costs from the S & H professionals' visit is enough to produce some type of effect. This reduction of risk may have varied time to onset after the contact with the S & H professional or a varying period of benefit after the contact, based on a number of factors. The loss prevention services offered in this study were at no cost to the companies, and some were required by the workers' compensation carrier. The addition of a direct monetary value, or a purely discretionary nature, to the services that companies are receiving may also effect associations on injury reduction. Identification of an optimal number or type of contacts from a safety professional to establish a severe injury reduction trend would be highly valuable knowledge for industry stakeholders and to facilitate reduction of injury burden.

Summary

Companies that have contact with a safety and health professional may have reduced risk for severe injury. The use of, and contact with, a S & H professional is easily available through resources such as OSHA consultative services, insurance programs, private consultants, and trade and professional organizations. They may be available for little to no cost for the interested company. This may be a feasible solution for reduction of workers' compensation claims and costs as well as injury burden in this high risk population.

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Table 1 Overall, Lost-Time, and Non-Lost Time Injury Claims and Rates[†] by Trade, Union Status, and Premium Size

Exposed	Overall Claims (n)	Overall Rates	Lost-Time Claims (n)	Lost-Time Rates	Non-lost time Claims (n)	Non-lost time Rates
<i>Total Population</i>	9,986	10.54	2,292	2.46	7,693	8.15
<i>Trade</i>						
Rough Carpentry	1,835	24.32	452	600.00	1,382	18.32
Interior Carpentry	336	20.53	77	4.79	259	15.92
Supervisors	259	5.31	60	1.24	199	4.09
Crane Operators	33	9.75	11	3.26	22	6.50
Sales and Retail	158	0.54	22	0.08	136	0.47
Shop, Yard, and Deliveries	1,240	7.56	238	1.46	1,002	6.11
Drywall	601	16.71	173	4.81	428	11.90
HVAC and Plumbing	1,304	26.22	259	5.21	1,045	21.02
Auto Repair	50	13.49	11	2.97	39	10.52
Roofing	94	31.12	27	8.95	67	22.21
Manufacturing	606	19.00	85	2.67	521	16.35
Flooring Installation and Flatwork	441	24.05	123	6.72	318	17.35
Trucking	19	7.82	5	2.06	14	5.76
Electric Installation	271	14.22	48	2.52	223	11.70
Painting	437	14.61	104	3.48	333	11.14
Concrete and Masonry	1,107	14.39	334	4.38	773	10.07
Iron and Steel	274	82.79	58	17.62	216	65.34
Roadwork and Equipment Operators	310	11.22	89	3.24	221	8.01
Garbage and Recycling	155	12.42	33	2.65	122	9.79
Nursery and Landscaping	287	23.96	54	4.53	233	19.46
Equipment Installation and Assembly	169	21.11	29	3.66	140	17.56
<i>Union Status</i>						
Non-Union	5,920	9.83	1,272	2.13	4,647	7.73
Union	4,066	11.86	1,020	3.07	3,046	8.94
<i>Premium Size Classification</i>						
\$0-15K	788	7.23	198	1.83	590	5.42
\$15,001-75K	4,226	9.49	940	2.13	3,285	7.40
\$>75,001	4,972	12.76	1,154	3.02	3,818	9.83

[†] Rate per 100 FTE (200,000 hours)

Table 2 Risk of Lost-Time Claims Associated with Safety and Health Professional Contact

Variable	Crude HR	95% CI	Adjusted[†] HR	95% CI
<i>LC Contact</i>				
3+ contacts	0.70	0.62-0.79	0.73	0.65-0.82
2 contacts	0.42	0.37-0.49	0.59	0.51- 0.68
1 contact	0.50	0.45- 0.56	0.72	0.65- 0.81
0 contacts (referent)	1.00	.	1.00	.
<i>Premium Size</i>				
>\$75,000	.	.	13.74	11.71- 16.11
\$15,000-\$75,000	.	.	3.89	3.33- 4.54
<\$15,000 (referent)	.	.	1.00	.
<i>Union Status</i>				
Union	.	.	1.16	1.06-1.27
Non-Union (referent)	.	.	1.00	.

[†] Adjusted for premium size and union status

Chapter Seven

Discussion

The results of this research provided insight into the injury burden of small- and medium-sized contractors. It highlighted some potential indicators for increased risk of injury as well as some potential solutions to reduce risk of injury. The results coincided with much of the existing literature, but added additional depth and nuances. It also underlined some unique information specific to the construction industry and small- and medium-sized contractors. Additional years of data are available for this population, which would enhance power and ability to detect smaller associations, specifically when broken down into trades and types and mechanism of injury. The additional years of data could allow further characterizations of economic and business trends encountered subsequent to the end of the study time period.

A consideration across all of the analysis of this study was the accurate reporting of injuries by the companies in the population. Non-reporting could make some groups appear at an increased risk of injury, or mute the associations in other groups. Numerous techniques were employed by the insurance company to promote accurate reporting of injuries.

Some surprising results included the apparent increased risk of larger companies, compared to smaller companies, in the study. Previous literature almost always indicates that smaller companies are at increased risk. However, all companies included in this research are of a size deemed as “small” in previously published studies, so a direct comparison cannot be precisely made. Union contractors also had higher rates of injury and were found to be at increased risk when examining non-lost-time injuries on severe injuries and S & H professional contact on reduction of severe injuries. Other published research suggests that union companies are usually at a reduced risk of injury due to their extensive training and inclusion of safety curriculum in trade schools, regulatory attention on their jobsites, and type of projects on which they work. But, literature also suggests that union contractors were more likely to report injuries than non-union contractors.

Companies that used a drug-testing program had lower rates of injury than those that did not. This agrees with the results of other studies, particularly when the studies focused just on the construction industry. The data in this study covered a far greater time period and more detailed information on testing programs than most of the other

published literature. The separation of type of program, pre-employment and post-accident, or pre-employment, post-accident, random, and reasonable suspicion was not seen previously in other research. The findings that only companies using pre-employment and post-accident testing have lower injury rates more often than those using all four types of testing was interesting. This could have significant ramifications on cost savings from both an insurance claim standpoint as well as testing program expenses. A more in-depth look at the components of drug and alcohol testing programs, such as type, consistency of testing, and program administrator, could shed more light on how to utilize these programs to have the most effect on the reduction of injuries.

Overall, there was no association found between the rating of a S & H professional of a company's management attitude and commitment and that company's risk of injuries, but when broken down by trade there were some significant results. Further study on the factors that create a safety climate or culture within a company, and a more refined technique to detect or "rate" a company would benefit proactive injury reduction measures for high risk companies. However, companies in this population were at an increased risk of injury prior to a visit by a S & H professional. This was a result of interest, and also agreed with the subsequent analysis of this project that associated reduced risk of severe injury with contact from a S & H professional. Numerous other studies have associated best practices for safety and/or contact with some type of safety professional, and a reduced risk of injury, yet none had directly tied the association of ongoing visits or type of visits. There are abundant resources in industry for a company to utilize of a S & H professional. Determining the most effective type of contact as well as the optimum time periods between these contacts could allow enhanced injury reduction and utilization of limited resources for companies.

The study found that frequency of non-lost-time claims was associated with lost-time claims. These results agree with a commonly held belief in the S & H field as well as the results of other research focused just on construction contractors. The relation to studies in other literature, however, was mixed. Although the types and mechanisms of injury were not specifically analyzed, it could be assumed that the more common the type and mechanism of non-lost-time claim, the more predictive it would be of a similar type

of severe injury. Further research on specific categories of injuries could provide added insight into the predictive nature of non-severe claims on severe injury.

Other topics that were not the specific focus of this study, such as injuries from nail guns or small tools could enhance existing literature by using the data from this unique population.

Conclusion

The construction industry is a population at high risk of frequent and severe injuries. Results from this project show significant ability that some interventions, such as drug testing programs, may provide low cost and low risk solutions for injury reduction. The detection of associations between minor and severe injuries, as indicated by these research results, may allow for more accurate and proactive detection of companies at risk of severe injuries. An accurate tool for rating a S & H professional's opinion of a management's attitude and commitment toward safety may need more development. However, the presence and utilization of a S & H professionals appears to significantly reduce the risk of a company for both minor and severe injuries. The use of, and contact with, a S&H professional is easily available through resources such as OSHA consultative services, insurance programs, and private consultants, to name a few. The results of this study provide insight into the associations between various factors and work related injuries and point to a number of methods that can be applied directly into practice for reduction of injury burden in this high risk population.

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Appendix A
Permission Letter From CEO of The Builders Group



The Builders Group of MN

Sponsored and Endorsed by the Builders Associations of MN, the Twin Cities, and the Mpls & St. Paul Builders Exchanges

2919 Eagandale Blvd., Suite 100, Eagan, MN 55121-1214 www.tbgnm.com
888-824-3923 toll free 651-389-1140 local 651-389-1141 fax

To whom it may concern-

The following letter is in regard to The Builders Group (TBG) data being used in Katie Schofield's doctoral dissertation research project "Risk Factors for Injuries and Increased Severity of Injuries in Small and Medium Sized Construction Companies", study number 1004E80574:

I understand that Katie has passed her preliminary oral examination and attained doctoral candidacy in the School of Public Health, and that her project has been approved by her doctoral committee. Additionally, the research and design methods of the project have undergone review by the University of Minnesota Institutional Review Board and Human Subjects Committee. It was determined that the study was exempt from review under federal guidelines 45 CFR Part 46.101(b) category #4 EXISTING DATA; RECORDS REVIEW; PATHOLOGICAL SPECIMENS. The study was granted permission to commence under the outlined study methods.

The goal of the study is to examine a cohort of small and medium sized construction companies to evaluate injury risk and severity by company characteristics and determine efficacy of specific injury prevention efforts.

TBG has interest in the results of this study for outcomes regarding the efficiency and accuracy of some company procedures as well as a way to apply results to reduce the burden of injury in the construction workers employed by the companies insured by TBG. There is no personal incentive or gains for Katie from performing the research or in what the results show. TBG will not be contributing financially to this research.

The benefits of the research in this study can almost immediately impact those companies insured by TBG and their employees. TBG can better identify risk factors that lead to an increase in injury frequency and severity, and TBG can also implement procedures to better assist their clients in reducing injury frequency and severity.

The benefits of the research of this study can positively affect places of employment and employees in industry by better quantifying risk factors that increased injury severity and frequency, and well as potential safety and procedural interventions to reduce injury frequency and severity.

I understand that the **results** of this study may be published in scholarly, peer reviewed journals, shared with other academic researchers, presented in oral or poster presentation to various scholarly and industry groups, and become public record.

TBG agrees to allow the use of this data for research and academic purposes, including those listed above.

Sincerely

Stu Thompson, CEO

Appendix B
Loss Control Survey

	TBG Loss Control Profile		Date						
	MEMBER/PROSPECT COMPANY NAME		PC <input type="checkbox"/>						
ADDRESS									
CITY STATE ZIP									
PHONE									
CONTACT									
LOSS CONTROL REP		SAFETY DIRECTOR							
FREQUENCY RATE		EMR							
SEVERITY RATE		AGREEMENT #							
<p>Activity Summary</p> <table border="1"> <thead> <tr> <th>Activity</th> <th>Date</th> <th>TBG Rep</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> </tr> </tbody> </table>				Activity	Date	TBG Rep			
Activity	Date	TBG Rep							

Background and History

Length of time in business (Years)	<input type="radio"/> 1 - 5	<input type="radio"/> 6 - 10	<input checked="" type="radio"/> 10 +
Mgmt involved in, and supportive of company Sfty Efforts	<input type="radio"/> Yes	<input checked="" type="radio"/> N.I.	<input type="radio"/> No
Mgmt experience in similar or related work (Years)	<input type="radio"/> 1 - 5	<input type="radio"/> 6 - 10	<input checked="" type="radio"/> 10 +
Operations are stable (if no, explain)	<input checked="" type="radio"/> Yes	<input type="radio"/> No	
Favorable Growth/Profitability (if no, explain)	<input checked="" type="radio"/> Yes	<input type="radio"/> No	
Comments:			

Description of Operations

Type of business (explain)	Glass replacement - Auto, equipment, etc.			
Geographical work area (explain)	Minnesota, Western Wisconsin and Northern Iowa			
% of out of state work (explain any out of state work)	<input type="radio"/> None	<input checked="" type="radio"/> <10%	<input type="radio"/> 10 - 50%	<input type="radio"/> >50%
Work as Prime/Sub	<input type="radio"/> % Prime	<input checked="" type="radio"/> % Sub		
Enter into only std contractual agreements (if no, explain)	<input type="radio"/> Yes	<input checked="" type="radio"/> No		
Business is solely owned (if no, explain)	<input type="radio"/> Yes	<input checked="" type="radio"/> No		
Comments:				

Employment Practices

Union	<input type="radio"/> Yes	<input checked="" type="radio"/> No	<input type="radio"/> Open Shop	
Number of employees	70		Employees	
Average length of employment (Years)	<input checked="" type="radio"/> 1 - 5	<input type="radio"/> 6 - 10	<input type="radio"/> 10 +	
Average length of experience (Years)	<input type="radio"/> 1 - 5	<input checked="" type="radio"/> 6 - 10	<input type="radio"/> 10 +	
What is your primary new employee selection process	<input checked="" type="checkbox"/> Advertise	<input type="checkbox"/> Referral	<input checked="" type="checkbox"/> Word of mouth	
How many new hires per year	<input checked="" type="radio"/> <10%	<input type="radio"/> 10-25%	<input type="radio"/> 25% +	
Uses formal interview process	<input checked="" type="radio"/> Yes	<input type="radio"/> N.I.	<input type="radio"/> No	
Have formal job descriptions	<input checked="" type="radio"/> Yes	<input type="radio"/> N.I.	<input type="radio"/> No	
Informs employee of physical requirements of job	<input checked="" type="radio"/> Yes	<input type="radio"/> N.I.	<input type="radio"/> No	
Present conditional job offers	<input checked="" type="radio"/> Yes	<input type="radio"/> N.I.	<input type="radio"/> No	
Provides employees with health insurance	<input checked="" type="radio"/> Yes		<input type="radio"/> No	
Conducts formal new employee orientation/training	<input checked="" type="radio"/> Yes	<input type="radio"/> N.I.	<input type="radio"/> No	
Utilizes an effective, formalized return-to-work program	<input type="radio"/> Yes	<input checked="" type="radio"/> N.I.	<input type="radio"/> No	
Has an active drug testing program <i>(check all that apply)</i>	<input type="radio"/> Yes	<input checked="" type="radio"/> N.I.	<input type="radio"/> No	
	<input checked="" type="checkbox"/> Pre-employment	<input type="checkbox"/> Random	<input checked="" type="checkbox"/> Reasonable suspicion	<input checked="" type="checkbox"/> Post-accident
Name of program administrator				
Comments:				

Major Hazard Potentials and Related Controls

<i>Hazards</i>	<i>Effective Control Efforts Present</i>				
Is Mgmt aware of their major hazard potentials and related controls?	<input checked="" type="radio"/> Yes	<input type="radio"/> N.I.	<input type="radio"/> No	<input type="radio"/> N/A	<input checked="" type="checkbox"/> V.I.F.
Falls	<input type="radio"/> Yes	<input checked="" type="radio"/> N.I.	<input type="radio"/> No	<input type="radio"/> N/A	<input checked="" type="checkbox"/> V.I.F.
Struck by	<input type="radio"/> Yes	<input checked="" type="radio"/> N.I.	<input type="radio"/> No	<input type="radio"/> N/A	<input checked="" type="checkbox"/> V.I.F.
Handling materials	<input type="radio"/> Yes	<input checked="" type="radio"/> N.I.	<input type="radio"/> No	<input type="radio"/> N/A	<input type="checkbox"/> V.I.F.
Driving exposure	<input checked="" type="radio"/> Yes	<input type="radio"/> N.I.	<input type="radio"/> No	<input type="radio"/> N/A	<input type="checkbox"/> V.I.F.
Equipment, tool, material storage/maint.	<input checked="" type="radio"/> Yes	<input type="radio"/> N.I.	<input type="radio"/> No	<input type="radio"/> N/A	<input type="checkbox"/> V.I.F.
Excavation/trenching	<input type="radio"/> Yes	<input type="radio"/> N.I.	<input type="radio"/> No	<input checked="" type="radio"/> N/A	<input type="checkbox"/> V.I.F.
Electrical	<input type="radio"/> Yes	<input type="radio"/> N.I.	<input type="radio"/> No	<input checked="" type="radio"/> N/A	<input type="checkbox"/> V.I.F.
Repetitive motion	<input type="radio"/> Yes	<input type="radio"/> N.I.	<input type="radio"/> No	<input checked="" type="radio"/> N/A	<input type="checkbox"/> V.I.F.
Confined space	<input type="radio"/> Yes	<input type="radio"/> N.I.	<input type="radio"/> No	<input checked="" type="radio"/> N/A	<input type="checkbox"/> V.I.F.
Environmental hazards	<input type="radio"/> Yes	<input type="radio"/> N.I.	<input type="radio"/> No	<input checked="" type="radio"/> N/A	<input type="checkbox"/> V.I.F.
Occupational Disease	<input checked="" type="radio"/> Yes	<input type="radio"/> N.I.	<input type="radio"/> No	<input type="radio"/> N/A	<input checked="" type="checkbox"/> V.I.F.
Other (explain)	<input type="radio"/> Yes	<input type="radio"/> N.I.	<input type="radio"/> No	<input checked="" type="radio"/> N/A	<input type="checkbox"/> V.I.F.
Comments:					

Loss Prevention

<i>Controls</i>	<i>Effective Efforts Present</i>			
Have a formal safety/AWAIR program in place?	<input type="radio"/> Yes	<input checked="" type="radio"/> N.I.	<input type="radio"/> No	<input type="radio"/> N/A
Is the safety/AWAIR program active?	<input type="radio"/> Yes	<input checked="" type="radio"/> N.I.	<input type="radio"/> No	<input type="radio"/> N/A
How communicated to employees	Written, verbal			
Have a designated safety director?	<input checked="" type="radio"/> Yes	<input type="radio"/> N.I.	<input type="radio"/> No	<input type="radio"/> N/A
Safety director reports to top management?	<input checked="" type="radio"/> Yes	<input type="radio"/> N.I.	<input type="radio"/> No	<input type="radio"/> N/A
Have an active safety committee?	<input type="radio"/> Yes	<input checked="" type="radio"/> N.I.	<input type="radio"/> No	<input type="radio"/> N/A
Conduct regular safety meetings and training?	<input type="radio"/> Yes	<input checked="" type="radio"/> N.I.	<input type="radio"/> No	<input type="radio"/> N/A
Frequency	<input type="radio"/> Daily	<input type="radio"/> Weekly	<input type="radio"/> Monthly	<input checked="" type="radio"/> Other
Incentive program in place?	<input type="radio"/> Yes	<input checked="" type="radio"/> No		
Have a method of jobsite safety supervision, enforcement of safety rules and evaluation?	<input type="radio"/> Yes	<input checked="" type="radio"/> N.I.	<input type="radio"/> No	<input type="radio"/> N/A
Are supervisors/foreman evaluated on, and held accountable for safety?	<input type="radio"/> Yes	<input checked="" type="radio"/> N.I.	<input type="radio"/> No	<input type="radio"/> N/A
Require appropriate personal protective equipment?	<input type="radio"/> Yes	<input checked="" type="radio"/> N.I.	<input type="radio"/> No	<input type="radio"/> N/A
Have an effective system of jobsite organization, housekeeping and debris removal?	<input checked="" type="radio"/> Yes	<input type="radio"/> N.I.	<input type="radio"/> No	<input type="radio"/> N/A
Prior Osha Enforcement Activity? If Yes, Explain Below.	<input type="radio"/> Yes	<input type="radio"/> N.I.	<input checked="" type="radio"/> No	<input type="radio"/> N/A
Is there active direction and monitoring of subcontractor safety?	<input type="radio"/> Yes	<input type="radio"/> N.I.	<input type="radio"/> No	<input checked="" type="radio"/> N/A
Obtain proof of insurance from subs?	<input type="radio"/> Yes	<input type="radio"/> N.I.	<input type="radio"/> No	<input checked="" type="radio"/> N/A
A formal accident investigation process is utilized?	<input checked="" type="radio"/> Yes	<input type="radio"/> N.I.	<input type="radio"/> No	<input type="radio"/> N/A
Is Mgmt involved in the accident investigation process?	<input checked="" type="radio"/> Yes	<input type="radio"/> N.I.	<input type="radio"/> No	
Have a designated medical provider?	<input type="radio"/> Yes	<input checked="" type="radio"/> N.I.	<input type="radio"/> No	<input type="radio"/> N/A
Comments:				

Loss History

Is the loss experience free of trends or problems? (if no, explain)	<input type="radio"/> Yes	<input checked="" type="radio"/> No	
Comments:			

Opinion of Risk

Does management have a good attitude/commitment?	<input checked="" type="radio"/> Yes	<input type="radio"/> N.I.	<input type="radio"/> No
Does there appear to be effective organization and accountability?	<input type="radio"/> Yes	<input checked="" type="radio"/> N.I.	<input type="radio"/> No
Are there effective programs in place?	<input type="radio"/> Yes	<input checked="" type="radio"/> N.I.	<input type="radio"/> No
Work Environment	<input type="radio"/> Encouraging and Constructive	<input checked="" type="radio"/> Neutral	<input type="radio"/> Disapproving and Unconstructive
Comments:			

Recommendations

Were any past recommendations addressed?	<input type="radio"/> Yes	<input type="radio"/> No	<input checked="" type="radio"/> N/A
Were any recommendations made during this visit?	<input checked="" type="radio"/> Yes	<input type="radio"/> No	
Comments:			

Appendix C
Human Subjects Approval

From: irb@umn.edu
Sent: Thursday, December 15, 2011 9:43 AM
To: scho0535@umn.edu
Subject:1004E80574 - PI Alexander - IRB - APVD Add Title

TO : balex@umn.edu, scho0535@umn.edu,
IRB approval has been recorded for the additional title for the study listed below:

Study Number: 1004E80574

Principal Investigator: Bruce Alexander

Expiration Date:

Title(s):

Risk Factors for Injuries in Small and Medium Sized Construction Companies

You may go to the View Completed section of eResearch Central at
<http://eresearch.umn.edu/> to view your additional title request submission.

This action was based on your assurance that the research is the same project as that currently approved. If this new title results in a funded project, please provide the face page of this grant application along with the methods section of your grant.

All protocol titles will have the same approval date, 04/27/2010, and continuing review schedule.

You are reminded that the addition of a title to this file does NOT reflect IRB approval for any changes in protocol or additional subjects. If any changes are planned for this research or if the new grant submission will mean an increase in the subject accrual goal, you must submit a request for a change in protocol for review.

We will be happy to notify your funding agency of approval of this title. If you would like us to do this, please send us the name and address of your contact person at the agency.

Thank you for keeping the IRB informed of the status of your research.

From: irb@umn.edu

Sent: Thursday, December 15, 2011 9:41 AM

To: scho0535@umn.edu

Subject:IRB Acknowledgment of Change in Protocol Request

TO : balex@umn.edu, scho0535@umn.edu, The IRB has reviewed and acknowledged your change in protocol for the study listed below:

Study Number: 1004E80574

Principal Investigator: Bruce Alexander

Title(s):

Risk Factors for Injuries in Small and Medium Sized Construction Companies

Your study was determined previously to be exempt from IRB review in one of the following categories 45 CFR 46.101(b):

#1 INSTRUCTIONAL STRATEGIES IN EDUCATIONAL SETTINGS.

#2 SURVEYS/INTERVIEWS; STANDARDIZED EDUCATIONAL TESTS;
OBSERVATION OF PUBLIC BEHAVIOR.

#3 PUBLIC OFFICIALS; SURVEYS/INTERVIEWS; OBSERVATION OF PUBLIC
BEHAVIOR.

#4 EXISTING DATA; RECORDS REVIEW; PATHOLOGICAL SPECIMENS.

#6 TASTE TESTING AND FOOD QUALITY EVALUATION.

The changes you have proposed do not alter your exempt status. No action is needed at this time

Please do not hesitate to contact the IRB office at 612-626-5654 or irb@umn.edu if you have any questions.

From: irb@umn.edu

Sent: Wednesday, April 28, 2010 3:00 PM

To: scho0535@umn.edu

Subject:IRB Expedited Proposal #1004P80574 - Granted IRB Exemption

Ms. Schofield,

Please note the Expedited Reviewer granted your study an exemption under IRB exempt category 4.

Your study number has been changed to 1004E80574.

Feel free to contact the IRB if you have questions.

- IRB

From: irb@umn.edu

Sent: Wednesday, April 28, 2010 2:56 PM

To: scho0535@umn.edu

Subject:1004P80574 - PI Schofield - IRB - Exempt Study Notification

TO : balex@umn.edu, balex@umn.edu, scho0535@umn.edu,

The IRB: Human Subjects Committee determined that the referenced study is exempt from review under federal guidelines 45 CFR Part 46.101(b) category #4 EXISTING DATA; RECORDS REVIEW; PATHOLOGICAL SPECIMENS.

Study Number: 1004P80574

Principal Investigator: Katherine Schofield

Title(s):

Risk Factors for Injuries and Increased Severity of Injuries in Small and Medium Sized Construction Companies

This e-mail confirmation is your official University of Minnesota RSPP notification of exemption from full committee review. You will not receive a hard copy or letter.

This secure electronic notification between password protected authentications has been deemed by the University of Minnesota to constitute a legal signature.

The study number above is assigned to your research. That number and the title of your study must be

used in all communication with the IRB office.

If you requested a waiver of HIPAA Authorization and received this e-mail, the waiver was granted.

Please note that under a waiver of the HIPAA Authorization, the HIPAA regulation [164.528] states that the subject has the right to request and receive an accounting of Disclosures of PHI made by the covered entity in the six years prior to the date on which the accounting is requested.

If you are accessing a limited Data Set and received this email, receipt of the Data Use Agreement is Acknowledged.

This exemption is valid for five years from the date of this correspondence and will be filed inactive at that time. You will receive a notification prior to inactivation. If this research will extend beyond five years, you must submit a new application to the IRB before the study's expiration date.

Upon receipt of this email, you may begin your research. If you have questions, please call the IRB office at (612) 626-5654.

You may go to the View Completed section of eResearch Central at <http://eresearch.umn.edu/> to view further details on your study.