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Analyses of Occupational Injuries in School Workers
Utilizing Workers' Compensation Data

By

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Environmental Health and Epidemiology

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Abstract

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By Daniel D. Nguyen

BACKGROUND: Occupational injuries continue to be a significant public health burden. School workers represent a unique sector that faces challenges in adequate implementation and upkeep of effective interventions to reduce costs and incidence of workplace injuries.

OBJECTIVE: We examined injury causations and associated costs from workers' compensation (WC) data, and assessed its utility as a surveillance tool.

METHODS: We analyzed accepted/settled WC claims (n=1,934) provided by the Ohio Bureau of Workers' Compensation (OBWC) for injuries that occurred within a Midwestern public school district from 2004-2014. Along with descriptive statistics, we ran logistic and linear regression models to determine predictors of injury causations and total compensation costs (TCC), respectively.

RESULTS: The annual injury rate had a marginally significant (p-value=0.06) decrease (~4 to 2 cases per 100 staff) for total staff from 2008-2014; most of the decrease occurred after 2010. Injury rates were higher in support staff than teachers (p-value=0.04). Most injuries were caused by slips, trips, and falls (STF) (35.1%) or violence and other injuries by persons/animals (VIL) (28.9%). Adjusted odds of VIL were high for security, paraprofessionals, and teachers compared to other white collar (OWC) occupations, and males were more at odds than females; there was a significant negative trend (p-value=0.0002) with age. Adjusted odds of STF were high for females compared to males; there was a significant positive trend (p-value<0.0001) with age. Adjusted odds of injuries caused by contact with objects and equipment (COE) and overexertion and bodily reaction (OBR) were high for custodial, food services, and other blue collar compared to OWC. Medical compensation makes up the majority cost (71.4%) of overall claims cost, followed by lost-time (LT) payments (28.6%). Mean TCC was highest for injuries caused by OBR and STF, and for LT claims. TCC increased significantly with age (p-value=0.001) by about $40 per year.

CONCLUSION: These results may assist the school district, the OBWC, and the National Institute for Occupational Safety and Health in implementing and enhancing best practices for injury prevention and cost management in school workers. Using employer-specific WC data provides an opportunity to assess trends in occupational injuries and prioritize interventions that contribute the greatest impact.

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Introduction

Background

From 2005 to 2014, data from the National Vital Statistics System estimated that unintentional injuries were the leading cause of death in the United States for people aged 1-44 (National Center for Injury Prevention and Control, 2016). In more recent years, unintentional injuries has risen to rank 4 for overall leading cause of death. Even so, a substantial portion of the total injury burden has and continues to occur in the workplace (Smith, Sorock, Wellman, Courtney, & Pransky, 2006). According to estimates from the Survey of Occupational Injuries and Illnesses (SOII) conducted by the United States Bureau of Labor Statistics (BLS), nearly 3.7 million nonfatal occupational injuries and illnesses were reported for 2014 alone by private industry, state government, and local government employers (U.S. Bureau of Labor Statistics, 2015b). These occupational injuries and illnesses occurred at a rate of 3.4 cases per 100 equivalent full-time workers (U.S. Bureau of Labor Statistics, 2015a). Although this rate, with the exception of 2012, has declined over the last twelve years, the overall impact of injuries that occur in the workplace remains staggering. Annually, work-related injuries in the United States cost an estimated $140 to $145 billion (Mroz et al., 2014). This can be allocated into direct costs, such as medical expenses associated with treating the injury, or indirect costs, such as loss productivity.

School Workers

School workers are a vastly understudied population that embody unique risks for occupational injuries. School districts often employ a wide array of staff, ranging from

professional/licensed or non-licensed and full or part-time employees (Schofield Larson & Stroinski, 2015). Many of these occupations involve moderate to high physical demands contained within staff-student relations, general maintenance, ergonomics, and more.

Occupational injuries in educational workers can have negative implications on physical and mental health, personal finances, staff morale, and the overall educational mission (Schofield Larson & Stroinski, 2015). These can also translate to substantial economic impacts, largely influenced by insurance premiums, medical or lost wages costs, and staffing expenses. It therefore comes to no surprise that the repercussions of injuries subsequently trickle and negatively affect the students, taxpayers, school districts, and local communities (Schofield Larson & Stroinski, 2015). While school districts recognize the importance of employee safety and health, aspects such as time, funding, and competing priorities prove to be difficult challenges to overcome (Ohio Bureau of Workers' Compensation, 2016a).

Types of Injuries

Interventions for occupational injuries are often focused on ergonomics and preventing musculoskeletal diseases and disorders as these are applicable to a wide variety of industries (Myers, 2015). For example, a study conducted by Koehoorn *et al.* investigated the relationships between work exposures and injury risks among a cohort of custodial staff in order to target appropriate interventions (Koehoorn, Ostry, Hossain, & Village, 2011). Ergonomic hazards are common to teachers and clerical staff who are subjected to repetitive motions, as well as kitchen workers who may be exposed to strenuous lifting. Teachers and administrative staff are often comprised of an aging

population due to long-term or tenure statuses, and may therefore have higher risks of musculoskeletal disorders (Schofield Larson & Stroinski, 2015). Through using occupational data from 1999-2004 in Ohio, Davis *et al.* reported that aging may indeed have a role in the frequency and costs of musculoskeletal disorder claims, albeit industry-specific trends can also present other job-specific risk factors (Davis, Dunning, Jewell, & Lockey, 2014).

Recent years have spurred a development of epidemiological studies regarding student-perpetrated violence towards school teachers. The Bureau of Justice Statistics data from 2005-2009 revealed that in regards to annual nonfatal occupational violence, U.S. educators had an overall rate of 6.5 events per 1000 educators (Harrell, 2011). This rate increased with grade progression from elementary (4.3), junior high/middle (8.6) to high school (13.5) (Harrell, 2011). Understanding the risk factors for workplace violence against other occupation types is crucial as these can negatively impact their quality of life, job satisfaction, job retention, and work performance (Tiesman, Hendricks, Konda, & Hartley, 2014).

Current literature highlights the need for implementing improved occupational safety and health programs for specific types of injuries and jobs. However when presenting epidemiologic results to the school districts, it is necessary to tailor the proposed interventions according to the districts' specific needs. Resources and funding are often limited and must be efficiently disseminated to effectively improve the standards for the entirety of the affected workforce. As such, analyzing data from a specific school district can help identify the distinct workers at risk and the necessary interventions.

Workers' Compensation

Accurate and reliable surveillance of occupational injuries is fundamental in the development of evidence-based strategies. The BLS SOII data, while exceptionally valued and much relied-upon for most occupational epidemiology studies, has been shown to provide an incomplete and potentially misleading picture in regards to the true incidence of occupational injuries and diseases (Spieler & Wagner, 2014). Spieler & Wagner commented that SOII data, as a surveillance tool, needs improvement and supplemental systems in order to be reliable. One such complementary source of valuable data comes from workers' compensation (WC) systems. Although limited in its own ways, WC data typically contains information that is unavailable in national occupational surveillance systems (Utterback et al., 2012). It is advantageous that all states run a "no-fault" WC program, where injured workers are assured coverage of medical and wage loss expenses resulting from workplace injuries, and employers, who bear the cost of the insurance, are held free of liability under tort law (Myers, 2015).

The National Institute for Occupational Safety and Health (NIOSH) recognized the surveillance potential from these systems and thus established the Center for Workers' Compensation Studies (CWCS) in 2013 with the goals of preventing and reducing work-related injuries and illnesses, understanding the full economic impacts, and developing prevention strategies by using WC data (Center for Workers' Compensation Studies, 2015). While the Federal Government and each state governs and collects claims information for their respective WC systems, there is currently no central source for WC data in the U.S. Accordingly, the Center's collaborations with federal,

state, and private industry partners help to link study findings and advance current and future practices in occupational safety and health.

In Ohio, the law requires that all employers obtain WC coverage for their respective employees (Ohio Bureau of Workers' Compensation, 2016b). When an employee is injured on the job, they are to immediately report the injury or illness to their employer and seek medical care if necessary (Ohio Bureau of Workers' Compensation, 2016e). The medical care provider then files a claim with their managed care organization (MCO), or the injured worker files the claim on their own by filling out the First Report of Injury, Occupational Disease or Death (FROI). The Ohio Bureau of Workers' Compensation (OBWC) then assigns a claims number and after reviewing all relevant information on the work-related injury or illness, allows or denies the initial claim for benefits within twenty-eight days of filing (Ohio Bureau of Workers' Compensation, 2016e). The claimant or employer then has the right to appeal within fourteen days if they disagree with the initial claim decision.

Goals of Present Study

Through utilizing WC data provided by the OBWC, we aim to characterize the costs and types of injuries that occur within a cohort of educational workers from a large, metropolitan public school district in the Midwest. Specifically, trends and predictors of the costs of compensation as well as specific types of injury causes will be analyzed. In doing so, current occupational safety and health programs within this school district can be assessed, all the while proposing evidence-based interventions to alleviate the costs and incidence of future workplace injuries and claims. We also aim to assess the efficacy of using WC data as a surveillance tool in occupational safety and health studies.

Methods

Study Design and Population

Data used in our analyses, which were requested and de-identified by the Environmental Health and Safety Administrator of the school district, were provided by the OBWC. Study participants were drawn from WC claims that were filed for injuries that occurred from 2004-2014 under this particular state-funded employer. In total 2,160 claims were provided in the initial dataset: 1,829 (84.7%) allowed claims, 104 (4.8%) settled with medical and indemnity claims, 1 settled with medical only claim, 1 hearing claim, 196 (9.1%) disallowed claims, and 29 (1.3%) dismissed claims. Only allowed and settled claims statuses were included in this study for a total of 1,934 (89.5%) claims, while disallowed, dismissed, and hearing claims were excluded due to lack of compensation payouts and sufficient data.

Each claim included in our study provided information on claimant and injury demographics as well as compensation costs. Age in years at time of injury was provided based on date of birth, and was categorized into quartiles: less than 42 years, 42-50 years, 51-56 years, or 57 years or more. Gender was dichotomized as male or female. Occupation was numerically coded using the 1980[1] Standard Occupational Classification (SOC) system. SOC codes were then classified into occupation title categories: teachers, paraprofessionals, security, custodial, food services, other blue collar (OBC), or other white collar (OWC). OBC occupations were defined as building engineers, trade, or

[1] Although revised versions of the SOC system have been implemented (most recently 2010) by the U.S. Bureau of Labor Statistics, the OBWC has consistently used the 1980 version as these codes are submitted by MCOs. <http://www.bls.gov/soc/>

drivers; OWC occupations were defined as administrative, clerical, intervention specialists, nurses, or librarians.

International Classification of Diseases (ICD-9) codes and descriptions for the nature of the injury causation were missing for approximately 55% of the allowed/settled claims. Injury narratives describing the nature and causation of the injuries were provided as free text for all claims. Therefore, an auto-coding method developed and provided by NIOSH was utilized in assigning the primary injury causation from the injury narratives to each claim. The program, using a Naïve Bayesian analysis process, identifies key words and phrases in the unknown narrative and assigns a probability of belonging to the various injury categories based on a training set of previously coded claims (Bertke et al., 2012). When used with sizable datasets, the auto-coder program can be an asset in saving time and avoiding human error that might occur during manual coding. Even so, there are still degrees of uncertainty in solely relying on the program to classify the injury causation. Bertke *et al.* evaluated the sensitivity of using a training set derived from one sector to predict claims for a different sector; it was determined that there were only minor differences and that sector-specific training sets were not necessary for valid results. As an example, a narrative for slips, trips, and falls would read, "I FELL DOWN STEPS. THE STAIRS WERE SLIPPERY. OUR SHOES WERE WET FROM WALKING OUTSIDE. I WAS WALKING DOWN STAIRS W/ MY STUDENTS." The auto-coder assigns probabilities of belonging to each 2-digit Occupational Injury and Illness Classification Systems (OIICS, version 2.01) category. Each category is then scored and the primary injury causation is chosen from the highest calculated score/probability. At the 2-digit level, claims were classified into detailed causation

categories based on the event or exposure (U.S. Bureau of Labor Statistics, 2012) provided in the injury narrative:

- Intentional injury by person
- Injury by person – unintentional or intent unknown
- Animal and insect related incidents
- Pedestrian vehicular incident
- Roadway incidents involving motorized land vehicle
- Slip or trip without fall
- Falls on same level
- Falls to lower level
- Jumps to lower level
- Exposure to temperature extremes
- Exposure to other harmful substances
- Needlestick without exposure to harmful substance
- Struck by object or equipment
- Struck against object or equipment
- Caught in or compressed by equipment or objects
- Rubbed or abraded by friction or pressure
- Overexertion involving outside sources
- Repetitive motions involving microtasks
- Other exertions or bodily reactions
- Nonclassifiable

These were then collapsed into 1-digit level basic causation categories:

- Violence and other injuries by persons or animals (VIL)
- Transportation incidents
- Slips, trips, and falls (STF)
- Exposure to harmful substances or environments
- Contact with objects and equipment (COE)
- Overexertion and bodily reaction (OBR)
- Nonclassifiable

7.8% of the detailed causation codes assigned by the auto-coder program had greater than 90% calculated probabilities of the likelihood for correct categorization. All assigned causations were manually verified using injury narratives; 695 (36%) of the allowed/settled claims were miscoded for injury causation and required manual correction.

Injury season was categorized into fall, winter, spring, and summer based on the respective season in which the date of injury occurred. Injury year was categorized into the respective year from 2004-2014 in which the injury occurred. Lost-time benefits were typically approved when the injury or illness prevented the claimant from returning to work for eight or more calendar days (Ohio Department of Administrative Services, 2016); therefore days lost was categorized as no days (zero), 1-7 days, or 8 or more days lost. Claim type was categorized as medical only (MO) or lost-time (LT), where the latter consisted of combined medical benefits with lost-time wages.

Compensation costs, which were aged for 30 months for standardization, were provided from 2004-2013 as dollar amounts with total costs further divided into medical, indemnity, and reserve costs. Aged-30-months compensation data for 2014 had not been reached at the point of this study; therefore claims and injuries filed in 2014 were excluded in analyses for total compensation cost (TCC). Medical costs were payments that covered any factors involved in treating the occupational injury, such as visits to medical providers, diagnostic tests, or medication (Ohio Bureau of Workers' Compensation, 2016d). Indemnity costs were compensations for lost wages or permanent disability when the claimant was unable to return to work due to the nature of their injury (Ohio Bureau of Workers' Compensation, 2016d). Reserve costs, which were only applicable to LT claim types, were the anticipated future costs involved in a claim that were calculated at a specific point in time (Ohio Bureau of Workers' Compensation, 2016d). Reserve costs were set using the Micro Insurance Reserving Analysis (MIRA II) system, and used statistical analysis to predict future costs or liabilities based off of recent claim history and changes to payments and cost patterns (Blair, 2008). Due to possible changes in the MIRA system that would influence the reserve costs, these do not represent the ultimate paid costs and were thus excluded from TCC analyses.

Analysis

Descriptive and summary statistics were analyzed for age, gender, occupation, injury causation, injury season, injury year, days lost, and claim type. These factors were also evaluated by TCC and four basic injury causation types included in statistical models.

Injury incidence rates were calculated by year from 2008-2014 based on provided employee counts for total employees, total teachers, and total support staff. Detailed denominator data, such as age, gender, and occupation, were not provided. Support staff were defined as all other school workers who were not categorized as teachers.

Four basic injury causation types were modeled using logistic regression: VIL, STF, COE, and OBR. Each injury causation type was chosen and modeled against all other injury causation types (referent) based on having a sufficient amount of events. The remaining injury causation types, transportation incidents and exposure to harmful substances, had minimal cases and were collapsed into the category labeled as "other". Covariates of interest were determined *a priori* to be possible predictors of injury causation type and included in the final models: age, gender, occupation, and injury season. These covariates were kept in all four logistic models for consistency. Although injury year and school type were initially believed to play a role in predicting injury causation, likelihood ratio tests revealed that these variables were not significant predictors (p-value ≥ 0.05) and were therefore not included in the final models. Model fit was assessed using Hosmer-Lemeshow (HL) tests and area under receiver operating characteristic curves (AUC). Interactions between all covariates were tested using Wald chi-square and likelihood ratio tests.

TCC was the dependent outcome variable in a linear regression analysis. Square root transformation of the compensation cost outcome was necessary to ensure a normal distribution. Results from the linear regression models were back-transformed by squaring the appropriate beta coefficients. Covariates of interest were determined *a priori* to be possible predictors of TCC and included in the final model: age, gender,

occupation, injury causation, days lost, and claim type. Although injury season and school type (K-12, elementary, high school) were initially believed to play a role in predicting TCC, these variables were not significant predictors (p-value ≥ 0.05) and were not included. Injury year, despite having a few significant estimates (p-value < 0.05), exhibited a non-monotonic trend with TCC and was also not included. The final model fit was evaluated through adjusted R^2 values; normality was verified through assessment of randomness of plotted residuals. Multicollinearity was assessed through variance inflation factors (VIF) for each variable included in the model. Interactions between all covariates were tested using analysis of variance (ANOVA).

Statistical analyses were conducted using Microsoft Excel 2013 and SAS® version 9.4.

Results

Table 1 provides descriptive data for WC claims (n = 1,934) accepted and settled by the OBWC from a Midwestern public school district from 2004-2014. The mean age of claimants was 48.2 (SD = 11.0) years. The majority of claimants were female (71.4%) and were employed as teachers, paraprofessionals, or custodial staff (36.0%, 19.3%, and 16.1%, respectively). For injuries, most were caused by STF or VIL (35.1% and 28.9%, respectively), occurred in the fall, winter, or spring (30.0%, 26.1%, and 29.5%, respectively), and resulted in zero days out of work (62.7%). There were more MO (78.4%) than LT (21.6%) claims.

Figure 1 and Table 2 show the incidence rates of injury in total staff, also divided into teachers and support staff, from 2008-2014[2]. The annual injury incidence rate for total staff had a marginally significant decrease from 2008-2014, from about 4 to 2 cases of injury per 100 staff (p-value = 0.06); the most significant decrease in total staff occurred after 2010 (p-value = 0.01). Injury rates were higher in support staff than teachers (p-value = 0.04). The most significant decrease in support staff occurred after 2010, from about 6 to 2 cases of injury per 100 support staff (p-value = 0.004). The annual injury incidence rate for teachers had a significant decrease from 2008-2014, from about 3 to 1 cases of injury per 100 teachers (p-value = 0.003).

Figures 2a-d show the distribution of characteristics by the four basic injury causation types. For those injured by VIL (**Figure 2a**), a downwards trend could be seen with increasing age groups and days lost. A higher percentage of females than males

[2] Denominator data was not provided for 2004-2007

appeared to be injured by VIL, as well as teachers, paraprofessionals, and security compared to all other occupations. Most violence occurred in the fall and spring, while the least amount occurred during the summer. For those injured by STF (**Figure 2b**), an upwards trend could be seen with increasing age groups, while there was a downwards trend as number of days lost increased. A higher percentage of females than males appeared to be injured by STF, as well as teachers, paraprofessionals, custodial, and OWC compared to all other occupations. Most STF occurred in the winter compared to all other seasons. Females appeared to have more injuries caused by COE compared to males, and there was a sharp downwards trend as number of days lost increased (**Figure 2c**). Teachers and custodial staff were more likely to be injured through COE compared to all other occupations; these injuries also occurred more in the fall, spring, and summer compared to the winter. There was a much higher percentage of custodial staff injured by OBR (**Figure 2d**) compared to all other occupations, as well as during the fall and spring compared to the winter and summer.

HL statistics were non-significant (p-value ≥ 0.05) for all logistic models, indicating good model fits. Concordance probabilities ($c > 0.65$) indicated strong, predictive logistic models. **Figures 3a-d and Tables 3a-d** show the results of modeling the four injury causation types against all others with several categorical variables from Table 1 (n = 1,911). The odds of injury from VIL (**Figure 3a, Table 3a**) was lower for school workers aged 57 or older (OR = 0.57, CI 0.41-0.77) compared to workers less than 42 years old, and showed a significant negative trend with age (p-value = 0.0002). The odds of injury from VIL was low for females (OR = 0.65, CI 0.47-0.88) compared to males. For occupation, the odds of injury from VIL were high for security (OR = 6.66, CI

3.82-11.61), paraprofessionals (OR = 3.02, CI 1.98-4.61), and teachers (OR = 2.06, CI 1.38-3.08) compared to OWC jobs. For injury season, the odds of injury from VIL were high in the fall (OR = 2.78, CI 1.77-4.36) and spring (OR = 2.33, CI 1.48-3.66) compared to the summer.

The odds of injury from STF (**Figure 3b, Table 3b**) was high for school workers aged 57 or older (OR = 1.97, CI 1.49-2.59) compared to workers less than 42 years old, and showed a significant positive trend with age (p-value < 0.0001). The odds of injury from STF was high for females (OR = 1.86, CI 1.40-2.47) compared to males. For occupation, the odds of injury from STF were low for security (OR = 0.23, CI 0.13-0.42), paraprofessionals (OR = 0.48, CI 0.33-0.71), OBC (OR = 0.49, CI 0.27-0.89), food services (OR = 0.53, CI 0.34-0.85), custodial (OR = 0.58, CI 0.38-0.89), and teachers (OR = 0.66, CI 0.46-0.93) compared to OWC jobs. For injury season, the odds of injury from STF was high in the winter (OR = 1.65, CI 1.19-2.30) compared to the summer.

For occupation, the odds of injury from COE (**Figure 3c, Table 3c**) were high for food services (OR = 3.64, CI 2.06-6.45), OBC (OR = 2.85, CI 1.47-5.51), and custodial (OR = 2.65, CI 1.54-4.57) compared to OWC jobs. For injury season, the odds of injury from COE were low in the winter (OR = 0.43, CI 0.28-0.63) and fall (OR = 0.60, CI 0.42-0.87) compared to the summer.

The odds of injury from OBR (**Figure 3d, Table 3d**) were high for custodial (OR = 3.76, CI 2.06-6.88), OBC (OR = 3.60, CI 1.77-7.35), and food services (OR = 2.54 CI 1.32-4.90) compared to OWC jobs.

Interaction terms for all logistic models were tested and found to be non-significant (p-value ≥ 0.05); HL statistics were significant (p-value < 0.05) for all models with interaction terms, indicating lack of good model fit.

Figure 4a shows the distribution of cost types from the overall compensation cost ($10,431,267.14) of approved and settled claims from 2004-2013[3]. Medical (46.0%) costs were the most expensive factor over this ten year period, followed by reserve (36.3%) and indemnity (18.2%) costs. **Figure 4b** shows the distribution of cost types, excluding reserve costs, from the overall compensation cost ($6,647,452.76) of approved and settled claims from 2004-2013. Medical (71.4%) costs were the most expensive factor over this ten year period, followed by indemnity (28.6%) costs.

Table 4 provides summary data on TCC for WC claims (n = 1,817) accepted and settled by the OBWC from a Midwestern public school district from 2004-2013. The observed mean compensation cost increased from younger to older age quartiles. Males had a higher mean compensation cost than females ($4,536.78 versus $3,322.12, respectively). For occupations, OBC and custodial staff had the highest mean compensation costs ($5,299.48 and $5,122.50, respectively). Injuries caused by OBR and STF had the highest mean compensation costs ($6,852.11 and $4,258.13, respectively). The costs by injury season did not largely vary, although the mean cost was highest for injuries that occurred in the winter ($4,367.46). 2011 had the highest mean cost ($4,286.00) of this ten-year period. There was a considerable increase in mean compensation costs as days lost due to injury increased; those who lost 1-7 days as a

[3] Aged-30-months compensation data for 2014 not yet reached/provided

result of injury had a mean compensation of $2218.79, whereas those who lost 8 or more days as a result of their injury had a mean compensation cost of $16,531.18. There was also a substantial difference when comparing mean compensation costs of MO and LT claims ($1,060.69 and $13,010.53, respectively). From 2008-2013, 93.6% of claims had at least some form of compensation (> $0), of which all had a medical component. 12.8% of these claims had an indemnity compensation, and 9.0% had a reserve compensation. Among the compensation types, mean costs was highest for reserve ($23,213.59), followed by indemnity ($8,169.47) and medical ($2,788.93). The overall mean compensation cost when excluding reserves was $3,907.97.

Table 5 shows the results of modeling TCC with several categorical variables from Table 1 (n = 1,790). The linear regression model (adjusted $R^2 = 0.49$, p-value < 0.0001) was highly significant for injury causation, days lost, and claim type when controlling for all else. There was a significant positive trend (p-value = 0.001) in which the TCC increased about $40 per year of age. On average, injuries caused by OBR had more expensive TCC when compared to other injury causation types. The average TCC from OBR was $1,999.95 higher (p-value < 0.0001) than the average TCC from COE, $1,944.26 higher (p-value = 0.004) than the average TCC from other injuries, $1,872.00 higher (p-value < 0.0001) than the average TCC from VIL, and $745.19 higher (p-value = 0.05) than the average TCC from STF. On average, the TCC exponentially grew with increasing days lost from work resulting from injuries; the average TCC for workers who lost 8 or more days of work was $7,609.77 higher (p-value < 0.0001) than the average TCC for workers who lost no days of work, and the average TCC for workers who lost 1-7 of work was $929.25 higher (p-value = 0.002) than the average TCC for workers who

lost no days of work. On average, LT claims were more expensive than MO claims: the average TCC for workers who filed a LT claim was $5,193.85 higher (p-value < 0.0001) than the average TCC for workers who filed a MO claim. Interaction terms were all found to be non-significant (p-value ≥ 0.05).

Discussion

Overall, the number and incidence rate of injuries within this cohort of school workers have decreased over time despite slight surges in certain years (**Figure 1, Table 2**). When addressing prevention of occupational injuries within school workers, it would be beneficial to assess established factors that may have influenced this decline. If the results were in fact due to the implementation of a novel intervention, it would be advantageous to apply these tactics to other school districts that exhibit comparable trends and characteristics. Caution is necessary in generalizing our results and recommendations to other sectors and subsectors as these may prove inefficient without a proper assessment of applicability. Since stakeholders of a school district work with extremely limited resources, prioritization and implementation of interventions should be driven by the prospect of maximal impact when designed for the needs of the target population.

Most studies involved in occupational injuries of school workers refine their cohorts to specific job titles. For example, current research and evidence-based interventions have routinely placed precedence on teachers as they deliver the educational mission to fruition. Even though our study showed that the highest proportion of injuries were claimed by teachers (**Table 1**), it is evident that this school district was comprised of a variety of working groups whose needs may be overlooked. The growing epidemic of student-perpetrated violence towards teachers was reflected in our study, as the odds of VIL in teachers was nearly twice the odds of VIL in OWC jobs (**Figure 3a, Table 3a**). More striking was that the odds of VIL was substantially higher in security, nearly seven times, and paraprofessionals, nearly three times, when compared to the odds

of the same referent group. Therefore, the effectiveness of interventions related to injuries caused by VIL, such as non-restraining techniques or violence prevention education and training (Wei et al., 2013), should be emphasized for these occupations as well.

The higher odds of injuries caused by STF in the winter compared to the odds of STF in the summer was expected (**Figure 3b, Table 3b**), as the probability of slipping on icy surfaces or in inclement weather is assumed to surge. While this suggests that the school district could improve maintenance and upkeep of the grounds during this season to reduce winter-related hazards, other interventions outside of the seasonal aspect that reduce injuries caused by STF may also be influential, since the odds of this injury were higher in older, female, or OWC workers when compared to younger, male, or other occupations, respectively. For example, the school district could supply slip-resistant shoes to employees or improve upon the built environment by reducing STF hazards near stairs and walkways (Chang, Leclercq, Lockhart, & Haslam, 2016), all of which would be investments intended to reduce the long-term costs that accrue from these injuries.

Another interesting trend was that the odds of injury by COE or OBR in custodial, food services, and OBC were three to four times the odds of those same injuries in OWC (**Figure 3c-d, Table 3c-d**). Considering the extensive impact of musculoskeletal disorders, ergonomics, and disabilities related to COE and OBR, it might be in the best interest of this school district to enhance, if not implement, training programs focusing on injury prevention; education to better understand and reduce COE/OBR injuries should start from the top administrators down to all other school workers with special focus placed on the aforementioned occupations with higher odds (Ohio Bureau of Workers' Compensation, 2016a).

Interestingly enough, aging, which has been attributed to overall increased risk of injury in various sectors, did not exhibit significant trends in injuries caused by COE or OBR (p-value ≥ 0.05). This may be due to numerous confounders of age, such as other lifestyle and work-related factors, that were not identifiable in this study (Chang et al., 2016).

Various sectors interested in occupational injury prevention place emphasis in reducing musculoskeletal disorders from OBR and injuries caused by STF due to their high frequency and cost (Bertke et al., 2012) (Davis et al., 2014). Our study results indeed reinforced this notion; the highest percentage of injury causation in this cohort of school workers was due to STF, and injuries caused by OBR and STF had the highest average TCC compared to all other injury causation types (**Table 1, 4, and 5**).

Not only is the wellbeing of workers of utmost importance, but the costs associated with occupational injuries are also profoundly influential. Medical compensation alone had the highest overall expenditure and was involved in the greater majority of claims (**Figure 4b**); however, it is clear that indemnity, although less frequent, was more costly for those types of claims (**Table 4**). Although this study excluded reserve costs from the analysis due to variability from future predictions, rates of premium, and thereby covered benefits that are supplied to the employees, are set and governed by the OBWC and largely driven by the indemnity and reserve costs (Ohio Bureau of Workers' Compensation, 2016d). In order to reduce the overall costs associated with these compensation types, it is recommended that employers coordinate with the MCO to offer their injured employees accommodations for translational or remain/return-

to-work alternatives, as well as collaborate with the OBWC and third party administrators in facilitating settlements (Ohio Bureau of Workers' Compensation, 2016d).

Limitations

While estimates of the injury incidence rates were possible with provided data on total employee counts by year[4], a limitation was that we were unable to determine rates by age, gender, and detailed occupation due to the lack of information on non-injured employees. With access to detailed denominator data, future work may focus on estimating the risks of injuries within this school district and modify the interventions as needed. Indeed, the CWCS has described methods for identifying appropriate denominators, such as full-time equivalents (FTE), person-time, or employee counts, for use in WC trending studies (Wurzelbacher, Bushnell, Jones, & Lampl, 2013). Additional claimant characteristics not provided in WC data, such as race or highest level of completed education, would have supplemented the research and provided a greater level of detail in the results. Linking this resource with other surveillance tools would have strengthened our analysis and allowed for a more thorough representation of the drivers for injury within our study cohort.

Solely using WC data was a limitation of our study since all injury cases were restricted to claims that were allowed or settled by the OBWC, thereby introducing the possibility of selection bias. Although the original dataset included disallowed and dismissed cases, most of the studied factors were missing or not available for those claim statuses and were therefore excluded. Also, our cohort may not have included all true

[4] Denominator data was not available for 2004-2007

cases since injuries that occurred on the job may not have been reported to the employer and/or the OBWC. This could result from fear of employer retaliation, which is explicitly forbidden by the Occupational Safety and Health Act of 1970 (OSHAct), or from the process by which the OBWC determines claim validity and eligibility for compensation. Future work may focus on linking the provided WC data with another occupational surveillance tool that contains sufficient denominator data for the same population. Even so, WC data on its own provides an abundance of valuable information that may assist in identifying trends within specific sectors and subsectors.

Conclusion

Despite efforts in addressing the magnitude of occupational injuries and illnesses, the persistent rates of workplace injury remain problematic for public health. Given the results from broad studies and challenges that employers face in ensuring adequate employee safety and health, intervention strategies for injuries in school workers are typically funneled to the same occupations or injuries. Our study utilized an uncustomary surveillance tool, WC data, to identify the specific trends that occurred in a Midwestern public school district from past compensation claims. In doing so, our results should be able to assist this school district, the OBWC, and NIOSH in establishing customized, best practices moving forward. With access to WC data, the capability for personalized analyses of target populations from precise sectors or subsectors is a testament of its surveillance aptitude. Identifying and steering intervention efforts to address the distinctive issues and factors may prove to be more effective than current methodologies focused on lessening the burden of occupational injuries and illnesses.

Recommendations

In using the NIOSH injury causation auto-coder program, misclassification could have been a limitation of our study; this was not an issue since the injury causation categories were manually checked and, if necessary, edited for each claim. Our study noticed that rampant spelling and grammatical errors in the claim injury narratives significantly hampered the accuracy and effectiveness of the program. For example, suppose the algorithm places more weight on identifying the keywords “FALL” or “FELL” to be assigned as a STF. A narrative with a simple typo that reads, “I FSLL AND HURT MY BACK”, would have the primary causation miscoded as OBR due to

the keywords “HURT” and “BACK”. Therefore, quality checks and routine evaluations of the claims data should be implemented within the OBWC, as well as other federal and state custodians of WC data, in order to strengthen its accuracy and utility in future analyses.

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Tables

Table 1. Descriptive statistics of workers' compensation claims allowed/settled by the Ohio Bureau of Workers' Compensation from a Midwestern public school district from 2004-2014 (n = 1934).

Characteristic	Overall n = 1934
	No. (%) /
Claimants	Mean ± SD*
Age (years)	48.2 ± 11.0
<42	497 (25.7)
42-50	525 (27.2)
51-56	450 (23.3)
57+	462 (23.9)
Gender	
Male	547 (28.3)
Female	1381 (71.4)
Missing	6 (0.3)
Occupation	
Teacher	696 (36.0)
Paraprofessional	373 (19.3)
Security	122 (6.3)
Custodial	311 (16.1)
Food Services	150 (7.8)
Other Blue Collar†	112 (5.8)
Other White Collar‡	170 (8.8)
Injuries	
Injury Causation	
Violence & Other Injuries by Persons/Animals	559 (28.9)
Slips, Trips, & Falls	679 (35.1)
Contact with Objects & Equipment	341 (17.6)
Overexertion & Bodily Reaction	278 (14.4)
Other§	60 (3.1)
Nonclassifiable/Missing	17 (0.9)
Injury Season	
Fall	581 (30.0)
Winter	505 (26.1)
Spring	571 (29.5)
Summer	277 (14.3)
Injury Year	
2004	212 (11.0)
2005	246 (12.7)
2006	184 (9.5)
2007	169 (8.7)
2008	192 (9.9)
2009	159 (8.2)
2010	174 (9.0)
2011	180 (9.3)
2012	159 (8.2)
2013	142 (7.3)
2014‖	117 (6.1)
Days Lost	
0	1213 (62.7)
1-7	451 (23.3)
8+	265 (13.7)
Missing	5 (0.3)
Workers' Compensation Claims	
Claim Type	
Medical Only	1516 (78.4)
Lost-time	418 (21.6)

* Standard deviation

† Building Engineers, Trade, Drivers

‡ Administrative, Clerical, Intervention Specialists, Nurses, Librarians

§ Transportation Incidents, Exposure to Harmful Substances/Environments

‖ Aged-30-months compensation data for 2014 not yet reached/provided

Table 2. Incidence rates of injury from workers' compensation claims allowed/settled by the Ohio Bureau of Workers' Compensation from a Midwestern public school district from 2008-2014*.

	Total Staff			Teachers			Support Staff		
Injury Year	No. Cases	No. Total	IR†	No. Cases	No. Total	IR†	No. Cases	No. Total	IR†
2008	192	4734	0.04	73	2492	0.03	119	2242	0.05
2009	159	5906	0.03	65	2863	0.02	94	3043	0.03
2010	174	4734	0.04	62	2492	0.02	112	2242	0.05
2011	180	4689	0.04	67	2721	0.02	113	1968	0.06
2012	159	5148	0.03	55	2944	0.02	104	2204	0.05
2013	142	6138	0.02	37	2944	0.01	105	3194	0.03
2014	117	6187	0.02	31	2596	0.01	86	3591	0.02

* Denominator data for total employees counts (total/teachers/support staff) by year only available from 2008-2014

† Incidence Rate

Table 3a. Logistic regression analysis of predictors for injuries caused by violence and other injuries by persons or animals from workers' compensation claims allowed/settled by the Ohio Bureau of Workers' Compensation from a Midwestern public school district from 2008-2014 (n = 1911).

Predictor	Adjusted OR	L 95% CL*	U 95% CL*	p-value
Age (years)†				
<42	*Ref.*			
42-50	0.92	0.67	1.27	0.62
51-56	0.92	0.67	1.26	0.59
57+	0.57	0.41	0.77	0.0004
Gender				
Male	*Ref.*			
Female	0.65	0.47	0.88	0.01
Occupation				
Teacher	2.06	1.38	3.08	0.0004
Paraprofessional	3.02	1.98	4.61	<0.0001
Security	6.66	3.82	11.61	<0.0001
Custodial	0.07	0.03	0.15	<0.0001
Food Services	0.02	0.00	0.17	0.0002
Other Blue Collar‡	0.02	0.00	0.18	0.0003
Other White Collar§	*Ref.*			
Injury Season				
Fall	2.78	1.77	4.36	<0.0001
Winter	1.52	0.96	2.41	0.08
Spring	2.33	1.48	3.66	0.0002
Summer	*Ref.*			

* Lower/upper 95% confidence limits

† Significant negative trend with continuous age (p-value = 0.0002)

‡ Building Engineers, Trade, Drivers

§ Administrative, Clerical, Intervention Specialists, Nurses, Librarians

Table 3b. Logistic regression analysis of predictors for injuries caused by slips, trips, and falls from workers' compensation claims allowed/settled by the Ohio Bureau of Workers' Compensation from a Midwestern public school district from 2008-2014 (n = 1911).

Predictor	Adjusted OR	L 95% CL*	U 95% CL*	p-value
Age (years)†				
<42	*Ref.*			
42-50	0.95	0.72	1.25	0.70
51-56	1.24	0.93	1.65	0.14
57+	1.97	1.49	2.59	<0.0001
Gender				
Male	*Ref.*			
Female	1.86	1.40	2.47	<0.0001
Occupation				
Teacher	0.66	0.46	0.93	0.02
Paraprofessional	0.48	0.33	0.71	0.0002
Security	0.23	0.13	0.42	<0.0001
Custodial	0.58	0.38	0.89	0.01
Food Services	0.53	0.34	0.85	0.01
Other Blue Collar‡	0.49	0.27	0.89	0.02
Other White Collar§	*Ref.*			
Injury Season				
Fall	0.76	0.55	1.06	0.10
Winter	1.65	1.19	2.30	0.003
Spring	0.78	0.56	1.09	0.14
Summer	*Ref.*			

* Lower/upper 95% confidence limits

† Significant positive trend with continuous age (p-value < 0.0001)

‡ Building Engineers, Trade, Drivers

§ Administrative, Clerical, Intervention Specialists, Nurses, Librarians

Table 3c. Logistic regression analysis of predictors for injuries caused by contact with objects and equipment from workers' compensation claims allowed/settled by the Ohio Bureau of Workers' Compensation from a Midwestern public school district from 2008-2014 (n = 1911).

Predictor	Adjusted OR	L 95% CL*	U 95% CL*	p-value
Age (years)				
<42	*Ref.*			
42-50	1.29	0.93	1.81	0.13
51-56	1.09	0.76	1.56	0.65
57+	0.96	0.66	1.39	0.82
Gender				
Male	*Ref.*			
Female	0.82	0.59	1.15	0.26
Occupation				
Teacher	1.08	0.65	1.79	0.77
Paraprofessional	0.76	0.43	1.35	0.35
Security	0.23	0.08	0.69	0.01
Custodial	2.65	1.54	4.57	0.001
Food Services	3.64	2.06	6.45	<0.0001
Other Blue Collar†	2.85	1.47	5.51	0.002
Other White Collar‡	*Ref.*			
Injury Season				
Fall	0.60	0.42	0.87	0.01
Winter	0.43	0.28	0.63	<0.0001
Spring	0.75	0.53	1.07	0.12
Summer	*Ref.*			

* Lower/upper 95% confidence limits

† Building Engineers, Trade, Drivers

‡ Administrative, Clerical, Intervention Specialists, Nurses, Librarians

Table 3d. Logistic regression analysis of predictors for injuries caused by overexertion and bodily reaction from workers' compensation claims allowed/settled by the Ohio Bureau of Workers' Compensation from a Midwestern public school district from 2008-2014 (n = 1911).

Predictor	Adjusted OR	L 95% CL*	U 95% CL*	p-value
Age (years)				
<42	*Ref.*			
42-50	1.23	0.86	1.75	0.26
51-56	0.91	0.61	1.35	0.63
57+	0.85	0.57	1.28	0.44
Gender				
Male	*Ref.*			
Female	0.73	0.51	1.04	0.08
Occupation				
Teacher	0.81	0.45	1.46	0.48
Paraprofessional	0.99	0.53	1.85	0.98
Security	0.69	0.29	1.65	0.40
Custodial	3.76	2.06	6.88	<0.0001
Food Services	2.54	1.32	4.90	0.01
Other Blue Collar†	3.60	1.77	7.35	0.0004
Other White Collar‡	*Ref.*			
Injury Season				
Fall	1.00	0.66	1.50	0.99
Winter	0.80	0.52	1.23	0.31
Spring	1.06	0.71	1.58	0.79
Summer	*Ref.*			

* Lower/upper 95% confidence limits

† Building Engineers, Trade, Drivers

‡ Administrative, Clerical, Intervention Specialists, Nurses, Librarians

Table 4. Summary statistics of the overall compensation cost* of workers' compensation claims allowed/settled by the Ohio Bureau of Workers' Compensation from a Midwestern public school district from 2004-2013† (n = 1817).

Characteristic						Overall n = 1817
Claimants	**No.**	**Mean ($)**	**SD ($)‡**	**Median ($)**	**Q1 ($)§**	**Q3 ($)§**
Age (years)						
<42	460	2465.60	6713.68	476.81	233.52	1580.55
42-50	500	3197.19	8489.02	601.50	233.49	1955.69
51-56	427	4841.80	11162.50	750.00	304.91	3622.01
57+	430	4295.89	10268.51	868.42	297.88	3062.20
Gender						
Male	512	4536.78	11345.24	574.75	254.72	2750.92
Female	1300	3322.12	8330.52	651.81	261.63	2374.06
Missing	5	1174.22	925.80	945.01	696.95	1368.96
Occupation						
Teacher	664	3431.70	9889.75	591.30	227.73	1929.20
Paraprofessional	348	2572.49	4961.34	687.52	251.67	2501.07
Security	114	4278.86	10455.06	652.86	365.19	1987.16
Custodial	294	5122.50	12377.39	593.47	245.22	3897.43
Food Services	136	3099.89	6499.09	626.13	305.76	2505.08
Other Blue Collar‖	105	5299.48	9762.41	723.15	312.35	4401.48
Other White Collar¶	156	3216.30	7527.09	698.26	279.50	2183.56
Injuries						
Injury Causation						
Violence & Other Injuries by Persons/Animals	525	2941.26	9056.35	457.73	209.13	1684.58
Slips, Trips, & Falls	633	4258.13	9240.00	1075.99	342.66	3407.52
Contact with Objects & Equipment	319	1164.44	3109.70	416.75	188.36	765.10
Overexertion & Bodily Reaction	264	6852.11	13191.34	1619.67	371.33	6098.78
Other**	59	2924.65	9100.08	483.39	244.59	1498.24
Nonclassifiable/Missing	17	3230.98	6653.83	634.12	229.21	3106.44
Injury Season						
Fall	547	2985.04	8001.85	572.33	232.20	2058.18
Winter	468	4367.46	10617.56	673.84	263.58	3085.13
Spring	539	3833.79	10162.61	646.91	253.29	2242.21
Summer	263	3438.22	6993.45	693.78	302.45	2720.05
Injury Year						
2004	212	2817.66	8155.40	448.24	154.27	1620.81
2005	246	3344.58	10207.26	512.39	203.35	1650.37
2006	184	3708.37	12260.34	630.40	210.86	1640.95
2007	169	4157.56	10456.39	692.90	270.69	2926.97
2008	192	3946.28	10181.02	576.35	266.83	2283.65
2009	159	4208.85	8443.95	1049.87	332.11	3857.87
2010	174	3838.39	7658.65	692.94	315.57	2222.79
2011	180	4286.00	9558.92	931.86	335.93	3137.19
2012	159	2736.16	6457.30	510.75	290.53	2484.81
2013	142	3810.37	6742.82	944.00	349.20	3407.52
2014†	117	–	–	–	–	–
Days Lost						
0	1147	1413.94	2886.10	450.18	224.10	1139.89
1-7	417	2218.79	4327.55	809.62	326.26	2186.36
8+	248	16531.18	19232.27	10351.31	2874.77	23391.94
Missing	5	139.04	127.91	218.75	0.00	218.81
Workers' Compensation Claims						
Claim Type						
Medical Only	1422	1060.69	1827.96	448.88	221.94	1087.28
Lost-time	395	13010.53	16526.03	7285.78	2332.51	17411.16
Cost Type††						
Total*	1701	3907.97	9543.66	709.95	311.79	2672.04
Medical	1701	2788.93	5642.10	693.13	307.64	2445.99
Indemnity	233	8169.47	11418.83	4038.20	2096.90	7510.01
Reserves	163	23213.59	30152.38	13837.00	5902.44	28479.72

* Excluding reserve costs

† Aged-30-months compensation data for 2014 not yet reached/provided

‡ Standard deviation

§ Quartiles

‖ Building Engineers, Trade, Drivers

¶ Administrative, Clerical, Intervention Specialists, Nurses, Librarians

** Transportation Incidents, Exposure to Harmful Substances/Environments

†† Costs > $0

Table 5. Linear regression analysis* of predictors for total compensation costs† from workers' compensation claims allowed/settled with the Ohio Bureau of Workers' Compensation from a Midwestern public school district from 2008-2013‡ (n = 1790).

Predictor	Beta	SE§	t Value	p-value	Results ($)‖
Intercept	79.68	4.65	17.12	<0.0001	6348.98
Age (years)¶					
<42	*Ref.*	–	–	–	*Ref.*
42-50	1.41	2.09	0.68	0.50	227.40
51-56	6.26	2.18	2.87	0.004	1037.21
57+	5.07	2.18	2.32	0.02	832.96
Gender					
Male	*Ref.*	–	–	–	*Ref.*
Female	-1.74	2.09	-0.83	0.40	-274.41
Occupation					
Teacher	-1.48	2.87	-0.51	0.61	-233.01
Paraprofessional	-3.77	3.13	-1.21	0.23	-586.91
Security	2.85	4.15	0.69	0.49	462.77
Custodial	-6.06	3.47	-1.75	0.08	-928.53
Food Services	-6.51	3.83	-1.70	0.09	-994.45
Other Blue Collar**	-1.13	4.48	-0.25	0.80	-179.52
Other White Collar††	*Ref.*	–	–	–	*Ref.*
Injury Causation					
Violence & Other Injuries by Persons/Animals	-12.77	2.68	-4.77	<0.0001	-1872.00
Slips, Trips, & Falls	-4.82	2.46	-1.96	0.05	-745.19
Contact with Objects & Equipment	-13.73	2.72	-5.05	<0.0001	-1999.95
Overexertion & Bodily Reaction	*Ref.*	–	–	–	*Ref.*
Other‡‡	-13.31	4.66	-2.86	0.004	-1944.26
Days Lost					
0	*Ref.*	–	–	–	*Ref.*
1-7	5.63	1.84	3.05	0.002	929.25
8+	38.47	3.13	12.30	<0.0001	7609.77
Claim Type					
Medical Only	-45.69	2.60	-17.58	<0.0001	-5193.85
Lost-time	*Ref.*	–	–	–	*Ref.*

* Model adjusted R-squared value = 0.49

† Excludes reserve costs, outcome square-root transformed

‡ Aged-30-months compensation data for 2014 not yet reached/provided

§ Standard Error

‖ Back-tranformed results, in respect to reference groups

¶ Significant positive trend, ~$40 increase in total compensation costs with each year of age (p-value = 0.001)

** Building Engineers, Trade, Drivers

†† Administrative, Clerical, Intervention Specialists, Nurses, Librarians

‡‡ Transportation Incidents, Exposure to Harmful Substances/Environments

Figures

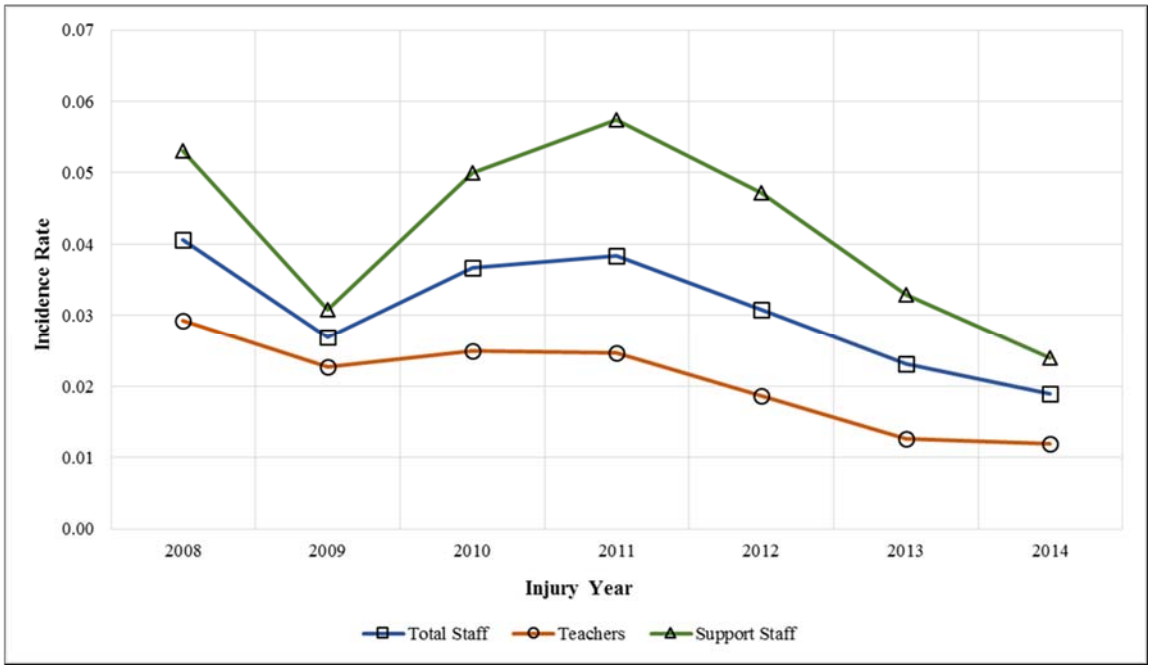

Figure 1. Injury incidence rates by year* for total staff, teachers, and support staff, from workers' compensation claims allowed/settled by the Ohio Bureau of Workers' Compensation from a Midwestern public school district from 2008-2014.

* Denominator data for employee counts (total/teachers/support staff) by year only provided for 2008-2014

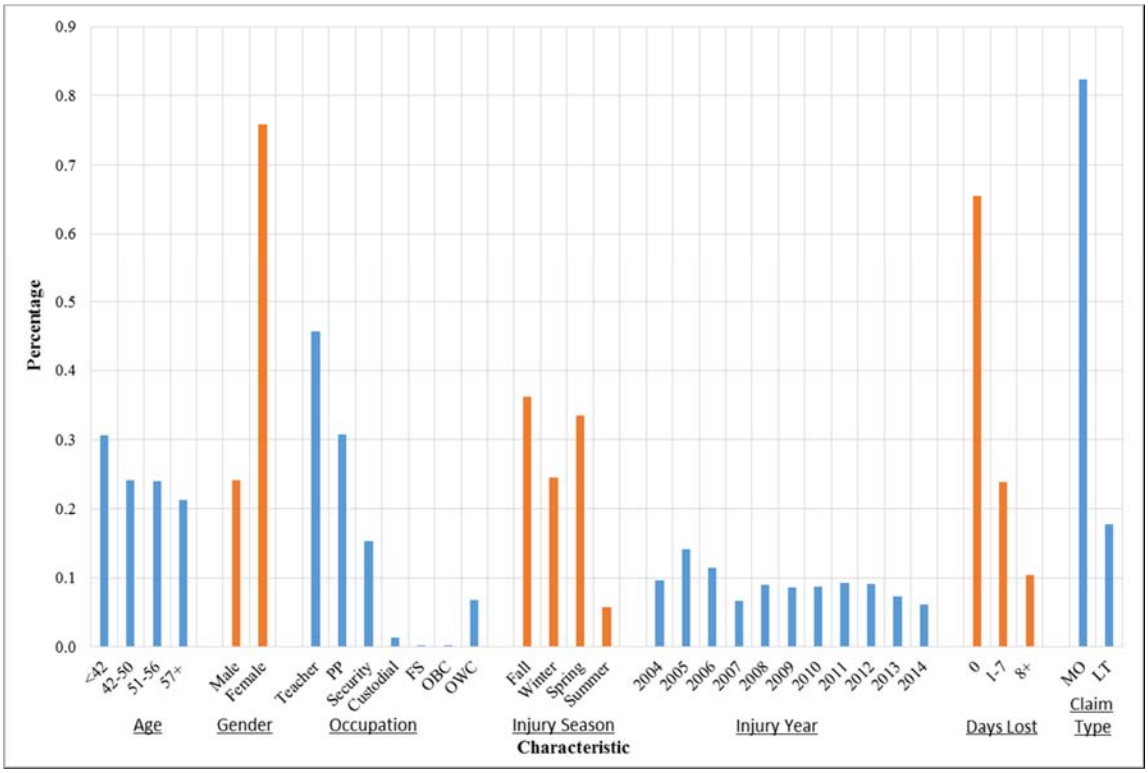

Figure 2a. Distribution of injuries caused by violence and other injuries by persons or animals (VIL) by characteristics from workers' compensation claims allowed/settled by the Ohio Bureau of Workers' Compensation from a Midwestern public school district from 2004-2014 (n = 559).

[PP = Paraprofessional, FS = Food services, OBC = Other blue collar, OWC = Other white collar, MO = Medical only, LT = Lost-time]

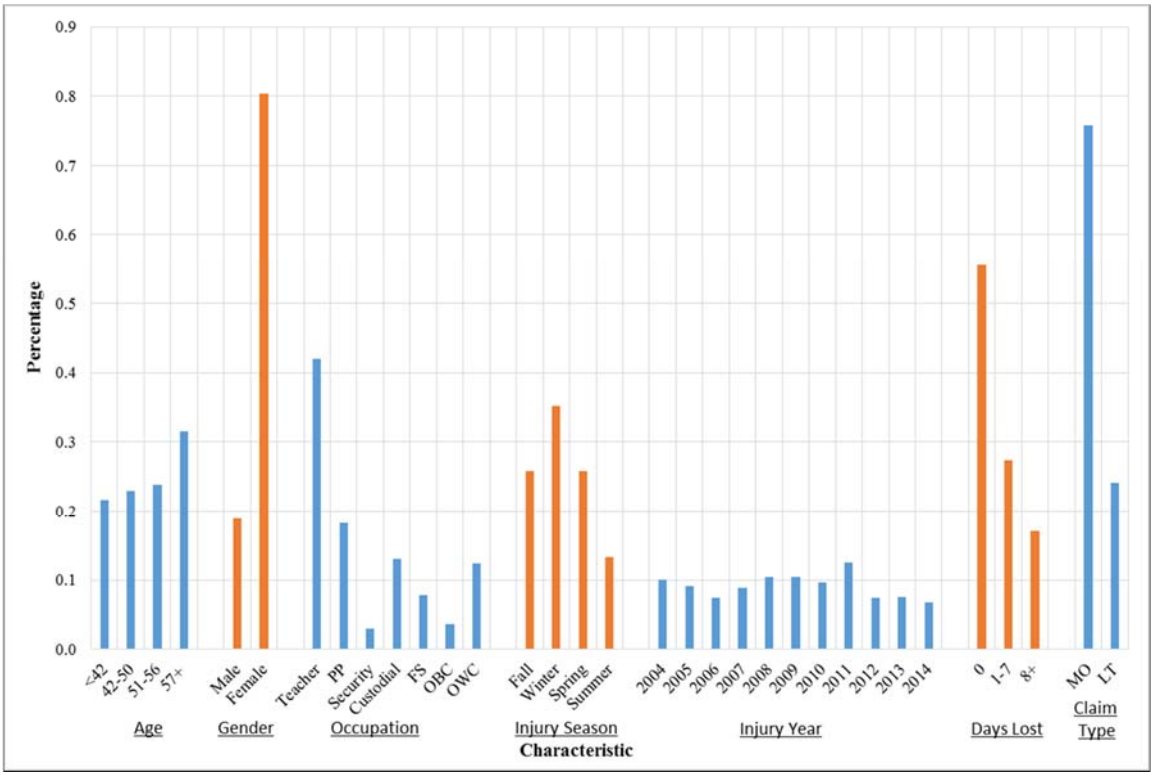

Figure 2b. Distribution of injuries caused by slips, trips, and falls (STF) by characteristics from workers' compensation claims allowed/settled by the Ohio Bureau of Workers' Compensation from a Midwestern public school district from 2004-2014 (n = 679).

[PP = Paraprofessional, FS = Food services, OBC = Other blue collar, OWC = Other white collar, MO = Medical only, LT = Lost-time]

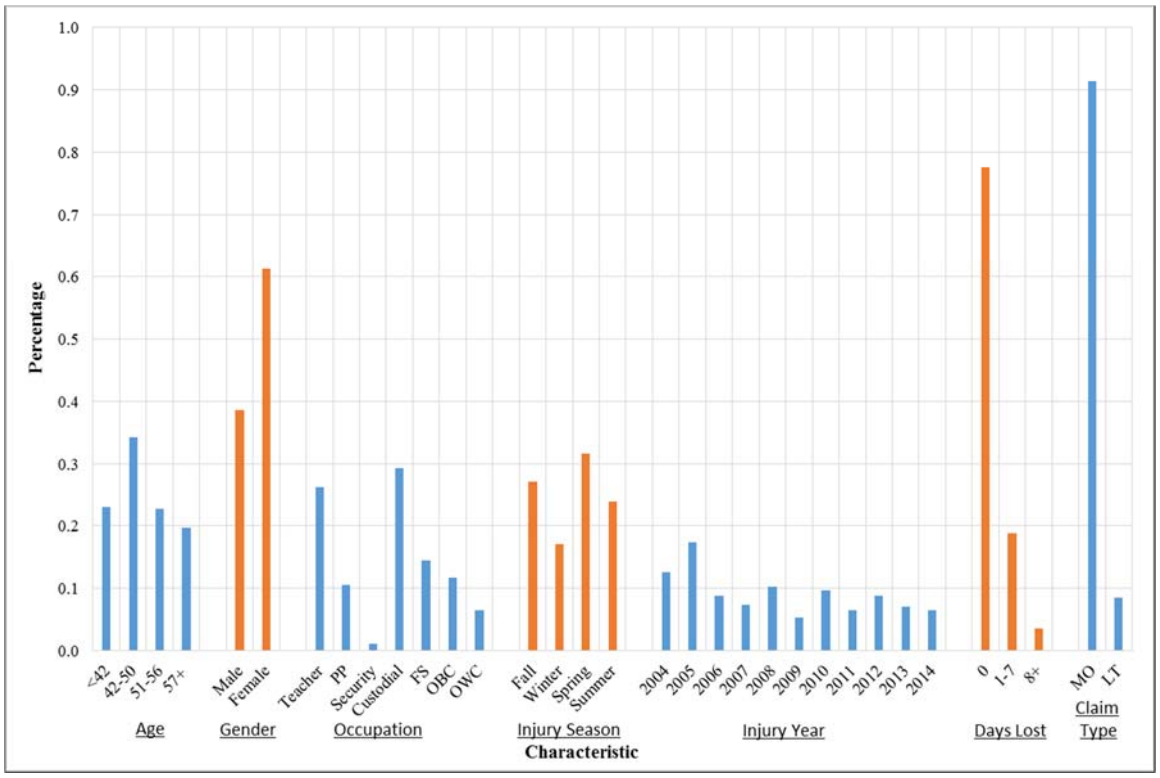

Figure 2c. Distribution of injuries caused by contact with objects and equipment (COE) by characteristics from workers' compensation claims allowed/settled by the Ohio Bureau of Workers' Compensation from a Midwestern public school district from 2004-2014 (n = 341).

[PP = Paraprofessional, FS = Food services, OBC = Other blue collar, OWC = Other white collar, MO = Medical only, LT = Lost-time]

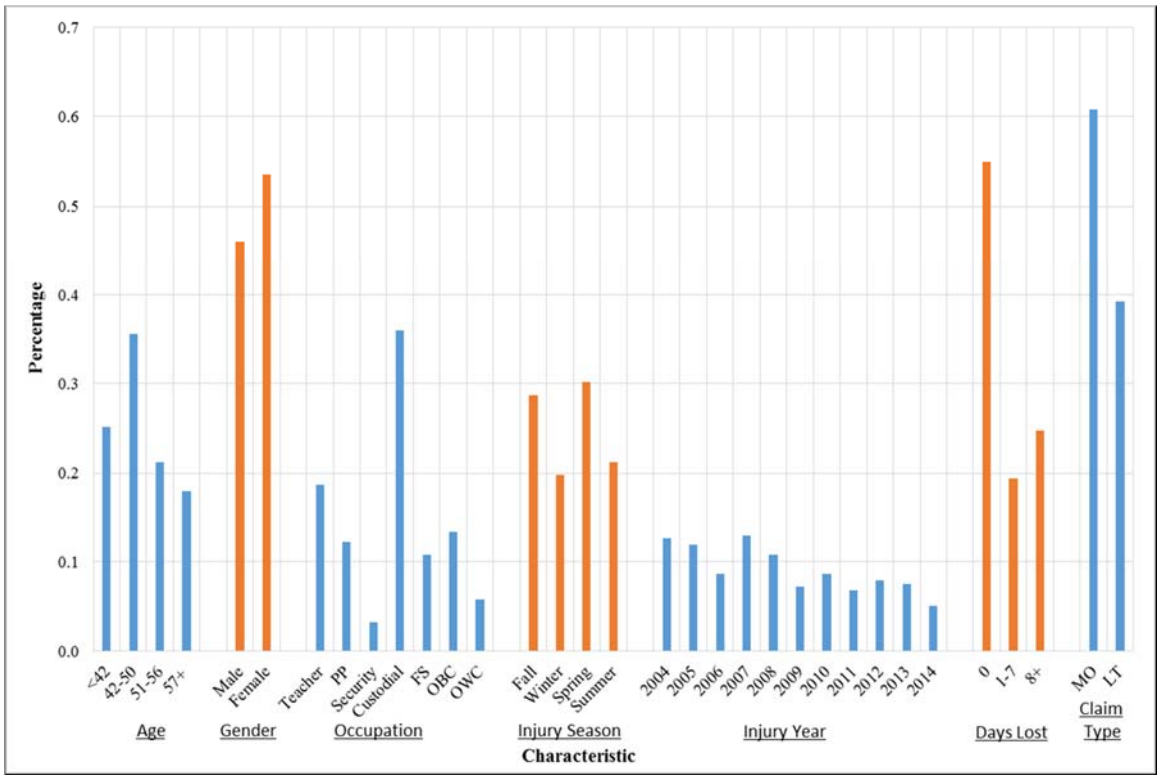

Figure 2d. Distribution of injuries caused by overexertion and bodily reaction (OBR) by characteristics from workers' compensation claims allowed/settled by the Ohio Bureau of Workers' Compensation from a Midwestern public school district from 2004-2014 (n = 278).

[PP = Paraprofessional, FS = Food services, OBC = Other blue collar, OWC = Other white collar, MO = Medical only, LT = Lost-time]

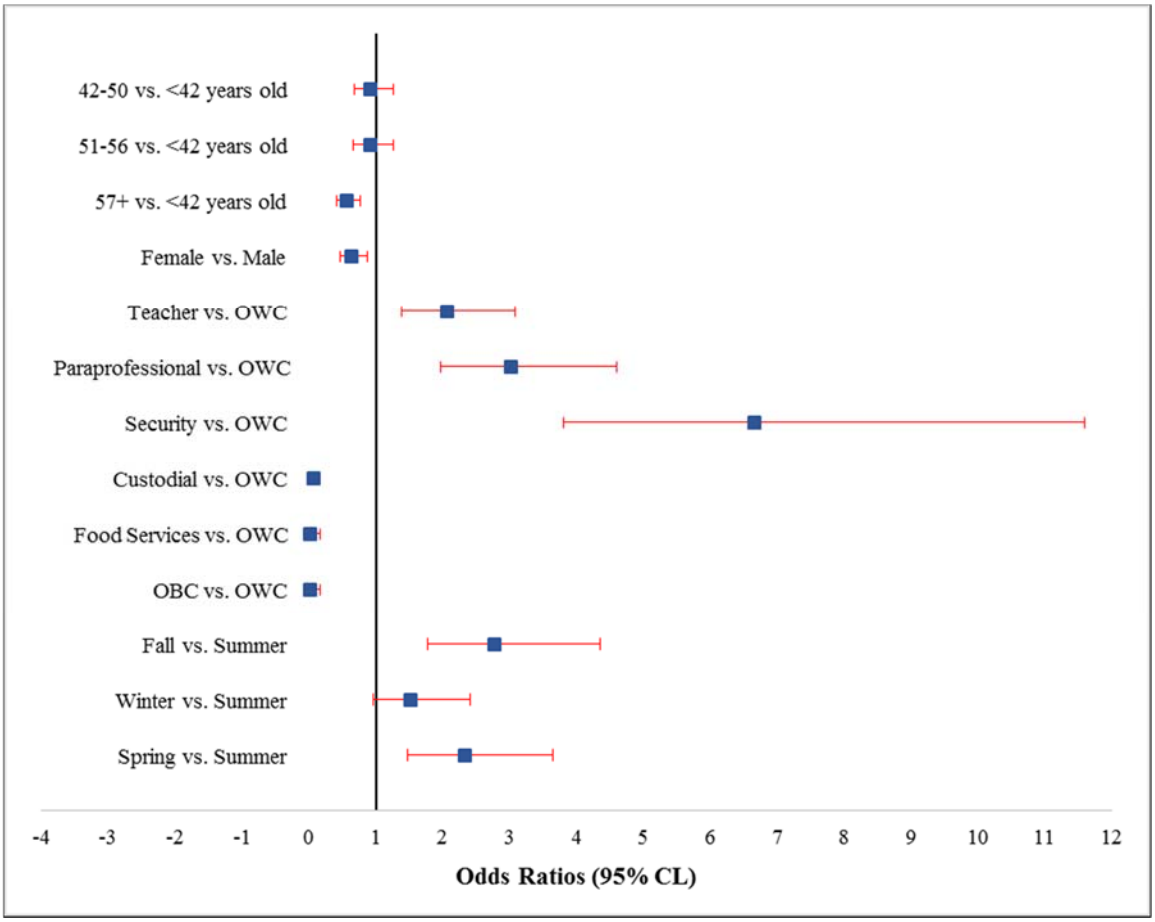

Figure 3a. Adjusted odds ratios* with 95% confidence limits for predictors of injuries caused by violence and other injuries by persons or animals (VIL).

[OBC = Other blue collar, OWC = Other white collar]

* Referent groups = <42 years old, Male, OWC, Summer

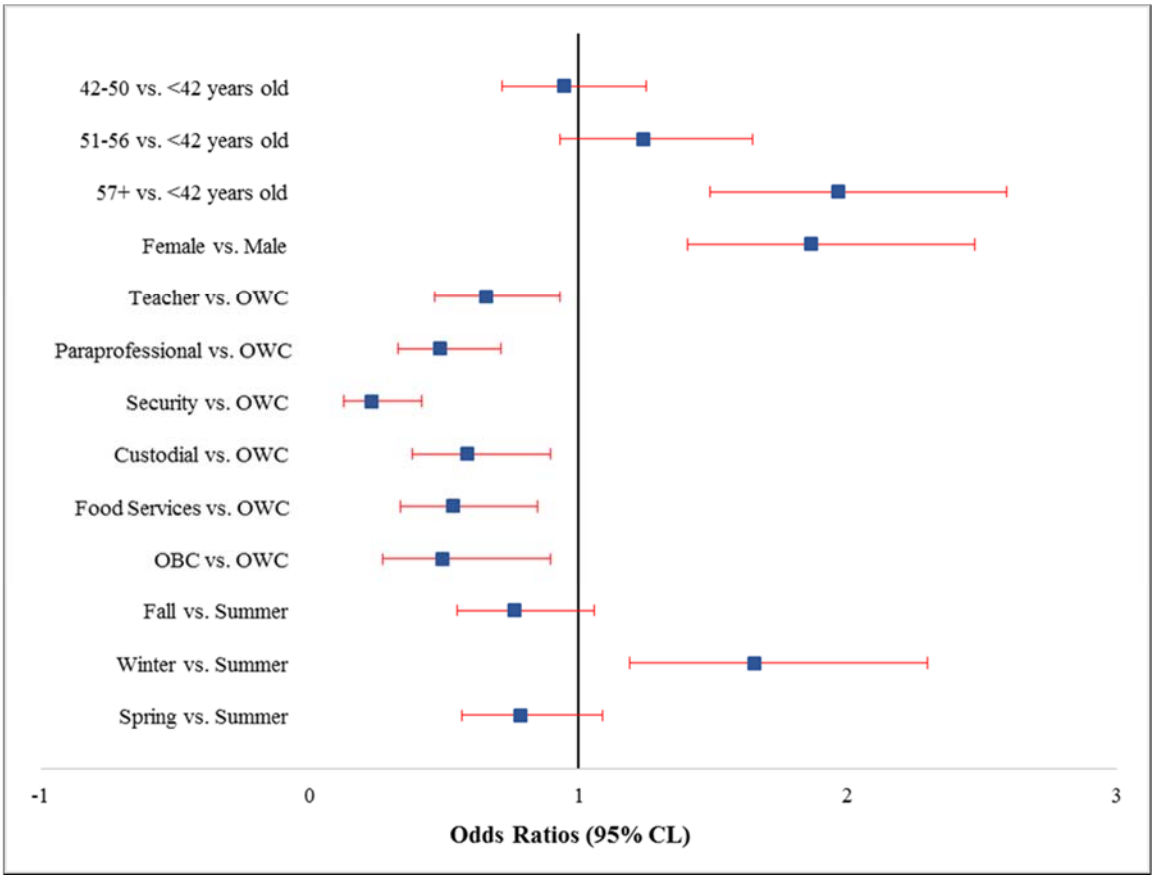

Figure 3b. Adjusted odds ratios* with 95% confidence limits for predictors of injuries caused by slips, trips, and falls (STF).

[OBC = Other blue collar, OWC = Other white collar]

* Referent groups = <42 years old, Male, OWC, Summer

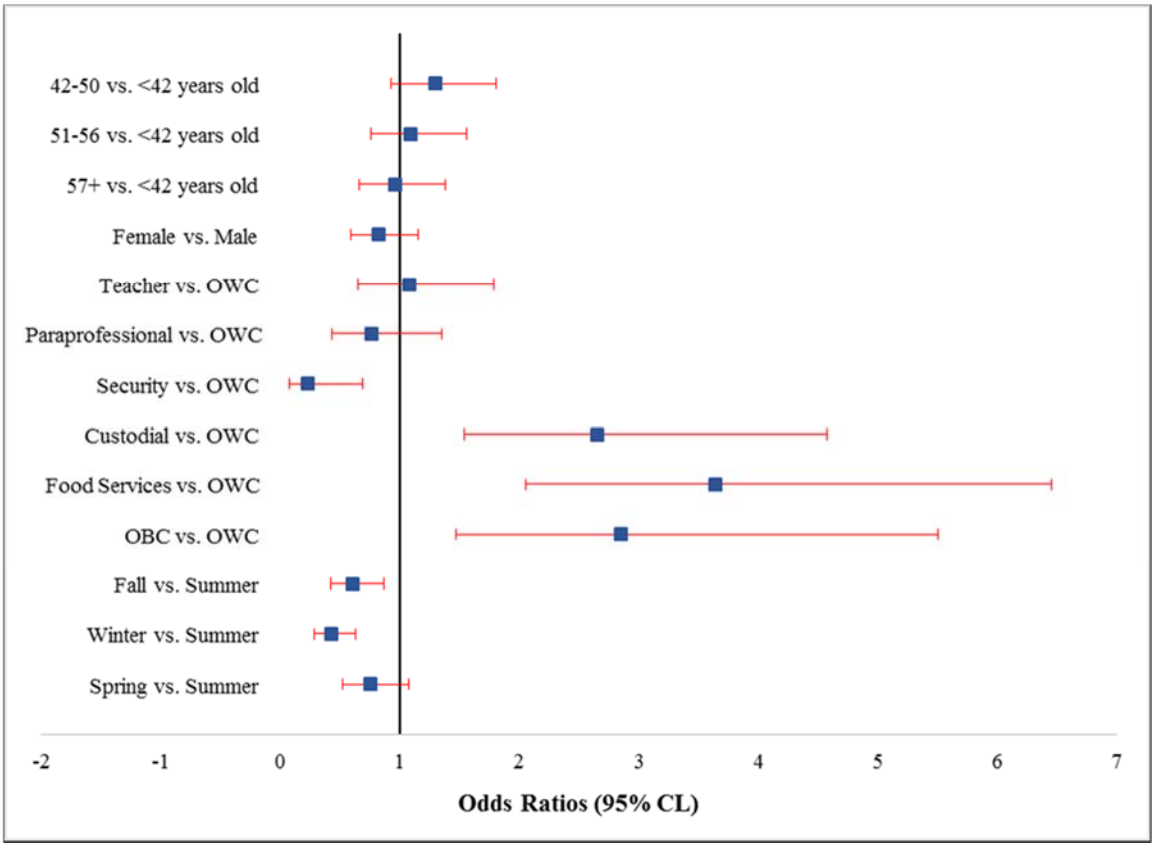

Figure 3c. Adjusted odds ratios* with 95% confidence limits for predictors of injuries caused by contact with objects and equipment (COE).

[OBC = Other blue collar, OWC = Other white collar]

* Referent groups = <42 years old, Male, OWC, Summer

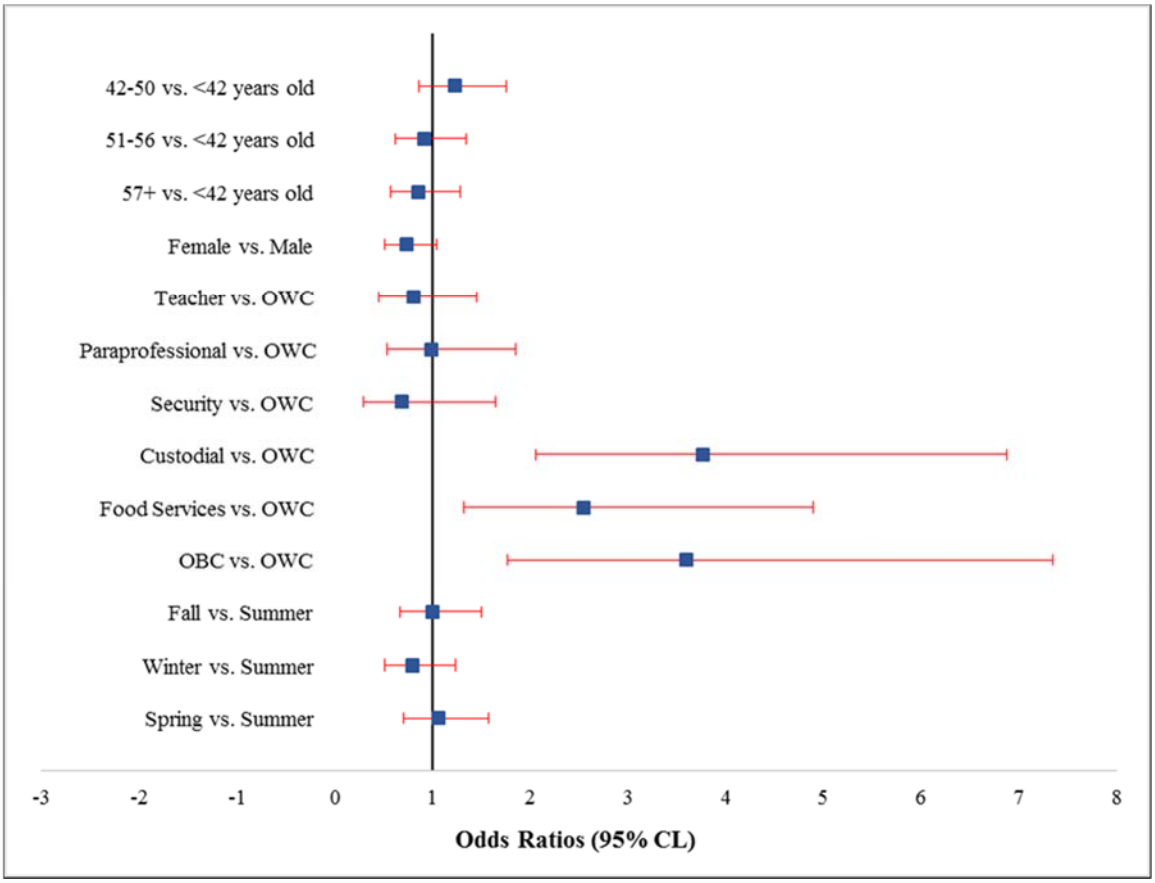

Figure 3d. Adjusted odds ratios* with 95% confidence limits for predictors of injuries caused by overexertion and bodily reaction (OBR).

[OBC = Other blue collar, OWC = Other white collar]

* Referent groups = <42 years old, Male, OWC, Summer

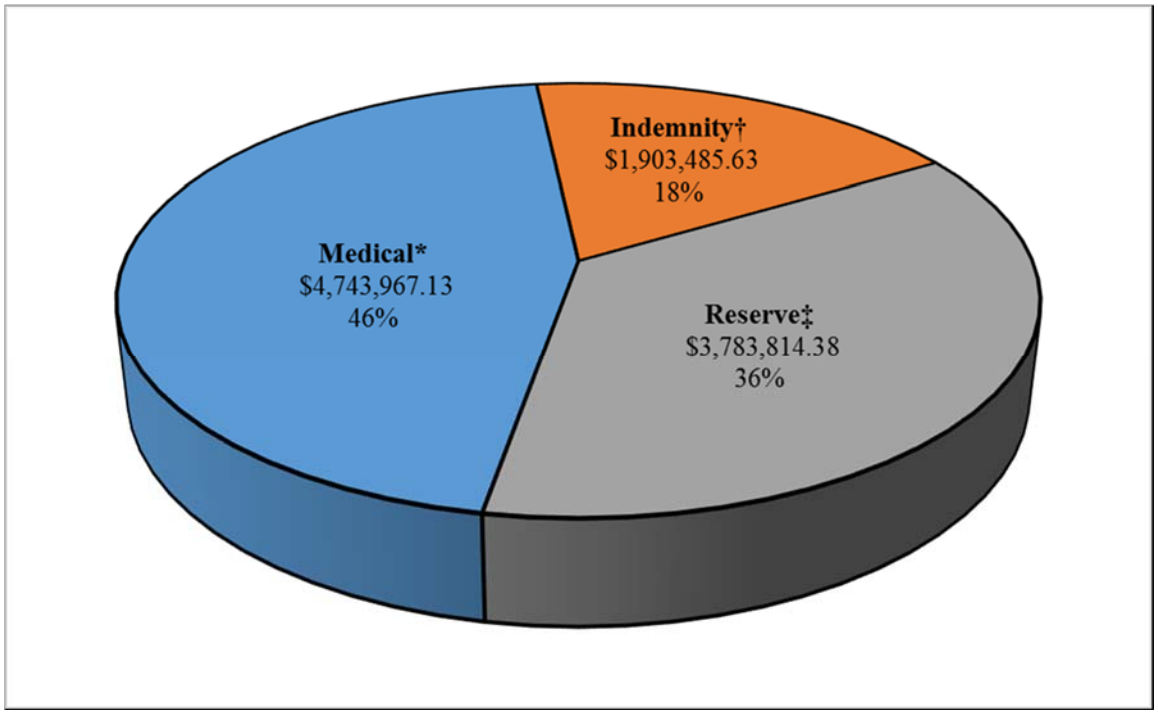

Figure 4a. Distribution of compensation cost types from the overall cost§ of workers' compensation claims allowed/settled by the Ohio Bureau of Workers' Compensation from a Midwestern public school district from 2004-2013‖.

* Medical costs = compensations covering any factors involved in treating the injury, ie. visits to medical providers, diagnostic tests, or medication
† Indemnity costs = compensations for lost wages or permanent disability when claimant was unable to return to work due to injury
‡ Reserve costs = compensations anticipating future costs involved in a claim, calculated at a specific point in time; only applicable to lost-time claims
§ $10,431,267.14
‖ Aged-30-months compensation data for 2014 not yet reached/provided

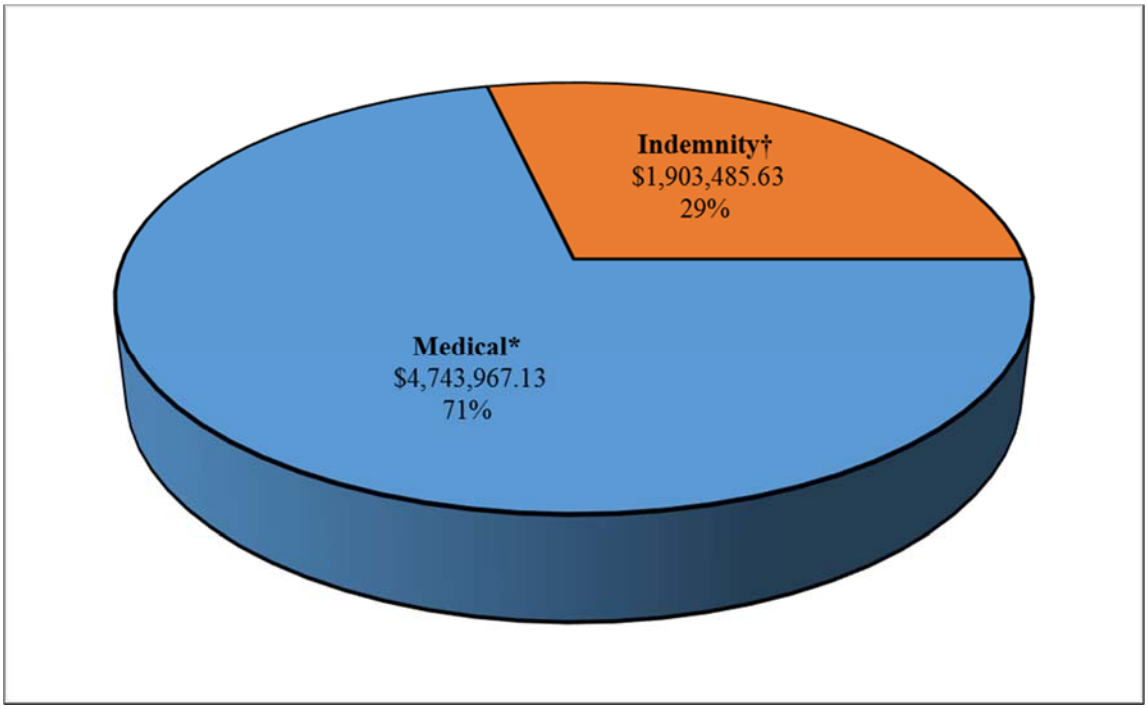

Figure 4b. Distribution of compensation cost types from the overall cost‡ of workers' compensation claims allowed/settled by the Ohio Bureau of Workers' Compensation from a Midwestern public school district from 2004-2013§.

* Medical costs = compensations covering any factors involved in treating the injury, ie. visits to medical providers, diagnostic tests, or medication
† Indemnity costs = compensations for lost wages or permanent disability when claimant was unable to return to work due to injury
‡ $6,647,452.76
§ Aged-30-months compensation data for 2014 not yet reached/provided

Appendix A

Abbreviations

ANOVA = Analysis of variance

BLS = United States Bureau of Labor Statistics

COE = Contact with objects and equipment

CWCS = Center for Workers' Compensation Studies

FROI = First Report of Injury, Occupational Disease or Death

FS = Food services

IC = Industrial Commission

ICD-9 = International Classification of Diseases, version 9

LT = Lost-time

MCO = Managed care organization

MO = Medical Only

OBC = Other blue collar

OBR = Overexertion and bodily reaction

OWC = Other white collar

OBWC = Ohio Bureau of Workers' Compensation

NIOSH = National Institute for Occupational Safety and Health

PP = Paraprofessional

SOII = Survey of Occupational Injuries and Illnesses

SOC = Standard Occupational Classification

STF = Slips, trips, and falls

TCC = Total compensation costs

VIL = Violence and other injuries by persons or animals

WC = Workers' compensation

Definitions

Claims Status: **Allowed** claims were granted with written clearance from OBWC orders once the appeal period expired with no appeals filed, or was allowed after a hearing order (Ohio Bureau of Workers' Compensation, 2016c). **Settlements** were paid sums of money, which were agreed upon by the injured worker, employer, and the OBWC, that forever resolved all past, present, or future compensation issues and liabilities in the claim, whether known or unknown (Ohio Bureau of Workers' Compensation, 2016b). Settlements may have resulted in lump sum payments for medical or indemnity (lost wages) benefits. **Hearings**, as part of the claims due process, were conducted with the Industrial Commission of Ohio (IC) when injured workers and/or employers wished to dispute and appeal any claim issues (Ohio Bureau of Workers' Compensation, 2016e). **Disallowed** claims were denied allowance by OBWC orders once the appeal period had expired with no appeals filed, or was denied after a hearing order (Ohio Bureau of Workers' Compensation, 2016c). **Dismissed** claims were voluntary withdrawals by the injured worker or authorized representatives before any decisions were made by the OBWC (Ohio Bureau of Workers' Compensation, 2016c).

Other blue collar: Building engineers, trade, and drivers

Other white collar: Administrative, clerical, intervention specialists, nurses, and librarians

Paraprofessionals: Instructional/teaching assistants

Appendix B

Table A1. Descriptive statistics of other factors from workers' compensation claims allowed/settled by the Ohio Bureau of Workers' Compensation from a Midwestern public school district from 2004-2014 (n = 1934).

Characteristic	Overall n = 1934
Claimant	**No. (%)**
School Type*	
Elementary	1049 (54.2)
High School	411 (21.3)
K-12	85 (4.4)
Other†	386 (20.0)
Missing	3 (0.2)
Injuries	
Injury Causation‡	
Intentional injury by person	265 (13.7)
Injury by person—unintentional or intent unknown	284 (14.7)
Animal and insect related incidents	10 (0.5)
Pedestrian vehicular incident	3 (0.2)
Roadway incidents involving motorized land vehicle	21 (1.1)
Slip or trip without fall	102 (5.3)
Falls on same level	448 (23.2)
Falls to lower level	125 (6.5)
Jumps to lower level	4 (0.2)
Exposure to temperature extremes	9 (0.5)
Exposure to other harmful substances	27 (1.4)
Needlestick without exposure to harmful substance	4 (0.2)
Struck by object or equipment	156 (8.1)
Struck against object or equipment	114 (5.9)
Caught in or compressed by equipment or objects	63 (3.3)
Rubbed or abraded by friction or pressure	4 (0.2)
Overexertion involving outside sources	209 (10.8)
Repetitive motions involving microtasks	9 (0.5)
Other exertions or bodily reactions	60 (3.1)
Nonclassifiable/Missing	17 (0.9)
Injury Time	
AM	660 (34.1)
PM	521 (26.9)
Missing	753 (38.9)
Student Related§	
Yes	586 (30.3)
No	1348 (69.7)
Workers' Compensation Claims	
Claim Status (n = 2160)‖	
Allowed	1829 (84.7)
Settled, Medical & Indemnity	104 (4.8)
Settled, Medical Only	1 (0.05)
Hearing	1 (0.05)
Disallowed	196 (9.1)
Dismissed	29 (1.3)

* Type of school at which injury occurred
† Preschool-8th grade, alternative education, service building
‡ Detailed injury causation, 2-digit Occupational Injury and Illness Classification Systems codes
§ Student related = yes, if injury narrative indicated causation was due to or involved a student
‖ Includes all workers' compensation claims

Table A2. Distribution of injury causation types (Figures 2a-2d) by characteristics of workers' compensation claims allowed/settled by the Ohio Bureau of Workers' Compensation from a Midwestern public school district from 2004-2014.

Characteristic										Overall n = 1917
	VIL* n = 559 (28.9%)		STF† n = 679 (35.1%)		COE‡ n = 341 (17.6%)		OBR§ n = 278 (14.4%)		Other‖ n = 60 (3.1%)	
Claimant	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Age (years)										
<42	171	30.6	147	21.7	79	23.2	70	25.2	24	40.0
42-50	135	24.2	156	23.0	117	34.3	99	35.6	13	21.7
51-56	134	24.0	162	23.9	78	22.9	59	21.2	12	20.0
57+	119	21.3	214	31.5	67	19.7	50	18.0	11	18.3
Gender										
Male	135	24.2	128	18.9	132	38.7	128	46.0	19	31.7
Female	424	75.9	546	80.4	209	61.3	149	53.6	41	68.3
Missing	.	.	5	0.7	.	.	1	0.4	.	.
Occupation										
Teacher	255	45.6	285	42.0	90	26.4	52	18.7	8	13.3
Paraprofessional	172	30.8	124	18.3	36	10.6	34	12.2	4	6.7
Security	85	15.2	20	3.0	4	1.2	9	3.2	4	6.7
Custodial	7	1.3	88	13.0	100	29.3	100	36.0	13	21.7
Food Services	1	0.2	53	7.8	49	14.4	30	10.8	14	23.3
Other Blue Collar¶	1	0.2	25	3.7	40	11.7	37	13.3	8	13.3
Other White Collar**	38	6.8	84	12.4	22	6.5	16	5.8	9	15.0
Injury										
Injury Season										
Fall	203	36.3	175	25.8	93	27.3	80	28.8	22	36.7
Winter	137	24.5	239	35.2	58	17.0	55	19.8	14	23.3
Spring	187	33.5	175	25.8	108	31.7	84	30.2	15	25.0
Summer	32	5.7	90	13.3	82	24.1	59	21.2	9	15.0
Injury Year										
2004	54	9.7	68	10.0	43	12.6	35	12.6	8	13.3
2005	79	14.1	62	9.1	59	17.3	33	11.9	12	20.0
2006	64	11.5	50	7.4	30	8.8	24	8.6	11	18.3
2007	37	6.6	60	8.8	25	7.3	36	13.0	8	13.3
2008	50	8.9	71	10.5	35	10.3	30	10.8	6	10.0
2009	48	8.6	71	10.5	18	5.3	20	7.2	.	.
2010	49	8.8	65	9.6	33	9.7	24	8.6	2	3.3
2011	52	9.3	85	12.5	22	6.5	19	6.8	2	3.3
2012	51	9.1	50	7.4	30	8.8	22	7.9	5	8.3
2013	41	7.3	51	7.5	24	7.0	21	7.6	5	8.3
2014	34	6.1	46	6.8	22	6.5	14	5.0	1	1.7
Days Lost										
0	366	65.5	377	55.5	265	77.7	153	55.0	39	65.0
1-7	133	23.8	186	27.4	64	18.8	54	19.4	12	20.0
8+	58	10.4	116	17.1	12	3.5	69	24.8	8	13.3
Missing	2	0.4	.	.	.	.	2	0.7	1	1.7
Workers' Compensation Claim										
Claim Type										
Medical Only	460	82.3	515	75.9	312	91.5	169	60.8	47	78.3
Lost-time	99	17.7	164	24.2	29	8.5	109	39.2	13	21.7

* Violence and Other Injuries by Persons or Animals

† Slips, Trips, and Falls

‡ Contact With Objects and Equipment

§ Overexertion and Bodily Reaction

‖ Transportation Incidents, Exposure to Harmful Substances/Environments

¶ Building Engineers, Trade, Drivers

** Administrative, Clerical, Intervention Specialists, Nurses, Librarians