



Risk factors for occupational injuries in schools among educators and support staff



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ABSTRACT

Introduction: School districts employ a large number of employees who work in educational (e.g., teachers) or other support roles, including educational assistants, custodians, food service, bus drivers, and community and recreation workers. District employees perform a wide array of job tasks and experience a wide spectrum of work-related risks and injuries. **Methods:** Workers' compensation data were coupled with Minnesota Department of Education district employee denominator data to evaluate risk factors for injury and severity. Variables included district location and type, employee job classification, age, and gender. Rates of injury and rate ratios were calculated to measure comparative injury risk using negative binomial regression and 95% confidence intervals. Incidence and frequency of injury cause, nature, and body part were calculated. **Results:** Saint Paul and Minneapolis metropolitan area (versus non-metro) districts had higher risk (RR = 1.35, 95%CI = 1.18–1.54) of employee injuries. All job classifications in support roles had increased risk of injury claims versus educators, however food service (RR = 5.14, 95%CI = 4.61–5.74), custodial (RR = 3.85, 95%CI = 3.41–4.34), and transportation (RR = 4.15, 95%CI = 3.38–5.10) exhibited the highest comparative risk to educators; significant risk of lost-time injury was also present in these workers. Males and females had similar risk of injury for all claims, however males had elevated risk of lost-time injury (RR = 1.46, 95%CI = 1.26–1.69) versus females. All age groups >41-years-old exhibited increased risk of injury as compared to 31–40-year-olds. The magnitude of lost-time injury risk also increased with age. Falls and slips (29.1%), strains/sprains/ruptures (45.2%), and upper extremities (31.3%) most frequent cause, nature, and body part injured, respectively. **Conclusions:** Characteristics of districts, schools, workers, and their jobs tasks and hazards vary. Many categories of support staff in schools have elevated risk of injury, including lost-time injury, as compared to educators. **Practical Applications:** Injury prevention in schools should be approached by targeting job classifications; high risk jobs can be prioritized for prevention.

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1. Introduction

Worker safety in schools is an issue of occupational and public health importance. Nationally, the educational services sector employs over 13.14 million workers (Bureau of Labor Statistics (BLS)a, 2020), of which, over 8.54 million work in elementary and secondary schools (BLSb, 2020). The vast majority of these elementary and secondary school workers (>7.62 million) are employed within state and local government-owned public schools (BLSc, 2020), directly impacting the local communities

and students they serve. School workers spend a significant amount of time in school buildings and in direct contact with students. In addition to educational staff, schools employ a wide-spectrum of workers providing educational support and non-instructional services, such as educational assistants, food service, and custodial workers. The job tasks and responsibilities of many support and service roles have been shown to include high physical demands (Cann et al., 2008; Unge, Ohlsson, Nordander, Hansson, Skerfving, & Balogh, 2007; Village et al., 2009; Woods & Buckle, 2006) which may increase risk of injury and lost-time, delayed return-to-work, and disability.

Those employed in public elementary and secondary schools within local government amassed an injury incidence rate ranging from 5.2 to 4.2 per 100 full-time equivalent (FTE) nationwide in

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study years of 2009–2014, trending downward during that time, and at a rate of 4.5 per 100 FTE in 2019 (BLS, 2021). Injuries resulting in lost work days have remained at a relatively consistent rate, ranging from 1.0 to 1.2 per 100 FTE (BLS, 2021). In Minnesota, data show an injury incidence rate of 3.6–4.6 per 100 FTE in public elementary and secondary schools in 2012–2014 (Zaidmen, 2016). While Minnesota school rates are lower than the national average for schools, the rates are still higher than the average rate of injury and illness in public and private industries in Minnesota (1.8 per 100 FTE) (Zaidmen, 2016). Over the course of 10 years in Minnesota (2003–2013), workers in K-12 schools suffered, on average, 910 workers' compensation injuries per year that were severe enough to result in lost-time from work (Zaidmen, 2016). In lost-time injury cases, injuries resulting from slips, trips, and falls and sprains/strains accounted for the majority (2/3) of school district injuries in Minnesota (Zaidmen, 2016). Student-inflicted injuries to staff have drawn more focus in recent years and were shown to account for as much as 26% of overall school claims (Schofield et al., 2019), with 13% linked directly to violence and assault (Zaidmen, 2016) in Minnesota.

The economic and personal impact of workplace injuries on employees can be profound. Musculoskeletal injuries to educators and staff have been associated with impaired work, increased sick leave (Maguire & O'Connell, 2007), and early retirement (Brown et al., 2006; Maguire & O'Connell, 2007). Furthermore, injuries can affect co-worker occupational stress, job satisfaction, and absentee rate. (Barling, Kelloway, & Iverson, 2003; Bradley, Green, & Leeves, 2007). Staff absence has been linked to negative effects on student achievement (Bruno, 2002; Miller, Murnane, & Willett, 2008; Woods & Montagno, 1997) and injuries have the potential to impact school budgets, both of which can be especially detrimental in economically disadvantaged districts. In this regard, consequences of school worker injury reach beyond schools and districts, to the local communities, tax payers, and beyond (Maguire & O'Connell, 2007).

Currently, there is limited literature that examines the risk of employee injury in schools based on district location and type, and worker characteristics such as age, gender, and job classification. Moreover, research on school workers in roles other than educators, custodians, and food service workers is sparse. The objective of the study was to identify potential risk factors for injury among district, worker, and job characteristics in Minnesota school districts; identification can lead to prioritization and injury prevention.

2. Methods

2.1. Study population and injury data

The study used workers' compensation claim data from a private, regional insurance company. All employee injury claims from five school years, 2009–2010 through 2013–2014, were included in the study and included 136 (of 336 total) independent school districts in Minnesota. Injury data were collected from workers' compensation claims. Data included employee age, gender and job classification, injury characteristics, and a text narrative of the injury event. Injury data were classified by the insurer according to the Workers' Compensation Insurance Organizations (WCIO) (Worker's Compensation Insurance Organizations, 2021) injury description codes for part of body, nature and cause of injury. Employee ages were categorized as ≤20, 21–30, 31–40, 41–50, 51–60, and ≥61. Severity of the injury was categorized as medical or lost-time; in Minnesota, a lost-time claim results when an employee misses more than three calendar days from work due to an injury. All workers' compensation data extraction, injury,

and age-group coding were completed by the insurer prior to acquisition by the research team. This study was reviewed and determined to be exempt status by the University of Minnesota Institutional Review Board.

2.2. School population data

Data on the underlying population of employees in school districts was available from the Minnesota Department of Education (MDE) and is populated from the annual Staff Automated Reporting (STAR) system, which is a web-based system used by school districts to report employment and assignment information (Minnesota Department of Education, 2020). The STAR is completed annually by each district.

The report used two different methods to describe staffing levels for job classifications. The first method was percent of full time contract (FTE). This was chosen as the denominator for the majority of rate and multivariate analysis. Researchers felt it was a closer approximation of time at-risk and had greater generalizability. The second method used in the STAR report was per-contracted-position (headcount), wherein an employee could be counted more than once in the underlying population if they held multiple different jobs within the district. This data for position denominator calculation included age and gender covariates, thus analyses of age and gender were only able to be calculated in this manner, and job classification analysis was also conducted a second time with the position denominator for results that controlled for age and gender.

Employee jobs were classified as educator, clerical, custodial, food service, community and recreation, general educational assistant, special education assistant, and transportation. Some job classifications were grouped according to similar job duties and/or risks to create the classifications. These classifications were aided by both the workers' compensation data as well as the parameters outlined in the STAR manual (Table 1).

The MDE categorizes school districts by location and type. Location was characterized by zip code and county. Those within the seven-county Minneapolis-St. Paul metropolitan area were categorized by researchers as metro (versus non-metro). District type was pre-determined and defined as public, charter, integration, or intermediate districts. Public districts are independent school districts serving communities based on geographic boundaries. Charter districts are independent public schools with a specific

Table 1
Categorization of job titles and tasks into job classification groups.

Job Classification	Job Types
Educator	Licensed staff; teachers, therapists, counselors, clinicians, academics, and administrators
Clerical	Secretaries, librarians, administrative and business workers, student records, finance, and human resources
Custodial	Facility workers, janitorial, custodians, building operations, engineers, technicians, grounds, maintenance, and information technology
Food Service	Cooks, servers, nutrition services, lunch room attendants
Community and Recreation	Coaches, community education, early childhood education, summer programming, child care, before and after school programs, recreation
General Educational Assistant	Paraprofessionals, classroom, and student support
Special Education Assistant	Paraprofessionals, class, and student support with specified special education focus; one-on-one student focus
Transportation	Bus drivers, bus assistants, mechanics, and other transportation department workers

academic focus, offering, or purpose. Integration districts are jointly funded districts that serve geographically surrounding districts and communities to prevent segregation and racial isolation of surrounding districts. They provide inter-district opportunities to promote racial integration. Intermediate districts are jointly funded districts that serve geographically surrounding districts to provide education and highly specialized services for students, particularly those with the highest level of special education needs.

2.3. Data analysis

We examined district location, district type, job classification, age, and gender and their effects on rates of injury, by severity. Injury claims served as the numerator and FTE or position/headcount served as the denominator to determine injury rates. Rates were reported as total, lost-time, and medical-only, which allowed an examination of severity. Rates were also calculated by further categorization of age and gender within job classification. Multivariate analysis measured injury rate ratios (RR) and 95% confidence intervals (CI). District type was adjusted for district location. Job classification was adjusted for district location, district type, and year for FTE calculations. Job classification was further adjusted for age and gender for position/headcount calculations. For the job classification exposure, educators served as the referent group. Custodial staff time at-risk was adjusted to account for work activities over the summer months (Village et al., 2009). The outcome data exhibited a variance approximately three times higher than the mean, and a significant LaGrange Multiplier test, indicating over-dispersion was present in the data. A negative binomial model was chosen for analysis. Zero-inflation was not present in the data; all employees were assumed to have a risk of injury while at work. In all models generalized estimating equations (GEEs) with a model based variance estimate accounted for correlated observations within districts over time (Zeger & Liang, 1986). Employee injury claims in the workers' compensation database that could not be linked to STAR employee rosters (denominator) via cross-reference by name by the insurer were excluded from rate and multivariate analysis. All analyses were conducted with SAS Version 9.4 (2013).

Descriptive analyses of claim injury characteristics for body, nature, and cause were calculated as a frequency and percent of total, lost-time, and medical-only claims. We also calculated percent of each subcategory that resulted in lost-time by dividing number of lost-time claims by number of total claims in the subcategory. All claims in the workers' compensation dataset were used in the descriptive analyses, regardless of their ability to be linked to underlying worker population.

3. Results

Approximately 40% (136) of the independent school districts in Minnesota contributed data to this study for a total of 8,626 claims over five years, with 94% (8,082) of claims linked to the denominator data. The population contributed 167,996 FTEs and 201,365 employee positions for analysis and incurred an overall injury rate of 4.8 per 100 FTE; 15.1% of all injuries were classified as lost-time.

3.1. FTE denominator

Districts located within the metro area exhibited higher total rates of injury in comparison to districts outside of the metro area, 5.1 per 100 FTE versus 4.4 per 100 FTE, respectively. Intermediate districts had the highest total rate of employee injury (14.6 per 100 FTE), which was over triple the rate of public school districts, with

medical-only injury rates in intermediate districts appearing to contribute the most to the difference in total rates (Table 2).

Employee job classifications exhibited varying rates of injury among groups. Food service and custodial experienced the highest rate of injury (12.7 per 100 FTE), followed by transportation (10.4 per 100 FTE) (Table 2). In lost-time injury trends, transportation employees incurred the highest rate (3.1 per 100 FTE), followed by custodial workers (2.9 per 100 FTE) and food service (2.4 per 100 FTE) (Table 2). Food service workers had the greatest rate of medical-only injury (10.3 per 100 FTE) as compared to their colleagues (Table 2).

Multivariate analysis of data revealed the employees of the metro districts were at higher risk of injuries (RR = 1.35, 95% CI = 1.18–1.54) versus non-metro districts. Intermediate district employees had increased risk of total (RR = 1.74, 95% CI = 1.22–2.49), lost-time (RR = 1.26, 95% CI = 1.10–1.44), and medical-only (RR = 1.98, 95% CI = 1.39–2.82), injuries as compared to public districts. Alternately, integration districts had a reduced risk of total and lost-time injuries and charter schools had a lower risk of medical-only claims compared to public districts (Table 2).

All job classifications exhibited significantly increased risk of overall injury compared to educators, with the exception of clerical. Food service exhibited a large magnitude of increased risk of injury in comparison to educational staff, for overall claims (RR = 5.14, 95% CI = 4.61–5.74), lost-time claims (RR = 9.72, 95% CI = 7.76–12.18), and for medical-only (RR = 4.60, 95% CI = 4.10–5.15) claims. Transportation workers were also at increased risk for overall injury claims (RR = 4.15, 95% CI = 3.38–5.10), as well as medical-only claims (RR = 3.28, 95% CI = 2.64–4.06), but exhibited the largest magnitude of increased risk of lost-time injuries (RR = 12.23, 95% CI = 8.91–16.78) for all employee groups, as compared to educational staff. Custodial workers also illustrated a magnitude of increased risk that was consistently high across categories of total, lost-time, and medical-only injuries (Table 2).

3.2. Position/headcount denominator

Using the headcount/position denominator allowed inclusion of age and gender covariates for further examination of the population and risk factors. Females and males experienced similar rates of total injury; 3.9 and 4.5 per 100 position, respectively (Table 3). The oldest employee groups, age 51–60 and 61+, experienced the highest total rates in the population (5.0 per 100 positions). The rate of lost-time claims increased as age increased, with age 61+ incurring the highest rate of lost-time claims (1.1 per 100 positions). Similarly, medical-only claim rates generally trended upward with age, and 51–60-year-olds had the highest rate of medical-only claims (4.1 per 100 positions; Table 3).

Injury rate trends in job classifications by position were similar to those reported in the FTE denominator calculations. However, most rates reported by position denominator were lower than those calculated by FTE. For example, the rate of overall injury for food service and transportation was almost half when calculated by position (Table 3). The exception was custodial; the rate increased from 9.6 per 100 FTE to 11.3 per 100 positions (Table 3).

Multivariate analyses indicated males did not differ in their risk of overall injury or medical-only injury in comparison to females; however, males had a 46% (RR = 1.46, 95% CI = 1.26–1.69) increased risk of experiencing a lost-time injury compared to female employees (Table 3). All age groups >41 years old exhibited higher risks of overall, lost-time, and medical-only injuries compared to 31–40 year olds. For lost-time injuries in particular, risk of losing time from work increased steadily as age increased 41–50 (65%), 51–60 (125%) and 61+ (182%) (Table 3).

Comparative risk for job classifications was calculated with positions as the denominator, controlling for age and gender. Cus-

Table 2
Rates and rate ratios (RR) for injury per 100-full-time-equivalents by school district location, type, and job classification.

Population District Location ^f	Total Claims				Lost-Time Claims				Medical-Only Claims								
	FTE [‡]	Claims	Rate	RR*	LowerCI	UpperCI	Claims	Rate	RR*	LowerCI	UpperCI	Claims	Rate	RR*	LowerCI	UpperCI	
Population	167,996	8,082	4.8				1,222	0.7				6,860	4.1				
Non-Metro (reference)	70,075	3,068	4.4	1.00			457	0.7	1.00			2,611	3.7	1.00			
Metro	97,921	5,014	5.1	1.35	1.18	1.54	765	0.8	1.40	1.15	1.72	4,249	4.3	1.34	1.16	1.55	
District Type^{‡,a}																	
Public (reference)	161,927	7,599	4.7	1.00			1,167	0.7	1.00			6,432	4.0	1.00			
Charter	1,311	55	4.2	0.73	0.54	1.00	7	0.5	0.51	0.26	1.01	48	3.7	0.76	0.58	0.99	
Integration	2,002	27	1.3	0.83	0.69	0.99	4	0.2	0.86	0.74	0.99	23	1.1	0.84	0.68	1.03	
Intermediate	2,756	401	14.6	1.74	1.22	2.49	44	1.6	1.26	1.10	1.44	357	13.0	1.98	1.39	2.82	
Job Classification^b																	
Clerical	10,395	275	2.6	1.01	0.84	1.21	39	0.4	1.44	0.97	2.13	236	2.3	0.96	0.81	1.15	
Custodial	12,313	1,558	12.7	3.85	3.41	4.34	362	2.9	8.68	6.84	10.99	1,196	9.7	3.28	2.91	3.70	
Educator (reference)	99,009	2,536	2.6	1.00			251	0.3	1.00			2,285	2.3	1.00			
Food Service	6,956	882	12.7	5.14	4.61	5.74	168	2.4	9.72	7.76	12.18	714	10.3	4.60	4.10	5.15	
Community & Recreation	9,829	316	3.2	1.23	1.00	1.52	43	0.4	1.70	1.20	2.41	273	2.8	1.20	0.95	1.50	
General Ed. Assist.	5,585	370	6.6	2.70	2.19	3.32	48	0.9	3.34	2.33	4.79	322	5.8	2.60	2.07	3.24	
Special Ed. Assist.	20,027	1,740	8.7	3.01	2.69	3.37	189	0.9	3.40	2.81	4.11	1,551	7.7	3.00	2.67	3.38	
Transportation	3,881	405	10.4	4.15	3.38	5.10	122	3.1	12.23	8.91	16.78	283	7.3	3.28	2.64	4.06	

^f Obtained from the Minnesota Department of Education (MDE) Staff Automated Reporting (STAR) July 1, 2009 through June 30, 2015.

[‡] Full-time equivalent = percent of full-time contract per MDE STAR Report.

^a Adjusted for within-district correlation (GEE) and months at-risk in the school year.

^b Adjusted for district location.

^c Adjusted for district location, district type, and year.

todial workers had the highest risk of injury (RR = 3.70, 95% CI = 3.28–4.18) compared to educators, followed by food service, transportation, and special education assistants, respectively (Table 3). Community and recreation workers had reduced risk of injury as compared to educators, reversing the increased risk exhibited with the FTE denominator. Magnitude of comparative risk for all job classifications was lower with the position than with the FTE denominator. This could be attributed to both controlling for effects of age and gender, which was possible with the position denominator and/or the higher count of positions, especially in some job classifications, as compared to the FTE calculation.

Gender and age were distributed differently in job classifications. Clerical (98%), food service (98%), general educational assistant (94%), and special educational assistant (93%) positions were almost solely comprised of female workers (Table 4). Educators and community and recreation workers were ~75% female. In transportation positions, males slightly outnumbered females (57%), and the majority of custodial positions (80%) were occupied by males (Table 4). Rates of injury for males and females were generally similar across job classifications, however the largest differences were exhibited in the greater injury rates for females (as compared to males) in educator, food service, and transportation positions (Table 4). Educators had the largest percentage (46%) of positions under 40 years of age, followed by community and recreation workers (32%); these groups also had the lowest percentages of total workers over age 61, or over age 50 (Table 4). Alternately, 34% of transportation workers were over age 61 (~2.5–7x the amount of any other job class), with 69% of total transportation positions over the age of 50. Clerical (56%), custodial (54%), and food service (51%) all had the majority of their job positions over the age of 50 (Table 4). Rates of total injury in each job classification generally trended upward as age group increased; a notable exception included special education assistants, which seemed to exhibit a reserve trend, with rates generally decreasing with age (Table 4).

The leading causes, nature, and body parts for injury claims were similar across job classifications, ages, and genders (results not shown). The injury causes of falls, slips, and trips (29.1%), struck by (27.4%) and strains (25.0%) accounted for over 80% of injuries. When examining injury cause and lost-time injuries, strains accounted for 39.0% of all lost-time claims, followed by falls, slips, trips with 36.2% of all lost-time injury sources. Motor vehicles were involved in only a small percentage of overall claims (1.0%), however injury severity was often high, with 25.3% of motor-vehicle claims causing lost-time when they occurred (Table 5).

The nature of injury that occurred most frequently in the population was sprains and strains (45.2%), which also comprised the most lost-time injuries (58.5%) and medical-only injuries (42.9%); contusions were a second-leading nature of injury in total (26.8%), lost-time (14.0%) and medical-only (29.1%) categories (Table 4). Fractures were the third-leading type of lost-time injury (11.3%) and lacerations the third-leading type of total (9.0%) and medical-only (10.0%) injuries (Table 5). Collectively, carpal tunnel, concussions, and hernias occurred in less than 2% of all injury claims, however, these types of injury resulted in lost-time in 58.6%, 43.8%, and 57.9%, respectively, of all cases when they occurred.

Upper extremities were the body part(s) injured most frequently (31.3%), and, contributed to the largest percentage of lost-time (27.9%) claims. Lower extremity (24.7%) trunk (21.2%) injuries were the second and third, respectively, largest percent of lost-time cases (Table 5). Injuries to the neck were present in only 1.3% of all claims, but resulted in lost-time in 18.0% of cases when employees suffered injury to this body part (Table 4).

Table 3
Rates and rate ratios (RR) for injury per-100-positions by employee gender, age group, and job classification.

	Total Claims						Lost-Time Claims					Medical-Only Claims				
	Positions ^{1,2}	Claims	Rate	RR ^a	LowerCI	UpperCI	Claims	Rate	RR ^a	LowerCI	UpperCI	Claims	Rate	RR ^a	LowerCI	UpperCI
Population	201,365	8,082	4.0				1,222	0.6				6,860	3.4			
Gender¹																
Female (reference)	153,190	5,899	3.9	1.00	.	.	795	0.5	1.00	.	.	5,104	3.4	1.00	.	.
Male	48,175	2,183	4.5	1.04	0.96	1.13	427	0.8	1.46	1.26	1.69	1,756	3.4	0.99	0.92	1.07
Age Group¹																
20 or less	399	12	3.1	0.80	0.40	1.63	4	1.0	2.52	0.89	7.08	8	2.0	0.61	0.26	1.46
21–30	25,024	753	3.0	0.93	0.81	1.06	59	0.2	0.64	0.46	0.88	694	2.8	0.98	0.85	1.14
31–40 (reference)	42,433	1,291	3.0	1.00	.	.	145	0.3	1.00	.	.	1,146	2.7	1.00	.	.
41–50	58,606	2,251	3.9	1.21	1.08	1.35	339	0.6	1.65	1.27	2.16	1,912	3.3	1.16	1.05	1.30
51–60	58,922	2,923	5.0	1.45	1.29	1.64	487	0.8	2.25	1.79	2.83	2,436	4.1	1.38	1.23	1.56
61 and over	17,533	852	5.0	1.41	1.22	1.62	188	1.1	2.82	2.14	3.70	664	3.8	1.27	1.10	1.45
Job Classification^{1,2}																
Clerical	11,671	275	2.4	0.85	0.71	1.00	39	0.3	1.09	0.74	1.59	236	2.0	0.82	0.70	0.97
Custodial	13,816	1,558	11.3	3.70	3.28	4.18	362	2.6	7.72	6.08	9.80	1,196	8.7	3.21	2.84	3.64
Educator (reference)	102,866	2,536	2.5	1.00	.	.	251	0.2	1.00	.	.	2,285	2.2	1.00	.	.
Food Service	11,677	882	7.6	2.88	2.60	3.20	168	1.4	4.97	3.96	6.23	714	6.1	2.63	2.35	2.94
Community & Recreation	15,959	316	2.0	0.79	0.64	0.97	43	0.3	1.02	0.74	1.42	273	1.7	0.77	0.61	0.96
General Ed. Assist.	11,447	370	3.2	1.25	1.04	1.49	48	0.4	1.47	1.05	2.07	322	2.8	1.22	1.00	1.48
Special Ed. Assist.	27,037	1,740	6.4	2.28	2.03	2.55	189	0.7	2.37	1.94	2.89	1,551	5.7	2.27	2.02	2.56
Transportation	6,892	405	5.9	2.45	2.00	3.01	122	1.8	6.44	4.44	9.32	283	4.1	1.95	1.59	2.40

¹ Obtained from the Minnesota Department of Education (MDE) Staff Automated Reporting (STAR) July 1, 2009 through June 30, 2015.

² Positions = per contracted position/headcount; employees may have more than 1 position in district, per MDE STAR. Age and gender were only reported as position.

^a Adjusted for within-district correlation (GEE) and months at-risk in the school year.

^a Adjusted for age, gender, district location, district type, and year.

Table 4
Frequency and rate of injury per-100-positions within job classifications by gender and age group.

	Clerical			Custodial			Educator			Food Service			Community & Rec			General Ed. Assist			Special Ed. Assist			Transportation		
	Positions	%	Rate	Positions	%	Rate	Positions	%	Rate	Positions	%	Rate	Positions	%	Rate	Positions	%	Rate	Positions	%	Rate	Positions	%	Rate
Population	11,671	100%	2.4	13,816	100%	11.3	102,866	100%	2.5	11,677	100%	7.6	15,959	100%	2.0	11,447	100%	3.2	27,037	100%	6.4	6,892	100%	5.9
Gender																								
Female	11,399	98%	2.4	2,730	20%	11.0	76,268	74%	2.7	11,444	98%	7.6	12,637	79%	2.0	10,716	94%	3.2	25,010	93%	6.4	2,986	43%	6.6
Male	272	2%	2.6	11,086	80%	11.4	26,598	26%	1.8	233	2%	6.4	3,322	21%	1.9	731	6%	3.7	2,027	7%	6.7	3,906	57%	5.3
Age																								
20 or less	2	0%	0.0	53	0%	7.5	1	0%	0.0	12	0%	8.3	247	2%	1.2	20	0%	0.0	35	0%	8.6	14	0%	7.1
21–30	391	3%	2.0	980	7%	8.1	17,329	17%	1.9	228	2%	7.5	2,233	14%	2.5	906	8%	2.6	2,708	10%	8.5	297	4%	5.1
31–40	1,056	9%	2.2	1,609	12%	8.1	30,175	29%	2.1	1,209	10%	7.6	2,673	17%	1.5	1,382	12%	3.0	3,988	15%	7.1	516	7%	7.4
41–50	3,723	32%	1.9	3,749	27%	11.5	27,934	27%	2.3	4,251	36%	7.1	4,700	29%	2.0	3,593	31%	3.1	9,009	33%	6.0	1,282	19%	5.9
51–60	5,048	43%	2.5	5,558	40%	12.7	22,711	22%	3.3	4,371	37%	8.4	4,579	29%	2.2	4,151	36%	3.4	9,061	34%	6.4	2,421	35%	6.3
61 and over	1,451	12%	3.2	1,867	14%	11.0	4,716	5%	3.9	1,606	14%	6.5	1,527	10%	1.8	1,395	12%	3.7	2,236	8%	5.0	2,362	34%	5.2

Table 5
Injury Characteristics – injury cause, nature, and body part.*

	Total Claims		Lost-time Claims		Medical-Only Claims		% of Total Resulting in Lost Time
	N	(%)	N	(%)	N	(%)	
Population	8,626	100	1,289	14.9%	7,337	85.1%	
Injury Cause							
Caught In, Under or Between	210	2.4%	16	1.2%	194	2.6%	7.6%
Cut, Puncture, Scrape, Injured By	515	6.0%	33	2.6%	482	6.6%	6.4%
Exposures	421	4.9%	27	2.1%	394	5.4%	6.4%
Fall, Slip, Trip Injury	2,514	29.1%	472	36.6%	2,042	27.8%	18.8%
Misc., Mental	51	0.6%	6	0.5%	45	0.6%	11.8%
Motor Vehicle	87	1.0%	22	1.7%	65	0.9%	25.3%
Strain or Injury By	2,159	25.0%	503	39.0%	1,656	22.6%	23.3%
Strike Against or Stepping On	303	3.5%	36	2.8%	267	3.6%	11.9%
Struck or Injured By	2,366	27.4%	174	13.5%	2,192	29.9%	7.4%
Injury Nature							
All Other	156	1.8%	15	1.2%	141	1.9%	9.6%
Amputation	6	0.1%	4	0.3%	2	0.0%	66.7%
Burn	150	1.7%	13	1.0%	137	1.9%	8.7%
Carpal Tunnel	29	0.3%	17	1.3%	12	0.2%	58.6%
Concussion	73	0.8%	32	2.5%	41	0.6%	43.8%
Contusion	2,313	26.8%	180	14.0%	2,133	29.1%	7.8%
Crushing	17	0.2%	5	0.4%	12	0.2%	29.4%
Cumulative	9	0.1%	2	0.2%	7	0.1%	22.2%
Dislocate	32	0.4%	8	0.6%	24	0.3%	25.0%
Elc. Shock	5	0.1%	0	0.0%	5	0.1%	0.0%
Exposure/Disease/Ill/Infect	155	1.8%	11	0.9%	144	2.0%	7.1%
Fracture	339	3.9%	146	11.3%	193	2.6%	43.1%
Frgn. Body	107	1.2%	3	0.2%	104	1.4%	2.8%
Hear Loss	12	0.1%	2	0.2%	10	0.1%	16.7%
Hernia	19	0.2%	11	0.9%	8	0.1%	57.9%
Inflammation	43	0.5%	4	0.3%	39	0.5%	9.3%
Laceration	773	9.0%	36	2.8%	737	10.0%	4.7%
Mult. Physical	192	2.2%	39	3.0%	153	2.1%	20.3%
No Physical	28	0.3%	3	0.2%	25	0.3%	10.7%
Puncture	268	3.1%	4	0.3%	264	3.6%	1.5%
Sprain/Strain/Rupture	3,900	45.2%	754	58.5%	3,146	42.9%	19.3%
Injured Body Part							
Head	1,015	11.8%	69	5.4%	946	12.9%	6.8%
Lower Extremities	1,705	19.8%	319	24.7%	1,386	18.9%	18.7%
Multiple Body Parts	1,694	19.6%	246	19.1%	1,448	19.7%	14.5%
Neck	111	1.3%	20	1.6%	91	1.2%	18.0%
No Physical/Mental	31	0.4%	3	0.2%	28	0.4%	9.7%
Trunk	1,373	15.9%	273	21.2%	1,100	15.0%	19.9%
Upper Extremities	2,697	31.3%	359	27.9%	2,338	31.9%	13.3%

* Workers' Compensation Insurance Originations (WCIO) uses cause, nature, and part for claim injury coding (WCIO, 2021).

4. Discussion

School districts are a major employer of local government and community employees. Minnesota school workers in this study were, on average, experiencing rates of injury of 4.8 per 100 FTE, with some of those injuries being severe. This injury rate is greater than the reported average rate (3.6–4.6 per 100 FTE) in Minnesota public elementary and secondary schools (Zaidmen, 2016). Moreover, non-educator employees, in support staff roles, made up approximately 40% of the study school worker population, and some classifications had injury rates ranging from 6.6 to 12.7 per 100 FTE, far higher than the reported Minnesota state average for school employees. District location and type, along with worker job classification, gender, and age were shown to be factors for significantly increased risk of injury. We captured a sizable percentage of Minnesota school districts over multiple years and were able to use workers' compensation data coupled with MDE data, which provided a relevant denominator.

4.1. Location

Metro districts have higher rates and risk of injury than districts from outside the seven-county Minneapolis-St. Paul geo-

graphic area. Most metro districts are considerably larger than non-metro districts; many in the study served student populations around 10,000, and some up to 20,000 students. The sheer number of metro districts' staff, students, and communities-served, coupled with the wide range of programs and services offered to diverse student populations, may create widely varying risk factors. Additionally, the scope, size, and square footage of buildings, facilities, and infrastructure within metro districts may differ significantly from other districts, also posing unique risks to employees. District characteristics, such as community affluence and tax base, are closely correlated with infrastructure upkeep, capital expenditures, staffing levels, programs, and services that schools provide (Crampton, Thompson & Vesely, 2004; Darden & Cavendish, 2012; Duncombe & Wang, 2009; Filardo, Vincent, Sung & Stein, 2006). Disparities in funding, regardless of district location, could affect injury risk (Sage et al., 2010). Relatedly, intermediate districts had significantly elevated rates and risk of injury, likely attributable to their student population with high levels of special needs (Schofield et al., 2019). All of the intermediate districts included in the study were located within the metro area, thus also contributing to elevated metro rates and risk.

4.2. Age

Older workers were at greater risk for injury, including lost-time from work. This finding agrees with literature across workplace settings and job classifications (Green et al., 2019; Scott, Liao, Fisher, Stallones, DiGuiseppi, & Tompa, 2018). When examining age in context of job classification, certain job classifications had a much older age demographic, especially in relation to the reference group (educators) age distribution. Notably, 34% of transportation workers were in the oldest age category, >61 years old, and 69% in total over the age of 51. Food service and custodial job classifications also had an older age distribution, and physical demands for these jobs can be high. High physical demands can both increase risk of injury and, coupled with longer recovery times for older workers, increase risk and duration of lost-time from work. Considerations must be made for work accommodation or modification in the event of an injury, especially in jobs with high physical demands (Scott et al., 2018). Additional staffing to assist workers on modified duty during recovery could be an option, however, this may pose a challenge for district staffing levels, budgets, or in fast-paced environments (Cann et al., 2008). For example, it may not be feasible to staff two custodians in an elementary school, when only one is needed, or similarly, placing two educational assistants with a single child who has lifting or mobility needs, when only one is required or funded.

Age also seemed to play a role in injury for special education assistants; however they displayed an inverse trend of reduced injury rate as age increased. This could be attributed to many possible variables, but seniority (a surrogate for age) likely plays a role in gaining preferred assignments, potentially with less risky (violent, physical lifting and transfers, greatest need) students as the employee increases their tenure. An interesting age-related finding was the elevated risk for workers under the age of 21, which has also been reported in other literature, especially in relation to teen workers (Breslin & Smith, 2005; Breslin & Smith, 2006; CDC, 2011; Zierold & Anderson, 2006). If older co-workers were engaged in risky or high-risk work activities within job roles, this may, in turn, increase young workers risk (Westaby, & Lowe, 2005). It is concerning inasmuch that employees in this age group are likely inexperienced, temporary, part-time, and/or transient seasonal staff; they may lack workplace experience, hazard recognition ability, injury reporting knowledge, and/or many of the contractual protections and training that regular, full-time employees receive. Similarly, incidence of injuries and count of young workers in the underlying population were comparatively low; ascertainment of true counts for both may be difficult to capture in this data (CDC, 2011).

4.3. Gender

Results indicated that female and male employees had equal risk of overall and medical-only injury, but male employees were at significantly greater risk of a lost-time injury. Females comprised ~75% of the total population and the majority (>90%) of many job categories, including food service, which is a highly gendered role (Bond, Punnett, Pyle, Cazeca & Cooperman, 2004; Messing, 2004) and also shown to be high risk. The exceptions were transportation and custodial, which were majority males. These job roles in school districts, which also included bus mechanics, groundskeepers, and facility maintenance, have greater risk of injury severity, and higher physical work demands (Bond, et al., 2004), thus being more likely to experience severity and/or an inability for early-return to work after injury (Pransky, Benjamin, Hill-Fotouhi, Fletcher, Himmelstein, & Katz, 2002; Shaw, Pransky, & Fitzgerald, 2001). These factors likely contribute to the increased risk of lost-time claims for males; additionally, the

age distributions of these jobs skewed toward older employees. Conversely, it has been reported that female food service and custodial workers (Alamgir, Swinkels, Yu, & Yassi, 2007; Alamgir & Yu, 2008; Cavallari et al., 2016; Smith & Anderson, 2017) are at higher risk of injury as compared to male counterparts, due to job demands, and coupled with inappropriately-sized work stations, poor task design, and higher likelihood of reporting musculoskeletal injuries (Treaster & Burr, 2004). While this was not directly indicated in our research, these considerations could be addressed to reduce injury risk within high-priority job classifications, and with a gender-focused approach (Messing et al., 2003; Punnett & Bergqvist, 1999), when appropriate. The findings of increased risk of injury in male staff in our study also differs from studies that focused primarily on teachers and staff in educational or interpersonal-related roles, where female employees were shown to be at significantly higher risk for injury, especially violence-related injury (Schofield, Ryan, & Stroinski, 2019; Wei, Gerberich, Alexander, Ryan, Nachreiner, & Mongin, 2013).

4.4. Job classifications

Findings from our study indicated that some job classifications within school districts are incurring injury rates (6.6–12.7 per FTE) far in excess of the average rates reported in Minnesota for public elementary and secondary schools (3.6–4.6 per 100 FTE during the time period of this study). Additionally, all job classes were at higher risk of overall injury than educators in the population; these findings persisted even after controlling for age and gender. Moreover, job classifications of educational assistant, transportation, and community and recreation staff are largely unrepresented in literature, making our results the first reported information of injury and risk for these classes of workers.

Food service and custodial workers were at consistently high risk for injury in this study, which is consistent with other research (Bell and Steele, 2012; Alamgir et al., 2007; Cann, 2008; Gleeson, 2001; Unge et al., 2007; Village et al., 2009). These job roles typically have higher physical job demands and a wide array of hazard exposures as compared to educators, which likely contributes to the elevated risk. Higher physical job demands can also make return-to-work after an injury more difficult, creating lost-time or increasing the length and cost of injury. The transportation job classification was also at high risk for injury, especially lost-time. While this job is also subject to high physical job demands, transportation employees differ from other employees in that their work tasks are wholly outside of the classroom and school buildings. Additionally, they perform their jobs in dynamic outdoor and road environments, with children passengers (Zohar & Lee, 2016), and coupled with commercial vehicle operation and passenger transport safety and regulations. Thus, they are a highly safety-sensitive position, and policy or environmental intervention that may be effective for other school workers may not be effective for transportation workers.

Educational and special education assistants had a comparative risk that was lower than other worker groups, but their injury burden shouldn't be discounted. They also are subject to potentially high physical job demands with patient-handling type tasks, and research indicates that these groups are at a highly elevated risk of certain types of injury, notably violence and student-related injury (Schofield et al., 2019; Tiesman, Konda, Hendricks, Mercer, & Amandus, 2013). While they may be engaged in educational and student-focused activities similar to educators, their organizational and work construct may differ. In addition to physical job demands and hazards, other environmental and organizational factors (Cann, 2008; Sogaard, Blangsted, Herod, & Finsen, 2006) could lead to increased risk for workers in the educational support and non-instructional service roles. They may lack the comparative

contractual protections, benefits and wages, control of environment, and training opportunities that educational/licensed staff have. Similarly, employees working in roles that we classified as community and recreation category face these same challenges and conditions compared to educators and licensed staff and exhibited an increased risk of lost-time injuries. Staff in this group are engaged in activities that sometimes take place outside of the standard academic year, day, classroom, or with a community-based population. Thus, they may not only face less job protections and security, but a more ambiguous work and organizational environment for which non-traditional policy or injury interventions may be needed.

Slips and falls and sprains and strains were the leading injury sources for lost-time injuries in our data, agreeing with a MNDLI report [Zaidmen, 2016](#) focusing on lost-time injuries in Minnesota schools. These sources were leading causes of lost-time injuries across all job classifications. Additionally, the severity of motor-vehicle accidents, when they occurred, is attention worthy. In examination of total injury in the population, struck-by events were the second-leading cause of all injuries, and the leading cause of medical-only injuries. These events are often attributable to less serious, but nonetheless concerning, physical contact from students. In the study population, winter weather created a significant injury source for all district employees, and poses additional risk for those employees whose jobs require outdoor work, such as transportation employees or groundskeepers. Slip and fall events, and subsequent injuries due to ice and snow, may make injury rates higher, with Minnesota DLI (2016) indicating an up to two-fold increase or more, in slip and fall lost-time claims over winter months, and not fully comparable to school districts in locations without winter weather.

Notably, Minnesota also has significant union representation for educational staff, as well as many support and service staff groups. Union status has been linked with benefits, social support, and employment protections ([Park & Bhattacharya, 2013](#)), including within school districts ([Clemens & Cutler, 2014](#)). Subsequent higher injury reporting rates have been observed with union workers in other industries, thus the appearance of higher comparative nonfatal injury rates in a union workforce ([Altassan, Sakr, Galusha, Slade, Tessier-Sherman, & Cantley, 2018](#); [Morantz, 2013](#); [Morse, Punnett, Warren, Dillon, & Warren, 2003](#)). This may reduce generalizability across states where little or no union representation is present in educational environments due to potentially different baseline risks, organizational support, and/or variable levels of injury reporting.

Similarly, within our study, under-reporting or differential reporting of injury by the educators versus the support and service employees, or subgroups within, could affect estimation of magnitude of risk ([Tiesman et al., 2013](#)). However, workers' compensation data appear to provide a higher estimate of injury than BLS estimates ([Glazner, Borgerding, Lowery, Bondy, Mueller, & Kreiss, 1998](#)), thus may be well-suited source of injury surveillance.

Some reported injuries in the workers' compensation data could not be linked to the underlying population due to the reporting methodologies of the STARS report, thus were excluded from multivariate analysis. We know that many of these unlinked injuries occurred to employees in positions that were newer, temporary, part-time, seasonal, and/or transient. Young workers (<21) ([CDC, 2011](#)), as well as workers classified as community and recreation staff, exhibited increased risks of injury, and would presumably be some of the most at-risk of not being captured in the STARS report. This is an important subset of employees to examine, especially due to the potential precarious nature of their employment, and the true magnitude and nature of their risks may be underestimated in this study. Further research should focus on ascertaining characteristics of this collective group.

5. Conclusions

District locations and characteristics may affect the risk of school workers within the districts. The focus in schools is often on educators, but housed within school districts is a large subset of workers providing essential support and services, including educational assistants, food service, custodial, transportation, and community and recreation staff. These groups are at a higher risk of workplace injury than educational staff, including lost-time from work. If some employee groups have differential benefits, job security, and workplace control, while also shouldering a disproportionate injury burden, occupational injury disparities are present. The burden and prevention needs of these workers should be promoted and highlighted to the same extent as educators. Additionally, age and gender also affect risk and severity of injury. When occupational injury occurs in schools, the consequences are detrimental not only to the injured worker, but also students, and the community as a whole.

6. Practical Applications

Our study examined risk factors for injury in school based on district characteristics and for all employee groups, including educators and support and service staff. Due to the widely varying nature of jobs, responsibilities, and work environments within districts, it would be appropriate to approach injury prevention by department or job classification, and then perhaps further, by age or gender specific priorities. Injury prevention techniques from other industries, such as health care, manufacturing, construction, or other jobs within the service industry, may be applicable to translate into the school environment. Methods to reduce risk for employees may include alternative means of doing work tasks, new or different equipment that provides ergonomic advantages, modification of the workstation or school environment as well as policy changes, with an acknowledgement that a one-size-fits-all jobs solution is not feasible.

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Declaration of Competing Interest

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