

The Price of Pain

Workers Compensation Costs for Musculoskeletal Claims in the State of Kansas, 2014–2022

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Objective: The aim of the study is to describe cost and frequency of work-related musculoskeletal disorders in Kansas. **Methods:** Data were provided by the Kansas Department of Labor and included all closed workers' compensation claims entailing indemnity and medical costs from 2014 to 2022. **Results:** Work-related musculoskeletal disorder claims entailed a median total cost of \$20,097. Medical comprised 48.4% of costs, indemnity 46.4%, and legal 5.2%. The most frequently injured and costliest body part was the shoulder. Manufacturing comprised 28.4% of claims, followed by health care and office. Lifting was the most common cause, generating 32.0% of claims. Education, transportation, and mining were among industries with above average claim rates. **Conclusions:** Very few studies use workers' compensation data to assess work-related musculoskeletal disorder costs. This study introduces a state not yet analyzed and presents more recent years of data than available in the literature.

Keywords: work-related musculoskeletal disorders, worker's compensation, Kansas, indemnity costs, medical costs

LEARNING OUTCOMES

- Describe the direct cost of WMSDs in Kansas across body parts, industries, diagnoses, and causes.
- Describe frequency of WMSDs in Kansas across body parts, industries, diagnoses, and causes.

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It has long been known that work-related musculoskeletal disorders (WMSDs) impose a significant burden on employers.¹ Work-related musculoskeletal disorders were by far the leading cause of nonfatal occupational injuries resulting in lost time in 2019, outpacing the next leading cause of lost time by approximately 40%.² Using data from the US Bureau of Labor Statistics Annual Survey, the proportion of work-related MSD cases involving days away from work remained steady ranging from 28.8% to 34.7% from 1993 to 2019.³ Work-related MSDs have also been shown to comprise 43% of compensable workers' compensation claims in Washington state from 1999 to 2013, with 43.6 million lost workdays.⁴ Costs of WMSDs to employers are substantial, with estimates for direct workers' compensation of approximately \$13 billion to \$20 billion, which increases to \$45 to \$54 billion when indirect costs are considered as well.⁵ The most recent Liberty Mutual Safety Index,⁶ which estimates annual direct costs due to disabling injuries with more than 5 lost days, indicates overexertion (eg, handling objects) and other exertions or bodily reactions (eg, awkward postures) ranked first and fifth in terms of causes of such disabling injuries, resulting in \$12.84 billion and \$3.67 billion in direct costs, respectively. There are also financial costs to employees who suffer compensable WMSDs. Wages lost in construction alone due to WMSDs were estimated at \$46 million in 2014,⁷ whereas long-term earning losses for employees with carpal tunnel syndrome (CTS) far exceeded the reported direct costs of CTS claims with wages lost ranging from \$45,000 to \$89,000 for each claimant over 6 years after a claim.^{8,9} Work-related musculoskeletal disorders incur social costs as well. A 1998 survey of working individuals in Connecticut revealed that workers with chronic upper extremity WMSD conditions were more likely to have difficulties in activities of daily living with odds ratios from 8.2 to 35.2 depending on the task.¹⁰ These individuals were also more likely to have lost a home or car. A literature review of the subject corroborated the increased adverse financial impact on individuals experiencing a WMSD, citing claim payment delays, reduced wages, and sometimes job loss.¹¹ Injured individuals also reported difficulty exercising, sleeping, doing chores, and coping with stress. In addition, with the American Association of Medical Colleges projecting a physician shortage in the United States of up to 124,000 doctors by 2034,¹² the 130 million healthcare visits each year in the United States attributable to WMSDs¹³ will have a substantial negative public health impact on diseases not even related to the musculoskeletal system.

Workers compensation claims are a resourceful set of data that has been used by many researchers to identify trends of compensable injuries and illnesses and provide direction for prevention efforts. Most employers in every state except Texas are required to carry workers compensation insurance, and every state has an official department that plays some role in administration, arbitration, monitoring, or enforcement of worker's compensation.¹⁴ In addition, the nonprofit organization National Council on Compensation Insurance provides services such as classification, residual market insurance, and data collection for 33 states.¹⁵ Many studies use such state-level data to examine individual industries, for example agriculture in Colorado,¹⁶ seafood packaging in Oregon,¹⁷ law enforcement in Kentucky,¹⁸ distilleries in Kentucky,¹⁹ construction in Ohio,²⁰ and health care in Ohio.²¹ Other studies have examined specific injuries,

such as heat-related illnesses in Washington state,²² acute low back pain in California,²³ traumatic brain injuries in Ohio,²⁴ and knee disorders in Washington state.²⁵ Some studies examine the state-level data broadly across all industries and injuries, such as Alaska²⁶ or Maryland.²⁷ However, only two previous studies have been found that use state-level worker’s compensation databases to specifically examine musculoskeletal injuries, Ohio²⁸ and Washington state,⁴ with no known analysis conducted in the state of Kansas nor any known analysis for years more recent than 2013. As such, the objective of this study was to evaluate trends and direct costs of WMSDs in the state of Kansas across available industries by reporting and analyzing data on worker’s compensation claim payments made for closed musculoskeletal-related cases, 2014 to 2022.

MATERIALS AND METHODS

Data Source

The data were taken from claims submitted to the State of Kansas Department of Labor’s Workers’ Compensation Division and represents claims from 2014 to 2022 organized by the date the claim was closed. The Kansas Workers Compensation Division does not directly administer claims but does administer the Kansas Workers Compensation laws and rules. With the exception of employers with a payroll of \$20,000 or less, some agricultural employers, some realty employers, firefighters belonging to a firefighters’ relief association, and owner-operated vehicle drivers, all other employers in Kansas are required to carry worker’s compensation insurance.²⁹ When an injury occurs, these employers must submit a first report of injury to the division, who then tracks the claims in the Online System for Claims Administration Research/Regulation (OSCAR).³⁰ Should the lost time from the injury exceed 6 days, employers are required to submit a subsequent report of injury. Indemnity benefits only begin to accrue in the state of Kansas after seven lost workdays.³¹ Therefore, the dataset curated in OSCAR contained only claims with both medical and benefit payouts, meaning that the claim resulted in seven or more days away from work, and excluded medical-only claims, which entailed less than 7 days away from work. The following information was available per claim: age, gender, employment status (full-time, part-time, volunteer, retired, seasonal, apprentice), North American Industry Classification System (NAICS) or Standard Industrial Classification (SIC) code, insurance carrier, loss type (injury, disease, disability), annual wage, body part, cause of injury, type of injury (burn, fracture, respiratory disease, etc), permanent injury body part, total claim amount, medical cost, legal cost, and benefits paid. Our university’s institutional review board for Human Subjects Research determined that this research and analysis of secondary data did not involve human subjects as all data used were deidentified and therefore was categorized as exempt from human subjects research requirements.

Data Preparation

The largest total claim of \$12.1 million was eliminated from analysis because it was almost six times higher than the next highest

group of claims and likely to unduly influence the sum total claim calculations for the classifications it belonged to. In addition, duplicate claims, claims with missing industry information, and claims with unallocated payments were excluded, resulting in 373 total exclusions or 0.71% of all claims.

To isolate the WMSDs from the dataset, the “type of injury” category was examined and “carpal tunnel syndrome,” “dislocation,” “inflammation,” “sprain/tear,” “strain/tear,” and “VDT-related diseases” were selected. Table 1 presents the descriptions available in OSCAR for these six injury types. Note that zero claims in the 9-year dataset were labeled as “VDT diseases” so this type of injury was simply eliminated from further analysis. To further ensure that WMSDs were isolated from the dataset, the “cause” category was examined and only causes normally associated with WMSDs were included. These causes were as follows: lifting, pushing/pulling, repetition, twisting, carrying/holding, strain when using tools or machinery, and strain not otherwise classified.

Industry was categorized based on the categories in the two-digit NAICS or SIC parent codes.³² While most industries were reported based on NAICS code, some entries where the incident was incurred before 2014 were reported based on SIC code. Therefore, the industries identified by the SIC were reallocated into the NAICS parent codes.³³ See Appendix A (<http://links.lww.com/JOM/B481>) for a detailed list of the SIC codes that were allocated to the appropriate NAICS code. The category “office” does not specifically appear in NAICS or SIC and was generated for the convenience of this analysis. It encompasses occupations such as finance, real estate, information technology, legal services, administrative, design, and management.

Indemnity costs were not directly reported in OSCAR, but instead grouped in with the “Benefits” category. To isolate indemnity costs, all payments related to medical and legal costs were subtracted from “Benefits” and re-allocated to the medical and legal cost categories.

Body part categories for this analysis were determined based on the body parts reported in OSCAR, and some categories in this analysis represent composite body parts determined at the discretion of the authors. For example, “neck”, “shoulder”, and “hand/wrist” are presented as their own categories, but a separate category called “upper body” was created to capture “upper arm”, “lower arm”, and “multiple upper extremities.” the “back, general” category was created for back labels that could not be classified as either belonging to the upper or lower back, for example “vertebrae” and “spinal column.” See Appendix B (<http://links.lww.com/JOM/B482>) for a detailed breakdown of body parts that were included in each label in this analysis. It was further desired to specifically analyze intervertebral disc injuries in the low back and neck. To obtain these, low back and neck were isolated from the dislocation claims and analyzed separately. The language defining “dislocation” in the database specifies that it includes “pinched nerve, slipped/ruptured disc, herniated disc, sciatica, complete tear, HNP subluxation, and MD dislocation.” Therefore, low back and neck dislocations encompassed herniated, slipped, and ruptured discs in those body parts.

This analysis sought to obtain injury rates by industry in addition to raw totals. To obtain this, annual employment data by year

TABLE 1. Work-Related Musculoskeletal Disorder Injuries Classified by OSCAR

Type of Injury	Description
Carpal Tunnel Syndrome	Soreness, tenderness and weakness of the muscles of the thumb caused by pressure on the median nerve at the point at which it goes through the carpal tunnel of the wrist
Dislocation	Pinched nerve, slipped disc, ruptured disc, herniated disc, sciatica, complete tear, HNP subluxation
Inflammation	The reaction of tissue to injury characterized clinically by heat, swelling, redness and pain
Sprain or tear	Internal derangement, a trauma or wrenching of a joint, producing pain and disability depending upon degree of injury to ligaments
Strain or tear	Internal derangement, the trauma to the muscle or the musculotendinous unit from violent contraction or excessive forcible stretch
VDT-related diseases	Video display terminal diseases other than carpal tunnel syndrome

HNP, herniated nucleus pulposus.

and by industry was obtained from the Kansas Department of Labor's Quarterly Census of Employment and Wages.³⁴ To match employment by year to injuries by year, the authors needed to sort the dataset by year the claim was opened instead of by year the claim was closed. Claims opened in recent years, however, might not have had time to close and thus would not be included in the dataset, biasing the results. To decide which years contained enough data to use, the number of claims initiated in each year was compared with the average number of claims closed per year. In an unbiased year, these numbers should be roughly equivalent. Figure 1 shows that the years 2020–2022 contain much fewer cases than expected and therefore were excluded from the injury rate portion of this analysis.

Statistical Analysis

Cost of claim information was normalized to 2022 US dollars using the Consumer Price Index (CPI) for all urban consumers.^{35–37} Descriptive statistics were derived for the annual and cumulative costs for cost categories of medical, indemnity, and total claim cost. Because the distribution of the resulting cost data was heavily skewed, descriptive statistics used in this study consisted of determining the median and interquartile range of the costs. Cost distribution statistics were also derived as a function of industry (two-digit NAICS code), body part, and specific diagnosed WMSDs including carpal tunnel syndrome, inflammation, sprain, strain, and injuries consistent with intervertebral disc herniations for the low back and neck. Frequency and percentages were calculated to describe all WMSD claims and claims as a function of industry, body part, and cause. Yearly incident rates per 1000 employees were obtained by industry by dividing the number of claims in each industry by employment in that industry. Data cleaning was done in Excel (Microsoft Corporation, Redmond, WA) and Python (Python Software Foundation, Wilmington, DE) and statistical analysis was performed in Python.

RESULTS

Summary

From 2014 to 2022 in the state of Kansas, 51,864 total claims were closed that were eligible for inclusion, and WMSDs constituted 30.0% of those closed claims, or 15,528 cases. Of the WMSD claims, the average claimant age was 46 years and comprised 63.3% males, 36.2% females, and less than 1% unidentified. The total dollar value of closed WMSD claims was \$556,971,105 of which approximately 48.4% were medical costs, 46.4% were indemnity costs, and 5.2%

were legal costs. Legal costs are not depicted in the tables because their median was frequently \$0. Figure 2 presents median total claim cost and total number of closed claims by year for WMSDs. Median total claim costs remained consistent around the mean of \$20,097 and number of claims each year may have increased slightly over the 9-year period.

Industry

As seen in Table 2, by industry the greatest number of claims came from manufacturing (28.4%), followed by healthcare (10.4%) and office professions (10.0%). By cost, the largest median total claim cost was in wholesale (\$27,754) followed closely by manufacturing (\$26,714). The greatest sum total of claims came disproportionately from manufacturing, comprising \$178,878,083 over 9 years. The next leading sum total came from health care with \$58,057,747 and wholesale with \$55,768,794 in claims over 9 years. Manufacturing led industries in terms of total claims filed, highest median total claim cost, and leading number of claims. The smallest median total claim cost was in hospitality (\$9,652) followed by government (\$14,635).

Body Part

Table 3 displays frequency and costs by body part. The most frequently injured body part was the shoulder (23.8%), followed by the low back (20.9%). The costliest body part was also the shoulder with a median total claim amount of \$35,426, and the next costliest body part was the neck with a median claim amount of \$28,178, although neck was one of the least frequently occurring body parts accounting for only 1.5% of all claims. The least costly body parts were ankle/foot incurring a median total claim amount of \$6,236, other with median total claim \$9,404, and hip/low body with median claim \$11,493. Table 4 reports the three most commonly injured body parts stratified by industry. Notably, only the shoulder and low back appeared as the top most commonly injured body part in every industry. Common body parts by highest median total cost per claim as seen in Table 5 were shoulder (5), multiple body parts (4), general back (3) neck (2), and upper back (1).

Diagnosis

By diagnosis, the overwhelming majority of the claims were sprains as seen in Table 6, at 74.3%. The median total cost of claims in the lumbar and cervical spine related to injuries to the intervertebral discs far exceeded other highest median total costs reported thus far, with cervical dislocation entailing a median claim cost of \$113,146

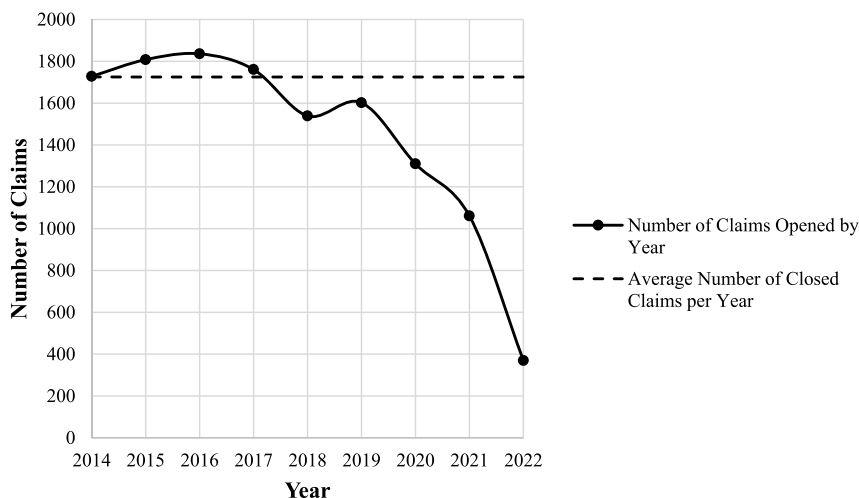


FIGURE 1. Finding bias in claims by year opened: discrepancy between actual and expected.

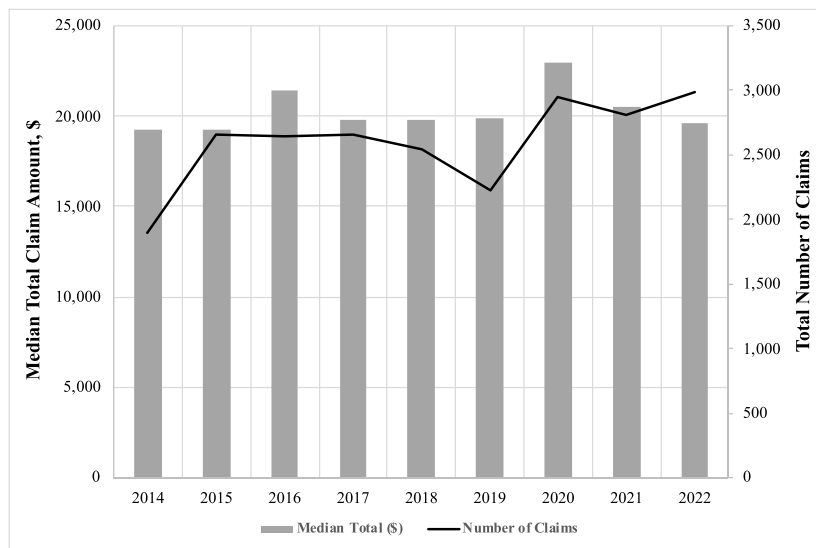


FIGURE 2. Median total claim cost and number of closed WMSD claims from 2014 to 2022.

and lumbar spine dislocation \$76,293. The median total cost of a carpal tunnel syndrome diagnosis was high as well (\$27,924), exceeding the median total cost of the most expensive industry and all but one of the most expensive two body parts. Carpal tunnel syndrome constituted 5.0% of all WMSD closed claims, and 31.6% of all closed hand/wrist-related claims.

Causes and Rates

Figure 3 presents the number of claims by cause. Lifting was by far the most common cause of WMSD claims in Kansas from 2014 to 2022, comprising 4,973 claims or 32.0% of total WMSD claims. Nonspecified source of strain was the next common cause comprising 19.0% of claims. The least common cause was throwing or wielding comprising less than 1% of claims.

Table 7 contains incidence rates per 1000 workers by industry sorted from highest to lowest and Figure 4 provides a graphical illustration. The education industry incurred the highest mean rate of WMSD claims with an average of 3.71 claims per year per 1000 employees over the span of 2014–2019. The next highest mean was

manufacturing with 3.09 claims per year per 1000 employees. Arts, entertainment, recreation, government work, and hospitality had the lowest WMSD claim rates.

DISCUSSION

Summary

The purpose of this analysis was to investigate costs and trends of musculoskeletal disorder related injuries filed in a comprehensive dataset of closed claims in the state of Kansas from the years 2014–2022. Much of the findings are as expected and agree with prior literature, with some notable exceptions that may likely be unique to the state of Kansas.

Overall, 30.0% of claims in this dataset were WMSDs. There is some variation in findings for the portion of total injuries should be WMSDs. Marcum and Adams⁴ in their state worker’s compensation analysis found that 43% of all submitted claims were WMSDs. A 2017 rheumatology textbook claims that more than 50% of all nonfatal injuries involving days away from work are attributable to WMSDs.³⁸

TABLE 2. Frequency and Cost (Adjusted to 2022 US Dollars) of Musculoskeletal Claims as a Function of Industry

Industry	No. Claims	Percent of Claims	Total Claim, \$			Medical, \$			Indemnity, \$		
			Median	IQR	Sum	Median	IQR	Sum	Median	IQR	Sum
Wholesale	1,323	8.5%	27,754	7,567–58,824	55,768,794	10,204	2,077–23,964	22,641,474	12,341	3,105–31,378	30,073,936
Utilities	143	0.9%	25,467	12,689–45,539	5,306,382	13,839	5,170–23,427	2,885,294	9,809	2,912–19,523	2,337,622
Manufacturing	4,400	28.4%	27,446	12,319–51,527	178,878,083	12,100	4,705–24,859	83,748,515	10,805	3,632–24,197	84,156,860
Construction	998	6.4%	22,287	5,931–51,268	44,189,353	8,741	621–23,062	19,207,943	9,262	2,571–25,990	23,523,297
Mining	161	1.0%	20,310	5,641–48,521	6,674,723	6,529	0–20,665	2,723,861	9,186	2,490–22,258	3,727,389
Healthcare	1,611	10.4%	18,982	6,033–43,610	58,057,747	9,021	2,533–22,769	30,797,295	6,000	1,501–16,937	24,052,490
Agriculture	225	1.4%	18,306	5,017–41,635	6,920,491	8,098	1,878–23,764	3,529,868	5,647	1,258–14,680	3,012,528
Office	1,554	10.0%	16,351	5,016–42,159	48,886,234	6,523	1,781–19,345	23,022,223	6,166	1,584–18,807	22,971,299
Transportation	1,337	8.6%	15,420	4,440–41,559	43,986,942	5,135	1,403–18,591	19,794,602	6,289	1,626–19,987	22,155,153
Retail	1,449	9.3%	14,477	4,099–39,593	40,930,736	7,206	1,715–22,324	23,264,195	3,277	607–11,680	15,099,720
Education	534	3.4%	17,703	5,346–36,111	16,619,753	10,031	2,013–22,646	10,987,923	4,548	1,391–11,502	5,173,916
Government	1,069	6.9%	14,782	3,664–35,421	28,417,211	5,932	708–20,343	15,457,138	5,464	1,580–16,284	12,637,085
Arts, Entr, Rec	104	0.7%	14,635	3,867–41,650	3,258,671	7,069	1,587–19,391	1,689,668	4,207	686–16,029	1,413,492
Other services	316	2.0%	15,669	4,566–41,294	10,767,885	8,113	1,885–19,993	5,776,054	5,577	1,446–14,634	4,506,435
Hospitality	296	1.9%	9,652	3,310–32,589	8,012,275	4,123	380–17,367	4,369,528	4,316	1,020–10,376	3,113,590

IQR, interquartile range

TABLE 3. Frequency and Cost (Adjusted to 2022 US Dollars) of Musculoskeletal Claims as a Function of Body Part

Body Part	No. Claims	Percent of Claims	Total Claim, \$			Medical, \$			Indemnity, \$		
			Median	IQR	Sum	Median	IQR	Sum	Median	IQR	Sum
Shoulder	3,700	23.8%	35,426	13,356–59,344	168,413,471	19,679	4,149–34,381	91,619,881	11,503	3,719–25,368	70,046,270
Neck	228	1.5%	28,178	9,340–78,285	12,640,480	10,618	2,970–35,416	5,614,379	12,606	3,851–34,097	6,262,289
Upper body	1,761	11.3%	26,990	11,489–50,453	65,505,589	13,447	3,680–26,199	31,774,381	9,340	3,259–21,970	30,323,766
Back, general	201	1.3%	18,676	5,739–52,460	8,470,849	6,966	1,683–20,966	3,446,524	8,435	1,287–26,721	4,591,317
Multiple	436	2.8%	24,615	7,735–58,275	18,507,296	8,248	2,055–25,926	8,420,318	10,939	3,097–26,068	9,080,261
Hand/wrist	2,282	14.7%	19,860	9,233–42,030	71,522,476	9,765	3,739–17,433	30,204,410	7,628	2,682–21,659	36,739,604
Knee	1,830	11.8%	17,685	7,082–31,311	46,212,098	10,311	2,405–16,687	23,839,001	5,789	2,250–13,659	20,445,776
Upper back	372	2.4%	14,219	3,960–38,721	13,563,484	4,295	1,680–11,565	4,906,268	5,826	1,289–21,079	7,685,783
Other	154	1.0%	9,404	2,225–27,529	3,705,981	2,822	694–14,511	1,693,559	3,771	643–10,009	1,651,578
Low back	3,247	20.9%	12,141	3,188–40,451	120,539,856	4,245	1,078–14,508	53,575,937	4,859	930–20,073	59,859,746
Hip/lower body	813	5.2%	11,493	4,461–22,258	18,188,328	6,036	1,596–14,196	9,744,626	3,092	1,079–7,770	7,330,932
Ankle/foot	504	3.2%	6,236	2,388–23,126	9,701,197	2,548	810–10,793	5,242,644	2,725	728–8,388	4,031,184

IQR, interquartile range

The US Bureau of Labor Statistics states that in 2018, 30% of days away from work cases were attributable to musculoskeletal injuries.³⁹ The exact figures may depend on whether total injuries are counted or only days away from work injuries, and they may vary by how WMSDs are defined. Work-related musculoskeletal disorder claims in this dataset were incurred by males in 63.3% of claims. Prior literature examining worker’s compensation databases also documented males incurring the majority of WMSDs, with 59% male in Washington state,⁴ 60.3% male in Ohio,²⁸ and approximately 60% in Maryland²⁷ although those cases included non-WMSDs. Females may still tend to incur WMSDs at higher rates though—a literature review found that 15 of 32 studies reported a statistically significantly higher risk for WMSDs for females as compared with males.⁴⁰ Employment trends may partially explain the difference. For example, in the OSCAR dataset used in this study, the transportation sector incurred a higher than average rate of WMSD claims, and more than 90% of truck drivers are male.⁴¹ Mining also exhibited a higher than average rate, and 83% to 90% of miners are male.⁴² By contrast, hospitality represented the lowest rate of WMSD claims in the OSCAR dataset, and 55% of hospitality workers are female.⁴³

Industry

National data indicate that the largest number of recordable nonfatal injuries come from health care.⁴⁴ However, compensable worker’s compensation claims may show a different type of trend. Dunning et al²⁸ reported that manufacturing incurred the second largest percentage of WMSD worker’s compensation claims, behind service industries, and Marcum and Adams⁴ found manufacturing as incurring the highest percentage of cases followed closely by health care. This dataset found manufacturing as overwhelmingly comprising the largest percentage of claims by about 18% more than the next leading

industry, health care. In Kansas, the top sector of employment is manufacturing, and its top sector in terms of revenue generation is aviation manufacturing with \$23.1 billion in business in 2022.⁴⁵ Therefore, the finding that health care was the second most expensive and frequently incurred industry instead of the first and that manufacturing led is consistent with the circumstances in the state and in worker’s compensation injuries. Agriculture comprised a small percentage of all claims at 1.4%, second only to mining and arts/entertainment/recreation, which is consistent with national recordable injury data.⁴⁴

Body Part

The shoulder was the most commonly impacted body part accounting for 23.8% of claims, followed by the low back and knee. The most expensive body part was also shoulder, and five of the 15 industries posted shoulder injuries as the most expensive. Comparing this study with two others who examined WMSDs in a state workers’ compensation database, Marcum and Adams⁴ showed the shoulder as comprising 13.7% of all WMSD cases and Dunning et al²⁸ 12%. In Dunning’s²⁸ analysis, the lumbar spine, then shoulder, and then knee entailed the highest total claim costs. The lumbar spine was the most frequently injured body part, with about double the claim numbers and triple the total cost of the next leading body part. Similarly, Marcus and Adams⁴ identified the back as the most frequently injured body part with 42.9% of injuries followed by the shoulder at 13.7%. Neither did the National Safety Council, who relies on BLS data, identify the shoulder as a leading body part in WMSD injuries, instead pointing to trunk, back, and upper extremities⁴⁶ although these cases do not necessarily reflect worker’s compensation claims. Mroz et al²⁷ found the shoulder as the second most expensive body part on average behind multiple body parts in their analysis of all claim types in Maryland. Other studies examining general musculoskeletal symptoms have found shoulder

TABLE 4. Top Three Body Parts as a Percentage of Musculoskeletal Claims and Industry

	Agriculture	Mining	Construction	Arts, Entr, Rec	Retail	Manufacturing	Wholesale	Education
Body part	Low back 26%	Low back 27%	Shoulder 26%	Shoulder 21%	Shoulder 25%	Shoulder 27%	Shoulder 22%	Shoulder 22%
	Shoulder 24%	Shoulder 25%	Low back 24%	Low back 18%	Low back 23%	Low back 13%	Low back 21%	Low back 19%
	Knee 13%	Upper body 12%	Knee 19%	Knee/upper body 16%	hand/wrist 12%	Upper body 12%	Hand/wrist 17%	Knee 19%

	Transportation	Healthcare	Other Services	Office	Government	Utilities	Hospitality
Body part	Shoulder 25%	Low back 32%	Low back 22%	Low back 24%	Shoulder 22%	Shoulder 29%	Low back 25%
	Low back 23%	Shoulder 21%	Shoulder 22%	Shoulder 19%	Low back 20%	Knee 20%	Shoulder 20%
	Knee 13%	Knee 11%	Knee 14%	Hand/wrist 17%	Knee 18%	Low Back 18%	Hand/wrist 18%

TABLE 5. Top Three Costly Body Parts (Median Cost, Adjusted to 2022 US Dollars) as a Function of Industry

Body part	Agriculture			Mining			Construction			Arts, Entri, Rec			Retail			Manufacturing			Wholesale			Education		
	Multiple	Shoulder	Upper back	Neck	Shoulder	Multiple	Neck	Shoulder	Upper body	Multiple	Back, general	Hand/wrist	Shoulder	Neck	Upper body	Multiple	Shoulder	Neck	Back, general	Upper body	Shoulder	Back, general	Shoulder	Upper body
Multiple	43,616	31,885	24,622	119,965	39,233	34,076	24,989	209,891	60,658	27,508	44,163	38,809	32,266	17,182	17,783	32,266	41,089	47,289	42,260	41,089	47,289	28,477	27,388	22,457
Shoulder	39,781	33,952	22,152	33,626	33,626	30,097	24,861	35,248	34,530	32,487	34,002	23,193	14,537	24,648	27,899	24,648	24,648	58,644	31,615	30,606	58,644	35,277	35,505	32,558
Upper body	Neck	Shoulder	Upper body	Shoulder	Back, general	Shoulder	Neck	Shoulder	Neck	Shoulder	Upper body	Neck	Upper body	Upper body	Shoulder	Upper body	Neck	Upper back	Upper back	Low back	Multiple	Upper back	Neck	Multiple
Neck	Shoulder	Upper body	Neck	Shoulder	Back, general	Shoulder	Neck	Shoulder	Neck	Shoulder	Upper body	Neck	Upper body	Upper body	Shoulder	Upper body	Neck	Upper back	Upper back	Low back	Multiple	Upper back	Neck	Multiple
Shoulder	Upper body	Neck	Shoulder	Back, general	Shoulder	Neck	Upper body	Shoulder	Neck	Shoulder	Upper body	Neck	Upper body	Upper body	Shoulder	Upper body	Neck	Upper back	Upper back	Low back	Multiple	Upper back	Neck	Multiple
Upper body	Neck	Shoulder	Upper body	Shoulder	Back, general	Shoulder	Neck	Shoulder	Neck	Shoulder	Upper body	Neck	Upper body	Upper body	Shoulder	Upper body	Neck	Upper back	Upper back	Low back	Multiple	Upper back	Neck	Multiple

complaints common but second to other body parts in industries such as agriculture,⁴⁷ office work,⁴⁸ health care,⁴⁹ and manufacturing,⁵⁰ but sometimes shoulder is a close first such as in construction.⁵¹

The reason shoulder dominates in frequency and cost in this dataset may be due to the nature of the data collected. The dataset contained only claims, which accrued indemnity benefits, meaning that the claim incurred seven or more days of lost work time. Shoulder injuries generally entail more time off work than other injury types. In 2020, shoulder injuries entailed more than triple the lost time of back injuries.⁵² Weston et al⁵³ in their analysis of mining injuries found that the shoulder entailed the highest number of median days off work, almost double the duration of the second leading contender, the knee. It could be that shoulder injuries are more debilitating than other injuries because it is more difficult for employers to find light duty work for an employee who cannot use this key component of the upper body. If employers must grant employees with shoulder injuries time off instead of light duty, or if shoulder cases for whatever reason entailed longer lengths of time off, then the shoulder cases would be more likely to begin accruing indemnity benefits payments and thus make it into this dataset. A 2023 population level study of workers' compensation cases in Korea revealed that shoulder was the most commonly impacted body part and confirmed that the shoulder accounted for the greater number of "chronic" claims, specifically highlighting rotator cuff syndrome as debilitating.⁵⁴

A secondary reason may be that this dataset represents the most recent claims as of this writing. It could be that much attention has been paid to low back issues in recent years that low back problems have indeed improved. The high attention to the low back is supported by a finding that the NIOSH lifting equation was the most commonly used tool among ergonomics professionals surveyed, with use increasing over time, and that other low back tools like the ACGIH Threshold Limit Value for Lifting, and the Washington State Lifting Calculator were also popular.⁵⁵ However, tools are only recently starting to be put to use that target the shoulder, such as the design tool from Rempel and Potvin⁵⁶ (2022) and The Shoulder Tool from Hani et al⁵⁷ (2021). Data support this idea. Marcum and Adams⁴ showed a decrease in back claims in Washington state of approximately 60% from 1999 to 2013, whereas shoulder claims exhibited little change. A study in the Netherlands showed a significant decrease in the number of total sick leave days and number of workers on sick leave due to low back problems from 2002 to 2007, entailing a €7 million decrease in costs related to low back pain.⁵⁸ The more recent and comprehensive Global Burden of Disease Study revealed that the prevalence of low back pain declined by 10.4% from 1990 to 2020.⁵⁹ A Washington state analysis of shoulder claims from 2005 to 2016 showed that while overall WMSD claims decreased, shoulder claims decreased less than expected, meaning that by 2016, shoulder claims accounted for a greater proportion of claims than before.⁶⁰

The neck, multiple body parts, and upper back or general back were listed as incurring the highest costs behind shoulder, even though, according to Table 3, they occurred with the least frequency of all body parts. This suggests that even though these areas of the body may not seem like major concerns to employers due to a low frequency of injury, the expected value of the injury is high enough that it may warrant attention. Not surprisingly, upper body WMSDs dominated in terms of frequency and cost in office work, government work, health care, transportation, and other services.

Diagnosis

This study found that 31.6% of all hand/wrist claims were diagnosed as carpal tunnel syndrome. By contrast, this was 6.6% in Dunning et al²⁸ and 10.2% in Marcus and Adams.⁴ The median total cost of CTS claims was \$27,924. This is much more expensive than found in previous work, with Dunning et al²⁸ reporting median total cost of \$11,191 in 2022 dollars. This study found higher median costs for

TABLE 6. Frequency and Cost (Adjusted to 2022 US Dollars) as a Function of Diagnosis and Category

Diagnosis	No. Claims	Percent of Claims	Total Claim, \$			Medical, \$			Indemnity, \$		
			Median	IQR	Sum	Median	IQR	Sum	Median	IQR	Sum
CTS*	780	5.0%	27,924	15,131–50,794	30,668,397	12,409	7,307–19,749	12,398,456	12,245	5,145–27,207	16,409,566
Sprain	11,530	74.3%	19,155	5,741–44,081	398,733,650	8,164	1,849–21,837	194,690,525	6,862	1,714–19,420	183,998,579
Strain	2,022	13.0%	20,056	5,311–46,139	71,882,079	9,402	1,811–23,842	36,595,901	7,039	1,698–19,166	31,766,594
Dislocation	467	3.0%	46,589	24,994–79,481	30,435,815	26,337	13,483–39,102	15,170,560	19,105	7,078–35,245	13,730,176
Dislocation: low back*	94	20.1%	76,293	42,324–117,102	9,383,088	31,132	18,175–52,803	3,965,787	34,614	19,111–64,807	4,813,577
Dislocation: neck*	10	2.1%	113,146	102,111–142,497	1,532,174	52,904	42,467–75,306	731,507	47,533	32,449–69,727	673,773
Inflammation	729	4.7%	23,962	10,185–44,178	25,251,163	10,965	3,673–20,786	11,226,487	8,742	3,037–21,235	12,143,591

CTS, Carpal tunnel syndrome; IQR, interquartile range.
 *Percentage of dislocation claims.

lumbar spine dislocation as well. Bhattacharya et al⁶¹ used Dunning’s analysis to project an overall cost, incorporating direct and indirect costs, per CTS case, of \$28,433 in 2022 dollars. Yet the cost quoted in this analysis included only direct costs. The difference is likely that this dataset captured the more expensive claims, that is, the indemnity claims, and excluded the less expensive medical-only claims. Overall though, the majority of WMSD cases were sprains, at 74.3% which is expected. Another dataset also identified 68% of all WMSD injuries as sprains⁴⁶ although this is not necessarily worker’s compensation cases. In 2002, sprains, strains, and tears comprised 43% of all recordable injuries both musculoskeletal and nonmusculoskeletal across all industries according to the BLS.

Causes

Exertion has been cited before as a common cause of injury in worker’s compensation data,^{17,19} and indeed nationally overexertion is the most common cause of injuries with days away from work.⁵² The Liberty Mutual 2023 Safety Index⁶ also pins overexertion involving outside sources as the most common injury cause. It was difficult to ascertain exactly how many WMSD claims in this dataset were attributable to exertion. However, lifting was by far the most common cause in this analysis, which relates directly to exertion. All other cause classifications except two could also be definitely attributable to exertion, for example, pushing or pulling, twisting, throwing, or using a tool. The two exceptions were repetition, causing 14.3% of claims, and

strain not otherwise classified causing 19.0% of claims. Therefore, it is still likely that the major driving force behind the causes for WMSDs in this analysis was exertion.

Rates

Education workers had the highest rate of injuries, at an average of 3.71 per 1000 workers per year, higher than manufacturing, transportation, mining, and construction. It is expected for transportation to be one of the highest rates as a 2018 BLS report⁴⁴ stated that the overall recordable injury rate among transportation workers exceeded that of all other industries by almost double. It is unknown why this anomaly is occurring, since there do not seem to be any inconsistencies between the worker’s compensation and the Quarterly Census of Employment and Wages datasets. A breakdown of the causes of WMSD in this dataset in education is presented in Table 8. Lifting was the most common cause, with other common causes falling under generalized “NOC” (not otherwise classified) categories that are not possible to narrow down further. The natures of the educational WMSDs were as expected, with the overwhelming majority being strains, not pictured in the table.

Other than education, some other industry rates were slightly different than expected. In overall injuries the BLS reports⁴⁴ that health care and retail rank second only to transportation in number of injuries per employee, and Marcus and Adams⁴ similarly found that health care and retail incurred above average rates of WMSD worker’s

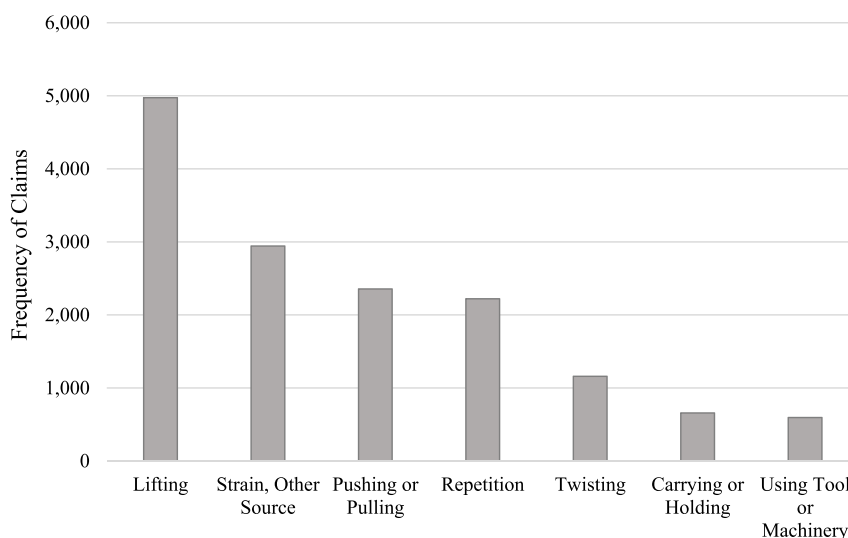


FIGURE 3. Frequency of musculoskeletal claims as a function of cause and injury.

TABLE 7. Work-Related Musculoskeletal Disorder Incident Rates (Claims per 1,000 Workers) as a Function of Industry and Year

Industry	Year						Mean
	2014	2015	2016	2017	2018	2019	
Education	5.94	4.63	4.43	3.97	2.76	0.50	3.71
Manufacturing	2.93	3.37	3.57	3.26	2.54	2.91	3.09
Transportation	2.55	2.53	2.32	3.71	3.19	3.37	2.94
Mining	2.29	3.53	3.80	2.52	2.07	2.22	2.74
Agriculture	1.90	2.36	2.69	2.20	2.08	2.06	2.21
Utilities	2.06	2.37	2.54	2.29	1.73	1.77	2.13
Construction	1.96	1.64	2.33	2.08	1.80	1.70	1.92
Wholesale	1.72	2.09	1.77	1.85	1.84	2.02	1.88
Other	1.08	1.12	0.81	0.98	1.10	1.00	1.02
Health care	1.16	1.24	1.00	0.97	0.92	0.71	1.00
Retail	0.96	0.87	0.93	1.02	1.09	1.05	0.99
Office	0.65	0.62	0.72	0.63	0.63	0.64	0.65
Arts, ent, rec	0.93	0.74	0.84	0.41	0.52	0.41	0.64
Government	0.72	0.76	0.72	0.49	0.27	0.27	0.54
Hospitality	0.32	0.34	0.33	0.41	0.29	0.38	0.35

compensation claims. However, in this dataset, both health care and retail incurred lower than the average rate of 1.72 per year per 1000 employees. Agriculture incurred higher than average rates, which is also in contradiction to Marcus and Adams.⁴ In general, however, the finding that sectors such as construction, mining, and utilities scored higher than average and industries like government, hospitality, and office work lower, are generally as expected. The differences may stem from the nature of the dataset, which captures only the most severe cases, that is, the ones which entail seven or more missed workdays. Thus, even if retail and health care are sustaining high injury rates in

Kansas, if the injuries are not severe they will not be reflected in this dataset. Conversely, if agriculture and education both have relatively low incidence rates but the incidents are severe, they will appear in this dataset in disproportionately high numbers.

Indirect Costs

The information presented in this analysis gives concrete information about direct costs of musculoskeletal claims. Unless the employer is self-insured, the insurance company shoulders the cost of these claims. However, employers can expect to pay at least the same amount or more themselves in the form of indirect costs. Indirect costs include absent time from the injured worker, lost time from other employees, investigation costs, down time, supervision and management related to the incident, replacement recruitment and training, property damage, and reduced productivity related to impairment.^{62,63} A detailed study of 100 construction incidents found an indirect to direct cost ratio of 1.6 to 1 for nonfatal incidents. The total cost of the 100 incidents exceeded US \$1.9 million.⁶⁴ The range that Occupational Safety and Health Administration⁶⁵ uses to calculate indirect costs of incidents ranges from 1.1:1 to 1.2:1 based on data from the National Council on Compensation Insurance, Inc. Interviews with 23 contractors in Singapore⁶⁵ revealed that indirect costs showed a statistically significant increase with company size, project size, and percentage of work completed by subcontractors, with a ratio of 0.67:1. An older study from Stanford found ratios ranging from 1.1 to 9.2 depending on claim cost and lost time.⁶⁶ In manufacturing, an analysis of 342 cases yielded an indirect cost to direct cost ratio ranging from 2.4 for cases under \$1000 to 1.0 for cases approximately \$1000 to 0.36 for cases between \$17,000 and \$18,000.⁶⁷ Most of these estimates do not even include the cost to employers of increased insurance premiums, which are structured to impose higher premium increases for frequent minor injuries compared with a few major injuries. In summary, the costs

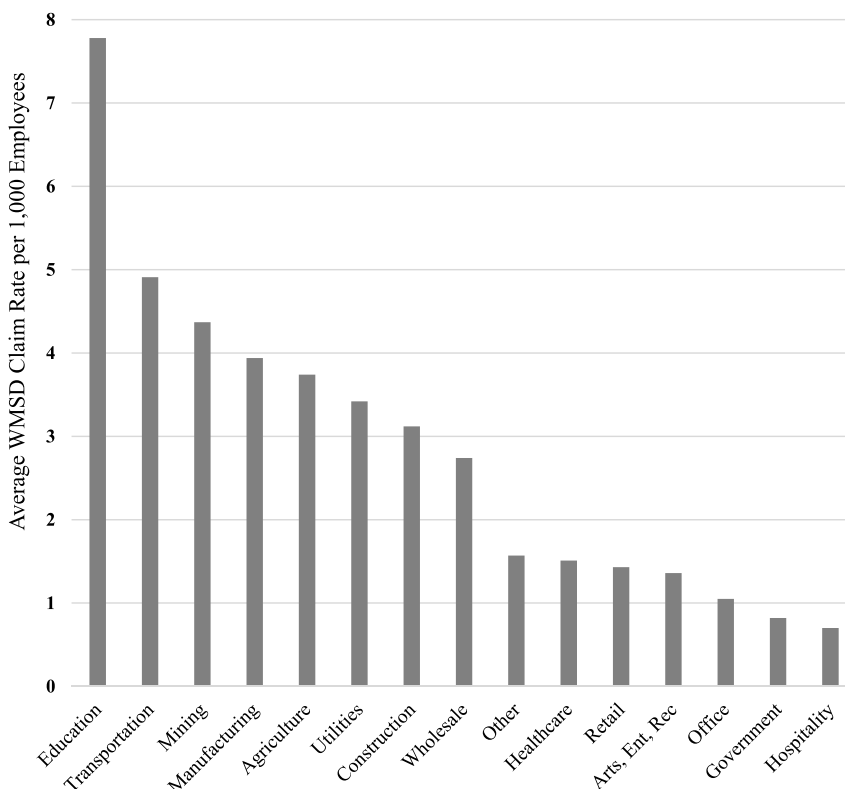


FIGURE 4. Mean WMSD incident rates (claims per 1000 workers, 2014 to 2019) as a function of industry.

TABLE 8. Common Injury Causes in Education

Cause	Count
Lifting	181
Not otherwise classified	161
Repetition	48
Pushing or pulling	48
Twisting	43
Reaching	24
Holding or carrying	23
Welding or throwing	3
Tool or machinery	3

presented in this article are highly relevant to employers even if they do not directly pay them, and these costs additionally represent underestimations of the true total cost of WMSD injuries.

Contributions and Limitations

The contributions of this analysis are several. First, it presents WMSD worker's compensation data for a state, which has not yet been explored, adding to the very small number of states whose comprehensive worker's compensation data on WMSDs has been made available in the literature, exceptions being Ohio²⁸ and Washington state.⁴ Worker's compensation datasets represent a valuable and underutilized resource in research on WMSD trends and prevention. Second, this analysis further provides information for the most recent years, up to 2022, giving not only updated injury information but updated cost information in terms of 2022-adjusted dollars. Indeed some of the trends observed may reflect real changes in WMSD injuries in recent years, and this study is the only known source of data for such current updates. Finally, this analysis separates out legal costs, which are not normally tracked or reported—in fact, the finding that legal costs comprised approximately 5% of all claim costs has never been documented in similar literature.

However, there are some limitations. First, the unavailability of medical-only claims necessarily excludes an unknown but presumably large fraction of claims. Therefore the true frequency of WMSD worker's compensation claims in Kansas is undoubtedly actually higher than reported here, and the total cost is greater. However, reporting only the claims that included both indemnity and medical costs may have some advantages, because these claims are the most costly in terms of time and money and therefore the claims employers are likely most concerned with preventing. The findings in this dataset related to body parts, industries, causes, and injury rates therefore yield insight into the most severe consequences of WMSDs that other datasets do not capture. Another limitation is that there is no information on the number of lost workdays associated with each claim, although it is known that each one had at least seven. In addition, the stratifications used to explore this data were constrained by the descriptions available in the OSCAR database. For example, only six types of WMSDs were tracked in OSCAR, limiting the ability of this analysis to perform more granular analysis on diagnoses than is available from Table 1. Finally, the Kansas Department of Labor tracks claims by the date the claim was closed, not opened, which could possibly smooth over any time-related trends in the data.

CONCLUSIONS

This is likely the first study to characterize WMSD-related worker's compensation claims in the state of Kansas. Work-related musculoskeletal disorders constituted 30.0% of all claims submitted to the state of Kansas between 2014 and 2022, and 63.3% of claims were incurred by males. The median total cost of all claims was \$20,097 in 2022 dollars. The most frequently injured body part was the shoulder constituting 23.8% of claims, with low back second at

20.9%, and the least frequently injured body parts were other, general back, and ankle/foot. The costliest body part was the shoulder entailing a median total cost of \$35,426 with neck second at \$28,178, and the least costly body part was the ankle/foot with a median total cost of \$6,236. Intervertebral disc claims incurred the highest median total cost of the injury types with a median total cost of \$113,146 for the cervical spine and \$76,293 for the lumbar spine, and CTS following at \$27,924. Meanwhile, sprains were the most common injury type comprising 74.3% of all WMSD claims. By cause, the most claims were attributable to lifting at 32.0%, followed by strain not otherwise classified at 19.0%. Manufacturing represented 28.4% of all WMSD claims, health care 10.4%, and office work 10.0%. Wholesale was the most expensive industry with a median total claim cost \$27,424, followed closely by manufacturing. Education, manufacturing, and transportation comprised the highest rates of claims with respect to employment, with office work, government, and hospitality the lowest. These findings can be used by safety and ergonomics researchers to prioritize directions for further investigation. They can also be utilized by occupational medicine specialists to prioritize prevention and intervention efforts.

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