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RESEARCH ARTICLE

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Workers' compensation prescription medication patterns and associated outcomes

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Abstract

Background: Opioid use in the treatment of musculoskeletal injuries is a complex decision where benefits must be balanced with risk. Previous research has shown an association between higher opioid doses and adverse health effects. The study's objective was to investigate whether opioid prescriptions are associated with increased costs and deaths through an injury mechanism or as a direct result of the opioid prescription.

Methods: Data for 144,553 deidentified Ohio Bureau of Workers' Compensation claims from 2010 to 2014 with shoulder, knee, and low back injuries were obtained and followed until 2016. Each claim had associated prescription information. Injury claims were further classified using the allowed diagnoses by single or multiple body areas affected and injury severity ("simple" or "complex"). The outcome variables were medical and indemnity costs, lost days, MaxMED (maximum claim-prescribed daily morphine equivalent dose), and death status. Association between maximum opioid dose with deaths was determined by logistic regression analysis.

Results: Several outcome variables, including claim medical and indemnity costs, and the likelihood of claimant death, showed significant associations with the MaxMED. In the analysis of claim deaths, these associations held for all claim types (except complex), even after adjusting for age, gender, surgery, and lost time.

Conclusion: The association between increasing opioid doses and deaths for low-severity diagnoses was disturbing given the lack of demonstrated efficacy of opioids for treatment of minor injuries. A focus on provider education, increased utilization of non-opioids, and early intervention for minor soft-tissue injuries could reduce claims costs, disability, and future deaths.

KEYWORDS

deaths, injuries, musculoskeletal, opioid

1 | INTRODUCTION

While opioids are one of the most often used medications for acute pain relief, their use is associated with a number of adverse medical outcomes, including mental slowing, fatigue, and respiratory depression. Their use is also responsible for millions of cases of overdose fatalities and addiction.[1,2] Long-term users of opioids have an increased risk of death when compared to those not taking opioids, both in the general population and in populations of patients treated with opioids for chronic pain.[3,4]

The same set of opioid prescriptions adverse outcomes in the general population are also seen in workers injured on the job. Studies have demonstrated that opioid prescriptions in workers' compensation claims are associated with increased risks of long-term opioid use and the cost of the claims.[5,6] Opioids are more frequently prescribed, both short and long term, in claims where workers have more severe injuries or where a hospital stay, time off work, or surgery is required.[5,7,8]

Opioid prescriptions in workers compensation claims could be expected to be associated with more adverse claim outcomes, and possibly a higher risk of claimant death, based on the side effects of opioids themselves. However, this relationship could be modulated by claim "severity of injury." In other words, more severe injuries lead to higher levels of pain experienced by the patient as well as more opioids being prescribed. These more severe injuries would also be expected to produce higher costs and longer periods of disability. So, it is likely that severity of injury is a confounding variable in the relationship between prescribed opioids and claim outcomes, including disability and death. In this study, we have attempted to isolate the confounding effect of severity of injury. We have classified claims so that those of lesser injury severity (single body part injuries with "simple" allowed conditions, SSBP claims) can be analyzed separately from other claims. The purpose of the current study is to investigate whether opioid prescriptions in workers compensation claims have effects on claim outcomes, unrelated to the severity of injury.

2 | METHODS

Deidentified Ohio Bureau of Workers Compensation (OBWC) claims data were obtained for a 5-year period (from 2010 to 2014). These claims were followed until November of 2016. Only injury claims were used. No claims with occupational illnesses were included. All claims with at least one claim allowance involving the lumbar spine, knee, or shoulder met the selection criteria. These three body areas (lumbar spine, knee, or shoulder) were chosen since they are the most common areas injured in OBWC claims involving the spine, lower extremity, and upper extremity, respectively. A total of 159,716 claims were received. Some of the claims had allowed conditions involving more than one of the lumbar, shoulder, and knee areas resulting in duplicate claims received. The duplicates were excluded (13,294 claims). The OBWC used ICD-9 diagnostic codes almost exclusively during the study period, but a small number of claims using ICD-10 codes were included in the initial data set. Once duplicate claims were removed, an additional 1869 claims with one or more ICD-10 coded claim allowances were excluded. After these two exclusions, 144,553 unique claims were left to analyze.

These unique claims were classified into three types: multiple body parts (MBP), simple single body part (SSBP), and complex single body parts (CSBP). The first step was to classify claims involving only one area of the body (low back, knee, or shoulder) versus multiple areas of the body. Classification of body region was based on the ICD-9 codes for back, knee, shoulder, and for claims with multiple areas (involving the low back only, a knee only, a shoulder only, or multiple areas of the body). The process began with the compilation of a unique list of the claim allowances from all the 144,553 unique claims analyzed. Each of these claim allowances were examined by two physicians who associated each unique allowed condition (diagnosis) in the data set with a body part (e.g., shoulder, lumbar, knee, neck, ankle, or "other"). Some claim allowed conditions could not be associated with a particular body area (e.g., sepsis) and their body area was classified as "other." At this point, the claims were determined to be single body area or multiple body areas.

Single body area claims (of the knee, shoulder, or lumbar spine) were then further classified as being simple or complex, with complex claims being those with one or more "complex" allowed conditions. The "complex" allowed conditions were those that might require surgical treatment (e.g., rotator cuff tear) or that represent permanent pathology (e.g., arthritis). Simple claims were overwhelmingly self-limited conditions (e.g., sprains, strains, and contusions) that, by themselves, should not require surgical treatment or result permanent pathology. These same two physicians referred to above also determined for each of the allowed knee, shoulder, or lumbar conditions, whether they were simple or complex using the definitions above.

The claim data received from the OBWC included procedure codes associated with each claim. One of the physician authors examined the set of all unique procedure codes for the claims in the study and determined which represented surgical procedures. Every claim with one or more associated surgery codes was determined to be a claim with a surgery for the purposes of analysis.

The OBWC also provided a field in each claim's data that represented the number of days away from work in that claim that was compensated by the OBWC. These days were termed "lost time." For purposes of analysis, any claim with one or more lost time days was considered to be a lost-time claim.

The maximum morphine equivalent dose (MaxMED) per claim was based on an assessment of the daily medication possession calculated from OBWC claims data. Using the start day of the prescription, the duration of the prescription, and the MED for each drug, which were all provided in the OBWC claims data, a 7.5 million-line table was created using a Perl program. The complete list of the opioids (in various formulations and strengths) prescribed in the claims studied is: buprenorphine, butorphanol, codeine, fentanyl, hydrocodone, hydromorphone, meperidine, methadone, morphine, oxycodone, oxymorphone, pentazocine, propoxyphene, tapentadol, and tramadol. Each line contained the deidentified claim number, day of the claim, medications in possession on that day, and the total MED for the day. Based on the prescription data, a MED was calculated based on equivalent daily milligram dose of morphine to the daily dose of a given opioid (e.g., Hydrocodone 10 mg three times a day has a MED of 30, Oxycodone 10 mg three times a day has a MED of 45).[9] The highest prescribed dose in the claim (MaxMED) and the number of days for which an opioid was prescribed were calculated for each claim. From this file, the MaxMED for each claim was

selected. To facilitate the analyses, drug names in the master file were translated to active ingredient names. Drug names listed in the OBWC claims data were translated to active ingredient names using the ScopiaRx drug name database (www.scopiarx.com).

Binary outcome variables were summarized using frequency (in %) and numerical outcome variables were summarized using mean (standard deviation). Logistic regression models were used to assess the associations of binary outcome variables to the fixed effect of injury type (simple, complex, and multi-area). Post hoc odds ratios were used to compare the risk (of binary outcome variable) between injury types, under the logistic model framework. For the numerical variable of medical cost, a fixed-effect model was used instead, and post hoc means were compared between injury types under the fixed effect model framework. Statistical analyses were performed using SAS 9.4 software. $p < 0.05$ were considered statistically significant.

3 | RESULTS

An analysis of the demographics of the injured workers in the claims studied showed the average age at injury was 43.7 (SD = 12.7) and the majority of the claimants, 58.3%, were male. Of the 144,553 claims (comprised of 131,441 individuals, since some individuals had more than one claim), just under half were classified as SSBP, just under a tenth were classified as CSBP, and the remainder involved MBP. The SSBP CSBP claims were each broken down into three groups: lumbar, shoulder, and knee. Taken as a whole, the number of "simple" SSBP claims was more than five times larger than the "complex" CSBP claims. A larger proportion of the SSBP claims involved the lumbar spine compared to CSBP claims. A higher proportion of CSBP claims involved knees or shoulders when compared to SSBP claims. Workers with "complex" injuries were more likely treated with surgery (as was expected given the definition of "complex" claims), and they had more lost time than "simple" claims. Among the CSBP injuries, over half had surgeries, and this was much higher than the percentage of surgeries in those with multi-area injuries (13.3%) and simple injuries (2.3%). The complex injury category had the most lost time cases (73.7%), which was much higher than the multi-area injury category (41.4%), and simple injury category (18.7%) (Table 1).

TABLE 1 Number and percentage of claims with surgery and lost time (Time of the Job) as a function of severity of claim (simple single body part [SSBP], complex single body part [CSBP], and multiple body part [MBP]) for the studied low back, knee, and shoulder OBWC claims (with injuries occurring 2010–2014)

		Surgery		Lost time	
Claim type	Total	Count	Percentage	Count	Percentage
SSBP	70,477	1653	2.3	13,208	18.7
CSBP	13,097	7431	56.7	9656	73.7
MBP	60,979	8090	13.3	25,251	41.4
Total	144,553	17,174	11.9	48,115	33.3

Abbreviation: OBWC, Ohio Bureau of Workers Compensation.

As expected, the vast majority of claims involved few or no opioids. Specifically, 90.40% of claims had MaxMEDs less than 40 mg (84.7% of all claims had no opioids prescribed), 6.86% of claims had MaxMEDs 40 mg or greater but less than 120 mg, and 2.74% of claims had MaxMEDs of 120 mg or greater. Workers with "complex" CSBP and multi-area injuries were more likely than those with SSBP claims to receive a maximum prescribed opioid MED over the whole claim (MaxMED) of at least 120 MED. In particular, 896 out of 13,097 "complex" CSBP injuries (6.8%) had a MaxMED of 120 or more. This percentage was 4.4% for multi-area injuries. Both of these frequencies were much higher than the frequency for "simple" SSBP injuries, where only 0.5% of claims had this level of opioid prescription (Table 2). The injury category with the highest percentage of claims (22.4%) with a MaxMED of ≥40 to <120 was CSBP, several times higher than the simple single and MBP claims.

Per claim medical costs were positively associated with the claim MaxMED, as well as injury type (Figure 1). As expected, MBP and CSBP claims had higher average medical costs than the SSBP claims, defined based on their allowed diagnoses being usually self-limited conditions. With higher maximum MED strata, the average medical costs of SSBP, CSBP, and MBP claims consistently increased. The average medical costs per claim ranged from under $1400 in the MaxMED under 0 mg SSBP category to just over $50,000 in the MaxMED over 120 mg MBP category. For indemnity costs, the relationship between increasing claim MaxMED and claim costs was very similar to that just described for medical costs for all three claim types (SSBP, CSBP, and MBP).

Figure 2 shows the percentage of claims involving a death for SSBP, CSBP, and MBP claims as categorized by MaxMED stratum. The percentage of claims involving a death increased with rising MaxMED for all three types of claims (SSBP death% rose dramatically from 0.27% to 2.22%, and MBP death% increased from 0.37% to 2.15%, whereas CSBP claims rose more gradually from 0.49% to 1.12%). The CSBP percentage of deaths in each MaxMED stratum fell with increases in the MaxMED. CSBP claims represented the highest percentage of deaths (0.49%) in the (no prescribed opioid) lowest MaxMED stratum and the lowest percentage of death (1.12%) in the (MaxMED of 120 or more) highest stratum.

The unadjusted logistic regression analysis showed statistically significant associations between deaths and MaxMED in SSBP and MBP claims with the opioid MaxMED as the only categorical independent variable. There was an association between MaxMED and deaths in CSBP claims that was not statistically significant. In the adjusted logistic regression model, age, gender, surgery (yes or no), and lost time (yes or no) were used as controlling independent variables (Table 3). In this adjusted analysis, the statistically significant association between the two higher MaxMED categories and death % in SSBP and MBP claims remained, and this relationship was independent of the effects of surgery, gender, age, and the presence or absence of lost time from work. The difference in the percent of deaths compared to the MaxMED = 0

TABLE 2 Number and percentage of all claims as a function of the level of maximum equivalent dosage of opioids for prescriptions and severity of claim (simple single body part [SSBP], complex single body part [CSBP], and multiple body part [MBP]) for the studied low back, knee, and shoulder OBWC claims (with injuries occurring 2010–2014)

	MaxMED = 0	MaxMED > 0 to < 40	MaxMED ≥ 40 to < 120	MaxMED ≥ 120	Total
SSBP	65,260 (45.0%) [92.6%]	2948 (2.0%) [4.2%]	1908 (1.4%) [2.7%]	361 (0.3%) [0.5%]	70,477 (48.7%) [100%]
CSBP	8110 (5.6%) [61.9%]	1152 (0.8%) [8.8%]	2939 (2.0%) [22.4%]	896 (0.6%) [6.8%]	13,097 (9.1%) [100%]
MBP	49,101 (34.0%) [80.5%]	4100 (2.8%) [6.7%]	5076 (3.5%) [8.3%]	2702 (1.9%) [4.4%]	60,979 (42.2%) [100%]
Total	122,471 (84.7%)	8200 (5.7%)	9923 (6.9%)	3959 (2.7%)	144,553 (100.0%)

Note: Percent of total claims is in parentheses and percent within the injury category is shown in brackets.
Abbreviation: OBWC, Ohio Bureau of Workers Compensation.

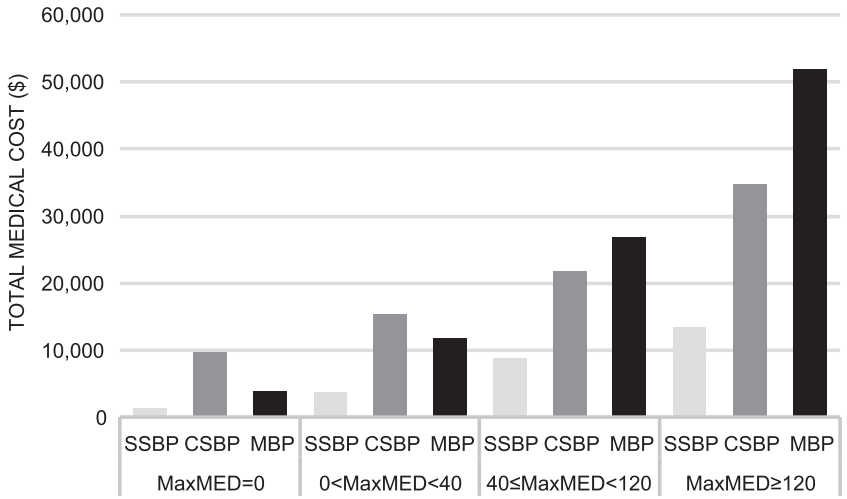

FIGURE 1 Average medical costs per claim as a function of severity of claim (simple single body part (SSBP), complex single body part [CSBP], and multiple body part [MBP]) and the maximum equivalent of opioid drug prescription for all low back, knee, and shoulder workers' compensation claims in the state of Ohio (2010–2014 and followed until 2016)

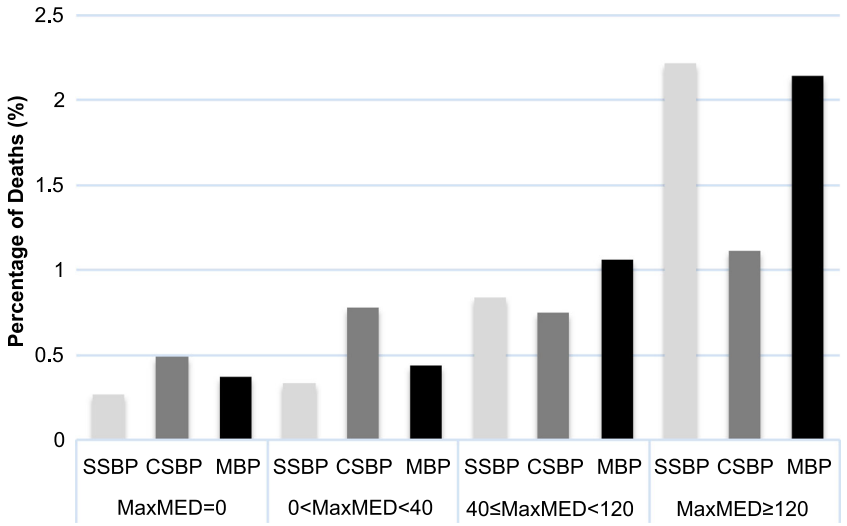

FIGURE 2 Percent of claims that resulted in death as a function of severity of claim (simple single body part [SSBP], complex single body part [CSBP], and multiple body part [MBP]) and the maximum equivalent of opioid drug prescription for all low back, knee, and shoulder workers' compensation claims in the state of Ohio (2010–2014 and followed until 2016)

(no opioids) was only significant in CSBP claims for the MaxMED >120 category. This strong association increased percent of deaths in the higher MaxMED categories in our study population is not explained by the severity of the injury, since this relationship between MaxMED and death is seen in the SSBP claims, which, by the manner in which they were defined, should all have had similar degrees of injury severity.

4 | DISCUSSION

This study shows that claims in which opioids are prescribed for workers' compensation injuries are associated with higher costs and more deaths. These associations hold within groups even when analyzing claims grouped by number of body areas involved and by the complexity of the allowed conditions. For deaths, the association

TABLE 3 Logistic regression models for deaths as a function of the level of maximum equivalent dosage of opioids for prescriptions and severity of claim (simple single body part [SSBP], complex single body part [CSBP], and multiple body part [MBP]) for the studied low back, knee, and shoulder OBWC claims (with injuries occurring 2010–2014)

				Adjusted method	
Injury	MaxMED	*n*	Deaths/1000	Odds ratio	*p* value
All (*N* = 144,553)	≥120	3883	19	4.8	**<0.0001**
	≥40 to <120	9831	9	2.4	**<0.0001**
	>0 to <40	8163	5	1.3	0.12
	=0	122,073	3	-	-
SSBP (*N* = 70,477)	≥ 120	353	22	8.5	**<0.0001**
	≥40 to <120	1892	8	3.2	**<0.0001**
	>0 to <40	2938	3	1.3	0.46
	=0	65,086	3	-	-
CSBP (*N* = 13,097)	≥ 120	886	11	2.3	**0.02**
	≥40 to <120	2917	7	1.5	0.12
	>0 to <40	1143	8	1.6	0.21
	=0	8070	5	-	-
MBP (*N* = 60,979)	≥ 120	2644	21	5.8	**<0.0001**
	≥40 to <120	5022	11	2.9	**<0.0001**
	>0 to <40	4082	4	1.2	0.52
	=0	48,917	4	-	-

Note: Bold values indicate significant effect at $p < 0.05$. The variables used as controlling independent variables in the adjusted method in this analysis were: age, gender, surgery (yes or no), and lost time (yes or no).

Abbreviation: OBWC, Ohio Bureau of Workers Compensation.

between higher claim MaxMED and percentages of deaths was statistically significant, even after adjusting for severity of injury, gender, age, surgery, and lost time. The results support other research that has found opioid prescriptions to be associated with more severe injuries.[5,7,8] Additional evidence for work-related musculoskeletal injuries having long-term impact on mortality outcomes[10] is the finding that 57% of the overdose deaths in Utah (in 2008–2009) had at least one work-related injury.

The associations seen between claim MaxMED and both claim costs and numbers of deaths (even after accounting for severity of injury and the other potential confounders) have more than one plausible explanation. One explanation, and the most disturbing, is that opioids prescribed for a workers' compensation claim could be causing a new addiction leading to more disability, higher claim costs, and an increased chance of death. Previous studies have demonstrated that opioid prescriptions in workers' compensation injury claims can lead to chronic use in the opioid naïve, even after the first prescription.[11–14] A second plausible explanation for the associations seen is that claimants who had a pre-existing opioid dependence who then sustained a workers' compensation injury would have a supplemental source for opioids (the workers compensation system) enabling them to obtain higher and potentially lethal doses of opioids. Many studies have shown that chronic opioid users have more disability and higher rates of death than comparable members of the general population.[5,6,10] However, the prescribing policies and initial claim management for both the newly addicted and chronic opioid-using workers would not be dissimilar. In both scenarios, claimants requiring more opioids than expected for the allowed conditions could benefit from early intervention. If opioid prescribing policies were to be put in place that limit the prescription of opioids in favor of alternatives, especially in claims with only "simple" allowed conditions, these could decrease both the new cases of opioid addiction and the number of opioid prescriptions for injured workers who were using opioids before the work injury. With preventive opioid prescription policies in place, the pre-injury long-term opioid user would have more difficulty receiving opioids through a claim with "simple" claim allowances. Early identification of claims where opioid prescription patterns do not match the severity of the severity of the claim allowances, in conjunction with consultation with the treating providers, could help both newly addicted workers and also long-term opioid users, especially if this resulted in early referrals to addiction specialists (even if outside the workers compensation system).

CSBP claims did not demonstrate the same relationship between MED, death, and costs of the claim as did SSBP and MBP injuries. Specifically, CSBP claims did not exhibit a statistically significant relationship between MaxMED and death, after adjusting for age,

gender, surgery, and lost-time. Because CSBP claims had to have one or more "complex" claim allowances, it is not surprising that significantly more CSBP claims had surgery than the other two claim types (Table 1). It is possible that opioids prescribed for surgical pain have a lower chance of causing addiction and long-term use and subsequent deaths. It is also possible that a lower percentage of individuals in the CSBP category had pre-existing long-term use and addiction with the intention to acquire opioids compared to the percentage of these individuals in the SSBP category. CSBP claims, by their definition, have one or more "complex" allowed conditions, and "complex" conditions are generally associated with objective findings on test results, including imaging. The "simple" claim allowances that are the only ones allowed in SSBP claims diagnostically rely on subjective symptoms only with fewer objective findings. An individual complaining of subjective pain in hopes of obtaining opioids would be far more likely to generate a SSBP claim than a CSBP claim, and this could cause a higher percentage of individuals with pre-injury opioid dependence (and seeking opioids) to be in the SSBP group than the CSBP group. This is also a potential mechanism to explain the clear associations between MaxMED and deaths in the SSBP group, but not the CSBP group. Future research would be needed to substantiate these theories regarding differences between the CSBP and SSBP claims.

This study is constrained by the available data—all from a workers' compensation system with no private medical data, which could contain information on legitimate and illicit opioid use outside the workers compensation system. Our study relies on the "allowed" medical conditions, diagnoses determined by the OBWC to be work-related, to determine which claims fall into the SSBP, CSBP, and MBP categories. In reality, there is not always a perfect match between the allowed conditions in a given body area (shoulder, lumbar, or knee) and the actual diagnoses that same body area. For example, if a worker had a pre-existing condition that was not deemed to have been aggravated by the injury in the claim (e.g., lumbar facet arthropathy in a worker whose claim has an allowance for lumbar strain), the classification system used in our study would only capture the lumbar strain. This individual would be lumped into the SSBP category along with individuals with no prior back injury or pathology.

It is not known whether all deaths for all the claims were actually captured by the OBWC, since there is no rigorous reporting system for deaths after the immediate post-injury period to the OBWC. The Ohio BWC system for collecting death information is passive one (e.g., relying on return of mailings with subsequent follow-up, notifications from other state entities) rather than an active one. This raises the possibility of possible biases to influence the results.

Lost time claims were initially considered a possible confounding variable in the mortality analysis, since those receiving temporary total disability checks from the OBWC would be more likely to be identified as having died when their checks were not cashed. However, the relationship between MaxMED and death percentage was independent of lost time status in the adjusted logistic regression analysis.

The different lengths of time that the claims were followed in the data set do introduce the possibility that claims with longer duration had an association with both the MaxMED and death. However, we did not find any relationship between MaxMED, percentage of claims being SSBP, or percentage of claims being CSBP, and the year of the claim injury. In addition, all claims were followed for at least 18 months. While claim duration was longer for CSBP and MBP claims than SSBP claims, this did not affect the analysis within each of these three groups.

An unfortunate shortcoming of the data was that there was no reliable way to determine the sidedness (right vs. left) of each allowed condition. This likely resulted in some misclassification of claims. While we were able to determine the body area (shoulder, knee, or lumbar, etc.) and to determine the claims involving only a single body area, there was no way to determine whether or not a given single body part claim (SSBP or CSBP) involved both a right and left side or only one side. For example, a claim allowed for right shoulder supraspinatus tear and left shoulder strain would be classified as a single body part claim (specifically CSBP in this case), whereas, if the sidedness information was available this example claim would have been classified as MBP. This issue was not a factor for lumbar claims. We suspect that the impact of this under-classification of MBP claims was small, since most knee and shoulder injuries are not bilateral. Furthermore, many of the bilateral knee and shoulder injuries would also involve another body area resulting in classification as MBP.

Future studies are needed to determine the causes of death in cohorts like the ones studied, since this was not available in the data we obtained from the Ohio BWC. In particular, we do not know how many of the deaths may have been due to opioid overdose. The previously mentioned Cheng and associates[10] study showed that a majority of opioid overdose deaths in one state were associated with a prior worker's compensation claim. It is reasonable to hypothesize that the excess deaths in our study among those prescribed higher opioid doses could be due to overdoses. Analysis of death certificates would clarify this hypothesis. Additionally, access to statewide databases containing all prescribed opioids (both private and through workers compensation) looking at both the pre-injury and post-injury periods of time in these claims would allow for characterization of the timing of onset of the opioid chronic use/addiction. This would help determine the relative contributions of pre-existing addiction as opposed to new addiction in opioid-naive individuals.

Our results indicate that prescribed opioids are associated with higher claim costs and higher chances of claimant death, independent of the severity of a given injury. As mentioned above, previous studies have shown that prescriptions exceeding 5 days increase the risk for chronic opioid use, as do high MED prescriptions. Other studies have shown that opioid prescribing guidelines for physicians can reduce the frequency and dosage of opioids given to patients with pain.[15,16]

Many new workers compensation opioid prescription guidelines and policies have been adopted throughout the country in recent years.[9] These efforts have resulted in reductions in opioid prescribing rates, and they take a variety of forms. Prescription drug monitoring programs (PDMPs) are electronic database systems implemented by a state (and now present in most states) that allow or require

prescribers to verify that patients are not receiving opioids from other sources in the state. Opioid dispensing limits are implemented via permitted opioid drug formularies, requiring prior authorizations, or otherwise limiting the quantity of opioid medications (and circumstances in which providers can prescribe them). Required physician education in effective opioid prescribing practices and automated alerts within electronic medical record systems flagging patients at risk of opioid misuse have also been effective. Encouraging pharmacists to review prescriptions and consult with health care providers has shown promising results. Specific examples of recent opioid prescription guidelines in workers compensation systems include the Federal Employees Program FECA Bulletin 19-04[17] and Ohio's Rule 4731-11-13.[18]

These policy Interventions are needed to prevent, where appropriate, or manage the prescriptions of opioids in workers' compensation claims, especially when only "simple" conditions are allowed. For "simple" conditions such as non-radicular low back pain, opioid use has not been found to improve functional outcomes compared NSAID use alone.[19] In the future, clinical decision tools[20] may allow prescreening of workers who are at high risk of opioid abuse and thus guide the selection of patients who may tolerate short-term use of opioids from those that should be treated with non-opioid therapy.[21]

5 | CONCLUSION

This study demonstrated that in a large workers compensation system, the risks of death and higher claim costs are higher with increasing prescribed opioid doses, even for minor injuries, unlikely to result in surgery or long-term disability. This is important for workers compensation case management, considering that the majority of injuries are in this category. These opioid-associated risks in even minor injuries are particularly alarming given that past research shows very limited benefits for using opioids to treat minor injuries. While many workers compensation providers have started to reduce the amount of opioids they prescribe since the years of claims in our study (dates of injury 2010 through 2014 and followed to 2016), future studies are needed to identify effective pharmacologic and non-pharmacologic alternatives to opioids and to educate providers on when to substitute these for opioids.

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CONFLICTS OF INTEREST

There are no conflicts of interest. Drs. Freeman, Huth, and Lang are physicians who see patients and evaluate claims within the workers' compensation system in Ohio, and who are compensated for these services by the Ohio Bureau of Workers' Compensation (OBWC).

DISCLOSURE BY AJIM EDITOR OF RECORD

John Meyer declares that he has no conflict of interest in the review and publication decision regarding this article.

AUTHOR CONTRIBUTIONS

Dr. Freeman was the principal investigator and led all aspects of the study including data set cleaning, data analysis, drug and injury coding, and manuscript preparation. Dr. Davis led the coding of injury mechanism, review of the data set, and assisted in manuscript preparation and revisions. Dr. Ying and Ms. Lui led the statistical analyses and interpretation as well as assisting in manuscript development. Dr. Huth prepared the drug prescription analysis and interpretation, along with assistance in manuscript preparation. Dr. Lang assisted in coding, data review, results interpretation, and manuscript preparation. All members contributed significantly to the study and paper writing.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from Ohio Bureau of Workers Compensation. Restrictions apply to the availability of these data, which were used under license for this study.

The research was deemed 'exempt' by the University of Cincinnati's Institution Review Board as the data was collected previously and all participants deidentified.

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REFERENCES

1. Franklin GM, Rahman EA, Turner JA, Daniell WE, Fulton-Kehoe D. Opioid use for chronic low back pain: a prospective, population-based study among injured workers in Washington state, 2002-2005. *Clin J Pain*. 2009;25(9):743-751.
2. Mai J, Franklin G, Tauben D. Guideline for prescribing opioids to treat pain in injured workers. *Phys Med Rehabil Clin*. 2015;26(3):453-465.
3. Garg RK, Fulton-Kehoe D, Franklin GM. Patterns of opioid use and risk of opioid overdose death among Medicaid patients. *Med Care*. 2017;55(7):661-668.
4. Sjøgren P, Grønbæk M, Peuckmann V, Ekholm O. A population-based cohort study on chronic pain: the role of opioids. *Clin J Pain*. 2010;26(9):763-769.
5. Berecki-Gisolf J, Collie A, McClure RJ. Prescription opioids for occupational injury: results from workers' compensation claims records. *Pain Med*. 2014;15(9):1549-1557.
6. Lavin RA, Tao XG, Yuspeh L, Bernacki EJ. Impact of the combined use of benzodiazepines and opioids on workers' compensation claim cost. *J Occup Environ Med*. 2014;56(9):973-978.
7. Stover BD, Turner JA, Franklin G, et al. Factors associated with early opioid prescription among workers with low back injuries. *J Pain*. 2006;7(10):718-725.
8. Webster BS, Verma SK, Gatchel RJ. Relationship between early opioid prescribing for acute occupational low back pain and disability duration, medical costs, subsequent surgery and late opioid use. *Spine*. 2007;32(19):2127-2132.

9. U.S. Department of Labor. Office of the Assistant Secretary for Policy. Workers' compensation and the opioid epidemic: Analysis and research design options. Contractor: Mathematica Policy Research with University of Connecticut Health Center and Summit Consulting; 2021.
10. Cheng M, Sauer B, Johnson E, Porucznik C, Hegmann K. Comparison of opioid-related deaths by work-related injury. *Am J Ind Med*. 2013;56(3):308-316.
11. Deyo RA, Hallvik SE, Hildebran C, et al. Association between initial opioid prescribing patterns and subsequent long-term use among opioid-naïve patients: a statewide retrospective cohort study. *J Gen Intern Med*. 2017;32(1):21-27.
12. Durand Z, Nechuta S, Krishnaswami S, Hurwitz EL, McPheeters M. Prevalence and risk factors associated with long-term opioid use after injury among previously opioid-free workers. *JAMA Netw Open*. 2019;2(7):e197222.
13. Franklin G, Sabel J, Jones CM, et al. A comprehensive approach to address the prescription opioid epidemic in Washington State: milestones and lessons learned. *Am J Public Health*. 2015;105(3):463-469.
14. Hah JM, Bateman BT, Ratliff J, Curtin C, Sun E. Chronic opioid use after surgery: implications for perioperative management in the face of the opioid epidemic. *Anesth Analg*. 2017;125(5):1733-1740.
15. Garg RK, Fulton-Kehoe D, Turner JA, et al. Changes in opioid prescribing for Washington workers' compensation claimants after implementation of an opioid dosing guideline for chronic noncancer pain: 2004 to 2010. *J Pain*. 2013;14(12):1620-1628.
16. Sullivan MD, Bauer AM, Fulton-Kehoe D, et al. Trends in opioid dosing among Washington State Medicaid patients before and after opioid dosing guideline implementation. *J Pain*. 2016;17(5):561-568.
17. U.S. Department of Labor. New opioid prescribing guidelines in the FECA program limiting initial fills to seven days and imposing LMN at 28 days. FECA BULLETIN NO. 19-04; 2019.
18. State of Ohio. Prescribing of opiate analgesics for acute pain. Rule 4731-11-13; 2016.
19. Friedman BW, Dym AA, Davitt M, et al. Naproxen with cyclobenzaprine, oxycodone/acetaminophen, or placebo for treating acute low back pain: a randomized clinical trial. *JAMA*. 2015;314(15):1572-1580.
20. Hastings JS, Howison M, Inman SE. Predicting high-risk opioid prescriptions before they are given. *Proc Natl Acad Sci*. 2020;117(4):1917-1923.
21. Finnerup NB. Nonnarcotic methods of pain management. *N Engl J Med*. 2019;380(25):2440-2448.

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