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Early opioid prescription and risk of long-term opioid use among US workers with back and shoulder injuries: a retrospective cohort study

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ABSTRACT

The number of prescription opioid overdose deaths has increased dramatically in recent years and many prescribers are unsure how to balance treatment of pain with secondary prevention. Guidelines recommend low-severity injury patients not receive opioids early in the course of their care, but evidence supporting this guideline is limited. Data from 123 096 workers' compensation claims with back and shoulder injuries were analysed to evaluate this guideline. Back and shoulder injury claimants with early opioid use (≤1 month after injury) had 33% lower (95% CI 24% to 41% lower) odds and 29% higher (95% CI 6% to 58% higher) odds, respectively, of long-term opioid use (>3 months) than claimants with late opioid use, after adjusting for key covariates. Stratified analyses indicate that early opioid use does not appear to increase the risk of long-term use except in cases where no diagnosis or only the diagnosis of unspecified shoulder pain is given prior to prescription.

INTRODUCTION

In recent years, mortality from prescription opioid abuse has increased at an alarming rate with the number of annual deaths nearly quadrupling since 1999.[1] The consequences of long-term opioid use have been well documented and include risk for overdose deaths, abuse, fractures, myocardial infarction and sexual dysfunction, according to a recent review.[2] At the same time, millions of workers are injured on the job annually—with back and shoulder injuries being the most common types of injury[3 4]—and need effective treatment for the pain associated with these injuries. Prescription opioids are the gold standard of pain treatment, but there is substantial concern about addiction and other negative health outcomes.

Balancing treatment of pain post injury and prevention of further negative health consequences remains a challenge. To address this concern, guidelines promoting the rational use of opioids have been disseminated. Guidelines recommend that opioids not be prescribed for patients with low-severity, chronic musculoskeletal injuries within the first 6 weeks of injury.[5] Previous studies of workers with low-severity back injuries have compared outcomes between those who received opioids early to those who did not and found that receiving early opioids was associated with longer disability, higher medical costs, greater risk of surgery and long-term late (after 30 days) opioid use.[6 7] A limitation of both studies is that they compare those who received opioids early to those who did not receive opioids early. In other words, the comparison group consisted of those who received opioids late and those who never received opioids at all.

No study has compared long-term opioid use among patients who received opioids early with those who received opioids late. The primary objective of this study is to determine whether early opioid use among workers' compensation claimants with low-severity back and shoulder injuries is associated with a higher risk of long-term opioid use. A secondary objective is to determine whether the relationship between early opioid use and long-term opioid use differs by injury diagnosis.

METHODS

This study is a retrospective cohort study using an administrative claims data set from a large, national insurance company. This study population consists of US workers who sustained a back or a shoulder injury from 1 June 1999 to 1 June 2010, and received medical and indemnity payments. Claimants were identified using an International Classification of Disease, Version 9 (ICD9)-based methodology.[4] Claimants who had undergone surgery for their main injury or who had a diagnosis indicating an injury for which early opioid use would likely be justified (as determined by a panel of occupational injury experts) within the 1st month were excluded from the analysis. These exclusions were made in order to focus on a group of claimants for whom early opioid use is controversial. The expert panel's composition and procedures have been described previously.[4]

The main, independent variable in this analysis was early opioid use, defined as an invoice indicating prescription of opioids within the 1st month of injury. A list of 5039 National Drug Codes for opioid prescriptions was compiled using the Cerner Multum's Lexicon[8] and matched to claimants' invoices.

The primary outcome measure was long-term opioid use defined as an average of at least one prescription per month for 3 months or at least three consecutive prescription refills with less than 1 month between refills. Similar definitions have been used by Von Korff *et al*[9] and Katz *et al*,[10] respectively. All other claimants who used opioids were defined as short-term users. Claimants who never used opioids were defined as opioid non-users.

Key covariates included sex, age, ISS, head AIS[11] (derived using ICDMAP-90 software[12]), medical

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spending within the 1st month of injury, time to first invoice (defined as time between the date of injury and the first invoice date, and included as a potential proxy for injury chronicity and delayed treatment), time in system potential (time from injury date to end of observation period, used to control for possible non-random data censoring), and indicators for the presence of specific diagnoses within the 1st month of injury.

Logistic regression models were stratified by injury type and included controls for the above covariates, transformed where appropriate. All models included interaction terms between early opioid use and specific injury indicators. Claimants missing one or more covariates were not included in the regression (<2% for back and shoulder). Claimants were further stratified by presence of diagnoses recorded in the 1st month of their injuries. Claimants with no diagnosis codes within the 1st month of their injuries were included separately for back and shoulder. Claimants may have had more than one diagnosis within the 1st month and, with the exception of those with no codes in the 1st month, strata are not mutually exclusive.

RESULTS

Demographic, injury and treatment characteristics of back and shoulder injuries for different categories of opioid use are shown in table 1 along with p values from χ^2 analyses. Data on opioid non-users are included for informational purposes, but these individuals are not included in subsequent regression analyses. As expected, long-term opioid users for back and shoulder injuries tended to have the highest ISS followed by short-term opioid users and opioid non-users ($p<0.001$ all).

For the main variable of interest, opioid initiation (early or late), results were inconsistent between back and shoulder. For back injuries, short-term users were much more likely to have received opioids within the 1st month (64%) than long-term users (50%) and this difference was statistically significant ($p<0.001$). Differences in early opioid use by opioid utilisation category were much less pronounced for shoulder patients with 42% of short-term opioid users and 45% of long-term opioid users receiving opioids within the 1 month of injury ($p<0.001$).

Regression results for back and shoulder are shown in tables 2 and 3, respectively. After controlling for several key covariates, the variable of interest, early opioid use, was still significantly associated with long-term opioid use for those with back and shoulder injuries, but in opposite directions. Among back claimants, those receiving opioids within the 1st month of their injuries had 33% lower odds of receiving long-term opioids than those who received opioids after the 1st month of their injuries, even after controlling for key covariates ($p<0.001$). By contrast, among shoulder claimants, those who received opioids within the 1st month had 29% higher odds of receiving long-term opioids than those who receive opioids after the 1st month ($p=0.01$).

Several significant interaction terms were noted for back and shoulder, indicating that the relationship between early opioid use and long-term opioid use may not be consistent across diagnoses. Stratified analyses of diagnoses are presented in table 4.

Among those with back injuries, the relationship between early use and long-term use is fairly consistent across diagnoses with those receiving opioids early having 22–45% lower odds of staying on opioids long-term. However, claimants who do not have any back diagnoses in the 1st month have 24% higher odds of becoming a long-term opioid user given early prescription of opioids ($p=0.03$).

Analyses of claimants with shoulder injuries stratified by diagnoses in the 1st month show little relationship between early opioid use and long-term opioid use for most categories of diagnosis. The exception is the stratum of claimants with a generalised shoulder pain diagnosis in the 1st month of injury who have 32% higher odds of becoming long-term users given early opioid use ($p=0.02$). Claimants with no shoulder diagnoses in the 1st month have more than twice the odds of staying on opioids long-term given early opioid use ($p<0.001$).

CONCLUSIONS

In this study, we did not find consistent evidence that opioid use in the 1st month following injury is associated with a higher risk of long-term opioid use compared with those who receive opioids after the 1st month. Among patients with back injury for whom immediate opioid use is typically not recommended, early opioid use was associated with a significantly lower risk of long-term opioid use. These findings are somewhat discrepant from previous studies in similar populations, which found that early opioid use was associated with worse outcomes.[6 7] However, these studies grouped those with late opioid use and no opioid use while the present study examined late opioid use separately.

Among shoulder injuries, a significant relationship was detected between early opioid use and greater risk of long-term opioid use. For back and shoulder, these relationships were not consistent across specific diagnoses. Stratified analyses of claimants with shoulder injury indicate that the relationship between early opioid use and long-term opioid use seems to be entirely driven by claimants without a clear diagnosis in the 1st month of injury.

This study has several strengths including a large, geographically diverse population, longitudinal data over an extended period, and controls for important confounders. Furthermore, this study improves upon previous work as it makes the more relevant comparison of early opioid use to late opioid use.

This study has several limitations; most importantly the observational study design provides no insight into the mechanism underlying the observed relationships between early opioid use and long-term opioid use. Patients receiving opioids early and receiving opioids late may be systematically different. For example, late opioid use may capture an underlying chronicity component of the injury or indicate other aspects of inadequate initial injury management which may be unmeasured confounders. Opioid use and injury history prior to the given claim were not captured in the data set and may be important, unmeasured confounders. The method used to identify prescription opioid use also has limitations. New drugs are continually introduced and lists classifying National Drug Codes may be incomplete.[13] It is also impossible to know from claims data whether claimants took the opioids on the date on which they filled the prescription, or if at all. Patients may have also taken opioids not paid for by the insurer, which would not have been captured in the claims data. Controls for injury severity may have been insufficient. ISS is well suited to predict mortality, but is of less use when differentiating between low-severity pain and sprain/strain injuries, as are common in this data set. Finally, the study population consisted only of US workers which may not represent the general US population.

Existing guidelines caution against the use of early opioid treatment in this class of musculoskeletal injuries, but these data suggest that clinicians must carefully evaluate the clinical merits of each case. In particular the stratified results of these analyses

Table 1 Back and shoulder descriptive characteristics

Back	Short-term opioid users (n=15 825)	Long-term opioid users (n=11 998)	Opioid non-users (n=64 991)	χ^2 test p Value
Sex, no. (%)				0.001
Female	5453 (35)	3881 (32)	21 867 (34)	
Male	10 314 (65)	8071 (68)	42 774 (66)	
Missing	58	46	350	
Age, mean (SD), years	39·5 (11.3)	41·5 (10.6)	39·2 (11.7)	<0.001
Missing	121	57	810	
Employment, no. (%)				
Part-time	1839 (12)	1495 (12)	6183 (10)	<0.001
Full-time	13 986 (88)	10 503 (88)	58 808 (90)	
ISS, no. (%)				
0–1	8803 (56)	5078 (43)	42 159 (65)	<0.001
2–9	6710 (43)	6453 (54)	21 963 (34)	
10+	257 (2)	385 (3)	607 (1)	
Missing	55	82	262	
Head AIS, no. (%)				<0.001
0	15 597 (99)	11 705 (98)	64 425 (99)	
1+	189 (1)	230 (2)	457 (1)	
Missing	39	63	109	
Opioid initiation, no. (%)				<0.001
Received opioids within 1st month	10 119 (64)	6014 (50)	N/A	
Received opioids after 1st month	5706 (36)	5984 (50)	N/A	
First month spending, mean (SD), $	1537 (3410)	1959 (4740)	1039 (1731)	<0.001
Time to first invoice, mean (SD), d	6.6 (18.7)	8.8 (22.7)	9.6 (24.2)	<0.001
Time in system potential, mean (SD), years	4.8 (2.6)	4.8 (2.6)	6.0 (2.9)	<0.001
Diagnoses received in 1st month, no. (%)*				
Thoracic and lumbar disc disorders	541 (3)	545 (5)	1572 (2)	<0.001
Thoracic or lumbosacral neuritis or radiculitis	1405 (9)	1488 (12)	4306 (7)	<0.001
Sprain/strain	11 937 (75)	7843 (65)	46 778 (72)	<0.001
Generalised back pain	7127 (45)	5679 (47)	25 431 (39)	<0.001
Shoulder	**Short-term opioid users (n=6348)**	**Long-term opioid users (n=4307)**	**Opioid non-users (n=21 627)**	**p Value**
Sex, no. (%)				0.08
Female	2227 (35)	1526 (36)	7884 (37)	
Male	4093 (65)	2768 (65)	13 641 (63)	
Missing	28	13	102	
Age, mean (SD), years	43.2 (11.6)	43.6 (10.5)	42.3 (12.2)	<0.001
Missing	41	10	233	
Employment, no. (%)				<0.001
Part-time	637 (10)	478 (11)	1975 (9)	
Full-time	5711 (90)	3829 (89)	19 652 (91)	
ISS, no. (%)				<0.001
0–1	4214 (67)	2427 (57)	15 946 (75)	
2–9	2000 (32)	1763 (41)	5172 (24)	
10+	58 (1)	70 (2)	123 (1)	
Missing	76	46	386	
Head AIS, no. (%)				<0.001
0	6263 (99)	4216 (98)	21 447 (99)	
1+	68 (1)	68 (2)	150 (1)	
Missing	17	23	30	
Opioid initiation, no. (%)				<0.001
Received opioids within 1st month	2639 (42)	1937 (45)	N/A	
Received opioids after 1st month	3709 (58)	2370 (55)	N/A	
First month spending, mean (SD), $	1514 (6125)	1893 (6683)	1002 (1981)	<0.001
Time to first invoice, mean (SD), d	11.8 (26.5)	10.9 (24.0)	14.6 (30.2)	<0.001
Time in system potential, mean (SD), years	4.3 (2.5)	3.9 (2.3)	5.7 (2.9)	<0.001
Diagnoses received in 1st month, no. (%)*				
Bursitis/tendonitis	1250 (20)	897 (21)	3816 (18)	<0.001
Arthritis	238 (4)	159 (4)	516 (2)	<0.001
Calcifying tendinitis	134 (2)	74 (2)	491 (2)	0.07
Sprain/strain	4047 (64)	2693 (63)	13 268 (61)	0.002
Generalised shoulder pain	3147 (50)	2320 (54)	8956 (41)	<0.001

*Claimants may have more than one diagnosis group in the 1st month.

Table 2 Back regressions, odds of becoming a long-term opioid user (N=27 519)

	OR (95% CI)	p Value
Received opioids within 1st month	0.67 (0.59 to 0.76)	<0.001
Male	1.12 (1.06 to 1.18)	<0.001
Age, years	1.01 (1.01 to 1.01)	<0.001
Full-time employment	0.92 (0.86 to 1.00)	0.04
ISS, square root	1.48 (1.42 to 1.54)	<0.001
Head AIS, square root	0.83 (0.71 to 0.96)	0.01
First month spending, log $	1.09 (1.07 to 1.11).	<0.001
Time to first invoice, log days	1.10 (1.07 to 1.14)	<0.001
Time in system potential, years	1.02 (1.01 to 1.04)	<0.001
Diagnoses recorded in 1st month*		
Thoracic and lumbar disc disorders	1.13 (0.92 to 1.40)	0.20
Thoracic or lumbosacral neuritis or radiculitis	1.13 (0.99 to 1.28)	0.07
Sprain/strain	0.66 (0.60 to 0.72)	<0.001
Generalised back pain	1.07 (0.98 to 1.16)	0.12
Interaction terms*		
Thoracic and lumbar disc disorders	1.24 (0.95 to 1.61)	0.12
Thoracic or lumbosacral neuritis or radiculitis	1.44 (1.22 to 1.70)	<0.001
Sprain/strain	0.85 (0.75 to 0.96)	0.007
Generalised back pain	1.12 (1.01 to 1.25)	0.04

*Claimants may have more than one diagnosis group in the 1st month.

indicate that there may be a benefit of delaying the prescription of opioids if the physician is unable to make a clear diagnosis of the injury. For patients whom providers believe will ultimately receive opioids and clear initial diagnoses are available, waiting does not appear to be beneficial. In particular, among those with back sprain/strain injuries or generalised back pain, patients who receive opioids late have a higher risk of long-term opioid use.

Table 3 Shoulder regressions, odds of becoming a long-term opioid user (N=10 472)

	OR	p Value
Received opioids within 1st month	1.29 (1.06 to 1.58)	0.01
Male	0.98 (0.90 to 1.07)	0.63
Age, years	1.01 (1.01 to 1.01)	<0.001
Full-time employment	0·91 (0.80 to 1.03)	0.14
ISS, square root	1.54 (1.43 to 1.66)	<0.001
Head AIS, square root	0·76 (0.59 to 0.98)	0.03
First month spending, log $	1.03 (1.00 to 1.06)	0.11
Time to first invoice, log days	1.07 (1.03 to 1.12)	0.003
Time in system potential, years	0.97 (0.96 to 0.99)	0.002
Diagnoses recorded in 1st month*		
Bursitis/tendonitis	1.06 (0.92 to 1.22)	0.45
Arthritis	0.95 (0.71 to 1.26)	0.71
Calcifying tendinitis	1.11 (0.75 to 1.63)	0.61
Sprain/strain	0.94 (0.83 to 1.06)	0.32
Generalised shoulder pain	1.10 (0.98 to 1.24)	0.12
Interaction terms*		
Bursitis/tendonitis	1.09 (0.89 to 1.33)	0.42
Arthritis	0.91 (0.60 to 1.39)	0.65
Calcifying tendinitis	0.53 (0.29 to 0.95)	0.03
Sprain/strain	0.80 (0.66 to 0.97)	0.02
Generalised shoulder pain	1.19 (1.00 to 1.41)	0.05

*Claimants may have more than one diagnosis group in the 1st month.

Table 4 ORs for long-term opioid use given early prescription and presence of diagnoses in 1st month

	N	OR, 95% CI	p Value
Back			
Thoracic and lumbar disc disorders	1059	0.59 (0.32 to 1.09)	0.09
Thoracic or lumbosacral neuritis or radiculitis	2893	0.78 (0.54 to 1.12)	0.18
Sprain/strain	19 780	0.55 (0.51to 0.60)	<0.001
Generalised back pain	12 806	0.69 (0.60 to 0.79)	<0.001
No back diagnoses in 1st month	17 453	1.24 (1.02 to 1.52)	0.03
Shoulder			
Bursitis/tendonitis	2147	0.91 (0.60 to 1.38)	0.64
Arthritis	397	0.85 (0.25 to 2.91)	0.78
Calcifying tendinitis	208	0.29 (0.06 to 1.35)	0.11
Sprain/strain	6740	0.95 (0.81 to 1.11)	0.49
Generalised shoulder pain	5467	1.32 (1.06 to 1.64)	0.02
No shoulder diagnoses in the 1st month	6004	2.38 (1.71 to 3.31)	<0.001

What is already known on this subject

- Long-term prescription opioid use is a risk factor for overdose death and other negative health consequences.
- Guidelines recommend low-severity injury patients not receive opioids early in the course of their care, but supporting evidence is limited.
- Previous observational research in workers with back injury concludes that early opioid prescription increases risk of negative health outcomes, including long-term late opioid use. However, the comparison groups in these studies combined late opioid users with those who never used opioids at all.

What this study adds

- This research improves and expands upon previous research by comparing early opioid use to late opioid use alone among workers' compensation claimants with shoulder or back injuries.
- In contrast to guideline recommendations and previous literature, our results suggest that early opioid prescription was not associated with long-term use, except where a specific diagnosis was not first ascertained.

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