BMJ Open

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Journal:	*BMJ Open*
Manuscript ID:	bmjopen-2015-007836
Article Type:	Research
Date Submitted by the Author:	30-Jan-2015
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Primary Subject Heading:	Rehabilitation medicine
Secondary Subject Heading:	Complementary medicine, Evidence based practice
Keywords:	COMPLEMENTARY MEDICINE, Pain management < ANAESTHETICS, OCCUPATIONAL & INDUSTRIAL MEDICINE

The association of physical therapy, chiropractic care and early opioid prescription for acute low back pain with Workers' Compensation claim duration: An observational cohort study

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Abstract

Objective: To assess the association between reimbursement for physiotherapy, chiropractic, and early opioid prescription for low back pain (LBP) with disability claim duration.

Design: Observational cohort study.

Setting and participants: From a random sample of 6,665 claims for acute, uncomplicated LBP approved by the Ontario Workplace Safety and Insurance Board (WSIB) in 2005, we analyzed 1,442 that remained on full benefits at four weeks.

Primary and secondary outcome measures: Our primary outcome was WSIB claim duration.

Results: In our adjusted analysis, older age (e.g. hazard ratio [HR] for age ≥55 versus <25 = 0.52; 99% confidence interval [CI] = 0.36, 0.74) and WSIB-reimbursement for opioid prescription in the first 4 weeks of a claim (HR = 0.69; 99% CI = 0.53, 0.89) were associated with longer claim duration. Higher pre-disability income was associated with longer claim duration, but only among persistent claims (e.g. HR for active claims at 1-year with a pre-disability income >$902/week versus ≤$480 = 0.32; 99% CI = 0.16, 0.63). Missing data for union membership (HR = 1.27; 99% CI = 1.01, 1.60), and working for an employer with a return-to-work program was associated with fewer days on claim (HR = 1.77; 99% CI = 1.45, 2.18). Neither reimbursement for physiotherapy (HR = 0.99; 99% CI = 0.85, 1.16) or chiropractic care (HR = 1.08; 99% CI = 0.91, 1.29) were associated with claim duration.

Conclusions: Our analysis found that treatment commonly reimbursed by the Ontario WSIB for disabling acute LBP does not affect, or prolongs, claim duration. Well-designed randomized controlled trials are needed to confirm or refute our findings.

Key Words: Low back pain; disability; compensation; Workers Compensation Board; physical therapy; chiropractic; opioid; survival analysis

Strengths and Limitations

- A *priori* creation of our regression model and the anticipated direction of included independent variables, and assessment of the proportional hazards assumption for all independent variables, provide greater confidence in our findings.
- The reasons for reimbursement of physiotherapy, chiropractic or opioid prescription are uncertain, and despite our adjustments for potential confounders it remains possible that LBP claimants chosen to receive these healthcare interventions were prognostically different than those claimants who did not.
- A number of variables that may be important to consider were unavailable (e.g., patient expectations regarding recovery), and some variables were not optimally collected. For example, chiropractic and physiotherapy are professions and not modalities, and there were no details of treatment provided.
- Our primary outcome, claim closure, is a surrogate for patient-important outcomes such as functional restoration or return to work.

Introduction

Back pain is a common problem among working adults in North America, with a lifetime prevalence of 63% and a point prevalence of 21%.[1] After the common cold, low back pain (LBP) is the most frequent cause of lost time from work.[2] Globally, LBP is the primary cause of years lived with disability.[3]

In Canada, annual medical expenditures for LBP are estimated to be between $6 and $12 billion, with additional costs associated with loss in worker productivity from time off work and associated disability payments.[4] Canadian workers who are disabled secondary to a work-related LBP injury are typically eligible for wage replacement benefits through their provincial Workers' Compensation Board.

In 2012, the Ontario Workplace Safety and Insurance Board (WSIB) approved approximately 233,000 claims that were associated with $2,918 million in payments, most commonly for strains and sprains affecting the low back.[5,6] The WSIB's liability associated with disability claims greatly exceeds their assets, and as of March 31, 2013 the WSIB's unfunded liabilities were $12.4 billion [7] – more than double their unfunded liability of $5.9 billion in 2006 [8].

Interventions that are commonly reimbursed by WSIB for LBP claims include physiotherapy, chiropractic care and opioids; however, there is limited evidence to inform their effectiveness. There are no randomized controlled trials of these interventions focused on workers disabled by LBP, and many trials that enroll LBP patients use receipt of disability benefits as an exclusion criterion because of concerns that secondary gain (e.g., receipt of financial compensation conditional on disability) will reduce the treatment effect of study

interventions. There is indirect evidence for this hypothesis from surgical research: a recent meta-analysis of 129 studies revealed that the odds of an unsatisfactory outcome in surgical patients receiving disability benefits or engaged in litigation was 3.79 times greater (95% confidence interval [CI]: 3.28 to 4.37) than similar patients not receiving disability benefits or pursuing litigation.[9]

Using administrative data from the Ontario WSIB, we evaluated the association between reimbursement for physiotherapy, chiropractic care, or early prescription for opioids for uncomplicated LBP with disability claim duration. We reported our findings in concordance with the STROBE [10] and TRIPOD [11] statements.

Methods

Patient characteristics and eligibility criteria

We enrolled an inception cohort of workers with uncomplicated low back injuries (i.e., strain or sprain) who were fully disabled from working and receiving wage replacement benefits from the Ontario WSIB. We excluded workers if they were approved for no-lost-time claims. The prognosis for chronic LBP (duration >12 weeks) is different than the prognosis for acute LBP,[12] and we excluded all claims in which the number of days between accident date and registration date of the claim was greater than 30 days. Most LBP claims resolve within the 1st month, [13] and Workers' Compensation Boards are primarily interested in factors that predict claim resolution among claimants that remain disabled after this time. Further, the Ontario WSIB administrative database we used to acquire our model variables consists of scanned forms, and all data had to be manually extracted by reviewers. To increase the feasibility of our study we excluded claims that ended before 4 weeks.

Between January 1 and June 30, 2005, the Ontario WSIB approved 18,974 lost-time claims for an uncomplicated back injury. Using the WSIB's administrative database, we acquired a random sample of 6,665 injured workers from this population; 1,442 remained on full benefits at four weeks and provided data for our analysis. The WSIB database recorded benefit status for two years after the first day of injury. Patient information was anonymized and de-identified prior to analysis. The Health Sciences Research Ethics Board of the University of Toronto approved our study protocol.

Administrative Variables

The WSIB database consisted of demographic, administrative, and clinical information, which we acquired from forms completed by the worker, their employer, and their primary health-care provider. The employer form (Employer's Report of Injury/Disease Form; Form 7) is mandatory and must be submitted within three days of a work-related injury. The worker may elect to fill out a form (Worker's Report of Injury/Disease; Form 6) on a voluntary basis if they have expenses related to their injury. The healthcare provider can elect to complete a form (Health Professional's Report; Form 8) to support their patient's claim that their injury is work-related, which is a pre-requisite for wage replacement benefits through the WSIB. Healthcare providers are asked to complete and submit a Functional Abilities Form for Planning Early and Safe Return to Work for each claim, and the WSIB provides reimbursement as incentive.

In order to increase confidence in our findings, we constructed our regression model before conducting any analyses. Guided by the results from our ongoing systematic review of observational studies evaluating predictors of recovery in patients receiving disability benefits,[14] feedback from administrators at WSIB, and content experts within our research team, we selected, *a priori*, 11 variables from the WSIB database that we judged may be associated with claim closure and predicted the direction of anticipated effects on claim duration (Table S1 in File S1). To avoid overfitting our models, we required at least 10 observations per variable term for our Cox regression model, for a total of 190 disabled workers.[15]

Data Extraction

The Ontario WSIB's database consists of scanned paper documents, and data must therefore be extracted manually for analysis. Two experienced reviewers extracted data, independently and in duplicate, from the first 100 eligible claims into an Access database. In order to minimize data entry mistakes, we developed data entry forms that included range checks and missing value alerts. The PROC COMPARE procedure in SAS version 9.2 (SAS Institute Inc., Cary, NC) revealed 98% agreement for the initial 100 claims; therefore, to increase feasibility, only a single abstractor completed data entry for the remaining claims used in our analysis.

We screened all data to identify outliers, inconsistencies and missing data by calculating summary statistics, and explored distributions graphically. We worked with WSIB representatives to correct identified outliers and inconsistencies. If inconsistencies could not be corrected, we treated them as missing data. Some WSIB forms are voluntary, and we included "missing data" as a discrete category for independent variables when applicable.

Statistical analysis

We generated frequencies for all collected data. We reported the mean and standard deviation (SD) of continuous variables, and the number of occurrences with proportions represented as percentages for categorical variables. Neither age nor pre-disability gross income were normally distributed and were therefore entered as categorical variables into our regression model; by decade for age, starting at age 15 and ending at age 65, and by quartiles for pre-disability income.

Our primary outcome was time to claim closure, defined as the duration from disability claim approval until the claim was closed. We performed a time-to-event analysis using a Cox

proportional hazards regression model to assess the association between time to claim closure and the independent variables. We treated receipt of WSIB-reimbursed chiropractic care or physiotherapy as time-dependent covariates to account for when treatments were initiated during the course of the disability claim.

We tested for collinearity to assess if an independent variable was highly correlated with another (correlation coefficient r>0.5) using a correlation matrix. If two variables were highly correlated, we removed the variable that was considered to be of lesser importance, as guided by content experts on our team.

For claims that were unresolved when the data was extracted, we used the date of data extraction as our censoring point. In order to be more stringent and minimize the likelihood of spurious findings, an independent variable was considered statistically significant if it had a p-value ≤0.01 in our adjusted model. We calculated adjusted hazard ratios (HRs) for our time-to-event analyses, their associated 99% confidence intervals (CIs), and the associated p-values. We assessed each independent variable in our model to ensure that the proportional hazards assumption was met by entering each variable in the model separately and calculating the interaction with time. We considered a p-value of ≤0.01 for the interaction term as significant to account for multiple comparisons. We reported the HRs for independent variables that violated the proportional hazards assumption at 30-days (baseline), 6-months, and 1-year.

Pooling data from similar studies

When possible, we pooled the association between physiotherapy, chiropractic care, or early opioid use and claim duration in our sample with similar data from observational studies

identified through an ongoing systematic review.[14] We considered studies to be similar if they enrolled Workers' Compensation patients with uncomplicated LBP and, in the case of physiotherapy or chiropractic care, entered these variables as time-dependent covariates. When necessary, we converted odds ratios measures to a relative risk (RR), then to a HR, using the following formula:[16]

$$RR = OR/(1-P_0 + P_0 \times OR)$$

$$HR = (\ln(1-RR \times P_0))/(\ln(1-P_0))$$

P_0 is the proportion of patients in the control group who had an event by the follow-up time

We used random-effects meta-analyses, which are conservative in that they take both within-study and between-study variability into account.[17] We examined heterogeneity using both a chi-squared test and the I^2 statistic, the latter being the percentage of the total variation in outcomes that is associated with between-study variability (i.e., true differences between studies rather than with sampling error (chance)).[18] Heterogeneity of 0% to 40% was considered 'might not be important', 30% to 60% to be 'moderate heterogeneity', 50% to 90% to be 'substantial heterogeneity', and 75% to 100% to be 'considerable heterogeneity'.[19] The Cochrane Collaboration has proposed overlapping categories to convey that there are no strict cut-offs for interpreting heterogeneity, and this decision will depend on the magnitude and direction of effects, and the strength of evidence for heterogeneity.

Results

Table 1 presents the baseline characteristics for the 1,442 disabled workers included in our analysis. At some point during their claim, the Ontario WSIB reimbursed 786 (55%) claimants for physiotherapy and 391 (27%) for chiropractic care; approximately 9% of claimants (n=136) were reimbursed for an opioid prescription in the first 4 weeks of their claim. 1348 (93.5%) claims were closed prior to 2 years and 94 (6.5%) were censored. Figure 1 presents the Kaplan-Meier curve for time to claim closure for LBP claimants.

We did not identify any significant collinearity among independent variables in our regression model. Our adjusted regression analysis showed that older age (e.g., HR for age ≥55 versus <25 = 0.52; 99% CI = 0.36, 0.74) and opioid prescription reimbursed by the Ontario WSIB in the first 4-weeks of claim (HR = 0.69; 99% CI = 0.53, 0.89) were associated with longer claim duration. In other words, at any point in time, claimants who were reimbursed for opioids within the first 4 weeks of their claim were 31% less likely to resolve their claim within 2 years versus claimants who were not reimbursed for opioids. The association of pre-disability income with claim duration was not proportional over time, and older claims showed a significant association with longer claim duration (e.g. HR for active claims at 1-year with a pre-disability income >$902/week = 0.32; 99% CI = 0.16, 0.63). Working for an employer that had a return-to-work program (HR = 1.77; 99% CI = 1.45, 2.18), and missing data regarding union membership (HR = 1.27, 99%CI = 1.01, 1.60) was associated with shorter claim duration. Contrary to our predictions, neither WSIB-reimbursement for physiotherapy nor chiropractic care were associated with claim duration (Table 2).

Our ongoing systematic review [14] identified 3 observational studies that explored early use of opioids for Workers' Compensation claims due to uncomplicated LBP, 2 of which adjusted for injury severity, and all of which reported a significant association with prolonged claim duration (Table S2 in File S1).[20-22] When our results were pooled with the 2 studies that reported measures of association in relative units,[21,22] resulting in a total of 51,069 participants, the association between early opioid use and prolonged claim duration was consistent with our findings (adjusted HR = 0.58, 95%CI (0.48 to 0.70), heterogeneity test p=0.02, I^2=76%) (Figure 2). The pooled effect was associated with substantial heterogeneity; however, statistical tests of heterogeneity can be misleading when sample sizes are very large and confidence intervals are therefore very narrow.[23] These results provide an excellent example of the phenomenon. The three studies all show a large effect, and the point estimates are very consistent one with the other (0.52 to 0.69) which increases confidence in our findings.

Discussion

Our analysis of the Ontario WSIB's administrative data revealed that older claimants who were disabled due to uncomplicated LBP and who are reimbursed for opioid prescription in the first 4 weeks of their claim are more likely to experience prolonged claim duration. Higher pre-injury income was also associated with prolonged claim duration, but only among persistent claims. Injured workers employed by organizations with a RTW program who are missing information on union affiliation are likely to resolve their claim faster. The WSIB reimburses physiotherapy for 55% of uncomplicated LBP claims, and chiropractic care for 27% of LBP claims, and neither was associated with claim duration.

The strengths of our study included the *a priori* creation of our regression model and the anticipated direction of included independent variables. We were unable to adjust for injury severity, but attempted to enroll patients with similar injuries by restricting our cohort to acute, uncomplicated LBP. Other strengths include limited missing data, correction of identifiable data errors and inconsistencies, and validation checks to ensure the accuracy of the data used to inform our regression model. We assessed the proportional hazards assumption for all independent variables in our regression model.

Our study has several limitations. First, it was a retrospective cohort study in which the reasons for reimbursement of physiotherapy, chiropractic or opioid prescription are uncertain. Thus, despite our adjustments for potential confounders, it remains possible that LBP claimants chosen to receive these healthcare interventions were prognostically different than those claimants who did not. Second, the WSIB database only records physiotherapy or chiropractic treatments that are reimbursed by the WSIB, and it is possible that some patients paid out-of-

pocket to receive these services. Third, a number of variables that may be important to consider were unavailable (e.g., patient expectations regarding recovery [24]), and some variables were not optimally collected. For example, chiropractic and physiotherapy are professions and not modalities, and there were no details of treatment provided. Fourth, our study focused on workers with LBP receiving disability benefits from the Ontario WSIB, we cannot say whether our findings are generalizable to other Workers' Compensation Boards. Finally, our primary outcome, claim closure, is a surrogate for patient-important outcomes such as functional restoration or return to work.

Our finding that older age is associated with prolonged claim duration is consistent with the literature.[25] We predicted that injured workers employed by companies that had formal return to work programs would resolve their claim faster, and this was supported by our findings. It is unclear why missing data for union membership was also associated with shorter claim duration. Our finding that higher pre-disability income is associated with prolonged claim duration, but only among persistent claims, suggests that injured workers with higher salaries that do not resolve their claim in the initial 6-months may find it more difficult to identify suitable employment that provides similar earnings.

Although there are no randomized controlled trials exploring the effect of physiotherapy, chiropractic care, or early opioid use for workers with uncomplicated LBP receiving compensation benefits, there are observational studies that are relevant to our findings. Wasiak and colleagues found that workers in Florida, USA, with low back injuries who were reimbursed for limited chiropractic care (<30 days) experienced an 8.6% shorter duration of work disability versus Workers' Compensation claimants who were reimbursed for prolonged

chiropractic care (>30 days).[26] The authors did exclude severe injuries from their population, but were unable to adjust for injury severity within their sample. Further, chiropractic care was collected after baseline and not treated as time-dependent, and so it is not surprising that claims with longer duration also received more chiropractic care.

Lemstra and Olszynski explored the effect of standard care (which included long waiting lists for physiotherapy) to provision of rapid rehabilitation services on Workers' Compensation claim duration from a company in Saskatchewan, Canada.[27] After adjusting for a number of factors, including age and injury severity, longer claim duration was associated with both chiropractic care (adjusted HR = 2.88, 95% CI = 1.45, 5.73) and physical therapist involvement (adjusted HR = 19.88, 95%CI = 7.95, 39.77). The authors collected healthcare provider utilization data after baseline and did not treat these variables as time-dependent, and an alternative explanation is that claims with longer duration are more likely to involve either chiropractors or physical therapists.

Turner and colleagues followed 1,885 workers from Washington for 1 year after they had been awarded Workers' Compensation benefits for acute LBP. In a comprehensive regression model adjusted for multiple sociodemographic, employment, clinical, healthcare, and administrative factors – including injury severity – they found that workers who attended a chiropractor first, versus a primary care provider, were significantly less likely to remain on disability benefits at 1 year (adjusted OR = 0.41, 95% CI = 0.24, 0.70).[28]

Canada is currently the largest per-capita consumer of opioids in the world; [29] however, prescribing patterns between primary care providers in Ontario show considerable variation [30]. Workers' Compensation data has shown an almost 10 fold difference (5.7% to 52.9%) in the

early prescription of opioid medications between various US states, suggesting that local prescribing patterns have significant influence on the use of these analgesics.[31] Findings from a study of Workers' Compensation nonspecific LBP claims revealed that, compared with a no opioid reference group, odds of chronic work loss were six times greater for claimants that used strong opioids and 11-14 times greater for claimants with opioid prescriptions which exceeded 90 days.[32] We found that reimbursement for early opioid use by the Ontario WSIB prolongs claim duration for uncomplicated back pain, and pooling of our data with similar studies [21,22] shows a consistent effect, which increases confidence in our findings.

To manage their growing unfunded liability, the Ontario WSIB has focused on increasing their claim denial rate, decreasing benefits to injured workers, reducing WSIB staff, and raising employer premiums.[33,34] Most employers are obligated to pay WSIB premiums as they are legally bound to provide injury benefits to their employees and the Ontario WSIB is protected by laws prohibiting competition in the marketplace. Another strategy is to optimize clinical management of injured workers. Our findings suggest that therapies for acute, uncomplicated LBP commonly reimbursed by the Ontario WSIB may be ineffective or even prolong claim duration. High quality, randomized controlled trials are urgently needed to confirm or refute our findings.

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Acknowledgements

The authors thank Dr. Gordon Guyatt for helpful discussion.

Contributors

JWB, SE, D-HA and SDW designed the study. DH-A and LW conducted data analysis and SDW provided statistical advice. JWB, SE, D-HA and SDW were involved in interpreting the data. JWB drafted the manuscript and wrote the final version. All authors critically revised the manuscript, provided comment and approved the final version for publication.

Funding

This study was funded by research grants from the Ontario Workers Safety and Insurance Board Research Advisory Council and the Ontario Chiropractic Association. Shanil Ebrahim is supported by a MITACS Elevate Postdoctoral Fellowship Award. The funding sources had no role in design

or conduct of the study; the collection, management, analysis, or interpretation of the data; or the preparation, review, or approval of the manuscript.

Competing interests

Jason Busse acts as a consultant to Prisma Health Canada, a private incorporated company funded by employers and insurers that consults on and manages long-term disability claims.

Ethics approval

The study was approved by the Health Sciences Research Ethics Board of the University of Toronto.

Provenance and peer review

Not commissioned; externally peer reviewed.

Data sharing statement

No additional data are available.

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Figure Legends

Figure 1: Kaplan-Meier curve for time to claim closure

Figure 2: The association between early opioid use/prescription and claim duration

Supporting Information Legends

Table S1: Description of model variables

Table S2: Observational studies exploring the association between early opioid use and Workers' Compensation claim duration

Table 1: Baseline Characteristics of WSIB Low Back Pain Claims (n=1,442)

Age, mean (SD)	41.3 (10.5)
Gender, n (%)	
Female	552 (38.3)
Male	890 (61.7)
First language, n (%)	
English	1372 (95.1)
Other	70 (4.9)
Pre-disability income (dollars/week) mean (SD)	731.4 (332.5)
Opioid prescription reimbursed by WSIB in the first 4-weeks of claim, n (%)	
Yes	136 (9.4)
No	1306 (90.6)
Prior WSIB claim, n (%)	
Yes	1091 (75.7)
No	351 (24.3)
Union membership, n (%)	
Yes	610 (42.3)
No	656 (45.5)
Missing data	176 (12.2)
Employer RTW program, n (%)	
Yes	1042 (72.3)
No	278 (19.3)
Missing data	122 (8.5)
Employer doubts work-relatedness of injury, n (%)	
Yes	195 (13.5)
No	1051 (72.9)
Missing data	196 (13.6)
Chiropractic care reimbursed by WSIB during claim, n (%)	391 (27.1)
Physiotherapy reimbursed by WSIB during claim, n (%)	786 (54.5)

Table 2: Factors associated with time to claim closure (n=1,442)*

	Adjusted Hazard Ratio (99% CI)	p-value
Age		<0.001
15 to <25	1.00	
25 to <35	0.79 (0.58, 1.08)	
35 to <45	0.70 (0.52, 0.95)	
45 to <55	0.67 (0.49, 0.91)	
55 to 65	0.52 (0.36, 0.74)	
Gender		0.45
Male	1.00	
Female	0.96 (0.82, 1.12)	
First language		0.33
English	1.00	
Other	0.88 (0.63, 1.23)	
Pre-disability gross income (dollars/week)		
At 30 days:		
≤480	1.00	
481-694	1.08 (0.85, 1.37)	0.396
695-920	1.05 (0.81, 1.36)	0.614
>920	1.04 (0.80, 1.35)	0.689
At 180 days:		
≤480	1.00	
481-694	0.85 (0.65, 1.12)	0.130
695-920	0.71 (0.52, 0.96)	0.003
>920	0.61 (0.45, 0.84)	<0.001
At 365 days:		
≤480	1.00	
481-694	0.63 (0.35, 1.16)	0.051
695-920	0.44 (0.23, 0.84)	0.001
>920	0.32 (0.16, 0.63)	<0.001
Opioid prescription reimbursed by the Ontario WSIB in the first 4 weeks of claim		<0.001
No	1.00	
Yes	0.69 (0.53, 0.89)	
Prior WSIB claim		0.66
No	1.00	
Yes	1.03 (0.87, 1.22)	
Union membership		0.01
No	1.00	
Yes	1.14 (0.96, 1.36)	
Missing data	1.27 (1.01, 1.60)	
Employer with a RTW program		<0.001
No	1.00	
Yes	1.77 (1.45, 2.18)	
Missing data	1.18 (0.86, 1.60)	
Employer doubts work-relatedness of injury		0.12
No	1.00	
Yes	0.87 (0.70, 1.08)	
Missing data	1.08 (0.87, 1.33)	
Chiropractic care reimbursed by WSIB	1.08 (0.91, 1.29)	0.27
Physiotherapy reimbursed by WSIB	0.99 (0.85, 1.16)	0.91

* HR>1 indicates faster claim closure; RTW = return to work

Figure 1: Kaplan-Meier curve for time to claim closure

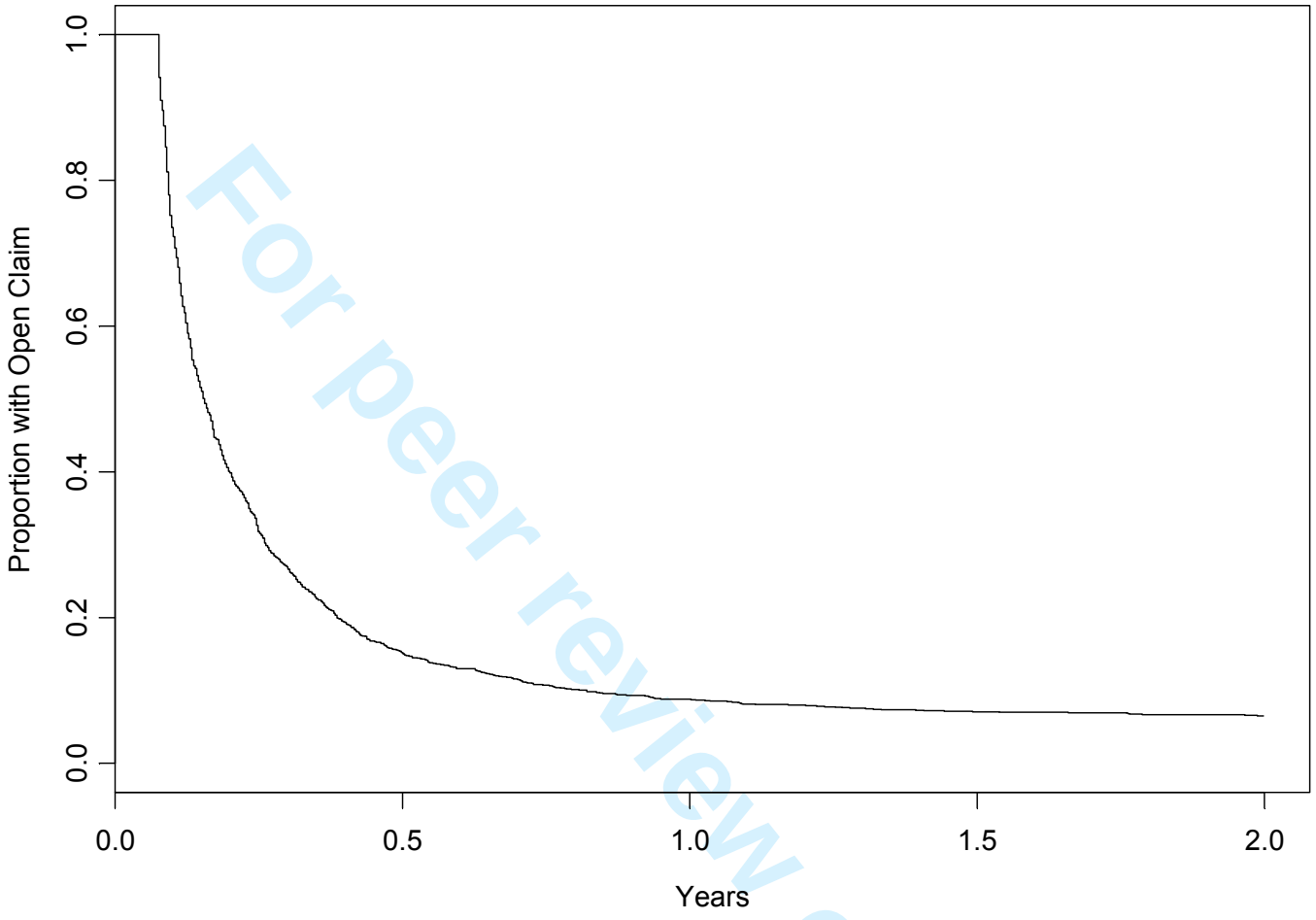

Figure 2: The association between early opioid use/prescription and claim duration

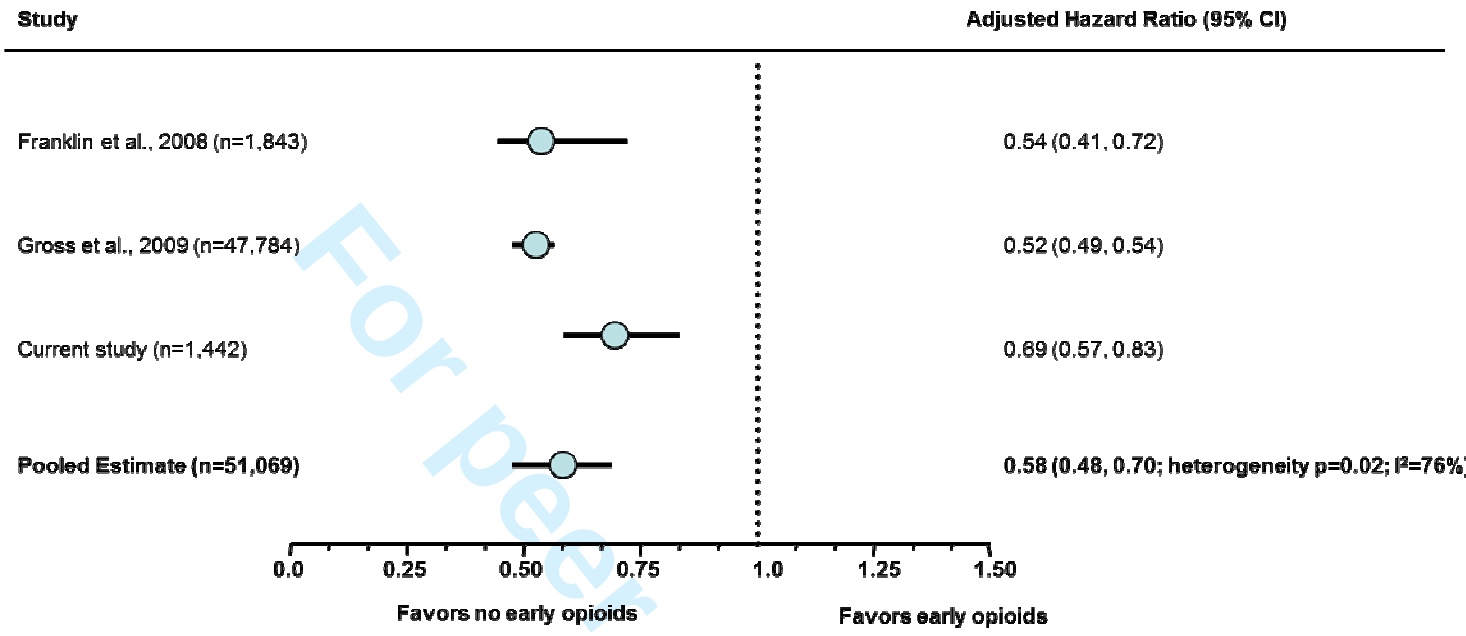

Table S1: Description of model variables

Variable	Anticipated Direction of Effect
Age	older age: -
Gender	female: -
First language	non-English: -
Pre-disability income	higher income: -
Reimbursement for opioid prescription	opioid reimbursement: -
Prior claim(s)	prior claim: -
Union membership	Union member: +
Employer RTW-program	RTW program: +
Work-relatedness	work-related: +
Chiropractic care*	DC care: +
Physiotherapy*	PT care: +

+: associated with faster claim closure
-: associated with slower claim closure
*: time dependant covariate

Table S2: Observational studies exploring the association between early opioid use and Workers' Compensation claim duration

Study	Population	Opioid variable tested	Adjustments	Dependant variable	Results*
Webster et al., 2007	8,443 American Workers' Compensation claimants with new-onset, disabling LBP	Receipt of opioids within the first 15 days of claim	Injury severity, age, gender, length of job tenure	Change in mean disability duration	**1-140mg MEA** 5.4 days, 95%CI = -14.6 to 25.0 **141-225mg MEA** 21.9 days, 95%CI = 3.2 to 40.6 **226-450mg MEA** 43.8 days, 95%CI = 23.7 to 63.9 **>450mg MEA** 69.1 days, 95%CI = 49.3 to 89.0
Franklin et al., 2008	1,843 Washington, US, Workers' Compensation claimants with new-onset, disabling LBP	Reimbursement for opioids within 6 weeks of 1st medical visit for LBP	Age, gender, race, education, injury severity, pain intensity, Roland disability questionnaire	Receipt of wage replacement benefits at 1-year	**1-150mg MED** OR = 1.9, 95%CI = 1.2 to 3.1 **151-300mg MED** OR = 2.0, 95%CI = 1.2 to 3.3 **301-650mg MED** OR = 1.6, 95%CI = 0.9 to 2.6 **>650mg MED** OR = 1.9, 95%CI = 1.2 to 2.9
Gross et al., 2009	47,784 Alberta, Canada, Workers' Compensation claimants with new-onset, disabling LBP	Reimbursement for opioids within the first 2 weeks of claim	Age, gender, annual salary, year of claim, number of previous claims	Receipt of wage replacement benefits at 1-year	**No early opioids** HR = 1.94, 95%CI = 1.86 to 2.02

* The reference group is no early receipt of opioids for Franklin et al., and Webster et al.
95% CI = 95% confidence interval
LBP = low back pain

MEA = morphine equivalent amount
MED = morphine equivalent dose
OR = odds ratio
HR = hazard ratio

STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract (**in title on title page**)
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found (**in Abstract**)
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported (**page 1 & 2 in Manuscript**)
Objectives	3	State specific objectives, including any prespecified hypotheses (**Appendix A**)
Methods		
Study design	4	Present key elements of study design early in the paper (**In Abstract, and page 3-7 in Manuscript**)
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection (**page 3 in Manuscript**)
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (**pages 3 & 4 in Manuscript**)
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed (**not applicable**)
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable (**Appendix A and pages 3 & 4 in Manuscript**)
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group (**pages 3-5 in Manuscript**)
Bias	9	Describe any efforts to address potential sources of bias (**pages 4-7 in Manuscript**)
Study size	10	Explain how the study size was arrived at (**page 3 & 4 in Manuscript**)
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why (**pages 5 & 6 in Manuscript**)
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding (**pages 3-7 in Manuscript**)
		(*b*) Describe any methods used to examine subgroups and interactions (**page 6 in Manuscript**)
		(*c*) Explain how missing data were addressed (**page 5 in Manuscript**)
		(*d*) If applicable, explain how loss to follow-up was addressed (**not applicable**)
		(*e*) Describe any sensitivity analyses (**not applicable**)
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (**Table 1 and page 8 in Manuscript**)
		(b) Give reasons for non-participation at each stage (**not applicable**)
		(c) Consider use of a flow diagram (**not informative in our case**)

Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (**Table 1**)
		(b) Indicate number of participants with missing data for each variable of interest (**Table 1**)
		(c) Summarise follow-up time (eg, average and total amount) (**Figure 1**)
Outcome data	15*	Report numbers of outcome events or summary measures over time (**page 8 in Manuscript**)
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (**Table 2**)
		(*b*) Report category boundaries when continuous variables were categorized (**Table 2**)
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period (**not relevant**)
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses (**page 8 in Manuscript**)
Discussion		
Key results	18	Summarise key results with reference to study objectives (**page 10 in Manuscript**)
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias (**pages 10 & 11 in Manuscript**)
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence (**page 13 in Manuscript**)
Generalisability	21	Discuss the generalisability (external validity) of the study results (**page 11 in Manuscript**)
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based (**page 14 in Manuscript**)

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

BMJ Open

The association of worker characteristics and early reimbursement for physical therapy, chiropractic and opioid prescriptions with Workers' Compensation claim duration, for cases of acute low back pain: An observational cohort study

Journal:	*BMJ Open*
Manuscript ID:	bmjopen-2015-007836.R1
Article Type:	Research
Date Submitted by the Author:	21-May-2015
Complete List of Authors:	Busse, Jason; McMaster University, Anesthesia; McMaster University, Clinical Epidemiology & Biostatistics Ebrahim, Shanil; Mcmaster University, Clinical Epidemiology and Biostatistics Heels-Ansdell, Diane; Mcmaster University, Clinical Epidemiology and Biostatistics Wang, Li; McMaster University, Anesthesia Couban, Rachel; McMaster University, Anesthesia Walter, Stephen ; Mcmaster University, Clinical Epidemiology and Biostatistics
Primary Subject Heading:	Rehabilitation medicine
Secondary Subject Heading:	Complementary medicine, Evidence based practice
Keywords:	COMPLEMENTARY MEDICINE, Pain management < ANAESTHETICS, OCCUPATIONAL & INDUSTRIAL MEDICINE

The association of worker characteristics and early reimbursement for physical therapy, chiropractic and opioid prescriptions with Workers' Compensation claim duration, for cases of acute low back pain: An observational cohort study

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Abstract

Objective: To assess the association between early reimbursement for physiotherapy, chiropractic, and opioid prescription for acute low back pain (LBP) with disability claim duration.

Design: Observational cohort study.

Setting and participants: From a random sample of 6,665 claims for acute LBP approved by the Ontario Workplace Safety and Insurance Board (WSIB) in 2005, we analyzed 1,442 that remained on benefits at 4-weeks.

Primary outcome measure: WSIB claim duration.

Results: Our time-to-event analysis was adjusted for demographic, workplace, and treatment factors, but not injury severity. Older age (e.g. hazard ratio [HR] for age ≥55 versus <25 = 0.52; 99% confidence interval [CI] = 0.36, 0.74) and WSIB-reimbursement for opioid prescription in the first 4-weeks of a claim (HR = 0.68; 99% CI = 0.53, 0.88) were associated with longer claim duration. Our systematic review (n=51,069 workers) confirmed a strong association between early opioid use and prolonged claim duration (HR = 0.57, 95%CI = 0.48 to 0.69). Among persistent claims, higher pre-disability income was associated with longer claim duration (e.g. HR for active claims at 1-year with a pre-disability income >$902/week versus ≤$480 = 0.34; 99% CI = 0.17, 0.68). Missing data for union membership (HR = 1.27; 99% CI = 1.01, 1.59), and working for an employer with a return-to-work program was associated with shorter claim duration (HR = 1.78; 99% CI = 1.45, 2.18). Neither reimbursement for physiotherapy (HR = 1.01; 99% CI = 0.86, 1.19) or chiropractic care (HR for active claims at 60 days = 1.15; 99% CI = 0.94, 1.41) within the first 4-weeks were associated with claim duration.

Conclusions: Our analysis found that early WSIB reimbursement for physiotherapy or chiropractic care is not associated with claim duration, and early reimbursement for opioids predicts prolonged claim duration. Well-designed randomized controlled trials are needed to verify our findings.

Key Words: Low back pain; disability; compensation; Workers Compensation Board; physical therapy; chiropractic; opioid; survival analysis

Strengths and Limitations

- A *priori* creation of our regression model and the anticipated direction of included independent variables, and assessment of the proportional hazards assumption for all independent variables, provide greater confidence in our findings.
- The reasons for reimbursement of physiotherapy, chiropractic or opioid prescription are uncertain, and despite our adjustments for potential confounders (but not injury severity) it remains possible that LBP claimants who chose to receive these healthcare interventions were prognostically different than those claimants who did not.
- A number of variables that may be important to consider were unavailable (e.g., patient expectations regarding recovery), and chiropractic and physiotherapy are professions, not modalities, and details of the treatment provided could not be obtained for our analysis.
- Our primary outcome, time to claim closure, is a surrogate for patient-important outcomes such as functional restoration or return to work.

Introduction

Back pain is a common problem among working adults in North America, with a lifetime prevalence of 63% and a point prevalence of 21%.[1] After the common cold, low back pain (LBP) is the most frequent cause of lost time from work.[2] Globally, LBP is the primary cause of years lived with disability.[3]

In Canada, annual medical expenditures for LBP are estimated to be between $6 and $12 billion, with additional costs associated with loss in worker productivity from time off work and associated disability payments.[4] Canadian workers who are disabled secondarily to a work-related LBP injury are typically eligible for wage replacement benefits through their provincial Workers' Compensation Board.

In 2013, the Ontario Workplace Safety and Insurance Board (WSIB) approved approximately 232,000 claims that were associated with $2,761 million in payments, and 18% of all allowed lost-time claims were for low back injuries.[5, 6] The WSIB's liability for disability claims greatly exceeds their assets, and as of March 31, 2013 the WSIB's unfunded liabilities were $12.4 billion[7] – more than double their unfunded liability of $5.9 billion in 2006.[8] Unfunded liability is the amount by which future payment obligations exceed the present value of funds available to pay them. To reduce their unfunded liability, the WSIB has become more aggressive about denying claims, decreasing disability benefits, and increasing employee premiums; [9, 10] however, these measures do not address optimal management of disability claims.

Interventions that are commonly reimbursed by WSIB for LBP claims include physiotherapy, chiropractic care and opioids; however, there is limited evidence about their effectiveness. Our systematic review of the Cochrane Back Review Group trial registry found no randomized controlled trials of these interventions focused on workers disabled by LBP and receiving benefits for lost-time claims (Tables S1 & S2, and Figure S1, in File S1). We also found that many trials that enroll LBP patients use receipt of disability benefits as an exclusion criterion, likely because of concerns that secondary gain (e.g., receipt of financial compensation conditional on disability) will reduce the impact of study interventions. Henshke and colleagues followed a cohort of 973 consecutive primary care patients with non-specific, acute LBP recruited from the clinics of 170 general practitioners, physiotherapists, and chiropractors for 1-year. They found that, in an analysis adjusted for age, gender, injury severity and psychological factors, receipt of disability benefits was strongly associated with delayed recovery (hazard ratio [HR]=0.59; 95%CI = 0.47 to 0.74).[11] As compensated acute LBP has a worse prognosis than uncompensated acute LBP, the results of trials that do not enroll patients receiving disability benefits cannot be confidently generalized to patients who are receiving compensation.

Using administrative data from the Ontario WSIB, we evaluated the association between receiving early reimbursement for physiotherapy, chiropractic care, or prescription for opioids for uncomplicated LBP and disability claim duration. On the basis of prior observational studies,[12-16] we hypothesized that early reimbursement for opioids would be associated with delayed recovery, and early reimbursement for physiotherapy or chiropractic care would be associated with faster recovery. We reported our findings in concordance with the STROBE [17] and TRIPOD [18] statements.

Methods

Patient characteristics and eligibility criteria

Using WSIB administrative data, we identified an inception cohort of workers with uncomplicated low back injuries (i.e., strain or sprain) who were fully disabled from working and receiving wage replacement benefits from the Ontario WSIB. We excluded workers if they were approved for no-lost-time claims. The prognosis for chronic LBP (duration >12 weeks) is different than for acute LBP,[19] and we excluded all claims in which the number of days between accident date and registration date of the claim was greater than 30 days. Most LBP claims resolve within the 1st month,[20] and Workers' Compensation Boards are primarily interested in factors that predict claim resolution among claimants that remain disabled after this time. We therefore excluded claims that ended before 4 weeks.

Between January 1 and June 30, 2005, the Ontario WSIB approved 18,974 lost-time claims for an uncomplicated, acute low back injury. Using the WSIB's administrative database, we acquired a random sample of 6,665 injured workers from this population; 1,442 unique workers remained on full benefits at four weeks and provided data for our analysis. If a worker had more than 1 claim for acute LBP, their first claim was used. The WSIB database recorded benefit status for two years after the first day of injury. Patient information was anonymized and de-identified prior to analysis. The Health Sciences Research Ethics Board of the University of Toronto approved our study protocol.

Administrative Variables

Our primary outcome was time to claim closure, defined as the duration in days from disability claim approval until the claim was closed. The WSIB database also contained demographic, administrative, and clinical information, which we acquired from forms completed by the worker, their employer, and their primary health-care provider. The employer form (Employer's Report of Injury/Disease Form; Form 7), which is used to indicate whether there is doubt regarding the work-relatedness of an employee's back injury, is mandatory and must be submitted within three days of a work-related injury. The form asks employer's "Do you have any reason to doubt the injury/disease is work-related?" and they can indicate either "no" or "yes".

The worker may elect to fill out a form (Worker's Report of Injury/Disease; Form 6) if they have expenses related to their injury. The healthcare provider can elect to complete a form (Health Professional's Report; Form 8) to support their patient's claim that their injury is work-related, which is a pre-requisite for wage replacement benefits through the WSIB. Healthcare providers are asked to complete and submit a Functional Abilities Form for Planning Early and Safe Return to Work for each claim, and the WSIB provides compensation as incentive.

In order to increase confidence in our findings, we defined our regression model before conducting any analyses. Guided by the results from our ongoing systematic review of observational studies evaluating predictors of recovery in patients receiving disability benefits,[21] feedback from administrators at WSIB, and content experts within our research team, we selected, *a priori*, 11 variables from the WSIB database that we judged may be associated with claim closure; we also specified the direction of anticipated effects on claim

duration (Table 1): age, gender, native language, pre-disability income, prior disability claim, union membership, employer with a return to work (RTW) program, employer's doubt that the injury was work-related, and early (1st month) receipt of reimbursement for treatment with opioids, physiotherapy, or chiropractic care (Table 1). The Ontario WSIB does not capture any measure of LBP injury severity, and as such we were unable to adjust for this variable. Injured workers may attend a healthcare provider for assessment purposes. We required ≥3 reimbursed visits for physiotherapy or chiropractic, within the first 28-days of claim, in order to qualify as reimbursement for treatment.

We hypothesized that workers represented by a union would resolve their claim faster, as they likely had more support for re-engagement with competitive employment (e.g. graduated work hours) versus workers who were not supported by a union. We also hypothesized that claims due to injuries that employers reported were work-related would resolve faster than injuries in which the employer doubted that the employee was injured at work, as we felt this may be a surrogate for the influence of non-medical factors (e.g. secondary gain). Based on the findings of a recent systematic review that found RTW coordination was associated with faster RTW for disabled employees,[22] we hypothesized that claimants employed by companies with formal RTW programs would resolve their claim faster.

Data Extraction

The Ontario WSIB's database consists of scanned paper documents, and data must therefore be extracted manually for analysis. Two reviewers extracted data, independently and in duplicate, from the first 100 eligible claims into an Access database (Microsoft Access, Filemaker). In order

to minimize data entry mistakes, we developed data entry forms that included range checks and missing value alerts. The PROC COMPARE procedure in SAS version 9.2 (SAS Institute Inc., Cary, NC) revealed 98% agreement for the initial 100 claims; therefore, to increase feasibility, only a single abstractor completed data entry for the remaining claims used in our analyses.

We screened all data to identify outliers, inconsistencies and missing data by calculating summary statistics, and explored distributions graphically. We worked with WSIB representatives to correct identified outliers and inconsistencies. If inconsistencies could not be corrected, we treated them as missing data. Some WSIB forms are voluntary, and so we included "missing data" as a discrete category for independent variables when applicable.

Statistical analysis

We generated frequencies for all collected data. We reported the mean and standard deviation (SD) of continuous variables, and the number of occurrences represented as proportions for categorical variables. Age was negatively skewed and pre-disability gross income was positively skewed and were therefore entered as categorical variables into our regression model; by decade for age, starting at age 15 and ending at age 65, and by quartiles for pre-disability income.

We performed a time-to-event analysis using a Cox proportional hazards regression model to assess the association between time to claim closure and all 11 independent variables described in Table 1. To avoid overfitting our models, we required at least 10 observations per variable term for our Cox regression model, for a total of 190 disabled workers.[23] We set a threshold of at least 50 observations per category for each independent factor in our regression

model to provide some reassurance that each variable had sufficient discriminant power to detect an association with claim duration, if such an association existed.

For claims that were unresolved when the data was extracted, we used 2-years after claim approval as a censoring point. In order to be more stringent and minimize the likelihood of spurious findings, an independent variable was considered statistically significant if it had a p-value of ≤0.01 in our adjusted model. We calculated adjusted hazard ratios (HRs) for our time-to-event analyses, their associated 99% confidence intervals (CIs), and the associated p-values. We assessed each independent variable in our model to ensure that the proportional hazards assumption was met, by entering each variable in the model separately and calculating its interaction with time. We considered a p-value of ≤0.05 for the interaction term as significant. We reported the HRs for independent variables that violated the proportional hazards assumption at 60-days, 6-months, and 1-year. We conducted a sensitivity analysis to investigate the impact of entering receipt of WSIB-reimbursed chiropractic care or physiotherapy as time-dependent covariates in a Cox proportional hazards regression model. This approach accounts for when treatments were initiated during the course of the disability claim.

Pooling data from similar studies

When possible, we pooled the association between early opioid, physiotherapy, or chiropractic care and claim duration in our sample with similar data from observational studies identified through a systematic review (search strategy, Table S4 in File S1). We considered studies to be similar if they enrolled Workers' Compensation patients with uncomplicated LBP and, explored

the association of early treatment with opioids, physiotherapy or chiropractic care with claim duration. Using a standardized, pilot-tested forms, 2 reviewers screened, independently and in duplicate, titles and abstracts of identified citations and then full texts of potentially eligible studies. The same reviewers extracted patient characteristics, methodology, and measures of association between early use of opioids, physiotherapy or chiropractic care and disability claim duration from eligible articles.

We used the following criteria to gauge risk of bias: (1) representativeness of the study population (low risk of bias when using random sampling, consecutive sampling, or data collected from national or international cancer registry, high risk of bias when the source of study population was not reported or acquired through convenience sampling); (2) validity of outcome assessment (low risk of bias when claim duration was acquired directly from the benefits administrator); (3) proportion of lost to follow-up (high risk of bias if >20%); and (4) whether or not predictive models were appropriately adjusted (low risk of bias if adjusted for age, gender, and illness severity).

When possible, we pooled measures of association between early opioid, physiotherapy, or chiropractic care and claim duration, and presented the pooled estimate as a HR and the associated 95%CI. When necessary, we converted odds ratios (ORs) to a relative risk (RR), then to a HR, using the following formula: [24]

$$RR = OR/(1-P_0 + P_0 \times OR)$$

$$HR = (\ln(1-RR \times P_0))/(\ln(1-P_0))$$

P_0 is the proportion of patients in the control group who had an event by the follow-up time.

We used random-effects meta-analyses, which are usually conservative in that they take both within-study and between-study variability into account.[25] We examined heterogeneity using both a chi-squared test and the I^2 statistic, the latter being the percentage of the total variation in outcomes that is associated with between-study variability (i.e., true differences between studies rather than with sampling error (chance)). [26] Heterogeneity of 0% to 40% was considered 'might not be important', 30% to 60% to be 'moderate heterogeneity', 50% to 90% to be 'substantial heterogeneity', and 75% to 100% to be 'considerable heterogeneity'.[27] The Cochrane Collaboration has proposed overlapping categories, to convey that there are no strict cut-offs for interpreting heterogeneity, and that this decision will depend on the magnitude and direction of effects, as well as the strength of evidence for heterogeneity.

We used the GRADE approach to summarize the certainty of evidence for the effect of early opioid use on claim duration as high, moderate, low, or very low.[28] Using GRADE, observational studies begin as moderate certainty but can be rated down due to: (1) risk of bias; (2) inconsistency; (3) indirectness; (4) imprecision; or (5) publication bias. GRADE suggests considering rating up quality of evidence one level when methodologically rigorous observational studies show at least a two-fold reduction or increase in risk, and rating up two levels for at least a five-fold reduction or increase in risk.[29] We assessed publication bias by visually observing asymmetry of funnel plots, but only if there were ≥10 studies eligible for meta-analysis. We performed all statistical analyses using SAS version 9.2 (SAS Institute Inc., Cary, NC, USA). All hypothesis tests were 2-tailed and $p \leq 0.05$ was considered statistically significant.

We estimated the cumulative proportion of claims closed in our WSIB dataset at 90-days for disabled workers that did, and did not, receive early opioids by using the following formula:

$$P_1 = 1 - (1 - P_0)^{HR}$$

where P_1 is the cumulative proportion of claims closed by 90-days in the early opioid group, P_0 is the cumulative proportion of claims closed by 90-days in the group that did not receive early opioids, and HR is the pooled estimate of the hazard ratio from our meta-analysis.

Results

Table 2 presents the baseline characteristics for the 1,442 disabled workers included in our analysis. The Ontario WSIB reimbursed 786 (55%) claimants for physiotherapy and 391 (27%) for chiropractic care. In the first 4 weeks of their claim, 27% (n=388) were reimbursed for ≥3 physiotherapy treatments, 17% (n=247) were reimbursed for ≥3 chiropractic treatments, and 9% of claimants (n=136) were reimbursed for an opioid prescription. Figure 1 presents the Kaplan-Meier curve for time to claim closure for LBP claimants. Most workers (67%, n=966) had their claim closed by 90 days, 84% (n=1211) by 180 days, and 91% by 1 year (n=1312); 1348 (93.5%) claims were closed prior to 2 years and 94 (6.5%) were censored.

Time-to-Event Analysis

Our adjusted regression analysis showed that older age (e.g., HR for age ≥55 versus <25 = 0.52; 99% CI = 0.36, 0.74) and opioid prescription reimbursed by the Ontario WSIB in the first 4-weeks of claim (HR = 0.68; 99% CI = 0.53, 0.88) were associated with longer claim duration. The hazard ratios for pre-disability income and receiving reimbursement for early chiropractic care with claim duration were not proportional over time (p=0.001 and 0.031, respectively), and older claims showed a significant association of greater pre-disability income with longer claim duration (e.g. HR for active claims at 1-year with a pre-disability income >$902/week versus ≤$480/week = 0.34; 99% CI = 0.17, 0.68). Working for an employer that had a RTW program (HR = 1.78; 99% CI = 1.45, 2.18), and missing data regarding union membership (HR = 1.27, 99%CI = 1.01, 1.59) were associated with shorter claim duration. Contrary to our predictions, neither

early receipt of WSIB-reimbursement for physiotherapy (HR = 1.01; 99% CI = 0.86, 1.19) nor chiropractic care (e.g. HR for active claims at 60-days = 1.15; 99% CI = 0.94, 1.41) were associated with claim duration (Table 3). We found no important differences using alternative analytic methods (Table S3 in File S1). Figures S2-S4 present the Kaplan-Meier curves for time to claim closure for LBP claimants who received reimbursement for early opioid prescription, physiotherapy and chiropractic care.

Systematic Review

Our systematic review of observational studies identified identified 2998 unique records, of which we retrieved 99 in full text; three were eligible for our review and explored early opioid use (Figure S5 in File S1). All 3 observational studies that explored early use of opioids for Workers' Compensation claims due to uncomplicated LBP reported a significant association with prolonged claim duration, and two studies adjusted for injury severity in their regression models (Table 4).[13-15] When our results were pooled with the 2 studies that reported measures of association in relative units,[14, 15] resulting in a total of 51,069 participants, the association between early opioid use and prolonged claim duration was consistent with our findings (adjusted HR = 0.57, 95% CI = 0.48 to 0.69), heterogeneity test p=0.02, I^2=75%; moderate certainty evidence) (Figure 2). Applying this effect to our WSIB dataset means that, at 90-days, 69% of workers without reimbursement for early opioids had resolved their disability claim versus 49% of workers who received reimbursement for early opioids.

The pooled effect was associated with substantial heterogeneity; however, statistical tests of heterogeneity can be misleading when sample sizes are very large and confidence

intervals for measures of association are therefore very narrow.[30] These results provide an excellent example of the phenomenon. The three studies all show consistent, large effect estimates (0.52 to 0.69), which increases confidence in our findings.

Discussion

Statement of Principle Findings

Our analysis of the Ontario WSIB's administrative data revealed that older claimants who were disabled due to uncomplicated LBP and who are reimbursed for opioid prescription in the first 4 weeks of their claim are more likely to experience prolonged claim duration. Higher pre-injury income was also associated with prolonged claim duration, but only among persistent claims. Injured workers employed by organizations with a RTW program and/or missing information on union affiliation are likely to resolve their claim faster. Neither early receipt of reimbursement for physiotherapy or chiropractic care for uncomplicated LBP was associated with claim duration.

Strengths & Weaknesses

A priori specification of our regression model and stating the anticipated direction of included independent variables, as well as the assessment of the proportional hazards assumption for all independent variables, provide greater confidence in our findings. The Ontario WSIB does not capture any measure of LBP injury severity and we were therefore unable to adjust for this factor, but we attempted to include patients with similar injuries by restricting our cohort to acute, uncomplicated LBP. There may still be important differences in injury severity in our cohort, but nevertheless our findings regarding the association with early opioid use and delayed claim recovery are consistent with other studies that have adjusted for low back injury severity.[13, 14] Other strengths include limited missing data, correction of

identifiable data errors and inconsistencies, and validation checks to ensure the accuracy of the data used to inform our regression model.

Our study has several limitations. First, it was a retrospective cohort study in which the reasons for reimbursement of physiotherapy, chiropractic or opioid prescription are uncertain. Thus, despite our adjustments for potential confounders, it remains possible that LBP claimants who chose to receive these healthcare interventions were prognostically different than those claimants who did not. Second, the WSIB database captures only those physiotherapy or chiropractic treatments that are reimbursed by the WSIB, and it is possible that some patients paid out-of-pocket to receive these services. It is highly unlikely that patients would have received opioids outside of WSIB reimbursement (personal communication, Dr. Norman Buckley, Chair of Anesthesiology, McMaster University). Third, a number of variables that may be important to consider were unavailable (e.g., patient expectations regarding recovery[31]), and some variables were not optimally collected. For example, chiropractic and physiotherapy are professions and not modalities, and there were no details of treatment provided. Fourth, our study focused on workers with LBP who were receiving disability benefits from the Ontario WSIB for at least 4-weeks in 2005, and we cannot say whether our findings are generalizable to other disabled workers. We are, however, unaware of any major changes in practices among Ontario chiropractors or physiotherapists since 2005, and there is evidence that both rates of opioids prescriptions and average morphine equivalent dose for non-malignant pain have increased since 2005, which would suggest that our findings regarding early reimbursement for opioids apply to a greater proportion of current WSIB LBP claimants.[32] Finally, our primary outcome, claim closure, is a surrogate for patient-important outcomes such as functional

restoration or return to work; however, claim closure and faster claim resolution is associated with functional recovery among adults disabled by non-severe whiplash injuries,[33] which provides some assurances that patients who resolve their disability claim are also likely to experience clinical improvement.

Our Findings in the Context of Other Relevant Literature

Our finding that older age is associated with prolonged claim duration is consistent with the literature.[34] We predicted that injured workers employed by companies that had formal return to work programs would resolve their claim faster, and this was supported by our findings. It is unclear why missing data for union membership was associated with shorter claim duration. Similarly, reasons why higher pre-disability income was associated with prolonged claim duration, but only among persistent claims, are uncertain. Possibilities include that injured workers with higher salaries who do not resolve their claim in the initial 6-months may find it more difficult to identify suitable employment at similar earnings levels, or that compared to other workers (i.e. with lower pre-disability income) workers with higher salaries can better afford to live with limited compensatory income for longer periods of time.

Although there are no randomized controlled trials exploring the effect of physiotherapy, chiropractic care, or early opioid use for workers with uncomplicated LBP receiving lost-time compensation benefits (Table S2 in File S1), our systematic review identified 6 observational studies that are relevant to our findings.[13-16, 35, 36] Turner and colleagues followed 1,885 workers from Washington for 1 year after they had been awarded Workers' Compensation benefits for acute LBP. In a comprehensive regression model adjusted for

multiple sociodemographic, employment, clinical, healthcare, and administrative factors – including injury severity – they found that workers who attended a chiropractor first, versus a primary care provider, were significantly less likely to remain on disability benefits at 1 year (adjusted OR = 0.41, 95% CI = 0.24, 0.70).[16]

Wasiak and colleagues found that workers in Florida, USA, with low back injuries who were reimbursed for limited chiropractic care (<30 days) experienced an 8.6% shorter duration of work disability versus Workers' Compensation claimants who were reimbursed for prolonged chiropractic care (>30 days).[35] The authors did exclude severe injuries from their population, but were unable to adjust for injury severity within their sample. Further, chiropractic care was collected after baseline and not treated as time-dependent, and so it is not surprising that claims with longer duration also received more chiropractic care.

Lemstra and Olszynski explored the effect of standard care (which included long waiting lists for physiotherapy) to provision of rapid rehabilitation services on Workers' Compensation claim duration from a company in Saskatchewan, Canada.[35] After adjusting for a number of factors, including age and injury severity, longer claim duration was associated with both chiropractic care (adjusted HR = 2.88, 95% CI = 1.45, 5.73) and physical therapist involvement (adjusted HR = 19.88, 95% CI = 7.95, 39.77). The authors collected healthcare provider utilization data after baseline and did not treat these variables as time-dependent, and so an alternative explanation is that claims with longer duration are simply more likely to involve either chiropractors or physical therapists.

Canada is currently the largest per-capita consumer of opioids in the world; [37] however, prescribing patterns in Ontario show considerable variation between primary care providers.[38]

Workers' Compensation data from the US has shown an almost 10-fold range (5.7% to 52.9%) in the early prescription of opioid medications between various states, suggesting that local prescribing patterns have significant influence on the use of these analgesics.[39] Findings from a study of Workers' Compensation nonspecific LBP claims (that did not adjust for injury severity) revealed that, compared with a no opioid reference group, the odds of chronic work loss were six times greater for claimants who used strong opioids and 11-14 times greater for claimants with opioid prescriptions which exceeded 90 days.[40] We found that reimbursement for early opioid use by the Ontario WSIB was associated with prolonged claim duration for uncomplicated back pain, and pooling of our data with similar studies [14, 15] shows a consistent effect, which increases confidence in our findings.

Implications & Future Research

To manage their growing unfunded liability, the Ontario WSIB has focused on increasing their claim denial rate, decreasing benefits to injured workers, reducing WSIB staff, and raising employer premiums.[9, 10] Most employers are obligated to pay WSIB premiums because they are legally bound to provide injury benefits to their employees, and the Ontario WSIB is protected by laws prohibiting competition in the marketplace. Another strategy is to optimize clinical management of injured workers. Our findings, which were not adjusted for illness severity, suggest that receiving reimbursement from the Ontario WSIB for early chiropractic care or physiotherapy for acute, uncomplicated LBP is not associated with shorter time to claim closure. Receiving reimbursement for early opioids was linked with longer claim duration.

However, observational data cannot establish causality and high quality, randomized controlled trials are urgently needed to confirm or refute our findings.

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Acknowledgements

The authors thank Dr. Gordon Guyatt for helpful discussion.

Contributors

JWB, SE, D-HA and SDW designed the study. DH-A and LW conducted data analysis and SDW provided statistical advice. JWB, SE, D-HA and SDW were involved in interpreting the data. RC designed and conducted all literature searches. JWB drafted the manuscript and wrote the final version. All authors critically revised the manuscript, provided comment and approved the final version for publication.

Funding

This study was funded by research grants from the Ontario Workers Safety and Insurance Board Research Advisory Council and the Ontario Chiropractic Association. Shanil Ebrahim was

supported by a MITACS Elevate Postdoctoral Fellowship Award. The funding sources had no role in design or conduct of the study; the collection, management, analysis, or interpretation of the data; or the preparation, review, or approval of the manuscript.

Competing interests

Jason Busse acts as a consultant to Prisma Health Canada, a private incorporated company funded by employers and insurers that consults on and manages long-term disability claims.

Ethics approval

The study was approved by the Health Sciences Research Ethics Board of the University of Toronto.

Provenance and peer review

Not commissioned; externally peer reviewed.

Data sharing statement

No additional data are available.

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Figure Legends

Figure 1: Kaplan-Meier curve for time to claim closure

Figure 2: The association between early opioid use/prescription and claim duration

Supporting Information Legends

Table S1: Search strategy for the Cochrane Back Group trials registry

Table S2: Randomized controlled trials of acute low back pain assessing the effect of opioids, chiropractic care, or physical therapy, and their generalizability to injured workers receiving disability benefits

Table S3: Sensitivity analysis of factors associated with time to claim closure, entering chiropractic care and physiotherapy as time-dependant co-variates (n=1,442)

Table S4: Search strategy for observational studies exploring the association of early opioid, physiotherapy, or chiropractic care for workers with acute low back pain with claim duration

Figure S1: A flow diagram of the literature search process for randomized controlled trials assessing the effect of opioids, physiotherapy, or chiropractic care for acute low back pain.

Figure S2: Kaplan-Meier curve for early reimbursement for Opioid prescription

Figure S3: Kaplan-Meier curve for early reimbursement for physiotherapy

Figure S4: Kaplan-Meier curve for early reimbursement for chiropractic care

Figure S5: A flow diagram of the literature search process for observational studies assessing the effect of early opioids, physiotherapy, or chiropractic care for acute low back pain.

Table 1: Description of model variables

Variable	Anticipated Direction of Effect
Age (in decades)	older age: -
Gender	female: -
First language	non-English: -
Pre-disability income	higher income: -
Reimbursement for opioid prescription in the first 4-weeks of a claim	opioid reimbursement: -
Prior claim(s)	prior claim: -
Union membership	Union member: +
Employer RTW-program	RTW program: +
Work-relatedness	work-related: +
Reimbursement for ≥3 chiropractic treatments in the first 4-weeks of a claim	DC care: +
Reimbursement for ≥3 physiotherapy treatments in the first 4-weeks of a claim	PT care: +

+: associated with faster claim closure
-: associated with slower claim closure

Table 2: Baseline Characteristics of WSIB Low Back Pain Claims (n=1,442)

Age in years, mean (SD)	41.3 (10.5)
Gender, n (%)	
Female	552 (38.3)
Male	890 (61.7)
First language, n (%)	
English	1372 (95.1)
Other	70 (4.9)
Pre-disability income (dollars/week) mean (SD)	731.4 (332.5)
Opioid prescription reimbursed by WSIB in the first 4-weeks of claim, n (%)	
Yes	136 (9.4)
No	1306 (90.6)
Prior WSIB claim, n (%)	
Yes	1091 (75.7)
No	351 (24.3)
Union membership, n (%)	
Yes	610 (42.3)
No	656 (45.5)
Missing data	176 (12.2)
Employer RTW program, n (%)	
Yes	1042 (72.3)
No	278 (19.3)
Missing data	122 (8.5)
Employer doubts work-relatedness of injury, n (%)	
Yes	195 (13.5)
No	1051 (72.9)
Missing data	196 (13.6)
Chiropractic care reimbursed by WSIB during claim, n (%)	391 (27.1)
Early Chiropractic care (≥3 treatments received within the first 28 days), n (%)	247 (17.1)
Physiotherapy reimbursed by WSIB during claim, n (%)	786 (54.5)
Early Physiotherapy (≥3 treatments received within the first 28 days), n (%)	388 (26.9)

Table 3: Factors associated with time to claim closure (n=1,442)*

	Univariate		Multivariable	
	Hazard Ratio (99% CI)	**p-value**	**Adjusted Hazard Ratio (99% CI)**	**p-value**
Baseline predictors				
Age categories in years		<0.001		<0.001
15 to <25	1.00		1.00	
25 to <35	0.88 (0.65, 1.19)		0.79 (0.58, 1.09)	
35 to <45	0.78 (0.59, 1.04)		0.70 (0.52, 0.95)	
45 to <55	0.76 (0.56, 1.02)		0.67 (0.49, 0.91)	
55 to 65	0.56 (0.40, 0.80)		0.52 (0.36, 0.74)	
Gender		0.114		0.446
Females	1.09 (0.95, 1.26)		0.96 (0.82, 1.12)	
Males	1.00		1.00	
First language		0.137		0.312
English	1.00		1.00	
Other	0.83 (0.59, 1.15)		0.88 (0.63, 1.23)	
Pre-disability income in dollars per week				
At 60 days:				
≤480	1.00	-	1.00	-
481-694	1.09 (0.89, 1.34)	0.273	1.03 (0.83, 1.27)	0.749
695-920	1.13 (0.92, 1.39)	0.137	0.96 (0.77, 1.21)	0.678
>920	1.08 (0.88, 1.33)	0.326	0.93 (0.74, 1.18)	0.443
At 180 days:				
≤480	1.00	-	1.00	-
481-694	0.89 (0.68, 1.17)	0.267	0.89 (0.67, 1.17)	0.266
695-920	0.84 (0.63, 1.12)	0.115	0.73 (0.54, 0.98)	0.006
>920	0.72 (0.54, 0.97)	0.004	0.63 (0.46, 0.86)	<0.001
At 365 days:				
≤480	1.00	-	1.00	-
481-694	0.65 (0.36, 1.18)	0.064	0.71 (0.38, 1.31)	0.147
695-920	0.53 (0.28, 1.02)	0.012	0.47 (0.24, 0.91)	0.003
>920	0.39 (0.20, 0.75)	<0.001	0.34 (0.17, 0.68)	<0.001
Early Reimbursement for Opioid prescription (within the first 28 days)		<0.001		<0.001
Yes	0.62 (0.48, 0.80)		0.68 (0.53, 0.88)	
No	1.00		1.00	
Prior claims		0.306		0.709
Yes	1.07 (0.91, 1.26)		1.03 (0.86, 1.22)	
No	1.00		1.00	
Union membership		<0.001		0.016
Yes	1.29 (1.11, 1.50)		1.14 (0.96, 1.35)	
No	1.00		1.00	
Missing	1.34 (1.07, 1.68)		1.27 (1.01, 1.59)	
Employer RTW program		<0.001		<0.001
Yes	1.73 (1.43, 2.09)		1.78 (1.45, 2.18)	
No	1.00		1.00	
Missing	1.17 (0.87, 1.58)		1.17 (0.86, 1.59)	
Doubt Work-relatedness		0.174		0.138
Yes	0.94 (0.76, 1.16)		0.88 (0.71, 1.08)	

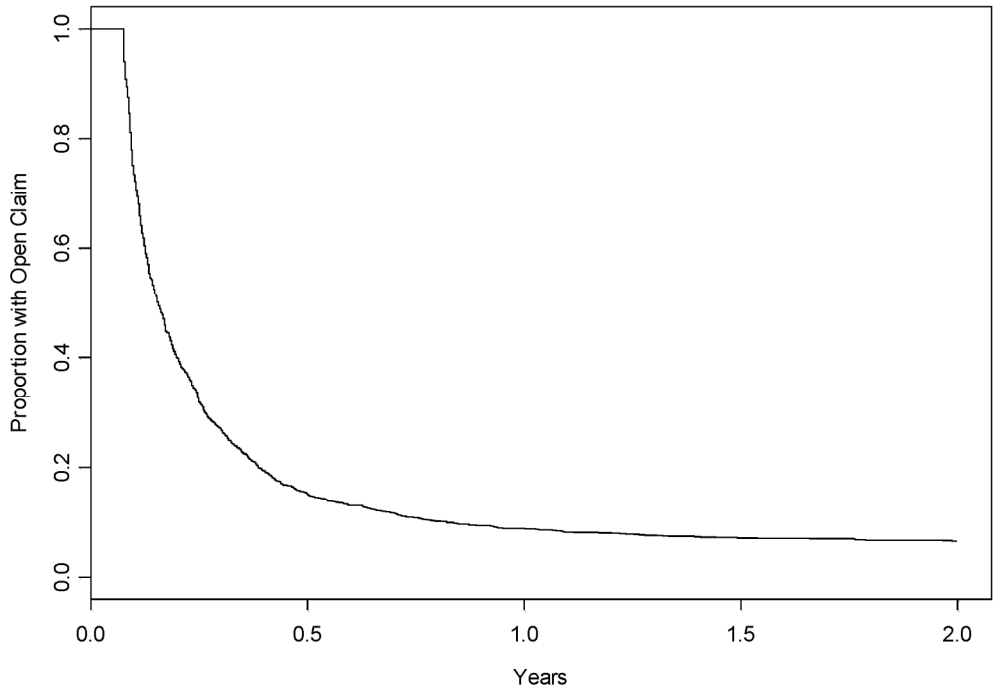
No Missing	1.00 1.13 (0.92, 1.39)		1.00 1.08 (0.87, 1.33)	
Early Reimbursement for Chiropractic care **At 60 days:** **At 180 days:** **At 365 days:**	 1.19 (0.99, 1.45) 0.91 (0.65, 1.24) 0.60 (0.29, 1.23)	 0.017 0.437 0.067	 1.15 (0.94, 1.41) 0.90 (0.65, 1.24) 0.61 (0.29, 1.29)	 0.067 0.392 0.089
Early Reimbursement for Physiotherapy	0.98 (0.84, 1.15)	0.726	1.01 (0.86, 1.19)	0.848

* HR>1 indicates faster claim closure; RTW = return to work; Early reimbursement for chiropractic or physiotherapy = 3 or more treatments received within the first 28 days

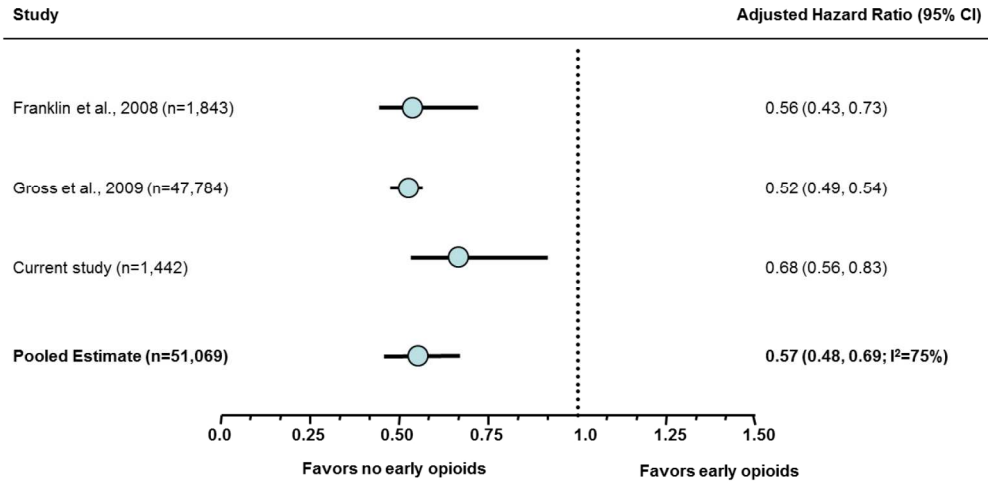
Table 4: Observational studies exploring the association between early opioid use and Workers' Compensation claim duration

Study	Population	Opioid variable tested	Adjustments	Dependent variable	Results*
Webster et al., 2007	8,443 American Workers' Compensation claimants with new-onset, disabling LBP	Receipt of opioids within the first 15 days of claim	Injury severity, age, gender, length of job tenure	Change in mean disability duration	**1-140mg MEA** 5.4 days, 95%CI = -14.6 to 25.0 **141-225mg MEA** 21.9 days, 95%CI = 3.2 to 40.6 **226-450mg MEA** 43.8 days, 95%CI = 23.7 to 63.9 **>450mg MEA** 69.1 days, 95%CI = 49.3 to 89.0
Franklin et al., 2008	1,843 Washington, US, Workers' Compensation claimants with new-onset, disabling LBP	Reimbursement for opioids within 6 weeks of 1st medical visit for LBP	Age, gender, race, education, injury severity, pain intensity, Roland disability questionnaire	Receipt of wage replacement benefits at 1-year	**1-150mg MED** OR = 1.9, 95%CI = 1.2 to 3.1 **151-300mg MED** OR = 2.0, 95%CI = 1.2 to 3.3 **301-650mg MED** OR = 1.6, 95%CI = 0.9 to 2.6 **>650mg MED** OR = 1.9, 95%CI = 1.2 to 2.9
Gross et al., 2009	47,784 Alberta, Canada, Workers' Compensation claimants with new-onset, disabling LBP	Reimbursement for opioids within the first 2 weeks of claim	Age, gender, annual salary, year of claim, number of previous claims	Receipt of wage replacement benefits at 1-year	**No early opioids** HR = 1.94, 95%CI = 1.86 to 2.02

* The reference group is no early receipt of opioids for Franklin et al., and Webster et al.
95% CI = 95% confidence interval; LBP = low back pain; MEA = morphine equivalent amount; MED = morphine equivalent dose; OR = odds ratio; HR = hazard ratio



Kaplan-Meier curve for time to claim closure
181x130mm (300 x 300 DPI)



The association between early opioid use/prescription and claim duration
177x88mm (300 x 300 DPI)

Table S1: Search strategy for the Cochrane Back Group trials registry*

Search Strategy in Cochrane Library:

*:ti,ab,kw in Trials, with Back Group in Review Groups 6476

Endnote search strategy:

Any field contains: acute AND Any field contains chiropractic (43)
Any field contains: acute AND Any field contains physiotherapy* (87)
Any field contains: acute AND Any field contains opioid (30)
Any field contains: opioid NOT Any field contains: surgery NOT Any field contains: chronic (28)
Any field contains: emergency (57) NOT Any field contains: whiplash (18)

*On May 1, 2015 we used the Cochrane Library to search the Cochrane Back Review Group (CBRG) Trials Register, which we exported to Endnote. We also screened the included studies lists of recent CBRG Reviews of chiropractic and physiotherapy interventions for acute low back pain (Franke et al., 2015, Rubinstein et al., 2012).

Table S2: Randomized controlled trials of acute low back pain assessing the effect of opioids, chiropractic care, or physical therapy, and their generalizability to injured workers receiving disability benefits

Study	Participants and Interventions	Representation of injured workers receiving lost-time disability benefits for acute low back pain
Glover 1974	84 patients with unilateral low back pain (LBP), randomized to manipulation or control (sham diathermy)	No mention regarding receipt of lost-time disability benefits
Bergquist-Ullman 1977	217 patients consulting a workplace health centre with acute or subacute LBP randomized to back school, physiotherapy or placebo	At least 88% of patients were enrolled with acute LBP, and of the 217, 184 were "sick-listed" for a median of 21 days during the study, but there was no mention regarding receipt of lost-time disability benefits
Rasmussen 1979	26 patients with LBP duration <3weeks, randomized to manipulation or diathermy	No mention regarding receipt of lost-time disability benefits
Hoehler 1981	95 patients with palpatory cues indicating hyperalgesia or a restricted or painful range of vertebral motion, randomized to rotational manipulation of the trunk or massage	No mention regarding receipt of lost-time disability benefits
Farrell 1982	48 subjects with acute LBP duration <3 weeks, randomized to passive mobilization and manipulation or combination of diathermy, exercises and ergonomic advice	No mention regarding receipt of lost-time disability benefits
Gilbert 1985	270 patients presenting with LBP, randomized to bed rest or physiotherapy	The authors reported that "people who were receiving workman's compensation were also slower to recover." p.794, but they did not report any associated data (e.g. how many patients were receiving disability benefits, or the quantitative results for this subgroup).
Waterworth 1985	112 patients with acute mechanical LBP, randomized to ergonomic advice/ Diflunisal or ergonomic advice/ conservative physiotherapy (ultrasound and exercise) or ergonomic advice/manipulation	The authors enrolled a mixed group of patients, that may include up to 54% receiving lost-time claim benefits, but that the proportion is unequal between study group (ranging from 47% to 63%) and the results are provided for the total population which precludes confident generalizability to only those who were receiving lost-time claim benefits.
Hadler 1987	54 subjects with acute LBP, randomized to mobilization or manipulation	Patients who were receiving disability benefits were explicitly excluded from this trial: "neither workers' compensation nor disability insurance should be at issued [sic] and the acute low-back pain must not be considered work-related."pg 703
MacDonald 1990	95 subjects with LBP duration <4 weeks, randomized to osteopathic manipulation or control (advice to rest and resume activities gradually)	"Less than 30% [of the study group] suffered loss of income because of disability" pg. 366

Cramer 1993	36 subjects with mechanical LBP less than two weeks duration randomized to side-lying manipulation, electrical stimulation and cold packs or control (detuned ultrasound, cold packs and 15-30 sec. gentle massage)	Patients who were receiving disability benefits were explicitly excluded from this trial. Inclusion criteria stipulate “no litigation or workers’ compensation” (as per the review by Rubinstein 2012, pg. 52)
Skargren 1997	323 patients with back and neck pain of mixed duration, randomized to chiropractic or physiotherapy.	51% of patients (166 of323) were on "sick-leave" when enrolled (Table 3, pg. 2170), but there was no mention regarding receipt of lost-time disability benefits.
Innes 1998	123 patients with acute LBP, randomized to ketorolac or acetaminophen/codeine	Patients who were receiving disability benefits were limited during enrollment: “Because Workers Compensation status might influence response to therapy, we limited each site to 10 work-related back injuries, hoping to limit such cases to no more than half the total study enrollment.” pg. 550
Cherkin 1998	321 adults with acute LBP randomized to the McKenzie method of physical therapy, chiropractic manipulation, or provision of an educational booklet	patients who were receiving disability benefits were explicitly excluded from this trial: "Subjects who… were involved in claims for compensation or litigation because of the back injury…were also excluded"; pg. 1022
Seferlis 1998	180 patients sick-listed for < 2 weeks for LBP randomized to General Practitioner Program (rest, sick-leave, analgesics etc.) or Manual Therapy Program (autotraction, manipulation, mobilization etc.) or Intensive Training Program (information, muscle training and general condition training 3x/week for 8 weeks)	All enrolled patients were "sick listed for acute low-back pain for up to 2 weeks", but there is no mention regarding receipt of lost-time disability benefits.
Morton 1999	29 patients with acute mechanical LBP, randomized to manipulation/ exercise or exercise alone	Patients who were receiving disability benefits were explicitly excluded from this trial: “Exclusion criteria were … third-party, public liability or workers’ compensation claimants”; pg. 185
Veenema 2000	155 patients with musculoskeletal LBP, randomized to meperidine or ketorolac	No mention regarding receipt of lost-time disability benefits
Metscher 2001	192 Patients with acute LBP randomized to dexketoprofen-trometamol or tramadolhydrochloride	Abstract in English, paper in German. No mention in the abstract about receipt of lost-time disability benefits
Palangio 2002	147 patients with acute LBP, first episode or exacerbation of chronic condition with onset <48 hours before enrolment, randomized to combination hydrocodone 7.5 mg and ibuprofen 200 mg (HC/IB) or combination oxycodone 5 mg and acetaminophen 325 mg (OX/AC)	No mention regarding receipt of lost-time disability benefits
Hofstee 2002	250 patients with sciatica of less than 1 months duration randomized to bed rest, physiotherapy or continuation of activities of daily living	No mention regarding receipt of lost-time disability benefits
Johnstone 2002	12 patients with acute LBP with signs of psychological distress (DRAM score Modified Zung score >17) randomized to cognitive behavioral therapy and conventional physiotherapy or conventional physiotherapy alone	Patients with “ongoing medico legal issues” were excluded (pg.183). No mention regarding receipt of lost-time disability benefits

Childs 2004	131 patients with LBP of median duration of 27 days, randomized to manipulation and exercise or exercise alone	39.8% of patients had missed work due to LBP, Table 2 pg. 925, but there was no mention regarding receipt of lost-time disability benefits
Hoiriis 2004	192 patients with LBP of 3 to 6 weeks duration randomized to chiropractic adjustments with placebo medicine, muscle relaxants with sham adjustments, or placebo medicine with sham adjustments	No mention regarding receipt of lost-time disability benefits
Salvador 2005	28 subjects randomly allocated to a muscle energy technique or transcutaneous electrical nerve stimulation (TENS)	Abstract in English, paper in Portuguese. No mention in the abstract about receipt of lost-time disability benefits
Brennan 2006	123 patients referred to physiotherapy for LBP less than 90 days duration, randomized to manipulation or specific exercise or stabilization	No mention regarding receipt of lost-time disability benefits
Santilli 2006	102 patients with acute moderate to severe radiating LBP of duration <10 days with MRI evidence of disc protrusion, randomized to manipulation or simulated manipulation	No mention regarding receipt of lost-time disability benefits
Hancock 2007	240 subjects with acute LBP duration < 6 weeks, randomized to four groups: control (placebo drug and placebo manipulation) or NSAIDs (diclofenac and placebo manipulation) or manipulation (placebo drug and active manipulation) or manipulation and NSAIDs (diclofenac and active manipulation)	No mention regarding receipt of lost-time disability benefits
Lee 2008	Study of 78 musculoskeletal pain patients, 67% with LBP, randomized to tramadol/paracetemol (n=28 with LBP) or ketorolac/paracetemol (n=24 with LBP)	No mention regarding receipt of lost-time disability benefits
Lau 2008	110 patients with acute LBP, randomized to immediate intervention (advice to stay active, Back Care booklet, reassurance, advice, interferential current therapy) or control (walking training and prescription of walking aids as indicated) followed by outpatient physiotherapy (for both groups)	12% of patients (13 of 110) had work-related injuries (see Table 1), but no mention regarding receipt of lost-time disability benefits
Selkow 2009	20 subjects with acute LBP, randomly allocated to muscle energy technique or sham manual treatment	No mention regarding receipt of lost-time disability benefits
Cleland 2009	112 subjects with LBP, that met 4 out of 5 criteria for a clinical prediction rule for LBP likely to respond to manipulation, randomized to supine thrust manipulation, side-lying thrust manipulation or non-thrust manipulation	Only 6% of patients were unable to work due to LBP. Table 2, pg.2724.
Hallegraef 2009	64 patients with acute nonspecific LBP duration <16 days, randomized to manipulative therapy plus physical therapy or physical therapy alone	No mention regarding receipt of lost-time disability benefits

Sutlive 2009	60 subjects with LBP meeting 3 out of 5 criteria for a clinical prediction rule for LBP likely to respond to manipulation, randomized to lumbopelvic manipulation or neutral gap manipulation	Patients "with litigation pending for their LBP" were excluded. No mention regarding receipt of lost-time disability benefits
Juni 2009	104 patients with acute LBP duration < 4 weeks, randomized to standard care with manipulation or standard care alone	No mention regarding receipt of lost-time disability benefits
Machado 2010	148 adults with acute LBP duration <6 weeks, randomized to the McKenzie method and first-line care (advice, reassurance and time-contingent acetaminophen) or first-line care alone	Only 3% of participants (4 of 146) were receiving disability benefits for their injury (see Table 1)
Lewis 2011	89 patients with acute LBP duration < 3 months, randomized to strain-counterstrain manual therapy/exercise or exercise alone	No mention regarding receipt of lost-time disability benefits
Biondi 2013	1664 patients with acute LBP, randomized to tapentadol or oxycodone	No mention regarding receipt of lost-time disability benefits
Goertz 2013	91 patients with acute LBP, duration < 4 weeks, randomized to standard medical care and chiropractic manipulation or standard care alone	No mention regarding receipt of lost-time disability benefits
Behrbalk 2014	65 adults with acute LBP, randomized to morphine or morphine/promethazine	No mention regarding receipt of lost-time disability benefits
Eken 2014	137 patients with moderate or severe acute LBP, randomized to paracetemol, morphine or dexketoprophen	No mention regarding receipt of lost-time disability benefits
Tanen 2014	44 patients with acute radicular LBP, randomized to lidocaine or ketorolac	No mention regarding receipt of lost-time disability benefits

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Table S3: Sensitivity analysis of factors associated with time to claim closure, entering chiropractic care and physiotherapy as time-dependant co-variates (n=1,442)

	Univariate		Multivariable	
	Hazard Ratio (99% CI)	**p-value**	**Adjusted Hazard Ratio (99% CI)**	**p-value**
Baseline predictors				
Age categories in years		<0.001		<0.001
15 to <25	1.00		1.00	
25 to <35	0.88 (0.65, 1.19)		0.79 (0.58, 1.08)	
35 to <45	0.78 (0.59, 1.04)		0.70 (0.52, 0.95)	
45 to <55	0.76 (0.56, 1.02)		0.67 (0.49, 0.91)	
55 to 65	0.56 (0.40, 0.80)		0.52 (0.36, 0.74)	
Gender		0.114		0.451
Females	1.09 (0.95, 1.26)		0.96 (0.82, 1.12)	
Males	1.00		1.00	
First language		0.137		0.327
English	1.00		1.00	
Other	0.83 (0.59, 1.15)		0.88 (0.63, 1.23)	
Pre-disability income in dollars per week				
At 30 days:				
≤480	1.00	-	1.00	-
481-694	1.15 (0.91, 1.45)	0.125	1.08 (0.85, 1.37)	0.396
695-920	1.21 (0.96, 1.54)	0.034	1.05 (0.81, 1.36)	0.614
>920	1.20 (0.94, 1.52)	0.050	1.04 (0.80, 1.35)	0.689
At 60 days:				
≤480	1.00	-	1.00	-
481-694	1.09 (0.89, 1.34)	0.273	1.03 (0.83, 1.27)	0.710
695-920	1.13 (0.92, 1.39)	0.137	0.97, (0.77, 1.22)	0.746
>920	1.08 (0.88, 1.33)	0.326	0.94 (0.74, 1.19)	0.477
At 180 days:				
≤480	1.00	-	1.00	-
481-694	0.89 (0.68, 1.17)	0.267	0.85 (0.65, 1.12)	0.130
695-920	0.84 (0.63, 1.12)	0.115	0.71 (0.52, 0.96)	0.003
>920	0.72 (0.54, 0.97)	0.004	0.61 (0.45, 0.84)	<0.001
At 365 days:				
≤480	1.00	-	1.00	-
481-694	0.65 (0.36, 1.18)	0.064	0.63 (0.35, 1.16)	0.051
695-920	0.53 (0.28, 1.02)	0.012	0.44 (0.23, 0.84)	0.001
>920	0.39 (0.20, 0.75)	<0.001	0.32 (0.16, 0.63)	<0.001
Opioid prescription		<0.001		<0.001
Yes	0.62 (0.48, 0.80)		0.69 (0.53, 0.89)	
No	1.00		1.00	
Prior claims		0.306		0.661
Yes	1.07 (0.91, 1.26)		1.03 (0.87, 1.22)	
No	1.00		1.00	
Union membership		<0.001		0.014
Yes	1.29 (1.11, 1.50)		1.14 (0.96, 1.36)	
No	1.00		1.00	
Missing	1.34 (1.07, 1.68)		1.27 (1.01, 1.60)	
Employer RTW program		<0.001		<0.001
Yes	1.73 (1.43, 2.09)		1.77 (1.45, 2.18)	

No Missing	1.00 1.17 (0.87, 1.58)		1.00 1.18 (0.86, 1.60)	
Doubt Work-relatedness Yes No Missing	 0.94 (0.76, 1.16) 1.00 1.13 (0.92, 1.39)	0.174	 0.87 (0.70, 1.08) 1.00 1.08 (0.87, 1.33)	0.119
Time-dependent predictors*				
Chiropractic care received after the accident prior to claim closure	1.11 (0.95, 1.30)	0.096	1.08 (0.91, 1.29)	0.268
Physiotherapy after the accident prior to claim closure	0.96 (0.83, 1.10)	0.420	0.99 (0.85, 1.16)	0.913

HR>1 indicates faster claim closure; RTW = return to work

* The time-dependent predictors are "turned on" once the claimant has received their first service after their accident.

Table S4: Search strategy for observational studies exploring the association of early opioid, physiotherapy, or chiropractic care with Workers' Compensation claim duration, for cases of acute low back pain

MEDLINE (OvidSP)

1 exp Whiplash Injuries/
2 exp Soft Tissue Injuries/
3 repetitive strain injur$.mp.
4 carpal tunnel syndrome.mp.
5 exp Cumulative Trauma Disorders/
6 exp Back pain/ or exp pain/ or chronic pain.tw.
7 exp Anxiety/
8 exp Depression/
9 exp Neck Pain/
10 exp Depressive Disorder/
11 exp Back Injuries/
12 injured worker$.mp.
13 musculoskeletal injur$.mp.
14 or/1-13
15 exp "Wounds and Injuries"/
16 Musculoskeletal System/ or Musculoskeletal Diseases/
17 15 and 16
18 14 or 17
19 exp insurance claim reporting/ or exp "insurance claim review"/ or exp insurance, disability/ or insurance, liability/
20 Insurance, Accident/
21 ((worker$ or workman$ or workmen&) adj compensation).mp. or exp Workers' compensation/
22 claim.mp.
23 claimant.mp.
24 or/19-23
25 prognosis.mp. or exp Prognosis/
26 Time/ or exp Time Factors/
27 exp "Recovery of Function"/
28 "Severity of Illness Index"/
29 exp Trauma Severity Indices/
30 (recovery or prognostic).mp.
31 or/25-30
32 18 and 24 and 31
33 exp Disability Evaluation/
34 24 and 31 and 33
35 exp Occupational Diseases/ or exp Accidents, Occupational/ or (occupational injur: or occupational accident:).mp.
36 24 and 31 and 35
37 exp Accidents, Traffic/
38 24 and 31 and 37
39 "Compensation and Redress"/
40 18 and 31 and 39

41 exp Work Capacity Evaluation/ or exp workload/ or workload.mp.
42 (18 or 35) and 24 and 41
43 32 or 34 or 36 or 38 or 40 or 42
44 18 or 33
45 31 or 41
46 35 and 44 and 45
47 46 or 43

EMBASE (OvidSP)
1 whiplash injur$.mp. or exp whiplash injury/
2 exp soft tissue injury/
3 soft tissue injur$.mp.
4 repetitive strain injur$.mp.
5 carpal tunnel syndrome.mp. or exp carpal tunnel syndrome/
6 exp cumulative trauma disorder/
7 back pain.mp. or exp backache/
8 backpain.mp.
9 chronic pain.mp. or exp chronic pain/
10 exp pain/
11 anxiety/
12 exp depression/
13 neck pain.mp. or exp neck pain/
14 back injur$.mp.
15 low back injury/
16 injured worker$.mp.
17 musculoskeletal injury/
18 occupational injuries.mp. or exp occupational accident/
19 occupational accidents.mp.
20 occupational diseases.mp. or exp occupational disease/
21 or/1-20
22 insurance/ or exp compensation/ or exp workman compensation/ or exp health insurance/ or exp "health plan employer data and information set"/
23 accident insurance.mp.
24 exp workman compensation/
25 ((worker$ or workman$ or workmen&) adj compensation).mp.
26 (claim or claimant).mp.
27 or/22-26
28 prognosis.mp. or prognosis/
29 exp time/
30 recovery of function.mp. or convalescence/
31 disease severity/
32 exp injury scale/
33 (recovery or prognostic).mp.
34 workload.mp. or exp workload/
35 exp work capacity/
36 exp work resumption/ or return to work.mp.
37 or/28-36

38 21 and 27 and 37
39 or/1-17
40 or/18-20
41 37 and 39 and 40
42 38 or 41

PsycInfo (OvidSP)
1 exp Whiplash/
2 whiplash injur:.mp.
3 soft tissue injur$.mp.
4 cumulative trauma disorder$.mp.
5 repetitive strain injur$.mp.
6 carpal tunnel syndrome.mp.
7 back pain.mp. or exp Back Pain/
8 (backpain or backache).mp.
9 chronic pain.mp. or exp Chronic Pain/
10 exp Musculoskeletal Disorders/ or exp Fibromyalgia/ or fibromyalgia.mp.
11 exp Anxiety/
12 exp "Depression (Emotion)"/ or exp Major Depression/
13 neck pain.mp.
14 back injur:.mp.
15 musculoskeletal injur$.mp.
16 exp Industrial Accidents/
17 exp Occupational Safety/
18 (occupational injur: or occupational accident:).mp.
19 exp Work Related Illnesses/
20 or/1-19
21 exp Workers' Compensation Insurance/
22 exp Employee Health Insurance/
23 exp Insurance/
24 disability insurance.mp.
25 (claim or claimant).mp.
26 ((worker: or workman: or workmen:) adj compensation).mp.
27 accident insurance.mp.
28 or/21-27
29 prognosis.mp. or exp Prognosis/
30 exp Time/
31 time factors.mp.
32 exp "Recovery (Disorders)"/
33 recovery of function.mp.
34 exp "Severity (Disorders)"/ or severity of illness.mp.
35 (recovery or prognostic).mp.
36 exp Work Load/ or workload.mp. or exp Job Performance/
37 exp Vocational Evaluation/ or exp Disability Evaluation/ or work capacity evaluation.mp. or exp Reemployment/
38 work resumption.mp.
39 or/29-38
40 20 and 28 and 39

41 16 or 17 or 18 or 19
42 or/1-15
43 39 and 41 and 42
44 28 and 41
45 40 or 43 or 44

CINAHL (Ebsco)
49 S46 or S48
S48 S22 and S45 and S47
S47 S23 or S24 or S25 or S26
S46 S27 and S33 and S45
S45 S34 or S35 or S36 or S37 or S38 or S39 or S40 or S41 or S42 or S43 or S44
S44 (MH "Disability Evaluation+")
S43 "work resumption"
S42 "return to work" OR (MH "Job Re-Entry")
S41 (MH "Work Capacity Evaluation")
S40 (MH "Workload Measurement") OR (MH "Workload") OR "workload"
S39 (recovery or prognostic)
S38 (MH "Severity of Illness") OR (MH "Severity of Illness Indices+")
S37 (MH "Recovery")
S36 "recovery of function"
S35 (MH "Time+") OR (MH "Time Factors")
S34 (MH "Prognosis+") OR "prognosis"
S33 S28 or S29 or S30 or S31 or S32
S32 "accident insurance"
S31 (worker* N2 compensation) OR (workman* N2 compensation) OR (workmen* N2 compensation)
S30 (Claim or claimant)
S29 (MH "Insurance") OR (MH "Insurance, Disability+")
S28 (MH "Worker's Compensation")
S27 S22 or S23 or S24 or S25 or S26
S26 "occupational accident" OR (MH "Accidents, Occupational+")
S25 "occupational inju*"
S24 (MH "Occupational-Related Injuries")
S23 (MH "Occupational Diseases+")
S22 S18 or S21
S21 S19 and S20
S20 (MH "Wounds and Injuries+") OR (MH "Occupational-Related Injuries")
S19 (MH "Musculoskeletal Diseases+") or (MH "Musculoskeletal System+")
S18 S1 or S2 or S3 or S4 or S5 or S6 or S7 or S8 or S9 or S10 or S11 or S12 or S13 or S14 or S15 or S16 or S17
S17 "musculoskeletal injur*"
S16 "back injur*"
S15 (MH "Back Injuries+")
S14 (MH "Neck Pain") OR "neck pain"
S13 (MH "Depression+")
S12 (MH "Anxiety+")
S11 (MH "Pain+")

S10 (MH "Fibromyalgia") OR "fibromyalgia"
S9 (MH "Chronic Pain") OR "chronic pain"
S8 (backpain or backache)
S7 (MH "Back Pain") OR "back pain"
S6 (MH "Carpal Tunnel Syndrome") OR "carpal tunnel syndrome"
S5 "repetitive strain injur*"
S4 (MH "Cumulative Trauma Disorders+")
S3 "soft tissue injur*"
S2 (MH "Soft Tissue Injuries")
S1 "whiplash injur*" OR (MH "Whiplash Injuries")

Figure S1: Flow diagram of the literature search process for randomized controlled trials assessing the effect of opioids, physiotherapy, or chiropractic care for acute low back pain.

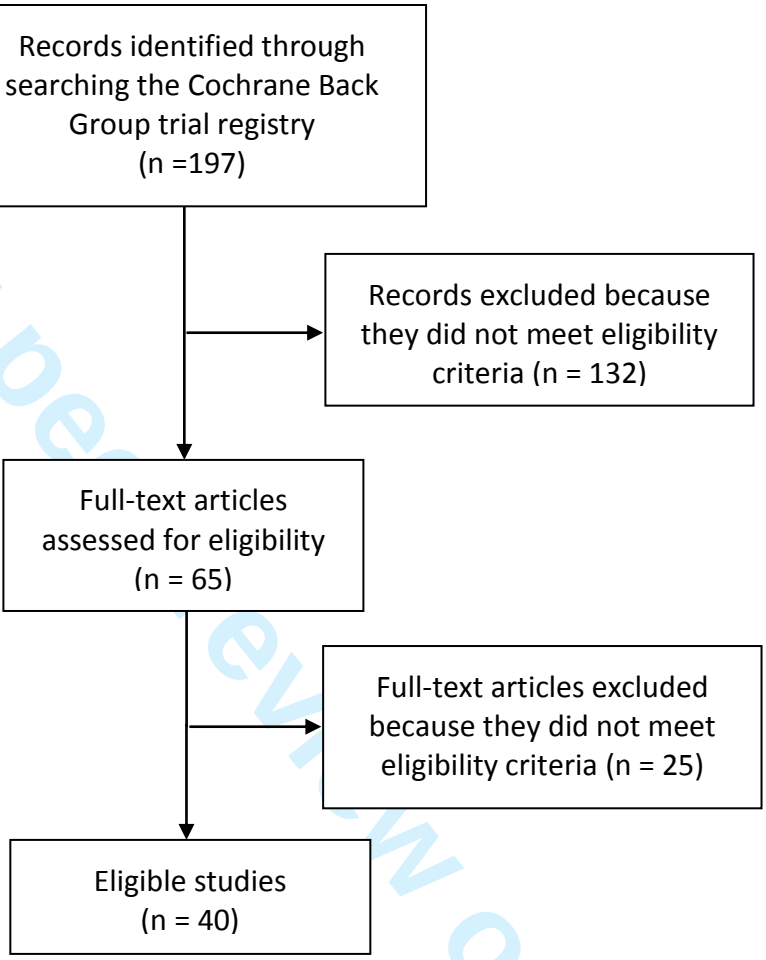


Figure S2: Kaplan-Meier curve for early reimbursement for Opioid prescription

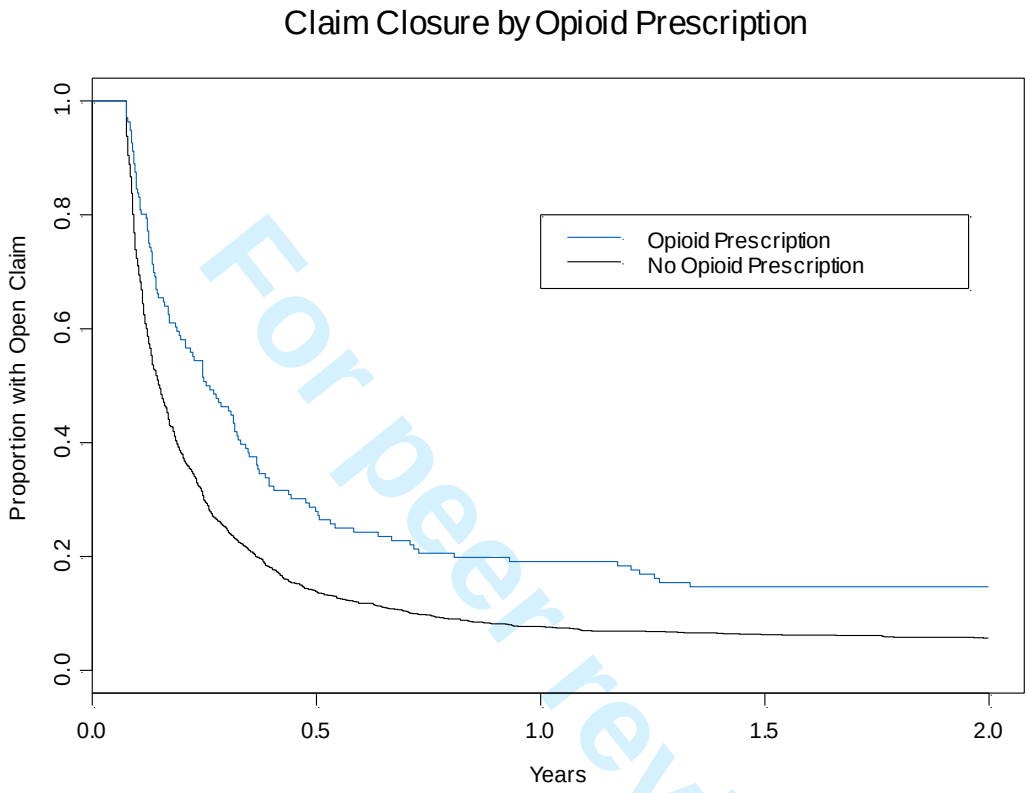


Figure S3: Kaplan-Meier curve for early reimbursement for physiotherapy

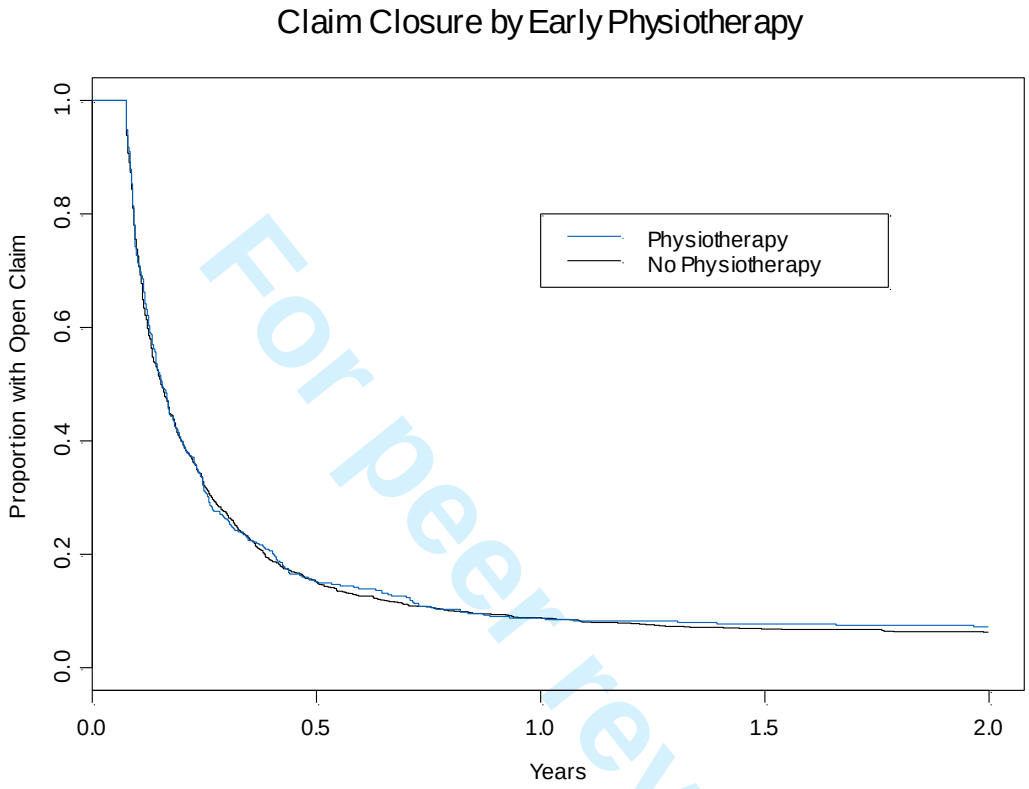


Figure S4: Kaplan-Meier curve for early reimbursement for chiropractic care

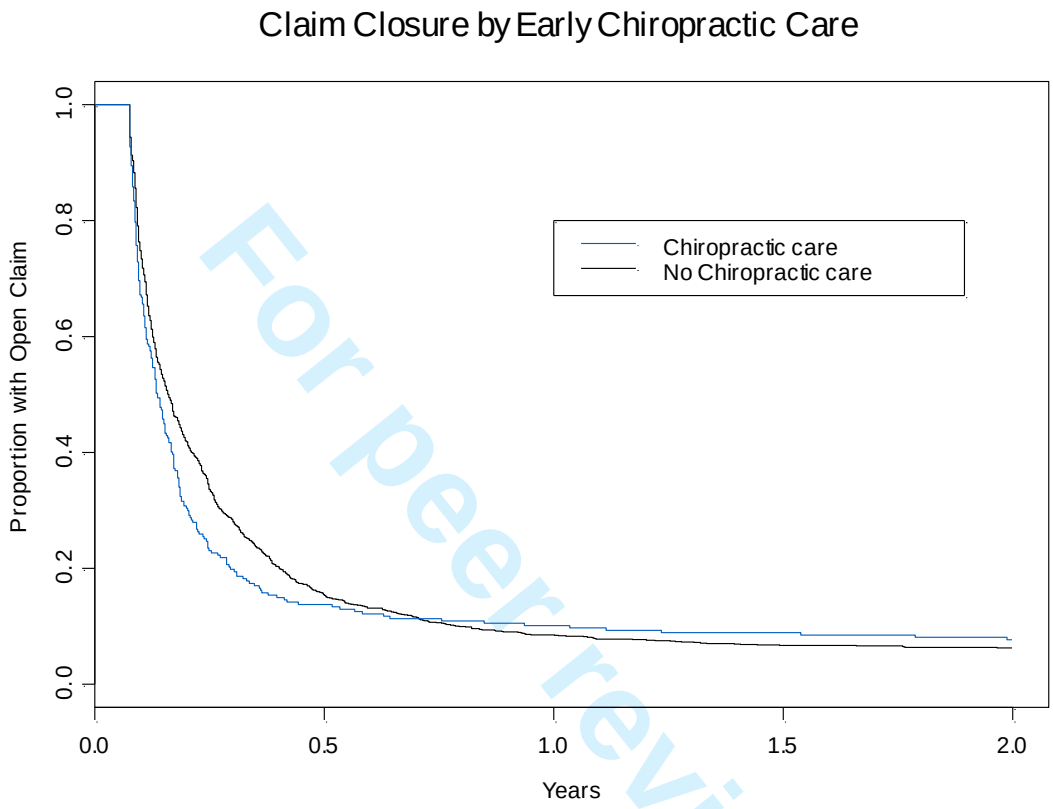
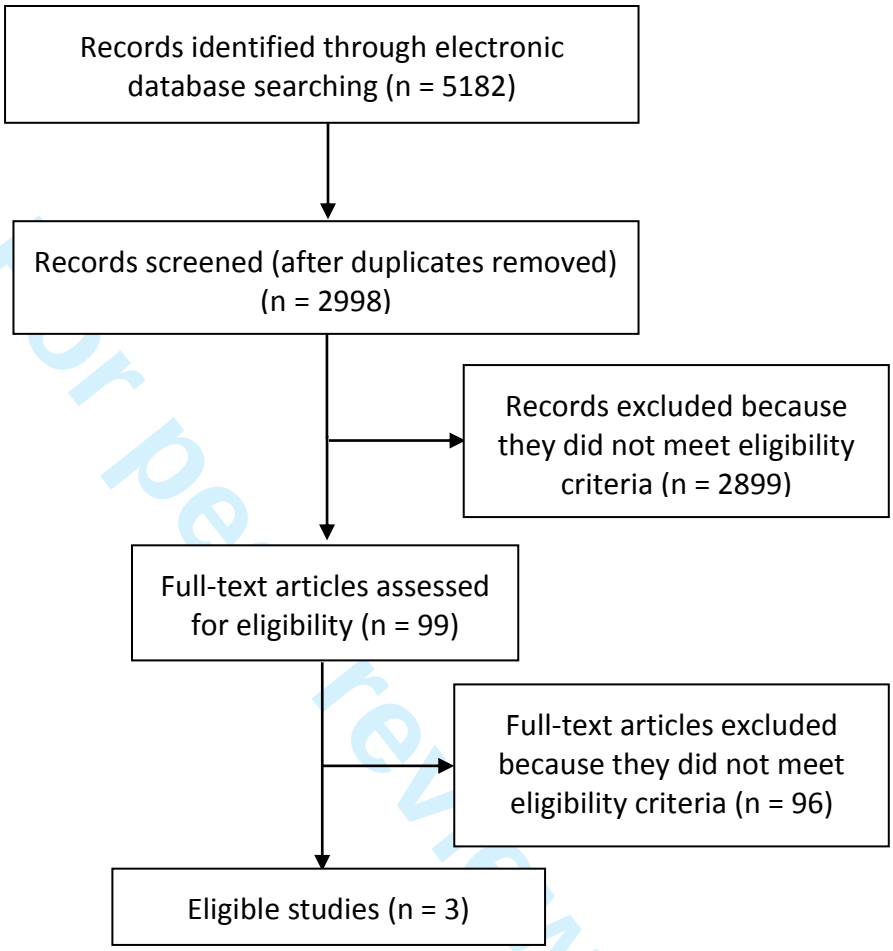


Figure S5: Flow diagram of the literature search process for observational studies assessing the effect of early opioids, physiotherapy, or chiropractic care for acute low back pain.



STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract (**in title on title page**)
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found (**in Abstract**)
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported (**page 1 & 2 in Manuscript**)
Objectives	3	State specific objectives, including any prespecified hypotheses (**Appendix A**)
Methods		
Study design	4	Present key elements of study design early in the paper (**In Abstract, and page 3-7 in Manuscript**)
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection (**page 3 in Manuscript**)
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (**pages 3 & 4 in Manuscript**)
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed (**not applicable**)
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable (**Appendix A and pages 3 & 4 in Manuscript**)
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group (**pages 3-5 in Manuscript**)
Bias	9	Describe any efforts to address potential sources of bias (**pages 4-7 in Manuscript**)
Study size	10	Explain how the study size was arrived at (**page 3 & 4 in Manuscript**)
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why (**pages 5 & 6 in Manuscript**)
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding (**pages 3-7 in Manuscript**)
		(*b*) Describe any methods used to examine subgroups and interactions (**page 6 in Manuscript**)
		(*c*) Explain how missing data were addressed (**page 5 in Manuscript**)
		(*d*) If applicable, explain how loss to follow-up was addressed (**not applicable**)
		(*e*) Describe any sensitivity analyses (**not applicable**)
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (**Table 1 and page 8 in Manuscript**)
		(b) Give reasons for non-participation at each stage (**not applicable**)
		(c) Consider use of a flow diagram (**not informative in our case**)

Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (**Table 1**)
		(b) Indicate number of participants with missing data for each variable of interest (**Table 1**)
		(c) Summarise follow-up time (eg, average and total amount) (**Figure 1**)
Outcome data	15*	Report numbers of outcome events or summary measures over time (**page 8 in Manuscript**)
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (**Table 2**)
		(*b*) Report category boundaries when continuous variables were categorized (**Table 2**)
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period (**not relevant**)
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses (**page 8 in Manuscript**)
Discussion		
Key results	18	Summarise key results with reference to study objectives (**page 10 in Manuscript**)
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias (**pages 10 & 11 in Manuscript**)
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence (**page 13 in Manuscript**)
Generalisability	21	Discuss the generalisability (external validity) of the study results (**page 11 in Manuscript**)
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based (**page 14 in Manuscript**)

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

BMJ Open

The association of worker characteristics and early reimbursement for physical therapy, chiropractic and opioid prescriptions with Workers' Compensation claim duration, for cases of acute low back pain: An observational cohort study

Journal:	*BMJ Open*
Manuscript ID:	bmjopen-2015-007836.R2
Article Type:	Research
Date Submitted by the Author:	13-Jul-2015
Complete List of Authors:	Busse, Jason; McMaster University, Anesthesia; McMaster University, Clinical Epidemiology & Biostatistics Ebrahim, Shanil; Mcmaster University, Clinical Epidemiology and Biostatistics Heels-Ansdell, Diane; Mcmaster University, Clinical Epidemiology and Biostatistics Wang, Li; McMaster University, Anesthesia Couban, Rachel; McMaster University, Anesthesia Walter, Stephen ; Mcmaster University, Clinical Epidemiology and Biostatistics
Primary Subject Heading:	Rehabilitation medicine
Secondary Subject Heading:	Complementary medicine, Evidence based practice
Keywords:	COMPLEMENTARY MEDICINE, Pain management < ANAESTHETICS, OCCUPATIONAL & INDUSTRIAL MEDICINE

The association of worker characteristics and early reimbursement for physical therapy, chiropractic and opioid prescription with Workers' Compensation claim duration, for cases of acute low back pain: An observational cohort study

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Abstract

Objective: To assess the association between early reimbursement for physiotherapy, chiropractic, and opioid prescription for acute low back pain (LBP) with disability claim duration.

Design: Observational cohort study.

Setting and participants: From a random sample of 6,665 claims for acute, uncomplicated LBP approved by the Ontario Workplace Safety and Insurance Board (WSIB) in 2005, we analyzed 1,442 that remained on full benefits at four weeks after claim approval.

Primary outcome measure: Our primary outcome was WSIB claim duration.

Results: We had complete data for all but 3 variables, which had <15% missing data, and we included missing data as a category for these factors. Our time-to-event analysis was adjusted for demographic, workplace, and treatment factors, but not injury severity although we attempted to include a sample with very similar, less severe injuries. Regarding significant factors and treatment variables in our adjusted analysis, older age (e.g. hazard ratio [HR] for age ≥55 versus <25 = 0.52; 99% confidence interval [CI] = 0.36, 0.74) and WSIB-reimbursement for opioid prescription in the first 4-weeks of a claim (HR = 0.68; 99% CI = 0.53, 0.88) were associated with longer claim duration. Higher pre-disability income was associated with longer claim duration, but only among persistent claims (e.g. HR for active claims at 1-year with a pre-disability income >$920/week versus ≤$480 = 0.34; 99% CI = 0.17, 0.68). Missing data for union membership (HR = 1.27; 99% CI = 1.01, 1.59), and working for an employer with a return-to-work program was associated with fewer days on claim (HR = 1.78; 99% CI = 1.45, 2.18). Neither reimbursement for physiotherapy (HR = 1.01; 99% CI = 0.86, 1.19) or chiropractic care (HR for

active claims at 60 days = 1.15; 99% CI = 0.94, 1.41) within the first 4-weeks were associated with claim duration. Our meta-analysis of 3 studies (n=51,069 workers) confirmed a strong association between early opioid use and prolonged claim duration (HR = 0.57, 95%CI = 0.48 to 0.69; moderate certainty evidence).

Conclusions: Our analysis found that early WSIB reimbursement for physiotherapy or chiropractic care, in claimants fully off work greater than 4 weeks, was not associated with claim duration, and that early reimbursement for opioids predicted prolonged claim duration. Well-designed randomized controlled trials are needed to verify our findings and establish causality between these variables and claim duration.

Key Words: Low back pain; disability; compensation; Workers Compensation Board; physical therapy; chiropractic; opioid; survival analysis

Strengths and Limitations

- A *priori* creation of our regression model and the anticipated direction of included independent variables, and assessment of the proportional hazards assumption for all independent variables, provide greater confidence in our findings.
- The reasons for reimbursement of physiotherapy, chiropractic or opioid prescription are uncertain, and despite our adjustments for potential confounders (but not injury severity) it remains possible that LBP claimants who chose to receive these healthcare interventions were prognostically different than those claimants who did not.
- A number of variables that may be important to consider were unavailable (e.g., patient expectations regarding recovery), and chiropractic and physiotherapy are professions, not modalities, and details of the treatment provided could not be obtained for our analysis.
- Our primary outcome, time to claim closure, is a surrogate for patient-important outcomes such as functional restoration or return to work.

Introduction

Back pain is a common problem among working adults in North America, with a lifetime prevalence of 63% and a point prevalence of 21%.[1] After the common cold, low back pain (LBP) is the most frequent cause of lost time from work.[2] Globally, LBP is the primary cause of years lived with disability.[3]

In Canada, annual medical expenditures for LBP are estimated to be between $6 and $12 billion, with additional costs associated with loss in worker productivity from time off work and associated disability payments.[4] Canadian workers who are disabled secondarily to a work-related LBP injury are typically eligible for wage replacement benefits through their provincial Workers' Compensation Board.

In 2013, the Ontario Workplace Safety and Insurance Board (WSIB) approved approximately 232,000 claims that were associated with $2,761 million in payments, and 18% of all allowed lost-time claims were for low back injuries.[5, 6] The WSIB's liability for disability claims greatly exceeds their assets, and as of March 31, 2013 the WSIB's unfunded liabilities were $12.4 billion[7] – more than double their unfunded liability of $5.9 billion in 2006.[8] Unfunded liability is the amount by which future payment obligations exceed the present value of funds available to pay them. To reduce their unfunded liability, the WSIB has become more aggressive about denying claims, decreasing disability benefits, and increasing employee premiums; [9, 10] however, these measures do not address optimal management of disability claims.

Interventions that are commonly reimbursed by WSIB for LBP claims include physiotherapy, chiropractic care and opioids; however, there is limited evidence about their effectiveness. Our systematic review of the Cochrane Back Review Group trial registry found no randomized controlled trials of these interventions focused on workers fully disabled by acute LBP and receiving benefits for lost-time claims (Tables S1 & S2, and Figure S1, in File S1). We also found that many trials of LBP patients use receipt of disability benefits as an exclusion criterion, likely because of concerns that secondary gain (e.g., receipt of financial compensation conditional on disability) will reduce the impact of study interventions. Henshke and colleagues followed a cohort of 973 consecutive primary care patients with non-specific, acute LBP recruited from the clinics of 170 general practitioners, physiotherapists, and chiropractors for 1-year. They found that, in an analysis adjusted for age, gender, injury severity and psychological factors, receipt of disability benefits was strongly associated with delayed recovery (hazard ratio [HR]=0.59; 95%CI = 0.47 to 0.74).[11] As compensated acute LBP has a worse prognosis than uncompensated acute LBP, the results of trials that do not enroll patients receiving disability benefits cannot be confidently generalized to patients who are receiving compensation.

Using administrative data from the Ontario WSIB, we evaluated the association between receiving early reimbursement for physiotherapy, chiropractic care, or prescription for opioids for uncomplicated, acute LBP and disability claim duration. On the basis of prior observational studies,[12-16] we hypothesized that early reimbursement for opioids would be associated with delayed recovery, and early reimbursement for physiotherapy or chiropractic care would be associated with faster recovery. We reported our findings in concordance with the STROBE [17] and TRIPOD [18] statements.

Methods

Patient characteristics and eligibility criteria

Using WSIB administrative data, we identified an inception cohort of workers with uncomplicated, acute low back injuries (i.e., strain or sprain) who were fully disabled from working and receiving wage replacement benefits from the Ontario WSIB. We excluded workers if they were approved for no-lost-time claims. The prognosis for chronic LBP (duration >12 weeks) is different than for acute LBP,[19] and we excluded all claims in which the number of days between accident date and registration date of the claim was greater than 30 days. Most LBP claims resolve within the 1st month,[20] and Workers' Compensation Boards are primarily interested in factors that predict claim resolution among claimants who remain disabled after this time. We therefore excluded claims that ended before 4 weeks.

Between January 1 and June 30, 2005, the Ontario WSIB approved 18,974 lost-time claims for an uncomplicated, acute low back injury. Using the WSIB's administrative database, we acquired a random sample of 6,665 injured workers from this population; 1,442 unique workers remained on full benefits at four weeks and provided data for our analysis. If a worker had more than 1 claim for acute LBP, their first claim was used. The WSIB database recorded benefit status for two years after the first day of injury. Patient information was anonymized and de-identified prior to analysis. The Health Sciences Research Ethics Board of the University of Toronto approved our study protocol.

Administrative Variables

Our primary outcome was time to claim closure, defined as the duration in days from disability claim approval until the claim was closed. The WSIB database also contained demographic, administrative, and clinical information, which were acquired from forms completed by the worker, their employer, and their primary health-care provider. The employer form (Employer's Report of Injury/Disease Form; Form 7), which is used to indicate whether there is doubt regarding the work-relatedness of an employee's back injury, is mandatory and must be submitted within three days of a work-related injury. The form asks employer's "Do you have any reason to doubt the injury/disease is work-related?" and they can indicate either "no" or "yes".

The worker may elect to fill out a form (Worker's Report of Injury/Disease; Form 6) if they have expenses related to their injury. The healthcare provider can elect to complete a form (Health Professional's Report; Form 8) to support their patient's claim that their injury is work-related, which is a pre-requisite for wage replacement benefits through the WSIB. Healthcare providers are asked to complete and submit a Functional Abilities Form for Planning Early and Safe Return to Work for each claim, and the WSIB provides compensation as incentive.

In order to increase confidence in our findings, we defined our regression model before conducting any analyses. Guided by the results from our ongoing systematic review of observational studies evaluating predictors of recovery in patients receiving disability benefits,[21] feedback from administrators at WSIB, and content experts within our research team, we selected, *a priori*, 11 variables from the WSIB database that we judged may be associated with claim closure; we also specified the direction of anticipated effects on claim

duration (Table 1): age, gender, native language, pre-disability income, prior disability claim, union membership, working for an employer with a return to work (RTW) program, employer's doubt that the injury was work-related, and early (1st month) receipt of reimbursement for opioids, physiotherapy, or chiropractic care (Table 1). In 2005, the Ontario WSIB did not capture any measure of LBP injury severity on Forms 6, 7 or 8, and as such we were unable to adjust for this variable. Injured workers may attend a healthcare provider for assessment purposes and we required ≥3 reimbursed visits for physiotherapy or chiropractic, within the first 28-days of claim, in order to qualify as reimbursement for treatment.

We hypothesized that workers represented by a union would resolve their claim faster, as we felt they would have more support for re-engagement with competitive employment (e.g. graduated work hours) versus workers who were not members of a union. We also hypothesized that claims due to injuries that employers reported were work-related would resolve faster than injuries in which the employer doubted that the employee was injured at work, as we felt this may be a surrogate for the influence of non-medical factors (e.g. secondary gain). Based on the findings of a recent systematic review that found RTW coordination was associated with faster RTW for disabled employees,[22] we hypothesized that claimants employed by companies with formal RTW programs would resolve their claim faster.

Data Extraction

The Ontario WSIB's database consists of scanned paper documents, and data must therefore be extracted manually for analysis. Two reviewers extracted data, independently and in duplicate, from the first 100 eligible claims into an Access database (Microsoft Access, Filemaker). In order

to minimize data entry mistakes, we developed data entry forms that included range checks and missing value alerts. The PROC COMPARE procedure in SAS version 9.2 (SAS Institute Inc., Cary, NC) revealed 98% agreement for the initial 100 claims; therefore, to increase feasibility, only a single abstractor completed data entry for the remaining claims used in our analyses.

We screened all data to identify outliers, inconsistencies and missing data by calculating summary statistics, and explored distributions graphically. We worked with WSIB representatives to correct identified outliers and inconsistencies. If inconsistencies could not be corrected, we treated them as missing data. Some WSIB forms are voluntary, and so we included "missing data" as a discrete category for independent variables when applicable.

Statistical analysis

We generated frequencies for all collected data. We reported the mean and standard deviation (SD) of continuous variables, and the number of occurrences represented as proportions for categorical variables. Age was negatively skewed and pre-disability gross income was positively skewed and were therefore entered as categorical variables into our regression model; by decade for age, starting at age 15 and ending at age 65, and by quartiles for pre-disability income.

We performed a time-to-event analysis using a Cox proportional hazards regression model to assess the association between time to claim closure and all 11 independent variables described in Table 1. To avoid overfitting our models, we required at least 10 observations per variable term for our Cox regression model, for a total of 190 disabled workers.[23] We set a threshold of at least 50 observations per category for each independent factor in our regression

model to provide some reassurance that each variable had sufficient discriminant power to detect an association with claim duration, if such an association existed.

For claims that were unresolved when the data was extracted, we used 2-years after claim approval as a censoring point. In order to be more stringent and minimize the likelihood of spurious findings, an independent variable was considered statistically significant if it had a p-value of ≤0.01 in our adjusted model. We calculated adjusted hazard ratios (HRs) for our time-to-event analyses, their associated 99% confidence intervals (CIs), and the associated p-values. We assessed each independent variable in our model to ensure that the proportional hazards assumption was met by entering each variable in the model separately and calculating its interaction with time. We considered a p-value of ≤0.05 for the interaction term as significant. We reported the HRs for independent variables that violated the proportional hazards assumption at 60-days, 6-months, and 1-year. We conducted a sensitivity analysis to investigate the impact of entering receipt of WSIB-reimbursed chiropractic care or physiotherapy as time-dependent covariates in a Cox proportional hazards regression model. This approach accounts for when treatments were initiated during the course of the disability claim.

Pooling data from similar studies

When possible, we pooled the association between early opioid, physiotherapy, or chiropractic care and claim duration in our sample with similar data from observational studies identified through a systematic review (search strategy, Table S4 in File S1). We considered studies to be similar if they enrolled Workers' Compensation patients who were completely disabled from

working secondary to acute, uncomplicated LBP and, explored the association of early treatment with opioids, physiotherapy or chiropractic care with claim duration. Using standardized, pilot-tested forms, 2 reviewers screened, independently and in duplicate, titles and abstracts of identified citations and then full texts of potentially eligible studies. The same reviewers extracted patient characteristics, methodology, and measures of association between early use of opioids, physiotherapy or chiropractic care and disability claim duration from eligible articles.

We used the following criteria to gauge risk of bias: (1) representativeness of the study population (low risk of bias when using random sampling or consecutive sampling, high risk of bias when the source of study population was not reported or acquired through convenience sampling); (2) validity of outcome assessment (low risk of bias when claim duration was acquired directly from the benefits administrator); (3) proportion of lost to follow-up (high risk of bias if >20%); and (4) whether or not predictive models were appropriately adjusted (low risk of bias if adjusted for age, gender, and injury severity).

When possible, we pooled measures of association between early opioid, physiotherapy, or chiropractic care and claim duration, and presented the pooled estimate as a HR and the associated 95%CI. When necessary, we converted odds ratios (ORs) to a relative risk (RR), then to a HR, using the following formula: [24]

$$RR = OR/(1-P_0 + P_0 \times OR)$$

$$HR = (\ln(1-RR \times P_0))/(\ln(1-P_0))$$

where P_0 is the proportion of patients in the control group who had an event by the follow-up time.

We used random-effects meta-analyses, which are usually conservative in that they take both within-study and between-study variability into account.[25] We examined heterogeneity using both a chi-squared test and the I^2 statistic, the latter being the percentage of the total variation in outcomes that is associated with between-study variability (i.e., true differences between studies rather than with sampling error (chance)). [26] Heterogeneity of 0% to 40% was considered 'might not be important', 30% to 60% to be 'moderate heterogeneity', 50% to 90% to be 'substantial heterogeneity', and 75% to 100% to be 'considerable heterogeneity'.[27] The Cochrane Collaboration has proposed overlapping categories, to convey that there are no strict cut-offs for interpreting heterogeneity, and that this decision will depend on the magnitude and direction of effects, as well as the strength of evidence for heterogeneity.

We used the GRADE approach to summarize the certainty of evidence for the effect of early opioid use on claim duration as high, moderate, low, or very low.[28] Using GRADE, observational studies begin as moderate certainty but can be rated down due to: (1) risk of bias; (2) inconsistency; (3) indirectness; (4) imprecision; or (5) publication bias. GRADE suggests considering rating up certainty of evidence one level when methodologically rigorous observational studies show at least a two-fold reduction or increase in risk, and rating up two levels for at least a five-fold reduction or increase in risk.[29] We assessed publication bias by visually observing asymmetry of funnel plots, but only if there were ≥10 studies eligible for meta-analysis. We performed all statistical analyses using SAS version 9.2 (SAS Institute Inc., Cary, NC, USA). All hypothesis tests were 2-tailed and $p \leq 0.05$ was considered statistically significant.

We estimated the cumulative proportion of claims closed in our WSIB dataset at 90-days for disabled workers that did, and did not, receive early opioids by using the following formula:

$$P_1 = 1 - (1 - P_0)^{HR}$$

where P_1 is the cumulative proportion of claims closed by 90-days in the early opioid group, P_0 is the cumulative proportion of claims closed by 90-days in the group that did not receive early opioids, and HR is the pooled estimate of the HR from our meta-analysis.

Results

Table 2 presents the baseline characteristics for the 1,442 disabled workers included in our analysis. The Ontario WSIB reimbursed 786 (55%) claimants for physiotherapy and 391 (27%) for chiropractic care. In the first 4 weeks of their claim, 27% (n=388) were reimbursed for ≥3 physiotherapy treatments, 17% (n=247) were reimbursed for ≥3 chiropractic treatments, and 9% of claimants (n=136) were reimbursed for an opioid prescription. Figure 1 presents the Kaplan-Meier curve for time to claim closure for LBP claimants. Most workers (67%, n=966) had resolved their claim by 90 days, 84% (n=1211) by 180 days, and 91% by 1 year (n=1312); 1348 (93.5%) claims were closed prior to 2 years and 94 (6.5%) were censored.

Time-to-Event Analysis

Our adjusted regression analysis showed that older age (e.g., HR for age ≥55 versus <25 = 0.52; 99% CI = 0.36, 0.74) and opioid prescription reimbursed by the Ontario WSIB in the first 4-weeks of claim (HR = 0.68; 99% CI = 0.53, 0.88) were associated with longer claim duration. The HRs for pre-disability income and receiving reimbursement for early chiropractic care with claim duration were not proportional over time (p=0.001 and 0.031, respectively), and older claims showed a significant association of greater pre-disability income with longer claim duration (e.g. HR for active claims at 1-year with a pre-disability income >$920/week versus ≤$480/week = 0.34; 99% CI = 0.17, 0.68). Working for an employer that had a RTW program (HR = 1.78; 99% CI = 1.45, 2.18), and missing data regarding union membership (HR = 1.27, 99%CI = 1.01, 1.59) were associated with shorter claim duration. Contrary to our predictions, neither early receipt

of WSIB-reimbursement for physiotherapy (HR = 1.01; 99% CI = 0.86, 1.19) nor chiropractic care (e.g. HR for active claims at 60-days = 1.15; 99% CI = 0.94, 1.41) were associated with claim duration (Table 3). We found no important differences using alternative analytic methods (Table S3 in File S1). Figures 2-4 present the Kaplan-Meier curves for time to claim closure for acute LBP claimants who received reimbursement for early opioid prescription, physiotherapy and chiropractic care.

Systematic Review

Our systematic review of observational studies identified 2998 unique records, of which we retrieved 99 in full text; three were eligible for our review and explored early opioid use (Figure S2 in File S1). All 3 observational studies that explored early use of opioids for Workers' Compensation claims due to uncomplicated, acute LBP reported a significant association with prolonged claim duration, and two studies adjusted for injury severity in their regression models (Table 4).[13-15] When our results were pooled with the 2 studies that reported measures of association in relative units,[14, 15] resulting in a total of 51,069 participants, the association between early opioid use and prolonged claim duration was consistent with our findings (adjusted HR = 0.57, 95% CI = 0.48 to 0.69), heterogeneity test p=0.02, I^2=75%; moderate certainty evidence) (Figure 5). Applying this effect to our WSIB dataset means that, at 90-days, 69% of workers without reimbursement for early opioids had resolved their disability claim versus 49% of workers who received reimbursement for early opioids.

The pooled effect was associated with substantial heterogeneity; however, statistical tests of heterogeneity can be misleading when sample sizes are very large and confidence

intervals for measures of association are therefore very narrow.[30] These results provide an excellent example of the phenomenon. The three studies all show consistent, large effect estimates (0.52 to 0.68), which increases confidence in our findings.

Discussion

Statement of Principle Findings

Our analysis of the Ontario WSIB's administrative data revealed that older claimants who were fully disabled at 4 weeks due to uncomplicated, acute LBP and who are reimbursed for opioid prescription in the first 4 weeks of their claim were more likely to experience prolonged claim duration. Higher pre-injury income was also associated with prolonged claim duration, but only among persistent claims. Injured workers employed by organizations with a RTW program and/or missing information on union affiliation were likely to resolve their claim faster. Neither early receipt of reimbursement for physiotherapy nor chiropractic care for uncomplicated LBP was associated with claim duration.

Strengths & Weaknesses

A priori specification of our regression model and stating the anticipated direction of included independent variables, as well as the assessment of the proportional hazards assumption for all independent variables, provide greater confidence in our findings. In 2005 the Ontario WSIB did not capture any measure of LBP injury severity on Forms 6-8 and we were therefore unable to adjust for this factor. The Ontario WSIB Health Professional's Report (Form 8) was updated in August 2011, and now includes capture of baseline pain.[31] We did attempt to include patients with similar injuries by restricting our cohort to acute, uncomplicated LBP, and while there may still be important differences in injury severity in our cohort, our findings regarding the association with early opioid use and delayed claim recovery are consistent with

other studies that have adjusted for low back injury severity.[13, 14] Other strengths include limited missing data, correction of identifiable data errors and inconsistencies, and validation checks to ensure the accuracy of the data used to inform our regression model.

Our study has several limitations. First, it was a retrospective cohort study in which the reasons for reimbursement of physiotherapy, chiropractic or opioid prescription are uncertain. Thus, despite our adjustments for potential confounders, it remains possible that acute LBP claimants who chose to receive these healthcare interventions were prognostically different than those claimants who did not. Second, the WSIB database captures only those physiotherapy or chiropractic treatments that are reimbursed by the WSIB, and it is possible that some patients paid out-of-pocket to receive these services. It is highly unlikely that patients would have received opioids outside of WSIB reimbursement (personal communication, Dr. Norman Buckley, Chair of Anesthesiology, McMaster University). Third, a number of variables that may be important to consider were unavailable (e.g., patient expectations regarding recovery[32]), and some variables were not optimally collected. For example, chiropractic and physiotherapy are professions and not modalities, and there were no details of treatment provided. Fourth, our study focused on workers with acute LBP who were receiving disability benefits from the Ontario WSIB for at least 4-weeks in 2005, and we cannot say whether our findings are generalizable to other disabled workers. We are, however, unaware of any major changes in practices among Ontario chiropractors or physiotherapists since 2005, and there is evidence that both rates of opioids prescriptions and average morphine equivalent dose for non-malignant pain have increased since 2005, which would suggest that our findings regarding early reimbursement for opioids apply to a greater proportion of current

WSIB LBP claimants.[33] Finally, our primary outcome, time to claim closure, is a surrogate for patient-important outcomes such as functional restoration or return to work; however, claim closure and faster claim resolution is associated with functional recovery among adults disabled by non-severe whiplash injuries,[34] which provides some assurances that patients who resolve their disability claim are also likely to experience clinical improvement.

Our Findings in the Context of Other Relevant Literature

Our finding that older age is associated with prolonged claim duration is consistent with the literature.[35] We predicted that injured workers employed by companies that had formal RTW programs would resolve their claims faster, and this was supported by our findings. It is unclear why missing data for union membership was associated with shorter claim duration. Similarly, reasons why higher pre-disability income was associated with prolonged claim duration, but only among persistent claims, are uncertain. Possibilities include that injured workers with higher salaries who do not resolve their claims in the initial 6-months may find it more difficult to identify suitable employment at similar earnings levels, or that compared to other workers (i.e. with lower pre-disability income) workers with higher salaries can accommodate limited compensatory income for longer periods of time.

Although there are no randomized controlled trials exploring the effect of physiotherapy, chiropractic care, or early opioid use for workers with acute, uncomplicated LBP receiving lost-time compensation benefits (Table S2 in File S1), our systematic review identified 6 observational studies that are relevant to our findings.[13-16, 36, 37] Turner and colleagues followed 1,885 workers from Washington for 1 year after they had been awarded Workers'

Compensation benefits for acute LBP. In a comprehensive regression model adjusted for multiple sociodemographic, employment, clinical, healthcare, and administrative factors – including injury severity – they found that workers who attended a chiropractor first, versus a primary care provider, were significantly less likely to remain on disability benefits at 1 year (adjusted OR = 0.41, 95% CI = 0.24, 0.70).[16]

Wasiak and colleagues found that workers in Florida, USA, with acute low back injuries who were reimbursed for limited chiropractic care (<30 days) experienced an 8.6% shorter duration of work disability versus Workers' Compensation claimants who were reimbursed for prolonged chiropractic care (>30 days).[36] The authors did exclude severe injuries from their population, but were unable to adjust for injury severity within their sample. Further, chiropractic care was collected after baseline and not treated as time-dependent, and so it is not surprising that claims with longer duration also received more chiropractic care.

Lemstra and Olszynski explored the effect of standard care (which included long waiting lists for physiotherapy) to provision of rapid rehabilitation services on Workers' Compensation claim duration from a company in Saskatchewan, Canada.[37] After adjusting for a number of factors, including age and injury severity, longer claim duration was associated with both chiropractic care (adjusted HR = 2.88, 95% CI = 1.45, 5.73) and physical therapist involvement (adjusted HR = 19.88, 95% CI = 7.95, 39.77). The authors collected healthcare provider utilization data after baseline and did not treat these variables as time-dependent, and so an alternative explanation is that claims with longer duration are simply more likely to involve either chiropractors or physical therapists.

Canada is currently the largest per-capita consumer of opioids in the world; [38] however, prescribing patterns in Ontario show considerable variation between primary care providers.[39] Workers' Compensation data from the US has shown an almost 10-fold range (5.7% to 52.9%) in the early prescription of opioid medications between various states, suggesting that local prescribing patterns have significant influence on the use of these analgesics.[40] Findings from a study of Workers' Compensation nonspecific LBP claims (that did not adjust for injury severity) revealed that, compared with a no opioid reference group, the odds of chronic work loss were six times greater for claimants who used strong opioids and 11-14 times greater for claimants with opioid prescriptions which exceeded 90 days.[41] We found that reimbursement for early opioid use by the Ontario WSIB was associated with prolonged claim duration for uncomplicated back pain, and pooling of our data with similar studies [14, 15] shows a consistent effect, which increases confidence in our findings.

Implications & Future Research

To manage their growing unfunded liability, the Ontario WSIB has focused on increasing their claim denial rate, decreasing benefits to injured workers, reducing WSIB staff, and raising employer premiums.[9, 10] Most employers are obligated to pay WSIB premiums because they are legally bound to provide injury benefits to their employees, and the Ontario WSIB is protected by laws prohibiting competition in the marketplace. Another strategy is to optimize clinical management of injured workers. Our findings, which were not adjusted for illness severity, suggest that receiving reimbursement from the Ontario WSIB for early chiropractic care or physiotherapy for acute, uncomplicated LBP is not associated with shorter time to claim closure

and receiving reimbursement for early opioids was linked with longer claim duration. We did find a non-significant association between early reimbursement for chiropractic care and shorter claim duration, which was lost by 6-months. In 2005 the Ontario WSIB typically limited reimbursement for chiropractic care to no more than 3-months after a low back injury and the change in association that we found may reflect discontinuation of reimbursement by the WSIB and consequent termination of chiropractic care.

The Ontario WSIB should continue to incorporate established prognostic factors for recovery into their baseline data collection forms, as well as outcomes of direct importance to patients, such as functional recovery, to facilitate more rigorous analyses of their administrative data. However, observational data cannot establish causality and high quality, randomized controlled trials are urgently needed to confirm or refute our findings.

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Acknowledgements

The authors thank Dr. Gordon Guyatt for helpful discussion.

Contributors

JWB, SE, D-HA and SDW designed the study. DH-A and LW conducted data analysis and SDW provided statistical advice. JWB, SE, D-HA and SDW were involved in interpreting the data. RC designed and conducted all literature searches. JWB drafted the manuscript and wrote the final version. All authors critically revised the manuscript, provided comment and approved the final version for publication.

Funding

This study was funded by research grants from the Ontario Workers Safety and Insurance Board Research Advisory Council and the Ontario Chiropractic Association. Shanil Ebrahim was

supported by a MITACS Elevate Postdoctoral Fellowship Award. The funding sources had no role in design or conduct of the study; the collection, management, analysis, or interpretation of the data; or the preparation, review, or approval of the manuscript.

Competing interests

Jason Busse acts as a consultant to Prisma Health Canada, a private incorporated company funded by employers and insurers that consults on and manages long-term disability claims.

Ethics approval

The study was approved by the Health Sciences Research Ethics Board of the University of Toronto.

Provenance and peer review

Not commissioned; externally peer reviewed.

Data sharing statement

No additional data are available.

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Figure Legends

Figure 1: Kaplan-Meier curve for time to claim closure

Figure 2: Kaplan-Meier curve for early reimbursement for opioid prescription

Figure 3: Kaplan-Meier curve for early reimbursement for physiotherapy

Figure 4: Kaplan-Meier curve for early reimbursement for chiropractic care

Figure 5: The association between early opioid use/prescription and claim duration

Supporting Information Legends

Table S1: Search strategy for the Cochrane Back Group trials registry

Table S2: Randomized controlled trials of acute low back pain assessing the effect of opioids, chiropractic care, or physical therapy, and their generalizability to injured workers receiving disability benefits

Table S3: Sensitivity analysis of factors associated with time to claim closure, entering chiropractic care and physiotherapy as time-dependant co-variates (n=1,442)

Table S4: Search strategy for observational studies exploring the association of early opioid, physiotherapy, or chiropractic care for workers with acute low back pain with claim duration

Figure S1: A flow diagram of the literature search process for randomized controlled trials assessing the effect of opioids, physiotherapy, or chiropractic care for acute low back pain.

Figure S2: A flow diagram of the literature search process for observational studies assessing the effect of early opioids, physiotherapy, or chiropractic care for acute low back pain.

Table 1: Description of model variables

Variable	Anticipated Direction of Effect
Age (in decades)	older age: -
Gender	female: -
First language	non-English: -
Pre-disability income	higher income: -
Reimbursement for opioid prescription in the first 4-weeks of a claim	opioid reimbursement: -
Prior claim(s)	prior claim: -
Union membership	Union member: +
Employer RTW-program	RTW program: +
Work-relatedness	work-related: +
Reimbursement for ≥3 chiropractic treatments in the first 4-weeks of a claim	DC care: +
Reimbursement for ≥3 physiotherapy treatments in the first 4-weeks of a claim	PT care: +

+: associated with faster claim closure
-: associated with slower claim closure

Table 2: Baseline Characteristics of WSIB Low Back Pain Claims (n=1,442)

Age in years, mean (SD)	41.3 (10.5)
Gender, n (%)	
Female	552 (38.3)
Male	890 (61.7)
First language, n (%)	
English	1372 (95.1)
Other	70 (4.9)
Pre-disability income (dollars/week) mean (SD)	731.4 (332.5)
Opioid prescription reimbursed by WSIB in the first 4-weeks of claim, n (%)	
Yes	136 (9.4)
No	1306 (90.6)
Prior WSIB claim, n (%)	
Yes	1091 (75.7)
No	351 (24.3)
Union membership, n (%)	
Yes	610 (42.3)
No	656 (45.5)
Missing data	176 (12.2)
Employer RTW program, n (%)	
Yes	1042 (72.3)
No	278 (19.3)
Missing data	122 (8.5)
Employer doubts work-relatedness of injury, n (%)	
Yes	195 (13.5)
No	1051 (72.9)
Missing data	196 (13.6)
Chiropractic care reimbursed by WSIB during claim, n (%)	391 (27.1)
Early Chiropractic care (≥3 treatments received within the first 28 days), n (%)	247 (17.1)
Physiotherapy reimbursed by WSIB during claim, n (%)	786 (54.5)
Early Physiotherapy (≥3 treatments received within the first 28 days), n (%)	388 (26.9)

Table 3: Factors associated with time to claim closure (n=1,442)*

	Univariate		Multivariable	
	Hazard Ratio (99% CI)	**p-value**	**Adjusted Hazard Ratio (99% CI)**	**p-value**
Baseline predictors				
Age categories in years		<0.001		<0.001
15 to <25	1.00		1.00	
25 to <35	0.88 (0.65, 1.19)		0.79 (0.58, 1.09)	
35 to <45	0.78 (0.59, 1.04)		0.70 (0.52, 0.95)	
45 to <55	0.76 (0.56, 1.02)		0.67 (0.49, 0.91)	
55 to 65	0.56 (0.40, 0.80)		0.52 (0.36, 0.74)	
Gender		0.114		0.446
Females	1.09 (0.95, 1.26)		0.96 (0.82, 1.12)	
Males	1.00		1.00	
First language		0.137		0.312
English	1.00		1.00	
Other	0.83 (0.59, 1.15)		0.88 (0.63, 1.23)	
Pre-disability income in dollars per week				
At 60 days:				
≤480	1.00	-	1.00	-
481-694	1.09 (0.89, 1.34)	0.273	1.03 (0.83, 1.27)	0.749
695-920	1.13 (0.92, 1.39)	0.137	0.96 (0.77, 1.21)	0.678
>920	1.08 (0.88, 1.33)	0.326	0.93 (0.74, 1.18)	0.443
At 180 days:				
≤480	1.00	-	1.00	-
481-694	0.89 (0.68, 1.17)	0.267	0.89 (0.67, 1.17)	0.266
695-920	0.84 (0.63, 1.12)	0.115	0.73 (0.54, 0.98)	0.006
>920	0.72 (0.54, 0.97)	0.004	0.63 (0.46, 0.86)	<0.001
At 365 days:				
≤480	1.00	-	1.00	-
481-694	0.65 (0.36, 1.18)	0.064	0.71 (0.38, 1.31)	0.147
695-920	0.53 (0.28, 1.02)	0.012	0.47 (0.24, 0.91)	0.003
>920	0.39 (0.20, 0.75)	<0.001	0.34 (0.17, 0.68)	<0.001
Early Reimbursement for Opioid prescription (within the first 28 days)		<0.001		<0.001
Yes	0.62 (0.48, 0.80)		0.68 (0.53, 0.88)	
No	1.00		1.00	
Prior claims		0.306		0.709
Yes	1.07 (0.91, 1.26)		1.03 (0.86, 1.22)	
No	1.00		1.00	
Union membership		<0.001		0.016
Yes	1.29 (1.11, 1.50)		1.14 (0.96, 1.35)	
No	1.00		1.00	
Missing	1.34 (1.07, 1.68)		1.27 (1.01, 1.59)	
Employer RTW program		<0.001		<0.001
Yes	1.73 (1.43, 2.09)		1.78 (1.45, 2.18)	
No	1.00		1.00	
Missing	1.17 (0.87, 1.58)		1.17 (0.86, 1.59)	
Doubt Work-relatedness		0.174		0.138
Yes	0.94 (0.76, 1.16)		0.88 (0.71, 1.08)	

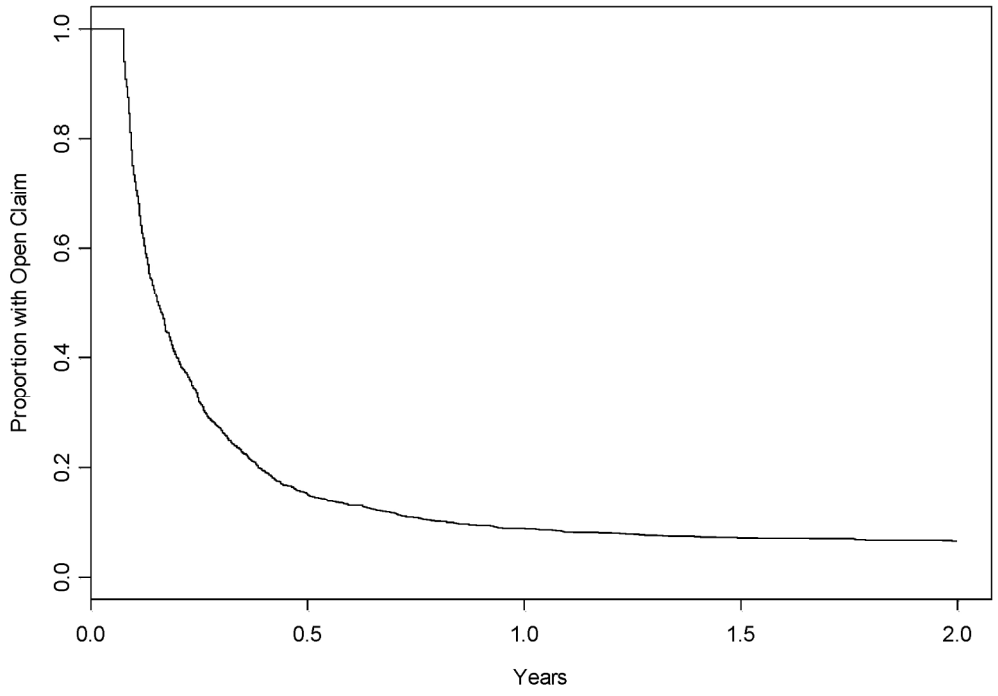
No Missing	1.00 1.13 (0.92, 1.39)		1.00 1.08 (0.87, 1.33)	
Early Reimbursement for Chiropractic care **At 60 days:** **At 180 days:** **At 365 days:**	 1.19 (0.99, 1.45) 0.91 (0.65, 1.24) 0.60 (0.29, 1.23)	 0.017 0.437 0.067	 1.15 (0.94, 1.41) 0.90 (0.65, 1.24) 0.61 (0.29, 1.29)	 0.067 0.392 0.089
Early Reimbursement for Physiotherapy	0.98 (0.84, 1.15)	0.726	1.01 (0.86, 1.19)	0.848

* HR>1 indicates faster claim closure; RTW = return to work; Early reimbursement for chiropractic or physiotherapy = 3 or more treatments received within the first 28 days

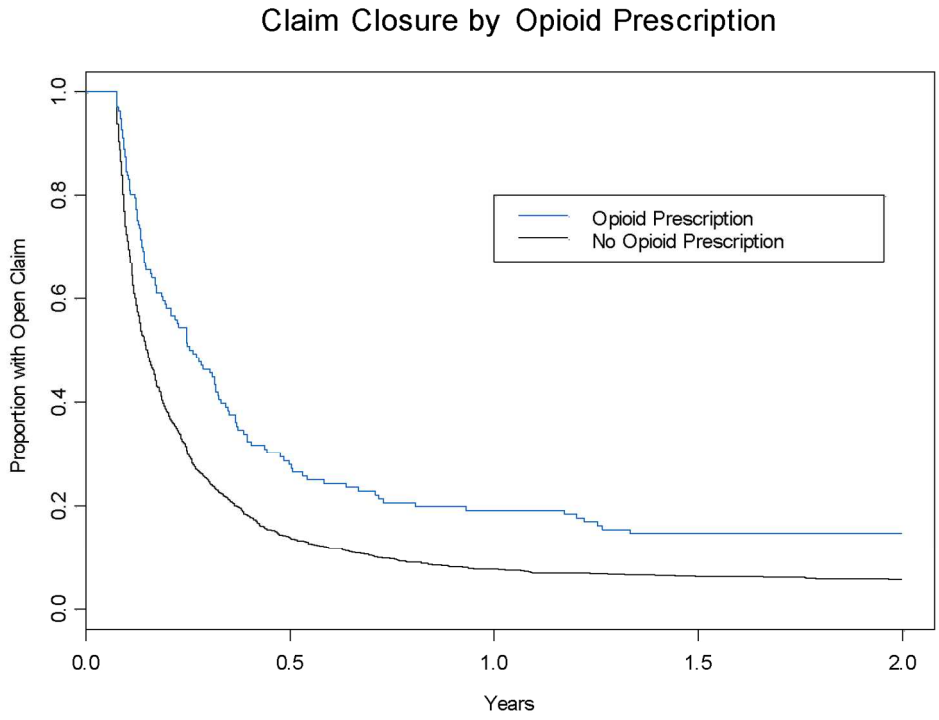
Table 4: Observational studies exploring the association between early opioid use and Workers' Compensation claim duration

Study	Population	Opioid variable tested	Adjustments	Dependent variable	Results*
Webster et al., 2007	8,443 American Workers' Compensation claimants with new-onset, disabling LBP	Receipt of opioids within the first 15 days of claim	Injury severity, age, gender, length of job tenure	Change in mean disability duration	**1-140mg MEA** 5.4 days, 95%CI = -14.6 to 25.0 **141-225mg MEA** 21.9 days, 95%CI = 3.2 to 40.6 **226-450mg MEA** 43.8 days, 95%CI = 23.7 to 63.9 **>450mg MEA** 69.1 days, 95%CI = 49.3 to 89.0
Franklin et al., 2008	1,843 Washington, US, Workers' Compensation claimants with new-onset, disabling LBP	Reimbursement for opioids within 6 weeks of 1st medical visit for LBP	Age, gender, race, education, injury severity, pain intensity, Roland disability questionnaire	Receipt of wage replacement benefits at 1-year	**1-150mg MED** OR = 1.9, 95%CI = 1.2 to 3.1 **151-300mg MED** OR = 2.0, 95%CI = 1.2 to 3.3 **301-650mg MED** OR = 1.6, 95%CI = 0.9 to 2.6 **>650mg MED** OR = 1.9, 95%CI = 1.2 to 2.9
Gross et al., 2009	47,784 Alberta, Canada, Workers' Compensation claimants with new-onset, disabling LBP	Reimbursement for opioids within the first 2 weeks of claim	Age, gender, annual salary, year of claim, number of previous claims	Receipt of wage replacement benefits at 1-year	**No early opioids** HR = 1.94, 95%CI = 1.86 to 2.02

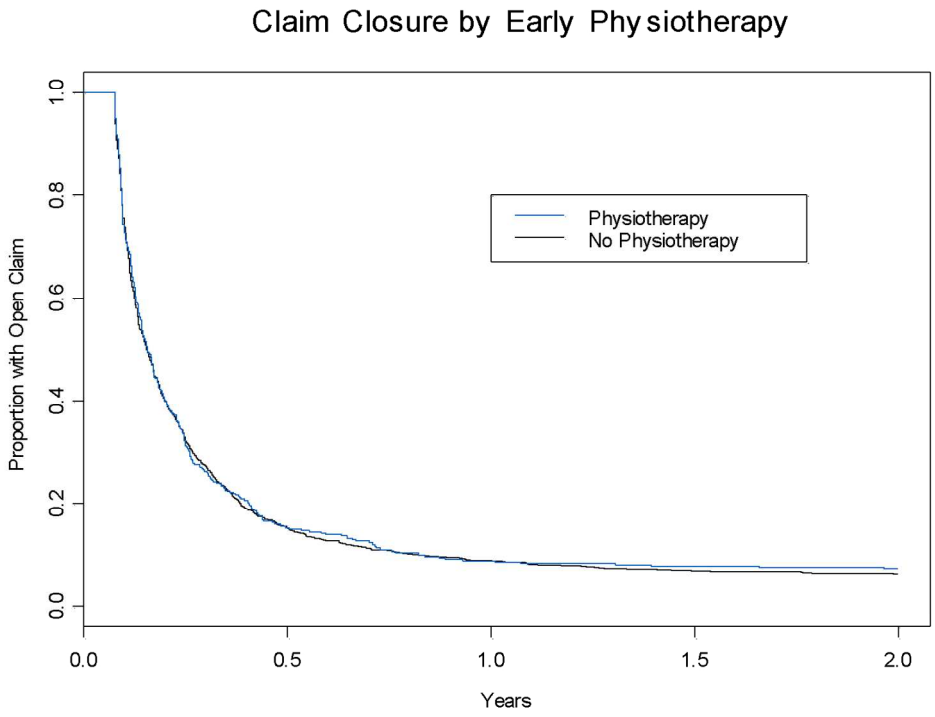
* The reference group is no early receipt of opioids for Franklin et al., and Webster et al.
95% CI = 95% confidence interval; LBP = low back pain; MEA = morphine equivalent amount; MED = morphine equivalent dose; OR = odds ratio; HR = hazard ratio



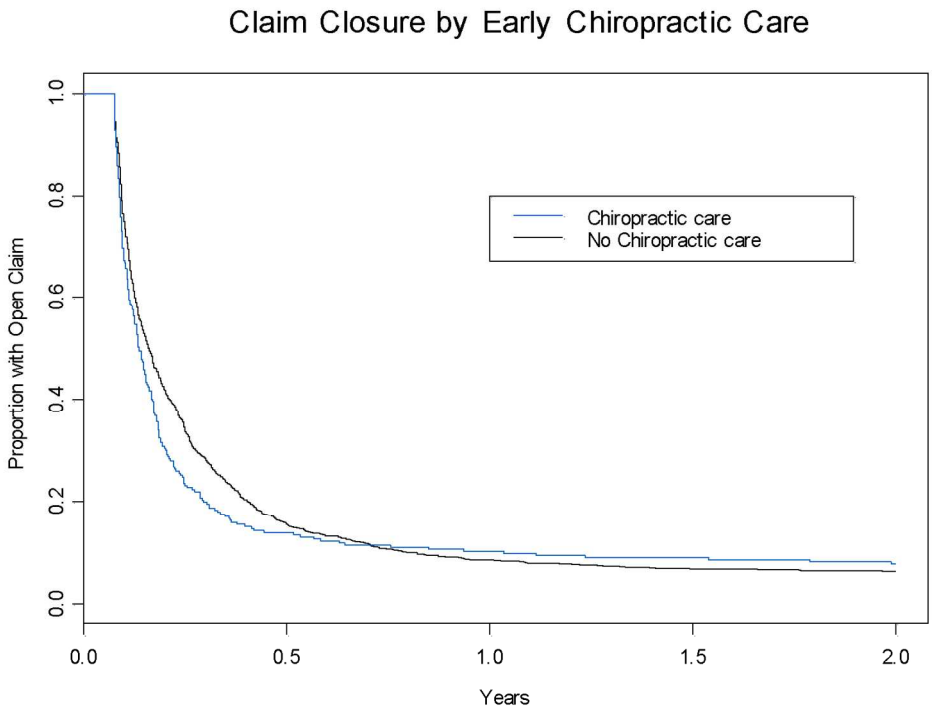
Kaplan-Meier curve for time to claim closure
181x130mm (300 x 300 DPI)



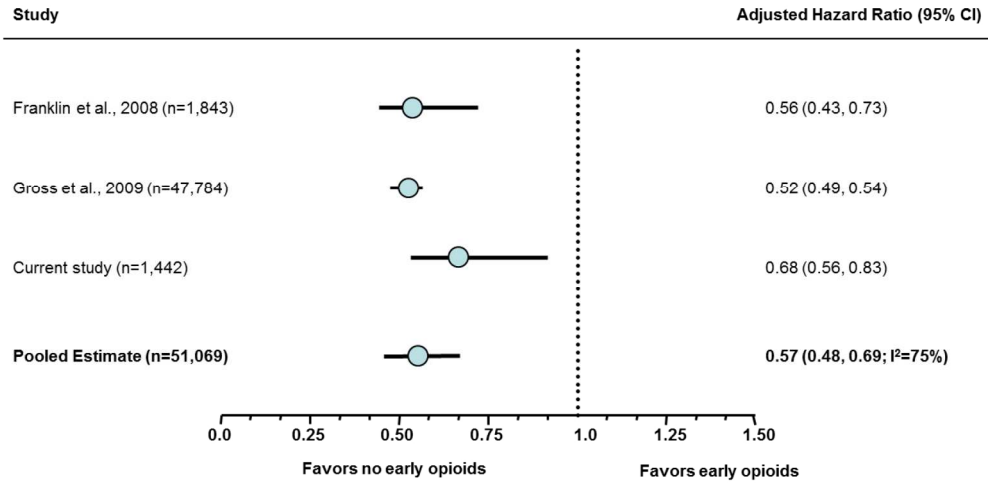
Kaplan-Meier curve for early reimbursement for opioid prescription
145x110mm (300 x 300 DPI)



Kaplan-Meier curve for early reimbursement for physiotherapy
146x107mm (300 x 300 DPI)



Kaplan-Meier curve for early reimbursement for chiropractic care
149x109mm (300 x 300 DPI)



The association between early opioid use/prescription and claim duration
177x88mm (300 x 300 DPI)

Table S1: Search strategy for the Cochrane Back Group trials registry*

Search Strategy in Cochrane Library:

*:ti,ab,kw in Trials, with Back Group in Review Groups 6476

Endnote search strategy:

Any field contains: acute AND Any field contains chiropractic (43)
Any field contains: acute AND Any field contains physiotherapy* (87)
Any field contains: acute AND Any field contains opioid (30)
Any field contains: opioid NOT Any field contains: surgery NOT Any field contains: chronic (28)
Any field contains: emergency (57) NOT Any field contains: whiplash (18)

*On May 1, 2015 we used the Cochrane Library to search the Cochrane Back Review Group (CBRG) Trials Register, which we exported to Endnote. We also screened the included studies lists of recent CBRG Reviews of chiropractic and physiotherapy interventions for acute low back pain (Franke et al., 2015, Rubinstein et al., 2012).

Table S2: Randomized controlled trials of acute low back pain assessing the effect of opioids, chiropractic care, or physical therapy, and their generalizability to injured workers receiving disability benefits

Study	Participants and Interventions	Representation of injured workers receiving lost-time disability benefits for acute low back pain
Glover 1974	84 patients with unilateral low back pain (LBP), randomized to manipulation or control (sham diathermy)	No mention regarding receipt of lost-time disability benefits
Bergquist-Ullman 1977	217 patients consulting a workplace health centre with acute or subacute LBP randomized to back school, physiotherapy or placebo	At least 88% of patients were enrolled with acute LBP, and of the 217, 184 were "sick-listed" for a median of 21 days during the study, but there was no mention regarding receipt of lost-time disability benefits
Rasmussen 1979	26 patients with LBP duration <3weeks, randomized to manipulation or diathermy	No mention regarding receipt of lost-time disability benefits
Hoehler 1981	95 patients with palpatory cues indicating hyperalgesia or a restricted or painful range of vertebral motion, randomized to rotational manipulation of the trunk or massage	No mention regarding receipt of lost-time disability benefits
Farrell 1982	48 subjects with acute LBP duration <3 weeks, randomized to passive mobilization and manipulation or combination of diathermy, exercises and ergonomic advice	No mention regarding receipt of lost-time disability benefits
Gilbert 1985	270 patients presenting with LBP, randomized to bed rest or physiotherapy	The authors reported that "people who were receiving workman's compensation were also slower to recover." p.794, but they did not report any associated data (e.g. how many patients were receiving disability benefits, or the quantitative results for this subgroup).
Waterworth 1985	112 patients with acute mechanical LBP, randomized to ergonomic advice/ Diflunisal or ergonomic advice/ conservative physiotherapy (ultrasound and exercise) or ergonomic advice/manipulation	The authors enrolled a mixed group of patients, that may include up to 54% receiving lost-time claim benefits, but that the proportion is unequal between study group (ranging from 47% to 63%) and the results are provided for the total population which precludes confident generalizability to only those who were receiving lost-time claim benefits.
Hadler 1987	54 subjects with acute LBP, randomized to mobilization or manipulation	Patients who were receiving disability benefits were explicitly excluded from this trial: "neither workers' compensation nor disability insurance should be at issued [sic] and the acute low-back pain must not be considered work-related."pg 703
MacDonald 1990	95 subjects with LBP duration <4 weeks, randomized to osteopathic manipulation or control (advice to rest and resume activities gradually)	"Less than 30% [of the study group] suffered loss of income because of disability" pg. 366

Cramer 1993	36 subjects with mechanical LBP less than two weeks duration randomized to side-lying manipulation, electrical stimulation and cold packs or control (detuned ultrasound, cold packs and 15-30 sec. gentle massage)	Patients who were receiving disability benefits were explicitly excluded from this trial. Inclusion criteria stipulate "no litigation or workers' compensation" (as per the review by Rubinstein 2012, pg. 52)
Skargren 1997	323 patients with back and neck pain of mixed duration, randomized to chiropractic or physiotherapy.	51% of patients (166 of323) were on "sick-leave" when enrolled (Table 3, pg. 2170), but there was no mention regarding receipt of lost-time disability benefits.
Innes 1998	123 patients with acute LBP, randomized to ketorolac or acetaminophen/codeine	Patients who were receiving disability benefits were limited during enrollment: "Because Workers Compensation status might influence response to therapy, we limited each site to 10 work-related back injuries, hoping to limit such cases to no more than half the total study enrollment." pg. 550
Cherkin 1998	321 adults with acute LBP randomized to the McKenzie method of physical therapy, chiropractic manipulation, or provision of an educational booklet	patients who were receiving disability benefits were explicitly excluded from this trial: "Subjects who… were involved in claims for compensation or litigation because of the back injury…were also excluded"; pg. 1022
Seferlis 1998	180 patients sick-listed for < 2 weeks for LBP randomized to General Practitioner Program (rest, sick-leave, analgesics etc.) or Manual Therapy Program (autotraction, manipulation, mobilization etc.) or Intensive Training Program (information, muscle training and general condition training 3x/week for 8 weeks)	All enrolled patients were "sick listed for acute low-back pain for up to 2 weeks", but there is no mention regarding receipt of lost-time disability benefits.
Morton 1999	29 patients with acute mechanical LBP, randomized to manipulation/ exercise or exercise alone	Patients who were receiving disability benefits were explicitly excluded from this trial: "Exclusion criteria were … third-party, public liability or workers' compensation claimants"; pg. 185
Veenema 2000	155 patients with musculoskeletal LBP, randomized to meperidine or ketorolac	No mention regarding receipt of lost-time disability benefits
Metscher 2001	192 Patients with acute LBP randomized to dexketoprofen-trometamol or tramadolhydrochloride	Abstract in English, paper in German. No mention in the abstract about receipt of lost-time disability benefits
Palangio 2002	147 patients with acute LBP, first episode or exacerbation of chronic condition with onset <48 hours before enrolment, randomized to combination hydrocodone 7.5 mg and ibuprofen 200 mg (HC/IB) or combination oxycodone 5 mg and acetaminophen 325 mg (OX/AC)	No mention regarding receipt of lost-time disability benefits
Hofstee 2002	250 patients with sciatica of less than 1 months duration randomized to bed rest, physiotherapy or continuation of activities of daily living	No mention regarding receipt of lost-time disability benefits
Johnstone 2002	12 patients with acute LBP with signs of psychological distress (DRAM score Modified Zung score >17) randomized to cognitive behavioral therapy and conventional physiotherapy or conventional physiotherapy alone	Patients with "ongoing medico legal issues" were excluded (pg.183). No mention regarding receipt of lost-time disability benefits

Childs 2004	131 patients with LBP of median duration of 27 days, randomized to manipulation and exercise or exercise alone	39.8% of patients had missed work due to LBP, Table 2 pg. 925, but there was no mention regarding receipt of lost-time disability benefits
Hoiriis 2004	192 patients with LBP of 3 to 6 weeks duration randomized to chiropractic adjustments with placebo medicine, muscle relaxants with sham adjustments, or placebo medicine with sham adjustments	No mention regarding receipt of lost-time disability benefits
Salvador 2005	28 subjects randomly allocated to a muscle energy technique or transcutaneous electrical nerve stimulation (TENS)	Abstract in English, paper in Portuguese. No mention in the abstract about receipt of lost-time disability benefits
Brennan 2006	123 patients referred to physiotherapy for LBP less than 90 days duration, randomized to manipulation or specific exercise or stabilization	No mention regarding receipt of lost-time disability benefits
Santilli 2006	102 patients with acute moderate to severe radiating LBP of duration <10 days with MRI evidence of disc protrusion, randomized to manipulation or simulated manipulation	No mention regarding receipt of lost-time disability benefits
Hancock 2007	240 subjects with acute LBP duration < 6 weeks, randomized to four groups: control (placebo drug and placebo manipulation) or NSAIDs (diclofenac and placebo manipulation) or manipulation (placebo drug and active manipulation) or manipulation and NSAIDs (diclofenac and active manipulation)	No mention regarding receipt of lost-time disability benefits
Lee 2008	Study of 78 musculoskeletal pain patients, 67% with LBP, randomized to tramadol/paracetemol (n=28 with LBP) or ketorolac/paracetemol (n=24 with LBP)	No mention regarding receipt of lost-time disability benefits
Lau 2008	110 patients with acute LBP, randomized to immediate intervention (advice to stay active, Back Care booklet, reassurance, advice, interferential current therapy) or control (walking training and prescription of walking aids as indicated) followed by outpatient physiotherapy (for both groups)	12% of patients (13 of 110) had work-related injuries (see Table 1), but no mention regarding receipt of lost-time disability benefits
Selkow 2009	20 subjects with acute LBP, randomly allocated to muscle energy technique or sham manual treatment	No mention regarding receipt of lost-time disability benefits
Cleland 2009	112 subjects with LBP, that met 4 out of 5 criteria for a clinical prediction rule for LBP likely to respond to manipulation, randomized to supine thrust manipulation, side-lying thrust manipulation or non-thrust manipulation	Only 6% of patients were unable to work due to LBP. Table 2, pg.2724.
Hallegraef 2009	64 patients with acute nonspecific LBP duration <16 days, randomized to manipulative therapy plus physical therapy or physical therapy alone	No mention regarding receipt of lost-time disability benefits

Sutlive 2009	60 subjects with LBP meeting 3 out of 5 criteria for a clinical prediction rule for LBP likely to respond to manipulation, randomized to lumbopelvic manipulation or neutral gap manipulation	Patients "with litigation pending for their LBP" were excluded. No mention regarding receipt of lost-time disability benefits
Juni 2009	104 patients with acute LBP duration < 4 weeks, randomized to standard care with manipulation or standard care alone	No mention regarding receipt of lost-time disability benefits
Machado 2010	148 adults with acute LBP duration <6 weeks, randomized to the McKenzie method and first-line care (advice, reassurance and time-contingent acetaminophen) or first-line care alone	Only 3% of participants (4 of 146) were receiving disability benefits for their injury (see Table 1)
Lewis 2011	89 patients with acute LBP duration < 3 months, randomized to strain-counterstrain manual therapy/exercise or exercise alone	No mention regarding receipt of lost-time disability benefits
Biondi 2013	1664 patients with acute LBP, randomized to tapentadol or oxycodone	No mention regarding receipt of lost-time disability benefits
Goertz 2013	91 patients with acute LBP, duration < 4 weeks, randomized to standard medical care and chiropractic manipulation or standard care alone	No mention regarding receipt of lost-time disability benefits
Behrbalk 2014	65 adults with acute LBP, randomized to morphine or morphine/promethazine	No mention regarding receipt of lost-time disability benefits
Eken 2014	137 patients with moderate or severe acute LBP, randomized to paracetemol, morphine or dexketoprophen	No mention regarding receipt of lost-time disability benefits
Tanen 2014	44 patients with acute radicular LBP, randomized to lidocaine or ketorolac	No mention regarding receipt of lost-time disability benefits

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Table S3: Sensitivity analysis of factors associated with time to claim closure, entering chiropractic care and physiotherapy as time-dependant co-variates (n=1,442)

	Univariate		Multivariable	
	Hazard Ratio (99% CI)	**p-value**	**Adjusted Hazard Ratio (99% CI)**	**p-value**
Baseline predictors				
Age categories in years		<0.001		<0.001
15 to <25	1.00		1.00	
25 to <35	0.88 (0.65, 1.19)		0.79 (0.58, 1.08)	
35 to <45	0.78 (0.59, 1.04)		0.70 (0.52, 0.95)	
45 to <55	0.76 (0.56, 1.02)		0.67 (0.49, 0.91)	
55 to 65	0.56 (0.40, 0.80)		0.52 (0.36, 0.74)	
Gender		0.114		0.451
Females	1.09 (0.95, 1.26)		0.96 (0.82, 1.12)	
Males	1.00		1.00	
First language		0.137		0.327
English	1.00		1.00	
Other	0.83 (0.59, 1.15)		0.88 (0.63, 1.23)	
Pre-disability income in dollars per week				
At 30 days:				
≤480	1.00	-	1.00	-
481-694	1.15 (0.91, 1.45)	0.125	1.08 (0.85, 1.37)	0.396
695-920	1.21 (0.96, 1.54)	0.034	1.05 (0.81, 1.36)	0.614
>920	1.20 (0.94, 1.52)	0.050	1.04 (0.80, 1.35)	0.689
At 60 days:				
≤480	1.00	-	1.00	-
481-694	1.09 (0.89, 1.34)	0.273	1.03 (0.83, 1.27)	0.710
695-920	1.13 (0.92, 1.39)	0.137	0.97, (0.77, 1.22)	0.746
>920	1.08 (0.88, 1.33)	0.326	0.94 (0.74, 1.19)	0.477
At 180 days:				
≤480	1.00	-	1.00	-
481-694	0.89 (0.68, 1.17)	0.267	0.85 (0.65, 1.12)	0.130
695-920	0.84 (0.63, 1.12)	0.115	0.71 (0.52, 0.96)	0.003
>920	0.72 (0.54, 0.97)	0.004	0.61 (0.45, 0.84)	<0.001
At 365 days:				
≤480	1.00	-	1.00	-
481-694	0.65 (0.36, 1.18)	0.064	0.63 (0.35, 1.16)	0.051
695-920	0.53 (0.28, 1.02)	0.012	0.44 (0.23, 0.84)	0.001
>920	0.39 (0.20, 0.75)	<0.001	0.32 (0.16, 0.63)	<0.001
Opioid prescription		<0.001		<0.001
Yes	0.62 (0.48, 0.80)		0.69 (0.53, 0.89)	
No	1.00		1.00	
Prior claims		0.306		0.661
Yes	1.07 (0.91, 1.26)		1.03 (0.87, 1.22)	
No	1.00		1.00	
Union membership		<0.001		0.014
Yes	1.29 (1.11, 1.50)		1.14 (0.96, 1.36)	
No	1.00		1.00	
Missing	1.34 (1.07, 1.68)		1.27 (1.01, 1.60)	
Employer RTW program		<0.001		<0.001
Yes	1.73 (1.43, 2.09)		1.77 (1.45, 2.18)	

No Missing	1.00 1.17 (0.87, 1.58)		1.00 1.18 (0.86, 1.60)	
Doubt Work-relatedness Yes No Missing	 0.94 (0.76, 1.16) 1.00 1.13 (0.92, 1.39)	0.174	 0.87 (0.70, 1.08) 1.00 1.08 (0.87, 1.33)	0.119
Time-dependent predictors*				
Chiropractic care received after the accident prior to claim closure	1.11 (0.95, 1.30)	0.096	1.08 (0.91, 1.29)	0.268
Physiotherapy after the accident prior to claim closure	0.96 (0.83, 1.10)	0.420	0.99 (0.85, 1.16)	0.913

HR>1 indicates faster claim closure; RTW = return to work
* The time-dependent predictors are "turned on" once the claimant has received their first service after their accident.

Table S4: Search strategy for observational studies exploring the association of early opioid, physiotherapy, or chiropractic care with Workers' Compensation claim duration, for cases of acute low back pain

MEDLINE (OvidSP)

1 exp Whiplash Injuries/
2 exp Soft Tissue Injuries/
3 repetitive strain injur$.mp.
4 carpal tunnel syndrome.mp.
5 exp Cumulative Trauma Disorders/
6 exp Back pain/ or exp pain/ or chronic pain.tw.
7 exp Anxiety/
8 exp Depression/
9 exp Neck Pain/
10 exp Depressive Disorder/
11 exp Back Injuries/
12 injured worker$.mp.
13 musculoskeletal injur$.mp.
14 or/1-13
15 exp "Wounds and Injuries"/
16 Musculoskeletal System/ or Musculoskeletal Diseases/
17 15 and 16
18 14 or 17
19 exp insurance claim reporting/ or exp "insurance claim review"/ or exp insurance, disability/ or insurance, liability/
20 Insurance, Accident/
21 ((worker$ or workman$ or workmen&) adj compensation).mp. or exp Workers' compensation/
22 claim.mp.
23 claimant.mp.
24 or/19-23
25 prognosis.mp. or exp Prognosis/
26 Time/ or exp Time Factors/
27 exp "Recovery of Function"/
28 "Severity of Illness Index"/
29 exp Trauma Severity Indices/
30 (recovery or prognostic).mp.
31 or/25-30
32 18 and 24 and 31
33 exp Disability Evaluation/
34 24 and 31 and 33
35 exp Occupational Diseases/ or exp Accidents, Occupational/ or (occupational injur: or occupational accident:).mp.
36 24 and 31 and 35
37 exp Accidents, Traffic/
38 24 and 31 and 37
39 "Compensation and Redress"/
40 18 and 31 and 39

41 exp Work Capacity Evaluation/ or exp workload/ or workload.mp.
42 (18 or 35) and 24 and 41
43 32 or 34 or 36 or 38 or 40 or 42
44 18 or 33
45 31 or 41
46 35 and 44 and 45
47 46 or 43

EMBASE (OvidSP)
1 whiplash injur$.mp. or exp whiplash injury/
2 exp soft tissue injury/
3 soft tissue injur$.mp.
4 repetitive strain injur$.mp.
5 carpal tunnel syndrome.mp. or exp carpal tunnel syndrome/
6 exp cumulative trauma disorder/
7 back pain.mp. or exp backache/
8 backpain.mp.
9 chronic pain.mp. or exp chronic pain/
10 exp pain/
11 anxiety/
12 exp depression/
13 neck pain.mp. or exp neck pain/
14 back injur$.mp.
15 low back injury/
16 injured worker$.mp.
17 musculoskeletal injury/
18 occupational injuries.mp. or exp occupational accident/
19 occupational accidents.mp.
20 occupational diseases.mp. or exp occupational disease/
21 or/1-20
22 insurance/ or exp compensation/ or exp workman compensation/ or exp health insurance/ or exp "health plan employer data and information set"/
23 accident insurance.mp.
24 exp workman compensation/
25 ((worker$ or workman$ or workmen&) adj compensation).mp.
26 (claim or claimant).mp.
27 or/22-26
28 prognosis.mp. or prognosis/
29 exp time/
30 recovery of function.mp. or convalescence/
31 disease severity/
32 exp injury scale/
33 (recovery or prognostic).mp.
34 workload.mp. or exp workload/
35 exp work capacity/
36 exp work resumption/ or return to work.mp.
37 or/28-36

38 21 and 27 and 37
39 or/1-17
40 or/18-20
41 37 and 39 and 40
42 38 or 41

PsycInfo (OvidSP)
1 exp Whiplash/
2 whiplash injur:.mp.
3 soft tissue injur$.mp.
4 cumulative trauma disorder$.mp.
5 repetitive strain injur$.mp.
6 carpal tunnel syndrome.mp.
7 back pain.mp. or exp Back Pain/
8 (backpain or backache).mp.
9 chronic pain.mp. or exp Chronic Pain/
10 exp Musculoskeletal Disorders/ or exp Fibromyalgia/ or fibromyalgia.mp.
11 exp Anxiety/
12 exp "Depression (Emotion)"/ or exp Major Depression/
13 neck pain.mp.
14 back injur:.mp.
15 musculoskeletal injur$.mp.
16 exp Industrial Accidents/
17 exp Occupational Safety/
18 (occupational injur: or occupational accident:).mp.
19 exp Work Related Illnesses/
20 or/1-19
21 exp Workers' Compensation Insurance/
22 exp Employee Health Insurance/
23 exp Insurance/
24 disability insurance.mp.
25 (claim or claimant).mp.
26 ((worker: or workman: or workmen:) adj compensation).mp.
27 accident insurance.mp.
28 or/21-27
29 prognosis.mp. or exp Prognosis/
30 exp Time/
31 time factors.mp.
32 exp "Recovery (Disorders)"/
33 recovery of function.mp.
34 exp "Severity (Disorders)"/ or severity of illness.mp.
35 (recovery or prognostic).mp.
36 exp Work Load/ or workload.mp. or exp Job Performance/
37 exp Vocational Evaluation/ or exp Disability Evaluation/ or work capacity evaluation.mp. or exp Reemployment/
38 work resumption.mp.
39 or/29-38
40 20 and 28 and 39

41 16 or 17 or 18 or 19
42 or/1-15
43 39 and 41 and 42
44 28 and 41
45 40 or 43 or 44

CINAHL (Ebsco)
49 S46 or S48
S48 S22 and S45 and S47
S47 S23 or S24 or S25 or S26
S46 S27 and S33 and S45
S45 S34 or S35 or S36 or S37 or S38 or S39 or S40 or S41 or S42 or S43 or S44
S44 (MH "Disability Evaluation+")
S43 "work resumption"
S42 "return to work" OR (MH "Job Re-Entry")
S41 (MH "Work Capacity Evaluation")
S40 (MH "Workload Measurement") OR (MH "Workload") OR "workload"
S39 (recovery or prognostic)
S38 (MH "Severity of Illness") OR (MH "Severity of Illness Indices+")
S37 (MH "Recovery")
S36 "recovery of function"
S35 (MH "Time+") OR (MH "Time Factors")
S34 (MH "Prognosis+") OR "prognosis"
S33 S28 or S29 or S30 or S31 or S32
S32 "accident insurance"
S31 (worker* N2 compensation) OR (workman* N2 compensation) OR (workmen* N2 compensation)
S30 (Claim or claimant)
S29 (MH "Insurance") OR (MH "Insurance, Disability+")
S28 (MH "Worker's Compensation")
S27 S22 or S23 or S24 or S25 or S26
S26 "occupational accident" OR (MH "Accidents, Occupational+")
S25 "occupational inju*"
S24 (MH "Occupational-Related Injuries")
S23 (MH "Occupational Diseases+")
S22 S18 or S21
S21 S19 and S20
S20 (MH "Wounds and Injuries+") OR (MH "Occupational-Related Injuries")
S19 (MH "Musculoskeletal Diseases+") or (MH "Musculoskeletal System+")
S18 S1 or S2 or S3 or S4 or S5 or S6 or S7 or S8 or S9 or S10 or S11 or S12 or S13 or S14 or S15 or S16 or S17
S17 "musculoskeletal injur*"
S16 "back injur*"
S15 (MH "Back Injuries+")
S14 (MH "Neck Pain") OR "neck pain"
S13 (MH "Depression+")
S12 (MH "Anxiety+")
S11 (MH "Pain+")

S10 (MH "Fibromyalgia") OR "fibromyalgia"
S9 (MH "Chronic Pain") OR "chronic pain"
S8 (backpain or backache)
S7 (MH "Back Pain") OR "back pain"
S6 (MH "Carpal Tunnel Syndrome") OR "carpal tunnel syndrome"
S5 "repetitive strain injur*"
S4 (MH "Cumulative Trauma Disorders+")
S3 "soft tissue injur*"
S2 (MH "Soft Tissue Injuries")
S1 "whiplash injur*" OR (MH "Whiplash Injuries")

Figure S1: Flow diagram of the literature search process for randomized controlled trials assessing the effect of opioids, physiotherapy, or chiropractic care for acute low back pain.

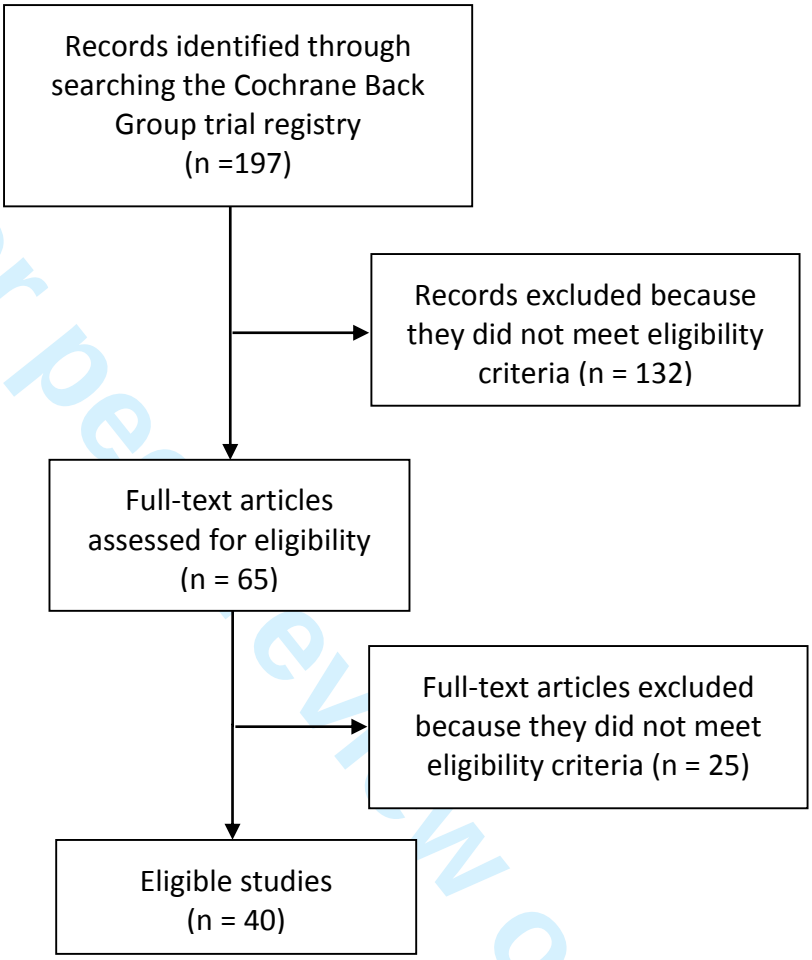
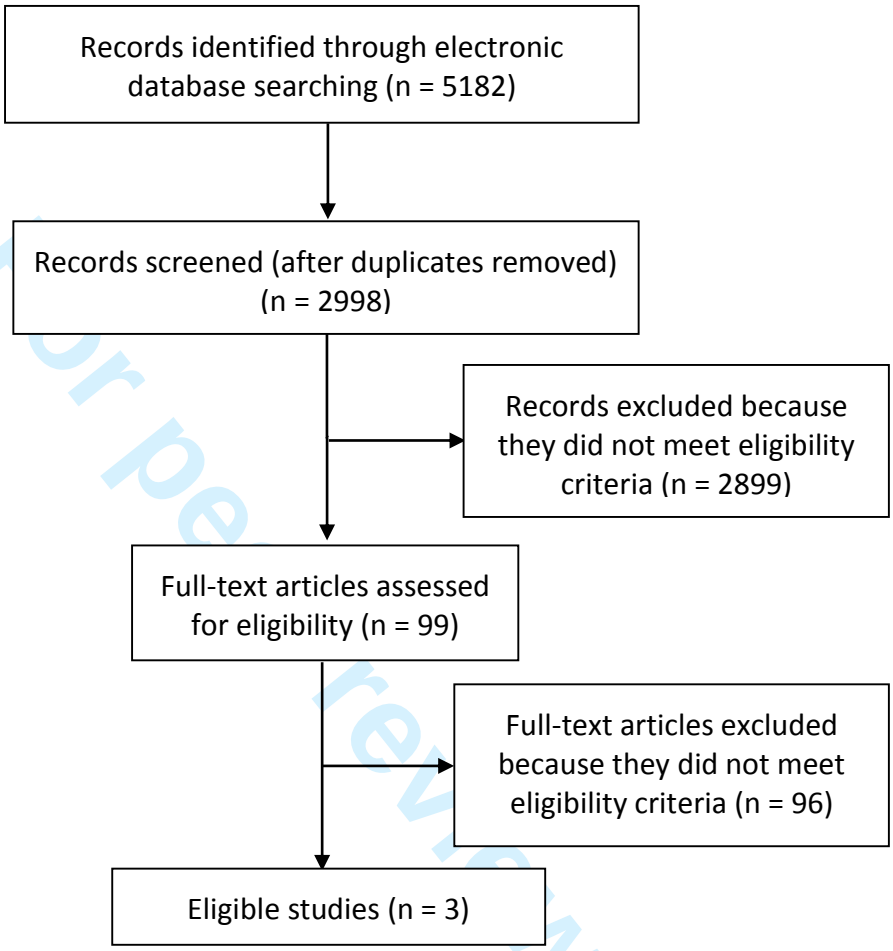


Figure S2: Flow diagram of the literature search process for observational studies assessing the effect of early opioids, physiotherapy, or chiropractic care for acute low back pain.



STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract (**in title on title page**)
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found (**in Abstract**)
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported (**page 1 & 2 in Manuscript**)
Objectives	3	State specific objectives, including any prespecified hypotheses (**Appendix A**)
Methods		
Study design	4	Present key elements of study design early in the paper (**In Abstract, and page 3-7 in Manuscript**)
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection (**page 3 in Manuscript**)
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (**pages 3 & 4 in Manuscript**)
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed (**not applicable**)
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable (**Appendix A and pages 3 & 4 in Manuscript**)
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group (**pages 3-5 in Manuscript**)
Bias	9	Describe any efforts to address potential sources of bias (**pages 4-7 in Manuscript**)
Study size	10	Explain how the study size was arrived at (**page 3 & 4 in Manuscript**)
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why (**pages 5 & 6 in Manuscript**)
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding (**pages 3-7 in Manuscript**)
		(*b*) Describe any methods used to examine subgroups and interactions (**page 6 in Manuscript**)
		(*c*) Explain how missing data were addressed (**page 5 in Manuscript**)
		(*d*) If applicable, explain how loss to follow-up was addressed (**not applicable**)
		(*e*) Describe any sensitivity analyses (**not applicable**)
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (**Table 1 and page 8 in Manuscript**)
		(b) Give reasons for non-participation at each stage (**not applicable**)
		(c) Consider use of a flow diagram (**not informative in our case**)

Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (**Table 1**)
		(b) Indicate number of participants with missing data for each variable of interest (**Table 1**)
		(c) Summarise follow-up time (eg, average and total amount) (**Figure 1**)
Outcome data	15*	Report numbers of outcome events or summary measures over time (**page 8 in Manuscript**)
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (**Table 2**)
		(*b*) Report category boundaries when continuous variables were categorized (**Table 2**)
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period (**not relevant**)
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses (**page 8 in Manuscript**)
Discussion		
Key results	18	Summarise key results with reference to study objectives (**page 10 in Manuscript**)
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias (**pages 10 & 11 in Manuscript**)
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence (**page 13 in Manuscript**)
Generalisability	21	Discuss the generalisability (external validity) of the study results (**page 11 in Manuscript**)
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based (**page 14 in Manuscript**)

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.