ORIGINAL ARTICLE

Opioid Use for Chronic Low Back Pain
A Prospective, Population-based Study Among Injured Workers in Washington State, 2002-2005

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Objectives: To determine (1) the natural history of prescription opioid use, (2) the predictors of long-term opioid use, and (3) the association between opioid dose and pain and function in a large cohort of workers with recent back injuries.

Methods: Prospective cohort of workers with back injuries (N = 1883) interviewed 18 days (median) and 1 year after claim submission. Detailed pharmacy data were obtained from computerized records of paid bills.

Results: Forty-two percent of workers (781/1843) received an opioid in the year after injury, most (694/781, 89%) at or shortly after the first medical visit for the injury. Of these, most (410/694, 59%) received opioids only within the first quarter after injury, whereas 16% (111/694) received opioids for 4 quarters. Among these long-term users, total morphine equivalent dose (MED) increased significantly ($P < 0.01$) from the first (mean, 2364 mg; standard deviation, 4019 mg) to the fourth (mean, 3824 mg; standard deviation, 5998 mg) quarter. Improvement by at least 30% in pain and function measure scores occurred in only 26% (95% confidence interval 18%-36%) and 16% (95% confidence interval 10%-25%), respectively, of long-term users. Opioid doses increased substantially over time in all but those in whom function improved. After adjustment for baseline pain, function, and injury severity, the strongest predictor of longer term opioid prescription was total MED in the first quarter. Workers receiving at least 40 mg MED per day in the first quarter had 6-fold odds of receiving longer-term opioids.

Discussions: For the small group of workers with compensable back injuries who receive opioids longer-term (111/1843, 6%), opioid doses increase substantially and only a minority shows clinically important improvement in pain and function. The amount of prescribed opioid received early after injury strongly predicts long-term use. More research is needed to understand clinical decisions to continue or increase opioid therapy after back injury.

Key Words: chronic pain, cohort, back pain, opiates, population-based, prospective, workers' compensation

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After the liberalization of laws governing opioid prescribing for the treatment of chronic non-cancer pain (CNCP) by State Medical Boards[1] in the late 1990s, the use of opioids in general and of the most potent forms (schedule II) in particular have dramatically increased.[2–4] The shift in the regulations was largely driven by published, albeit weak, evidence suggesting that opioids could be used safely in selected persons with CNCP[5]; by the advocacy of physicians and others who felt constrained by the near absolute prohibition of such use before that time[6]; and by consensus of professional societies of pain specialists who believed that CNCP had been previously undertreated.[7]

Nearly a decade later, the scientific evidence for the effectiveness of opioids in CNCP remains unclear, particularly regarding the long-term ability of such treatment to sustainably and safely improve pain and physical function.[8–10] A population-based study in Denmark was unable to demonstrate an advantage in quality of life among persons with CNCP taking opioids compared with those who were not.[11] However, more recent case series suggest that selected patients may benefit from opioids for CNCP longer-term.[12]

Along with the increased prescribing of opioids for CNCP, there has been a concerning increase in the number of unintentional poisoning deaths related to prescription opioid use.[13,14] The key contributors to this pattern of increased mortality likely include unsafe prescribing practices, misuse or abuse by patients, and diversion. The increase in deaths has prompted a recent congressional hearing and a call from the Centers for Disease Control for preventive measures,[15] including guidelines for prescribing providers.

It is crucial at this juncture in the evolution of the science and policy of opioid use for CNCP to identify, in population-based studies, factors related to safe and effective use of opioids. In a large, prospective cohort study of risk factors for long-term disability among injured workers in Washington State (The Disability Risk Identification Study Cohort; D-RISC), we investigated: (1) patterns of opioid prescription and morphine equivalent dose (MED) over a 1 year period among 1843 workers with new compensable back injuries, (2) factors associated with long-term opioid use, (3) the association of long-term opioid use with both baseline and 1 year worker-reported pain and function, and (4) the quality of medical record documentation related to opioid use among prescribing physicians.

MATERIALS AND METHODS

Study Participants and Procedures

The D-RISC is a prospective, population-based study that was designed to identify risk factors for chronic disability among workers with acute back injury.[16] Workers with acute back injuries were identified through weekly reviews of the Washington State Department of Labor and Industries State Fund claims database from July 2002 to April 2004. The State Fund of the Washington State Workers' Compensation Program insures about two-thirds of non-federal Washington workers. The other third, used by larger self-insured companies, were excluded because of insufficient administrative data.

Identified workers were screened for eligibility and those who were found eligible and who enrolled completed a computer-assisted telephone interview in English or Spanish.[17] The study was approved by the University of Washington Institutional Review Board and all participants provided informed consent.

Study inclusion criteria were age at least 18 years, 4 or more days of lost time from work because of injury (required for initiation of paid lost wage benefits), and at least 1 day of wage replacement compensation in the first year of the claim. This requirement for wage loss compensation was an inclusion criterion in the D-RISC study because we were interested in studying only workers at some risk for long-term disability; workers without any wage loss compensation in the first year after injury are very unlikely to be disabled 1 year or longer after injury. Exclusion criteria were hospitalization in the acute period after the injury, denial of work-related back pain, inability to be interviewed (eg, because of hearing impairment), and inability to communicate in English or Spanish.

Measures

Baseline Interview Measures

The baseline telephone interview included questions and measures to assess the following risk factor domains: sociodemographic, pain and function, clinical status, healthcare, health behavior (tobacco and alcohol use), and psychosocial. Interviewers did not ask about opioid or other prescription drug use. Questions and measures were selected on the basis of best available evidence in the literature regarding predictors of long-term disability.[16] Age was categorized as < 24, 25 to 34, 35 to 44, 45 to 54, and ≥ 55 years. Race or ethnicity was categorized as White non-Hispanic, Hispanic, and other. Education was categorized as less than high school, high school, some college or vocational training, and college degree. Tobacco use in the past year was categorized as never versus some (occasionally, frequently, or daily). Alcohol consumption was assessed by the Alcohol Use Disorders Identification Test, an instrument that has been validated as a screening tool for alcohol abuse or dependence.[18]

Participants rated their average pain in the past week on a 0-10 scale where 0 is "no pain" and 10 is "pain as bad as could be", and pain interference with daily activities and with work in the past week on 0-10 scales.[19] Workers also reported whether their pain was the same, better or worse compared with the time of injury. Function was measured by the Roland-Morris Disability Questionnaire (RDQ), an instrument for the assessment of physical disability towing to back pain that has been validated and found to be reliable and responsive to change.[20] The RDQ scores were categorized as 0 to 12, 13 to 17, and 18 to 24, with higher scores indicating the worse function.

Clinical status variables that were assessed included history of a prior compensable back claim, history of previous back injury that resulted in the worker being off work for 30 or more days, number of work days missed because of back pain in the past year, and number of work days missed owing to other problems in the past year. Workers were also asked whether or not they had other medical problems (eg, high blood pressure, diabetes, lung problems). Workers were categorized based on whether the first provider the worker saw for their injury was a chiropractor or not (based on administrative records). The nonchiropractor group included primary care physicians, occupational medicine doctors, emergency room physicians, and other physicians. Chiropractors see approximately 1/3 of Washington State workers with back injuries, and we previously found that chiropractic care was associated with lower odds of long-term disability in this cohort.[21] In addition, chiropractors do not have prescriptive privileges. For these reasons, type of health care provider seen for the injury could be an important influence on patient opioid use.

Within the psychosocial domain, catastrophizing was assessed by averaging the responses to three questions from the Pain Catastrophizing Scale.[22] Worker recovery expectations were assessed by a question from the Vermont Disability Prediction Questionnaire[23] (a rating from 0 = "not at all certain will be working in 6 months" to 10 = "extremely certain will be working in 6 months"). Two questions from the Fear-Avoidance Beliefs Questionnaire[24] were averaged to assess fear-avoidance. An indicator of the workers' overall mental health was obtained through the SF-36 v2 Mental Health scale.[25]

Follow-up Interview

A follow-up interview was conducted 1 year after the baseline interview. For the purpose of this report, we analyzed follow-up measures of pain intensity (0 to 10 numerical rating) and functional status (RDQ). The baseline to 1-year change in the worker's pain rating and RDQ score were dichotomized as clinically significant improvement (≥ 30% improved) or no clinically significant improvement. The 30% cutpoint is empirically supported as the minimal clinically important change in pain and function on these measures.[26]

Injury Severity

Information about back injury severity was obtained through review of medical records of each study participant by trained nurses; the instrument used for this purpose, previously tested in the D-RISC study, had substantial interrater reliability.[27] Chance-corrected agreement (weighted κ) was 0.66 and overall weighted percent agreement was 90%. Records from the first medical visit and up to several subsequent visits, if necessary, were reviewed. Injury severity ratings were based on the relevant information available at the time closest to the date of injury. Injuries were categorized into: (1) mild sprain or strain; (2) major sprain or strain; (3) evidence of radiculopathy or positive straight leg raising test; and (4) knee or ankle reflexes absent, injury related bladder symptoms, or motor abnormalities. For the purpose of the current analyses, the last 2 categories were combined.

Opioid Prescription Data

The computerized medical billing database of the Washington workers' compensation state fund was used to obtain data on opioid prescriptions. The pharmacy records included prescription date, name of drug, National Drug Code, drug strength, number of pills, days supply, and United States Drug Enforcement Administration schedule (II, III, or IV) according to potential for abuse and dependence (II-highest potential, eg, oxycodone, methadone, morphine; III-medium potential, eg, hydrocodone, codeine; and IV-lowest potential, eg, propoxyphene).

Opiate use was assessed each 3-month quarter (Q1, Q2, Q3, and Q4) in the year after the first medical visit for the work-related back injury. For each quarter, the number of opioid prescriptions filled that quarter was assessed as well as the MED per quarter and the average MED per day. The MED per quarter for each opioid prescription was calculated by multiplying the number of pills prescribed by the drug strength. These doses were then converted to MED using available equianalgesic conversions.[28] The total cumulative MED for all prescriptions within the quarter was then calculated. The average MED per day was calculated as the total MED per quarter divided by 90. MED per quarter was categorized as 1-899, 900-1799, 1800-3599, 3600-10799, and ≥ 10800 mg. If a patient used opiates all days in a quarter, these would be equivalent to 1-9, 10-19, 20-39, 40-119, and ≥ 120 mg/d. Long-term use of opiates was defined as receipt of prescribed opiates for 4 consecutive quarters. Sixty-seven percent of the cohort reported having other health insurance at the time of the baseline interview. We did not have access to other insurance data.

Review of Medical Records

To explore providers' documentation of opioid prescribing as required in Washington State regulations,[29] a random sample of medical records was reviewed. Medical records of attending providers, during the time frame that prescription opioids were prescribed, were reviewed for both workers who used opiates short-term (1 quarter or less, n = 21) and workers who used opiates long-term (4 quarters, n = 15). Providers' documentation of pain level, functional status, prescribed dose of opiates, and plan of treatment was recorded. Three visits per medical record, on average, were reviewed among the short-term opiate users and 10 visits per record, on average, were reviewed among the long-term users.

Analysis

Trends in opioid doses over time were analyzed using general linear models with repeated measures. To determine factors associated with long-term opioid use, workers who continued on opiates for 4 quarters (long-term users) were compared with those who started on opiates in the first quarter but discontinued their use before the fourth quarter. Bivariate associations between baseline characteristics from the 6 risk factor domains and the long-term opiate use among the workers who used opiates at all during the year were examined using logistic regression. Variables that were found to be significantly associated with a higher risk of being on opiates for 1 year in the bivariate analyses were tested in multivariate logistic regression models that included age, sex, injury severity, baseline pain level, and baseline RDQ scores. The latter 3 variables have been found in previous analyses of this cohort to be strong predictors of opioid use and long-term work disability.[21,30] As a sensitivity analysis, we repeated these analyses with long-term use defined as use of opioids for 3 or 4 quarters.

RESULTS

Study Participants

Figure 1 shows the flow of participants through the study. As described previously,[30] of the 4354 workers with
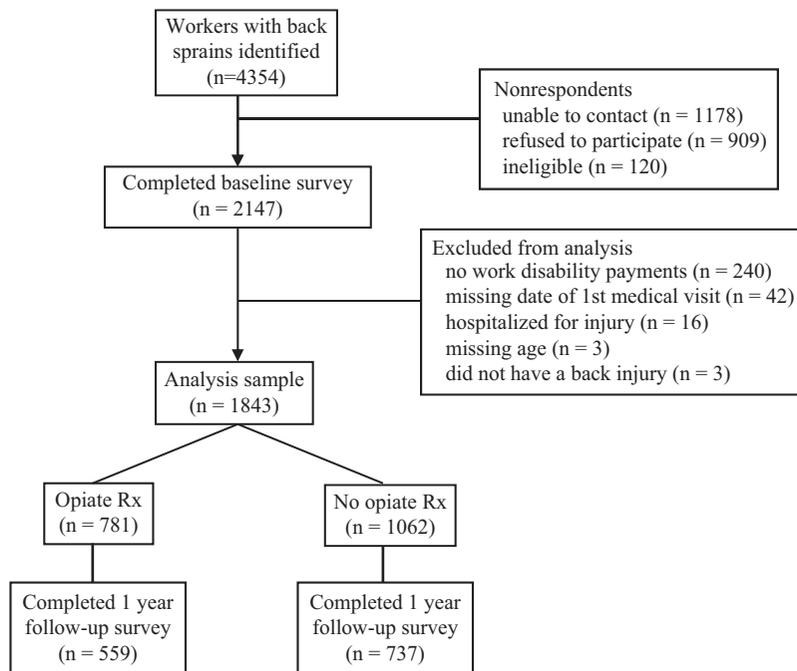

FIGURE 1. Cohort eligibility and final sample size—The Washington State D-RISC Study.

TABLE 1. Mean Morphine Equivalent Dose (mg) per Quarter Among Workers who Filled at Least 1 Opioid Prescription in the First Quarter

Quarters of Prescription Fills (n)	Q1 Mean (SD)	Q2 Mean (SD)	Q3 Mean (SD)	Q4 Mean (SD)
Q1 only (410)	465 (711)			
Q1 Q2 (103)	1209 (1452)	1053 (2436)		
Q1 Q2 Q3 (70)	1829 (2038)	2394 (3680)	1350 (2094)	
Q1 Q2 Q3 Q4 (111)	2364 (4019)	2518 (3446)	3077 (4998)	3824 (5998)

back sprain claims identified, 2147 (49%) enrolled in the study and completed the baseline interview a median of 18 days after claim filing, 1178 (27%) could not be contacted within the 6-week window for baseline interviews, 120 (3%) were ineligible, and 909 (21%) declined to enroll in the study.

Participants were excluded from analyses if they did not receive any work disability compensation during the year after claim submission (n = 240), were missing data on age (n = 3), were hospitalized for their injury (n = 16), were not confirmed to have a back injury upon review of medical and administrative records (n = 3), or were missing the date of their first medical visit (n = 42); this left an analysis sample of 1843 workers. This final sample as compared with study nonparticipants who met the same eligibility criteria (N = 1818) was slightly older {age mean [standard deviation (SD)] = 39.4 (11.2) years vs. 38.2 (11.1) years, $P = 0.001$}; included more females (32% vs. 26%, $P < 0.001$); and had more workers receiving wage replacement compensation at 1 year (13.8% vs. 11.3%, $P = 0.02$). Follow-up surveys conducted 1 year after the initial survey were completed by 1296 (70%) of the 1843 study participants. There were no significant differences in age, sex, baseline RDQ score, injury severity, or opioid use in the first quarter after injury between those who completed the follow-up interview and those who did not.

Opioid Use

Among the 1843 workers, 781 (42%) received at least 1 opioid prescription in the year after injury. Most (694; 89%) of those with at least 1 opioid prescription filled the first prescription in the first quarter, including and after the initial medical visit for the work-related back injury. Of those who filled the first prescription in the first quarter, 59% filled prescriptions in only 1 quarter, 15% in 2 quarters, and 10% in 3 quarters. One hundred eleven (16%) filled opiate prescriptions for 4 consecutive quarters. Workers who filled prescriptions only in the first quarter filled a mean of 2 prescriptions (SD = 1.7). Among workers who filled prescriptions for opiates in all 4 quarters after injury, the mean number of prescriptions filled in the first quarter was 5.8 (SD = 3.8).

The mean MED in the first quarter ranged from 465 mg (SD = 711) among those who used opiates for only 1 quarter to 2364 mg (SD = 4019) among those who would go on to long-term use (Table 1). Among the long-term users, the mean MED increased in each quarter from 2364 mg in the first quarter to 3824 mg in the fourth quarter ($P = 0.01$). Table 2 shows changes in categories of MED per quarter from Q1 to Q4 among the 111 long-term users. Thirty-nine percent (43/111) moved to a higher dose category, whereas 61% (68/111) remained in the first quarter category or moved to a lower category.

Changes in Pain and Function

We examined changes in pain and function among the workers who were long-term opioid users. Eighty-eight workers out of the 111 long-term users completed the 1-year follow-up interview. Among the 88 workers who were on opioids for 4 quarters and completed the 1-year interview, the mean baseline pain rating was 7.7 and the mean pain rating at 1 year was 6.8. Thus, the mean change in pain was 0.9 (an 8% decrease from baseline). The mean first quarter RDQ score was 18.8 (out of 24) and the mean RDQ score at 1 year was 17.5. The mean change was 1.3 (5% decrease).

Only 23 (26%, 95% CI 18%-36%) of the 88 workers had a clinically meaningful (≥ 30%) improvement in pain at 1 year. Only 14 (16%, 95% CI 10%-25%) had clinically meaningful improvement in function (at least 30% improvement on the RDQ). Table 3 shows, for workers whose pain and function improved and for those whose pain and function did not improve, the mean MED per quarter. The MED per quarter increased from the first to the fourth quarter in all groups except the small group in whom function improved by at least 30% (in this group, there was a nonsignificant decrease in MED per quarter). Among those who had improvement of 30% or greater in pain, the increase in MED from the first to the fourth quarter was not statistically significant. However, among those whose pain and function did not improve by at least 30%, there were statistically significant increases in MED from the first

TABLE 2. Patterns of Total Quarterly Opioid Dose Change Comparing Q1 to Q4 for 111 long-term Users Total MED in Q1*

	0-899 (n = 36)	900-1799 (n = 32)	1800-3599 (n = 24)	3600-10,799 (n = 17)	10,800 + (n = 2)
Total MED in Q4					
0-899	**19**	**8**	**5**	**1**	**0**
900-1799	5	**12**	**5**	**1**	**0**
1800-3599	7	9	**5**	**4**	**0**
3600-10,799	4	2	6	**6**	**1**
10,800 +	1	1	3	5	**1**

*Bold values indicate same or lower dose category in Q4 compared with Q1.
MED indicates morphine equivalent dose.

TABLE 3. Change in Pain and Function by MED (mg) per Quarter Among Workers on Opioids for 4 Quarters

	N	Q1MED	Q2MED	Q3MED	Q4MED
Pain					
≥ 30% improved	23	2950	2657	3735	4575
< 30% improved	65	2530	2790	3152	4106
Function					
≥ 30% improved	14	1954	1676	1758	1729
< 30% improved	74	2770	2960	3597	4702

MED indicates morphine equivalent dose.

to the fourth quarter ($P = 0.01$ for pain and $P < 0.01$ for function).

Table 4 summarizes the change in pain and function of 9 workers among the long-term opioid users who were on MED that were ≥ 120 mg/d in the fourth quarter. Among these, 3 workers had an improvement in pain that was at least 30% compared with baseline and none had an improvement in function that was at least 30%.

Predictors of Long-term Use

Table 5 shows the relationship between baseline variables and duration of opioid use (1-3 quarters vs. 4 quarters) among the workers who filled at least 1 opioid prescription. Baseline pain, function (RDQ), and injury severity were strongly predictive of long-term opioid use in multivariate logistic regression models. Age, sex, and education were not significant predictors of long-term opioid use in multivariate models. Hispanics were significantly less likely than non-Hispanic Whites to receive opiates long-term.

Among other clinical variables, having a prior back injury was significantly associated with long-term opioid use. In addition, opioid dose in the first quarter was associated with long-term opioid use. Compared with workers who received < 1-899 mg MED in the first quarter, all categories of higher MED in the first quarter were strongly predictive of long-term opiate use in both the bivariate and multivariate models. Within the healthcare domain, the odds of long-term opioid use were substantially lower for workers who had a chiropractor as the first attending provider compared with workers who initially saw other types of providers, after adjusting for baseline pain, function, and injury severity. Psychosocial variables that were associated bivariately with increased likelihood of long-term opioid use were catastrophizing, being less certain about being able to work in the next 6 months, fear-

avoidance beliefs, and lower (worse) scores on the SF-36 v2 Mental Health Scale. Low recovery expectations and high catastrophizing scores remained statistically significant after adjusting for pain level, injury severity, and functional status. Long-term opioid use was not associated with either tobacco use or high levels of alcohol use at baseline. Analyses of risk factors for long-term use defined as use for 3 or 4 quarters revealed no substantial difference in key findings.

Review of Medical Records

Medical records from 21 workers who used opiates for 1 quarter and from 15 workers who received opiate prescriptions for 1 year were reviewed for documentation of pain levels, functional status, and opioid prescription, including dose, duration, and plan for the treatment (Table 6).

Pain level was documented in 15/67 (22%) visits among the short-term users and in 41/150 (27%) visits in the long-term users. Documentation of functional status was absent in all the records reviewed of the short-term users and was present in only 2 chart notes among the long-term users. No plan of opiate treatment was documented in the short-term users' charts and a mention of some plan was present in 21/150 visits among the long-term users.

DISCUSSION

In this large prospective cohort of workers with compensable back injuries in the Washington State workers' compensation system, most of workers who received any opioid prescription in the year after injury began receiving an opioid in the first quarter (694/781, 89%) after the injury. Most of those receiving early opioids received them for 1 quarter or less, consistent with the fact that the majority of workers return to work during this time.[31] Among the 111 workers who received opioids in all 4 quarters, average MED increased 62%, from 26.3 mg/d in quarter 1 to an average of 42.5 mg/d in quarter 4. This long-term dose of opiates is consistent with that reported recently by Von Korff et al[32] in another population-based study of 2 large health maintenance organizations. Longer term, high dose use patients in that study, at an average duration of about 2.7 years, were taking an average daily dose of 55 mg MED.

Although the majority (61%) of long-term users of opioids remained on stable or decreased (from baseline) doses, 39% moved to a higher dose category from the first to fourth quarter. Twenty-five percent of the long-term users received at least 40 mg MED per day during the fourth quarter, including 9/111 (8.1%) who received 120 mg

TABLE 4. Change in Pain and Function Among Long-term Opioid Users With MED ≥ 120 mg/d in the Fourth Quarter

Workers	MED Q1 (mg/d)	MED Q4 (mg/d)	Baseline Pain	Follow-up Pain	Baseline RDQ	Follow-up RDQ
1	5	215	10	7	22	22
2	22	183	8	7	19	20
3	29	373	5	4	18	15
4	43	200	6	8	19	21
5	45	184	8	10	22	23
6	83	208	10	8	20	23
7	99	132	9	10	21	21
8	103	360	10	7	22	21
9	399	263	8	8	23	22

MED indicates morphine equivalent dose; RDQ, Roland-Morris Disability Questionnaire.

TABLE 5. Baseline Predictors of Long-term Opioid Use: the Washington State D-RISC Study

Domain	Percentage of Sample on Opiates 1-3 Quarters (n = 583)	Percentage of Sample on Opiates 4 Quarters (n = 111)	Univariate Odds Ratio (95% Confidence Interval)	Multivariate Odds Ratio (95% Confidence Interval)*
Sociodemographic				
Age (years)				
< 24	8.7	5.4	0.66 (0.27-1.66)	0.96 (0.36-2.59)
25-34	24.0	18.9	0.85 (0.48-1.51)	0.92 (0.50-1.72)
35-44	35.8	33.3	1.00	1.00
45-54	22.3	33.3	1.61 (0.97-2.67)	1.51 (0.87-2.62)
≥ 55	9.1	9.0	1.07 (0.50-2.28)	1.15 (0.51-2.60)
Sex				
Female	32.6	32.4	1.00	1.00
Male	67.4	67.6	1.01 (0.65-1.55)	1.28 (0.79-2.06)
Race/ethnicity				
White	72.6	79.3	1.00	1.00
Hispanic	13.9	8.1	0.53 (0.26-1.10)	0.42 (0.19-0.92)†
Other/don't know/refused	13.6	12.6	0.85 (0.46-1.57)	0.73 (0.37-1.43)
Education				
Less than high school	14.6	12.6	0.77 (0.40-1.48)	0.69 (0.34-1.40)
High school	33.6	37.8	1.00	1.00
Vocational/some college	44.9	45.0	0.89 (0.57-1.40)	0.90 (0.55-1.49)
College graduate	6.9	4.5	0.58 (0.22-1.57)	0.58 (0.20-1.71)
Pain and Function				
Pain intensity				
0-4	28.1	2.7	1.00	1.00
5-7	45.8	44.1	10.03 (3.08-32.71)†	5.88 (1.71-20.19)†
8-10	26.1	53.2	21.22 (6.51-69.11)†	9.41 (2.69-32.94)†
Number of pain sites				
0-2	43.4	17.1	1.00	1.00
3-4	39.8	60.4	3.85 (2.24-6.60)†	1.46 (0.79-2.70)
5-8	16.8	22.5	3.40 (1.79-6.45)†	1.19 (0.57-2.46)
Roland Disability Score				
0-12	34.1	8.1	1.00	1.00
13-17	24.5	19.8	3.40 (1.52-7.61)†	1.80 (0.76-4.26)
18-24	41.3	72.1	7.34 (3.59-14.99)†	2.65 (1.20-5.87)†
Pain change from injury to interview				
Better	57.9	26.4	1.00	1.00
Same	26.4	38.2	3.18 (1.91-5.30)†	1.57 (0.89-2.77)
Worse	15.7	35.5	4.97 (2.91-8.47)†	2.01 (1.08-3.75)†
Clinical status				
Injury severity				
Mild sprain	46.5	18.9	1.00	1.00
Severe sprain	23.0	14.4	1.54 (0.78-3.05)	1.06 (0.52-2.14)
Radiculopathy	30.4	66.7	5.39 (3.20-9.06)†	3.17 (1.83-5.51)†
Previous back injury				
No	72.8	47.7	1.00	1.00
Yes	27.2	52.3	2.93 (1.93-4.44)†	2.40 (1.50-3.83)†
First quarter morphine equivalent dose				
< 1-899	78.9	32.4	1.00	
900-1799	11.3	28.8	6.20 (3.60-10.65)†	4.01 (2.23-7.20)†
1800-3599	6.2	21.6	8.52 (4.59-15.80)†	5.46 (2.82-10.58)†
> 3600	3.6	17.1	11.56 (5.70-23.45)†	6.25 (2.91-13.41)†
Healthcare				
MD and other	88.7	96.4	1.00	1.00
Chiropractor	11.3	3.6	0.29 (0.10-0.82)†	0.29 (0.10-0.84)†
Psychosocial				
Catastrophizing				
Low (< 2)	40.5	18.0	1.00	1.00
Moderate (2- < 3)	33.1	26.1	1.77 (0.97-3.23)	0.98 (0.51-1.89)
High (3-4)	26.4	55.9	4.75 (2.76-8.18)†	2.11 (1.11-4.02)†
Recovery expectations				
Very high (10)	53.2	28.8	1.00	1.00
High (7-9)	21.4	19.8	1.70 (.95-3.05)	1.33 (0.71-2.47)
Low (0-6)	23.0	43.2	3.47 (2.12-5.67)†	1.88 (1.09-3.24)†
Don't know or refused	2.4	8.1	6.23 (2.50-15.52)†	3.05 (1.07-8.75)†

(continued)

TABLE 5. (continued)

Domain	Percentage of Sample on Opiates 1-3 Quarters (n = 583)	Percentage of Sample on Opiates 4 Quarters (n = 111)	Univariate Odds Ratio (95% Confidence Interval)	Multivariate Odds Ratio (95% Confidence Interval)*
Fear-avoidance				
Low (< 4)	21.3	13.5	1.00	1.00
Moderate (4-5.9)	60.2	47.7	1.25 (0.68-2.29)	0.85 (0.44-1.66)
High (6)	18.5	38.7	3.29 (1.73-6.25)†	1.99 (0.97-4.06)
Mental health				
At or above population	31.6	16.2	1.00	1.00
Mean < 1 SD below population mean	26.8	21.6	1.57 (0.82-3.00)	0.92 (0.45-1.87)
1-2 SD below population mean	23.2	31.5	2.65 (1.44-4.88)†	1.33 (0.66-2.67)
< 2 SD below population mean	18.5	30.6	3.22 (1.73-5.97)†	1.37 (0.67-2.80)
Health behavior				
Tobacco use				
No	46.1	46.6	1.00	1.00
Yes	53.9	53.6	0.99 (0.66-1.49)	0.95 (0.60-1.49)
Alcohol (AUDIT-C)				
Low risk (0-6)	95.4	93.6	1.00	1.00
High risk (7-12)	4.6	6.4	1.40 (0.59-3.29)	2.17 (0.79-5.95)

*Values for age, sex, pain level, injury severity, and RDQ come from a model containing those 5 variables. For each other predictor variable, the value shown is from a model containing those 5 variables plus the predictor of interest.
† < 0.05.
AUDIT C indicates alcohol use disorder identification test consumption; D-RISC, Disability Risk Identification Study Cohort; RDQ, Roland-Morris Disability Questionnaire; SD, standard deviation.

MED or more per day (range: 129 to 365 mg/d MED). Among these 9 patients, most had dramatic increases in dosage from the first quarter, yet only 3 had a clinically meaningful improvement in pain, and none had meaningful improvement in function. This suggests that substantial tolerance may have developed in these patients.

Only a minority of long-term opioid users in this study (26.9%) reported at least a 30% improvement in pain from baseline to 1 year, and only 15.9% reported at least 30% improvement in physical function as measured by the RDQ. This functionally improved group was the only subgroup among long-term users whose quarterly dose did not increase substantially.

As expected, greater pain intensity, worse physical function, and greater injury severity (presence of radiculopathy) at baseline were strong predictors of long-term opioid use. These factors are also strong predictors of long-term work disability in this population,[21] and it is likely that the majority of workers with acute back injury who develop long-term work disability are in chronic pain. Even after adjustment for these 3 key risk factors, receipt of ≥ 10 mg/d MED in the first quarter more than tripled the odds of receiving opioids long term. A history of prior back injury was also significant in multivariate models.

Both Hispanic ethnicity and seeing a chiropractor at the time of injury were associated with much lower odds of long-term opioid use. We had previously reported a lower odds of Hispanics receiving an opioid in this low back cohort,[27] and the probability of receipt of opioid prescriptions among Hispanics and other non-White race or ethnic groups in primary care settings nationally is reduced compared with that of Whites.[33] The dramatically lower odds associated with seeing a chiropractor initially may well be related to chiropractors not having prescriptive privileges; however, seeing a chiropractor initially is associated with a reduced risk of long-term disability in this population even after controlling for baseline pain, function, and severity.[21] In a recent systematic review of treatments for subacute and chronic low back pain,[34] spinal manipulation as well as cognitive-behavioral therapy, exercise, and interdisciplinary rehabilitation were all moderately effective.

By contrast, the evidence for efficacy of opioids for CNCP from clinical trials[8,9] or evidence of effectiveness from population-based observational studies[11] is not compelling. In addition, whereas true addiction related to chronic opioid use may not be common, substantially increased risk of morbidity and mortality has been recently documented.[13,14,35] Although the majority of long-term opioid users in this cohort of workers with back injuries remained on stable or decreasing doses of opioids, average doses increased by 62%, but without concomitant substantial improvement in pain or function. Thus, the effectiveness of this mode of treatment seems limited.

A small number of workers ended up on doses of opioids exceeding 120 mg/d MED, a dose that has been

TABLE 6. Summary of Medical Record Review

	On Opioids in the First Quarter (n = 21)	On Opioids all 4 Quarters (n = 15)
Total (mean/case) number of visit records reviewed	67 (3.2)	150 (10)
Documentation of pain level (n, %)	15 (22.4)	41 (27.3)
Documentation of function (n, %)	0 (0)	2 (1.4)
Opiate prescription (n, %)	22 (33)	67 (44.7)
Dose (n, %)	15 (22.4)	62 (41.3)
Duration (n, %)	3 (4.5)	21 (14)
Plan (n, %)	0 (0)	13 (8.7)

suggested as a yellow flag for increased risk of morbidity or mortality.[36] Five of these 9 workers were prescribed more than 200 mg MED/d, a dose associated with a high prevalence of ataxic or irregular breathing during nonrapid eye movement sleep.[37] Finally, our review of a small random sample of medical records revealed documentation of pain in only 25% of visits, and documentation of function in < 10% of visits. Adequate documentation of these data by physicians is necessary to physicians' ability to properly monitor progress in these patients.

Study limitations should be noted. The observational design precludes the ability to infer causality between exposures and outcome, and limits any further analysis or conclusion related to a possible effect of unmeasured confounders. For example, unmeasured reasons for choice of a chiropractor, even after adjusting for baseline pain, function, and severity, could also be related to better outcome. Similarly, such residual confounding could have affected the opioid-associated outcomes evaluated in this study. The number of workers who were prescribed opioids for the 4 quarters was relatively small compared with the original cohort (16% of 1843); this may have limited the power of the study to detect differences that are unique to the long-term users. We did not investigate other treatment variables that could have affected pain and function at 1 year, such as surgery. Also in regard to changes in pain and function among long-term users, we were not able to capture the degree of improvement between a workers first receipt of opioids and the baseline interview in cases that received opioids before the interview. In addition, the average MED per quarter and per day can only be considered crude estimates as we could not validate that workers actually took all the drugs prescribed, some workers were prescribed overlapping and multiple opioid prescriptions, and we have no way of knowing whether additional opioids may have been obtained outside of the workers' compensation system. Finally, it is uncertain as to the generalizability of these findings to a nonworkers' compensation population. Strengths include prospective design with baseline and follow-up assessment of important relevant variables, the use of a population-based cohort, the ability to adjust for baseline pain, function, and injury severity, and focus on patients with back pain. Fifty-nine percent of regular users of opioids report back pain in a nationally representative survey.[38]

We conclude that, among workers with acute back injuries, most do not go on to long-term opioid use, but among those who do; only a minority experienced a meaningful improvement in pain or function. Furthermore, higher dosages were not associated with clinical improvement and reached potentially dangerous levels in some cases, and provider documentation was commonly lacking. There is a clear need for closer scrutiny and improved management of opioids when used long-term for noncancer conditions such as chronic back pain. More research is needed to understand factors that govern clinical decisions to continue or increase opioids once they are started, and clinicians should reevaluate patients after starting opioids and consider discontinuing them if patients are not experiencing improvements in pain or function.

REFERENCES

1. Federation of State Medical Boards of the US. Model guidelines for the use of controlled substances for the treatment of pain: A policy document of the Federation of State Medical Boards of the United States, Inc Dallas, TX 1998.
2. Caudill-Slosberg MA, Schwartz LM, Woloshin S. Office visits and analgesic prescriptions for musculoskeletal pain In US: 1980 versus 2000. *Pain.* 2004;109:514–519.
3. Franklin GM, Mai J, Wickizer T, et al. Opioid dosing trends and mortality in Washington State workers' compensation, 1996–2002. *Am J Ind Med.* 2005;48:91–99.
4. Luo X, Pietrobon R, Hey L. Patterns and trends in opioid use among individuals with back pain in the United States. *Spine.* 2004;29:884–891.
5. Portenoy RK, Foley KM. Chronic use of opioid analgesics in non-malignant pain: report of 38 cases. *Pain.* 1986;25:171–186.
6. Hill CJ. Government regulatory influences on opioid prescribing and their impact on the treatment of pain of nonmalignant origin. *J Pain Symptom Manage.* 1996;11:287–298.
7. The use of opioids for the treatment of chronic pain. A consensus statement from the American Academy of Pain Medicine and the American Pain Society. *Clin J Pain.* 1997; 13:6–8.
8. Ballantyne JC, Shin NS. Efficacy of opioids for chronic pain: a review of the evidence. *Clin J Pain.* 2008;24:469–4778.
9. Kalso E, Edwards JE, Moore RA, et al. Opioids in chronic non-cancer pain: systematic review of efficacy and safety. *Pain.* 2004;125:172–179.
10. Noble M, Tregear SJ, Treadwell JR, et al. Long-term opioid therapy for chronic noncancer pain: a systematic review and meta-analysis of efficacy and safety. *J Pain Symptom Manage.* 2008;35:214–228.
11. Eriksen J, Sjogren P, Bruera E, et al. Critical issues on opioids in chronic non-cancer pain: an epidemiological study. *Pain.* 2006;125:172–179.
12. Portenoy RK, Farrar JT, Backonja MM, et al. Long-term use of controlled-release oxycodone for noncancer pain: results of a 3-year registry study. *Clin J Pain.* 2007;23:287–299.
13. Caravati EM, Grey T, Nangle B. Increase in poisoning deaths caused by non-illicit drugs—Utah, 1991-2003. Available at: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5402a1.htm. 2005.
14. Paulozzi LJ, Budnitz DS, Xi Y. Increasing deaths from opioid analgesics in the United States. *Pharmacoepidemiol Drug Saf.* 2006;15:618–627.
15. Paulozzi LJ. Trends in unintentional drug overdose deaths, Testimony before the Subcommittee on Crime and Drugs, Committee on the Judiciary and the Caucus on International Narcotics Control, March 12, 2008. Available at: http://www.cdc.gov/washington/testimony/2008/t20080312a.htm, accessed on: July 16, 2008.
16. Turner JA, Franklin G, Fulton-Kehoe D, et al. Prediction of chronic disability in work-related musculoskeletal disorders: a prospective, population-based study. *BMC Musculoskelet Disord.* 2004;5:14.
17. Turner JA, Franklin G, Fulton-Kehoe D, et al. Worker recovery expectations and fear-avoidance predict work disability in a population-based workers' compensation back pain sample. *Spine.* 2006;31:685–689.
18. Bush K, Kivlahan DR, McDonell MB, et al. The AUDIT alcohol consumption questions (AUDIT-C): an effective brief screening test for problem drinking. Ambulatory Care Quality Improvement Project (ACQUIP). Alcohol Use Disorders Identification Test. *Arch Intern Med.* 1998;158: 1789–1795.
19. Von Korff M, Ormel J, Keefe FJ, et al. Grading the severity of chronic pain. *Pain.* 1992;50:133–149.
20. Roland M, Morris R. A study of the natural history of back pain. Part I: development of a reliable and sensitive measure of disability in low-back pain. *Spine.* 1983;8: 141–144.
21. Turner JA, Franklin G, Fulton-Kehoe D, et al. ISSLS prize winner: Early predictors of chronic work disability. A prospective, population-based study of workers with back injuries. *Spine.* 2008;33:2809–2818.

22. Sullivan MJL, Bishop SR, Pivik J. The Pain Catastophizing Scale: development and validation. *Psychol Assess*. 1995;7:524–532.
23. Hazard R, Bachmann LM, Heitz CA. Early prediction of chronic disability after occupational low back injury. *Spine*. 1996;21:524–532.
24. Waddell G, Newton M, Henderson I, et al. A Fear-Avoidance Beliefs Questionnaire (FABQ) and the role of fear-avoidance beliefs in chronic low back pain and disability. *Pain*. 1993;52:157–168.
25. Ware JE Jr. SF-36 health survey update. *Spine*. 2000;25:3130–3139.
26. Farrar JT, Portenoy RK, Berlin JA, et al. Defining the clinically important difference in pain outcome measures. *Pain*. 2000;88:287–294.
27. Stover BD, Turner JA, Franklin G, et al. Factors associated with early opioid prescription among workers with low back injuries. *J Pain*. 2006;7:718–725.
28. American Pain Society. *Principles of Analgesic Use in the Treatment of Acute Pain and Cancer Pain*. 4th ed. Skokie, IL: American Pain Society; 1999.
29. Washington Administrative Code, WAC 206-20-03021, effective January 20, 2000.
30. Franklin GM, Stover BD, Turner JA, et al. Early opioid prescription and subsequent disability among workers with back injuries: the Disability Risk Identification Study Cohort. *Spine*. 2008;33:199–204.
31. Cheadle A, Franklin G, Wolfhagen C, et al. Factors influencing the duration of work-related disability: a population-based study of Washington State workers' compensation. *Am J Public Health*. 1994;84:190–196.
32. Von Korff M, Saunders K, Ray GT, et al. De facto long-term opioid therapy for noncancer pain. *Spine*. 2008;33:2809–2818.
33. Olsen Y, Daumit GL, Ford DE. Opioid prescriptions by US primary care physicians from 1992 to 2001. *J Pain*. 2006;7:225–235.
34. Chou R, Qaseem A, Snow V. Diagnosis and treatment of low back pain: a joint clinical practice guideline from the American College of Physicians and the American Pain Society. *Ann Intern Med*. 2007;147:478–491.
35. Ballantyne JC. Opioid analgesia: perspectives on right use and utility. *Pain Physician*. 2007;10:479–491.
36. The Agency Medical Directors' Group. Interagency Guideline on Opioid Dosing for Chronic Non-cancer Pain: an educational pilot to improve care and safety with opiois treatment. URL: http://www.agencymeddirectors.wa.gov/opioiddosing.asp, accessed on: January 21, 2009.
37. Walker JM, Farney RJ, Rhondeau SM. Chronic opioid use is a risk factor for the development of central sleep apnea and ataxid breathing. *J Clin Sleep Med*. 2007;3:455–461.
38. Hudson TJ, Edlund MJ, Steffick DE, et al. Epidemiology of regular prescribed opioid use: results from a national, population-based survey. *J Pain Symptom Manage*. 2008; 36:280–288. Epub 2008 July 10.