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RESEARCH ARTICLE

The Association of First Provider Seen With Time Loss From Work Among Workers With Back Injury: A Cohort Study

Morgan Young[1] | Andrea Elmore[2] | Eric J. Roseen[3] | Deborah Fulton-Kehoe[2] | Gary Franklin[1,2,4,5]

[1]Washington State Department of Labor and Industries, Tumwater, Washington, USA | [2]Department of Environmental and Occupational Health Sciences, University of Washington School of Public Health, Seattle, Washington, USA | [3]Section of General Internal Medicine, Department of Medicine, Boston University Chobanian & Avedisian School of Medicine and Boston Medical Center, Boston, Massachusetts, USA | [4]Department of Health Systems and Population Health, University of Washington School of Public Health, Seattle, Washington, USA | [5]Department of Neurology, University of Washington School of Medicine, Seattle, Washington, USA

Correspondence: Morgan Young (yomo235@lni.wa.gov)

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ABSTRACT

Background: Prior evidence suggests that seeking initial care from a chiropractor for back pain, compared to seeing a primary care provider first, is associated with better clinical outcomes. However, prior studies have not comprehensively adjusted for potential confounders and few studies have focused on work-related outcomes.

Methods: This population-based prospective cohort study analyzed data from workers' compensation claimants with a work-related back injury who initiated care with either a chiropractor or a primary care physician. We evaluated the association of seeing a chiropractor first, compared to seeing a primary care physician first, with receipt of wage replacement benefits for temporary total disability (time loss) at 1 year after claim initiation. Association was estimated using logistic regression adjusting for potential confounders including patient sociodemographic characteristics, employment details, self-reported pain and physical function, injury severity, healthcare factors, and psychological factors. The E-value was used to assess unmeasured confounding.

Results: Of 1219 participants (mean age = 39, 67.5% male, 72.1% non-Hispanic White), 541 (44.4%) initiated care with a chiropractor. Participants who saw a chiropractor first, compared to a primary care physician first, were less likely to be on time-loss at 1 year as estimated by adjusted multivariate logistic regression (4.8% vs. 11.8%; adjusted odds ratio [OR]: 0.45, 95% CI: 0.24–0.86; E-value: 3.8).

Conclusions: Patients with work-related back injury who initiated care with a chiropractor were less likely to be receiving time loss compensation at 1 year compared to those who saw a primary care physician. Comprehensive adjustment for patient characteristics did not account for the differential outcome by provider type.

Work was performed at the University of Washington.

1 | Introduction

Back pain is among the most prevalent causes of disability [1]. Work-related injuries are a common reason for back pain onset or reoccurrence [2–5]. Back pain is also a costly condition [6], with workers who progress from acute back pain to chronic disability accounting for the majority of workers' compensation costs [3, 7–9]. Understanding predictors of long-term disability is an important part of improving clinical outcomes for workers who experience back pain [10]. Prior studies have observed an association between the type of healthcare provider first seen following the onset of back pain and health care utilization and outcomes [11]. For example, seeing a chiropractor first, compared to a physician or primary care provider, has been associated with less disability [12], lower overall healthcare utilization [13–15], fewer opioid prescriptions [16, 17], and lower overall health care costs [18–22]. A patient's initial type of care may influence their understanding of their injury as well as the treatment strategies they subsequently receive to aid in recovery. While a minority of prior studies have occurred in a workers' compensation population, this population may be particularly important given their increased risk of disability [23–26].

While literature has supported the early use of chiropractic care or other non-pharmacologic approaches for improving clinical and cost outcomes in back pain patients [27–30], questions persist about whether differences in long-term disability are due to patient mix (e.g., differences in patient injury type, pain severity, psychosocial prognostic factors, etc. by provider type). The Disability Risk Identification Study Cohort (D-RISC) was a prospective, population-based study to identify risk factors for long-term disability after a work-related injury [31]. This study found early chiropractic care, compared to primary care, to be associated with a 59% lower odds of work disability at 1 year, adjusting for numerous employment- and health-related variables [31]. This is consistent with at least one other study indicating that use of chiropractors as a first provider is associated with decreased work disability in the first five months following injury [18]. However, the prior D-RISC analysis focused broadly on factors affecting work disability and did not examine all available differences in case-mix by provider type.

To address the above gaps in knowledge we expanded on the prior analysis from the D-RISC study [31] to include all measured factors thought to be potential confounders. Additionally, we included a sensitivity analysis using the E-value, a tool to assess unmeasured confounding that was unavailable at the time of the prior D-RISC analysis. This secondary analysis had three aims: First, we reassessed the relationship between the type of first provider (chiropractor or primary care physician) and time loss one year after claim submission for a work-related back injury; second, we described differences between injured workers who see a chiropractor versus primary care physician for their first medical visit; and third, we evaluated which individual worker characteristics are important confounders of the association between early provider type and time loss at one year.

2 | Materials and Methods

2.1 | Study Participants, Setting, and Procedures

D-RISC was a prospective, population-based study to identify a comprehensive set of risk factors for long-term disability after a work injury. Study details have been described previously [32]. Workers were eligible if they submitted a workers' compensation (WC) claim for work-related back sprain/strain between July 2002 and April 2004, were aged 18 years or older, and received at least one day of temporary total disability wage replacement (which requires at least four days of lost work time). Participants were identified through weekly reviews of the Washington State Department of Labor and Industries (L&I) claims database and contacted for a structured baseline telephone interview. In addition to the interview, data sources included L&I administrative data - claims, medical and hospital bills, pharmacy bills, diagnoses, provider history - and a medical records review by trained nurses to assess injury severity. The L&I State Fund insured approximately two-thirds of non-Federal workers in Washington during the study period. The remaining one-third of workers were covered by approximately 350 large self-insured companies and were not included in this study due to insufficient data availability. The study was approved by the University of Washington Institutional Review Board and all participants provided informed consent.

Of the 4354 back injury claimants identified for participation in the D-RISC study, 2147 (49.3%) enrolled and completed the baseline interview, 1178 (27.1%) could not be contacted, 909 (20.9%) declined to participate, and 120 (2.8%) could not complete the interview in English or Spanish (i.e., were ineligible). After the baseline interview, participants were excluded for the following reasons: did not receive wage replacement compensation ($n = 240$), unknown age ($n = 3$), hospitalization for injury ($n = 16$), and back injury not confirmed on medical record review ($n = 3$). The remaining 1885 claimants were included in the original D-RISC analysis [31]. For the current study, we included only participants who saw a primary care physician or chiropractor at their first medical visit ($N = 1222$).

2.2 | Measures

2.2.1 | *Outcome*

The study outcome was receipt of wage replacement benefits for temporary total disability one year after claim submission. This was determined from L&I administrative data and is referred to as "time loss" throughout. Time loss status is a useful proxy for return-to-work [33] and time loss at one year is regularly used as a metric for long-term disability by L&I. Time loss compensation ends when the worker returns to work or is determined to be medically stable and able to work. Workers whose claims closed or time loss ended before 1 year were categorized as not receiving time loss at one year. As a descriptive measure only, we also calculated cumulative number of days on time loss in the first year after claim submission by provider type subgroup.

2.3 | First Provider Seen

L&I administrative data were used to determine the type of provider (primary care physician or chiropractor) seen for the first medical visit for the back injury, at which time a WC claim is initiated. Washington is a worker-choice state and workers are free to choose their provider across a variety of practitioner types. Primary care physician was defined as a physician or osteopathic physician with a specialty of general practice, family practice, or internal medicine. Nurse practitioners and physician assistants were not eligible to initiate a claim at the time of the study, and are therefore not a part of this analysis.

The original D-RISC analysis included the following first provider types: primary care, chiropractic, occupational medicine, and other. We did not include the occupational medicine and other categories due to heterogeneity in provider specialty and small sample sizes. Primary care and chiropractic providers encompassed 65% of the sample and we chose to focus on these provider types for our analysis. We were primarily interested in the potential protective effect of chiropractic care on workers' time loss, how these workers may differ from workers who see a primary care physician, and if any of these worker factors account for differences in time loss by provider type.

2.4 | Potential Confounding Factors

2.4.1 | Sociodemographic Characteristics

Age at injury and sex were obtained from L&I data. Worker-reported race and ethnicity, highest level of education, and marital status were obtained in the baseline interview. Race/ethnicity was categorized as: White; Hispanic or Latino; and, due to small numbers, all others combined (which included Black or African-American; American Indian, Native Alaskan or Native American; Asian; Native Hawaiian or other Pacific Islander; and more than one race). Urban/rural residence designation was classified by worker ZIP code according to the Washington State Department of Health's Guidelines for Using Rural-Urban Classification Systems [34].

2.5 | Employment

Information about the worker's industry was obtained from L&I data. In the baseline interview workers were asked to describe the physical demands of their job and if they were asked to do an excessive amount of work.

2.6 | Pain and Function

Number of pain sites was computed from worker-reported persistent, bothersome pain in eight different areas of the body. Worker-reported measures of pain intensity, pain interference with daily activities, and pain interference with ability to work, in the past week, were assessed on a 0–10 numerical rating scale, with higher scores reflecting worse pain intensity or pain interference [35]. Worker-reported physical disability due to low back pain was assessed with the Roland-Morris Disability Questionnaire (RMDQ), which has a range of 0 (least disability) to 24 (most disability) [36]. Worker-reported physical functioning was assessed with the physical function subscale of the SF-36 [37], with norm-based scores having a possible range of 0 (worst physical functioning) to 100 (best physical functioning). Workers were also asked to rate their perception of how their pain and other problems related to their injury have changed since submitting their WC claim.

2.7 | Injury Severity and Other Health Factors

The medical file was reviewed by trained nurses to categorize injury severity into the following categories in order of ascending severity: (1) mild sprain or strain, (2) major sprain or strain with substantial immobility but no evidence of nerve injury or radiculopathy, (3) evidence of radiculopathy, and (4) presence of reflex, sensory, or motor abnormalities [38]. Workers were asked in the interview how many WC claims they'd had prior to the current injury and if they had any previous work-related injury with more than a month off work. Worker-reported current health (aside from the back injury) and health in the year before injury were rated on a scale from 1 (excellent health) to 5 (poor health). Workers were also asked about how many days of work they missed because of non-back-related problems in the year prior to the current injury.

2.8 | Health Care

Workers were asked in the interview if, since they submitted their claim, a health care provider had discussed injury prevention with them or recommended "strengthening or aerobic physical exercises, such as swimming, walking, exercise with weights, or active physical therapy." Workers were also asked if they had general health insurance coverage.

2.9 | Administrative

Time in days between injury and first medical visit and time between first medical visit and claim receipt were computed from L&I administrative data.

2.10 | Psychosocial Barriers to Recovery

Psychosocial barriers to recovery were evaluated in the worker interview. Pain catastrophizing was measured by averaging three items from the Pain Catastrophizing Scale [39], asking about the worker's thoughts when they are in pain. These were "I feel I can't stand it anymore," "It is awful and I feel that it overwhelms me," and "I keep thinking about how badly I want the pain to stop," measured on a scale from 0 (not at all) to 4 (all the time). Two questions were asked from the Fear-Avoidance Beliefs Questionnaire and their scores were averaged [40]. These were "My work might harm my back" and "My work makes, or would make, my pain worse" with responses on a scale from 0 (completely disagree) to 6 (completely agree). Mental health was assessed with the mental health subscale of the SF-36 [37]. The norm-based score has a possible range of 0 (worst mental health) to 100 (best mental health).

2.11 | Statistical Analysis

There were no missing data for the outcome (time loss) or primary predictor (provider type). Three cases with missing data for age were excluded, leaving a sample of 1219 for analyses. The remaining variables had ≤3% missing data. Pairwise deletion was utilized for regression analyses, resulting in a varied number of included cases for each model.

Tests for bivariate associations were conducted comparing the baseline characteristics of workers who saw a chiropractor to those who saw a primary care physician for their first medical visit. Chi-square tests were used for categorical data and *t*-tests for continuous data. Logistic regression analysis was used to assess the association between provider type at first medical visit and being on time loss at one year. An unadjusted base model was tested first. Next, age and sex were added to the model. Third, to determine if there are any confounding factors, a series of models were tested that, in addition to adjusting for age and sex, added one potential confounder at a time. We assessed change in the provider-type odds ratio for each model. A positive or negative change of 10% in the provider-type odds ratio (compared to the model adjusting for age and sex only) was used to identify potential confounding factors. Finally, two fully adjusted models were tested: Model 1 incorporated age, sex, and the potential confounders found to change the provider type odds ratio by 10% or more and Model 2, age, sex, and all potential confounders. For the second fully adjusted model, the E-value was calculated. The E-value estimates the minimum strength of association an unmeasured confounder would need to have with both first provider type and time loss at one year (taking into account the measured covariates) in order to negate the results [41]. The E-value is on the risk ratio scale but in the case of a rare outcome can be used to approximate an odds ratio. All analyses were conducted using R version 4.3.0 (2023-04-21 ucrt).

3 | Results

3.1 | Overall Sample Characteristics

Descriptive statistics of worker characteristics stratified by the type of provider seen at their first medical visit are in Table 1. Among the 1219 eligible workers, the average age at injury was 39 years (range 18-73) and 67.5% were male. Most were non-Hispanic White (72.1%); 16.2% identified as Hispanic or Latino. The median days between claim submission and the baseline interview was 18. Overall, 8.7% were on time loss at one year after claim submission and the mean number of days on time loss in the first year was 64. Worker time loss differed significantly by provider type. Among workers who saw primary care physicians at the first medical visit, 11.8% were on time loss at one year and the mean number of days on time loss in the first year after claim submission was 73 (median days on time loss: 15). Among workers who saw chiropractors, 4.8% were on time loss at one year and mean days on time loss was 52 (median days on time loss: 14).

3.2 | Characteristics by Provider Type

Of the 1219 eligible workers, 55.6% ($n = 678$) saw a primary care physician at the first medical visit and 44.4% ($n = 541$) saw a chiropractor. Workers who saw a chiropractor were more likely to be male (73.0% vs. 63.1% for primary care), identify as Hispanic or Latino (21.5% vs. 11.9%), and were slightly more urban (60.2% vs. 55.3%). There was an overall difference in industry of employment ($p < 0.001$), with workers who saw chiropractors more likely to work in construction (20.9% vs. 15.3%) and less likely to work in education and health (10.0% vs. 19.3%).

Most measures of pain, function, injury severity, and health did not differ by provider type. This included self-reported measures of the number of pain sites; pain intensity and pain interference in the past week; physical disability due to low back pain; physical functioning; current health; health in the year before injury; the number of prior WC claims; pain catastrophizing; and mental health. Differences were found in a few measures. Workers who saw a chiropractor were less likely to report a previous work-related injury with more than one month off work (21.9% vs. 28.5%, $p = 0.011$) and were less likely to have missed work due to other health reasons in the year before injury ($p = 0.027$). Regarding how their pain has changed since injury, workers who saw chiropractors were more likely to report their pain had improved ($p < 0.001$). Workers who saw chiropractors were less likely to report having general health insurance coverage (64.4% vs. 72.8%, $p = 0.002$). Workers who saw a chiropractor also expressed fewer fear-avoidance beliefs ($p = 0.003$), with 41.4% scoring high or very high, compared to 51.2% for the primary care group.

3.3 | Association Between Provider Type and Time Loss at One Year

The association between provider type at first medical visit and time loss at one year, unadjusted and adjusted for individual potential confounders, is shown in Table 2 and presented graphically in Figure 1. In the unadjusted model, workers who saw a chiropractor had a lower odds of being on time loss at 1 year compared to workers who saw a primary care physician (OR: 0.38, 95% CI: 0.24, 0.60). This estimate did not change after adjusting for worker age and sex.

Next, potential confounders to this association were added to the model one at a time. In all models, seeing a chiropractor was associated with a significantly lower odds of being on time loss at one year. Most factors evaluated did not confound the association between provider type and one-year time loss. Only two variables, change in pain since injury and fear-avoidance, attenuated the effect of provider type on time loss by our predetermined threshold of at least 10%, although the association between provider type and time loss remained strong and statistically significant.

The association between seeing a chiropractor and lower odds of time loss at one year remained statistically significant in the fully adjusted models (Table 3 and Figure 1): Model 1 adjusting for age, sex, change in pain since injury, and fear-avoidance beliefs (OR: 0.48, 95% CI: 0.30, 0.78) and Model 2 adjusting for age, sex, and all potential confounders (OR: 0.45, 95% CI: 0.24, 0.86).

The E-value analysis estimated a value of 3.8 and 1.6 for the upper confidence limit, suggesting reasonable robustness to

TABLE 1 | Characteristics of cohort by provider type at first medical visit ($N = 1219$).

	Primary care $N = 678$	Chiropractor $N = 541$	p-value[a]
Time loss at 1 year (n (%))			< 0.001
No	598 (88.2%)	515 (95.2%)	
Yes	80 (11.8%)	26 (4.8%)	
Number of days on time loss in first year (mean (SD))	73 (117)	52 (91)	< 0.001
Sociodemographic			
Age (mean [SD])	39.7 (11.2)	39.0 (11.8)	0.245
Sex (n (%))			< 0.001
Female	250 (36.9%)	146 (27.0%)	
Male	428 (63.1%)	395 (73.0%)	
Race/ethnicity (n (%))			< 0.001[b]
White	514 (76.3%)	360 (66.8%)	
Hispanic or Latino	80 (11.9%)	116 (21.5%)	
Black or African-American	15 (2.2%)	11 (2.0%)	
American Indian, Native Alaskan or Native American	17 (2.5%)	12 (2.2%)	
Asian	7 (1.0%)	4 (0.7%)	
Native Hawaiian or other Pacific Islander	5 (0.7%)	6 (1.1%)	
More than one race	36 (5.3%)	30 (5.6%)	
Education (n (%))			0.093
Less than high school	78 (11.5%)	80 (14.8%)	
High school	233 (34.4%)	188 (34.8%)	
Vocational or some college	312 (46.1%)	218 (40.3%)	
College or more	54 (8.0%)	55 (10.2%)	
Marital status (n (%))			0.330
Married or living with a partner	459 (67.7%)	351 (64.9%)	
Other	219 (32.3%)	190 (35.1%)	
Urban-rural classification (n (%))			< 0.001
Urban	363 (55.3%)	316 (60.2%)	
Suburban	117 (17.8%)	81 (15.4%)	
Large town	78 (11.9%)	84 (16.0%)	
Small town	99 (15.1%)	44 (8.4%)	
Employment			
Employer industry type (n (%))			< 0.001
Trade transportation	153 (22.6%)	148 (27.4%)	
Natural resources	31 (4.6%)	21 (3.9%)	
Construction	104 (15.3%)	113 (20.9%)	
Manufacturing	57 (8.4%)	44 (8.1%)	
Management	121 (17.8%)	76 (14.0%)	
Education/health	131 (19.3%)	54 (10.0%)	
Hospitality	81 (11.9%)	85 (15.7%)	
Physical demands of job (n (%))			0.101
Sedentary	24 (3.6%)	23 (4.3%)	
Light	102 (15.1%)	102 (18.9%)	
Medium	213 (31.6%)	184 (34.1%)	
Heavy	179 (26.5%)	113 (21.0%)	
Very heavy	157 (23.3%)	117 (21.7%)	

(Continues)

TABLE 1 | (Continued)

	Primary care $N = 678$	Chiropractor $N = 541$	p-value[a]
Asked to do excessive amount of work (n (%))			0.006
Strongly disagree	32 (4.8%)	35 (6.5%)	
Disagree	284 (42.3%)	207 (38.7%)	
Agree	196 (29.2%)	197 (36.8%)	
Strongly agree	159 (23.7%)	96 (17.9%)	
Pain and function			
Number of pain sites, range 0–8 (mean [SD])	2.5 (1.8)	2.7 (1.8)	0.148
Pain intensity, past week; scale 0–10, higher = worse (mean [SD])	5.1 (2.6)	5.1 (2.6)	0.901
Pain interference with daily activities, past week; scale 0–10, higher = worse (mean [SD])	4.8 (3.0)	4.7 (3.0)	0.485
Pain interference with ability to work, past week; scale 0–10, higher = worse (mean [SD])	4.9 (3.3)	4.8 (3.3)	0.373
Physical disability due to low back pain (RMDQ); scale 0–24, higher = worse (mean [SD])	12.2 (7.1)	12.4 (6.9)	0.646
Physical functioning (SF-36); scale 0–100, higher = better (mean (SD))	38.6 (12.8)	39.4 (11.5)	0.254
Change in pain since injury (n (%))			< 0.001
Better	455 (67.3%)	428 (80.0%)	
Same	155 (22.9%)	75 (14.0%)	
Worse	66 (9.8%)	32 (6.0%)	
Injury severity and other health factors			
Injury type[c] (n (%))			0.567
Mild sprain	395 (58.5%)	304 (56.3%)	
Major sprain/strain with substantial immobility but no evidence of nerve injury/radiculopathy	134 (19.9%)	120 (22.2%)	
Evidence of radiculopathy	125 (18.5%)	104 (19.3%)	
Reflex/sensory/motor abnormalities	21 (3.1%)	12 (2.2%)	
Number of prior workers' compensation claims (mean [SD])	1.3 (1.8)	1.2 (2.1)	0.238
Previous work-related injury with more than 1 month off work (n (%))			0.011
No	482 (71.5%)	421 (78.1%)	
Yes	192 (28.5%)	118 (21.9%)	
Current health; scale 1 (excellent) to 5 (poor) (mean [SD])	2.3 (0.9)	2.4 (1.0)	0.052
Health in year before injury; scale 1 (excellent) to 5 (poor) (mean [SD])	2.2 (0.9)	2.3 (1.0)	0.090
Days of work missed due to other health reasons in year before injury (n (%))			0.027
0	257 (38.9%)	247 (46.6%)	
1–29	381 (57.6%)	267 (50.4%)	
30 or more	23 (3.5%)	16 (3.0%)	
Health care			
Health care provider talked about injury prevention (n (%))			0.019
No	274 (40.5%)	182 (33.8%)	
Yes	403 (59.5%)	357 (66.2%)	
Health care provider recommended exercises (n (%))			0.002
No	176 (26.0%)	186 (34.5%)	

(Continues)

TABLE 1 | (Continued)

	Primary care $N = 678$	Chiropractor $N = 541$	p-value[a]
Yes	500 (74.0%)	353 (65.5%)	
Health insurance coverage (n (%))			0.002
No	184 (27.2%)	192 (35.6%)	
Yes	492 (72.8%)	348 (64.4%)	
Administrative			
Days between injury and first medical visit (n (%))			0.060
0–6	511 (77.9%)	442 (83.4%)	
7–13	79 (12.0%)	48 (9.1%)	
14 or more	66 (10.1%)	40 (7.5%)	
Days between first medical visit and claim receipt (n (%))			0.129
0–6	534 (81.4%)	450 (84.9%)	
7–13	122 (18.6%)	80 (15.1%)	
Psychosocial barriers to recovery			
Pain catastrophizing[d]; scale 0-4, higher = worse (n (%))			0.172
Very low (0–1)	212 (31.3%)	192 (35.5%)	
Low (1.33–1.67)	104 (15.3%)	94 (17.4%)	
Moderate (2–2.67)	198 (29.2%)	145 (26.8%)	
High (3–4)	164 (24.2%)	110 (20.3%)	
Fear-avoidance beliefs[d]; scale 0-6, higher = worse (n (%))			0.003
Very low (0–3)	118 (17.4%)	129 (23.8%)	
Low-moderate (3.5–4.5)	213 (31.4%)	188 (34.8%)	
High (5–5.5)	208 (30.7%)	143 (26.4%)	
Very high (6)	139 (20.5%)	81 (15.0%)	
Mental health (SF-36); scale 0-100, higher = better (mean [SD])	45.4 (12.8)	44.6 (12.9)	0.273

[a]Chi-square for categorical variables and *t*-test for continuous variables.
[b]For this chi-square test the following categories were combined: Black or African-American; American Indian, Native Alaskan or Native American; Asian; Native Hawaiian or other Pacific Islander; more than one race.
[c]Injury type was categorized in ascending order of severity based on a review of the medical file by a trained nurse.
[d]Average of three items from the Pain Catastrophizing Scale, asking about the worker's thoughts when they are in pain. These were "I feel I can't stand it anymore," "It is awful and I feel that it overwhelms me," and "I keep thinking about how badly I want the pain to stop," measured on a scale from 0 (not at all) to 4 (all the time).
[d]Average of two questions from the Fear-Avoidance Beliefs Questionnaire. These were "My work might harm my back" and "My work makes, or would make, my pain worse" with responses on a scale from 0 (completely disagree) to 6 (completely agree).

unmeasured confounding. In short, the observed odds ratio of 0.45 in Model 2 could be explained by an unmeasured confounder that was associated with both provider type and time loss by an odds ratio of 3.8-fold each, conditional on the measured confounders, but weaker confounding could not do so. Similarly, an unmeasured confounder associated with both provider type and time loss by an odds ratio of 1.6-fold each, conditional on the measured confounders, would be enough to move the upper limit of the confidence interval to include the null.

4 | Discussion

In this study of workers' compensation claimants with back injuries, we found that workers who saw chiropractors for their first medical visit after injury had a lower odds of being on time loss at one year, compared to workers who saw primary care physicians, and that this relationship remained after adjusting for a large number of administrative and patient-reported factors. We consider our findings robust given the large E-value (3.8) in a model that has comprehensively adjusted for key prognostic factors [41]. In other words, it would take a large confounder operating through pathways independent of the measured prognostic markers to change our interpretation [41].

Two prior studies in a workers' compensation population report similar results [18, 31]. Blanchette et al. found that workers who first saw a chiropractor after a workplace injury had a shorter duration of wage replacement compensation over the first five months after injury, compared to workers who first saw a medical doctor [18]. Our study adds important information to this prior finding. While both analyses accounted for demographic factors, job-related physical demands, previous injuries, time to first medical visit, and injury severity, we were able to include patient-reported measures of pain and psychological factors. Although our primary outcome was the proportion of workers on time loss at one year (4.8% for chiropractic vs. 11.8% for primary care), we also found the duration of time loss in the first year to differ by provider type, with an average of 52 days of time loss among workers who first saw chiropractors, compared

TABLE 2 | Association between provider type at first medical visit and time loss one year after injury: unadjusted; adjusted for age and sex; adjusted for age and sex plus each potential confounding factor one at a time ($N = 1219$[a]).

	Model results for the association between provider type and time loss (reference group: primary care)		
	OR	**95% CI**	***p*-value**
Chiropractor (base model)	0.38	0.24, 0.60	< 0.001
Chiropractor + age + sex	0.38	0.24, 0.60	< 0.001
Chiropractor + age + sex + *potential confounder*			
Sociodemographic			
Race/ethnicity[b]	0.37	0.23, 0.59	< 0.001
Urban-rural classification	0.40	0.25, 0.65	< 0.001
Employment			
Employer industry type	0.35	0.22, 0.56	< 0.001
Physical demands of job	0.38	0.24, 0.60	< 0.001
Asked to do excessive amount of work	0.37	0.23, 0.59	< 0.001
Pain and function			
Number of pain sites	0.34	0.21, 0.54	< 0.001
Pain intensity, past week	0.35	0.22, 0.57	< 0.001
Pain interference with daily activities, past week	0.36	0.22, 0.58	< 0.001
Pain interference with ability to work, past week	0.39	0.24, 0.63	< 0.001
Physical disability due to low back pain (RMDQ)	0.34	0.21, 0.55	< 0.001
Physical functioning (SF-36)	0.41	0.25, 0.66	< 0.001
Change in pain since injury	0.45[3]	0.28, 0.73	0.001
Injury severity and other health factors			
Injury type	0.36	0.22, 0.58	< 0.001
Number of prior workers' compensation claims	0.38	0.24, 0.61	< 0.001
Previous work-related injury with more than 1 month off work	0.40	0.25, 0.64	< 0.001
Current health	0.35	0.22, 0.56	< 0.001
Health in year before injury	0.38	0.24, 0.60	< 0.001
Days of work missed due to other health reasons in year before injury	0.36	0.22, 0.58	< 0.001
Health care			
Health care provider talked about injury prevention	0.39	0.24, 0.62	< 0.001
Health care provider recommended exercises	0.37	0.23, 0.59	< 0.001
Health insurance coverage	0.35	0.22, 0.56	< 0.001
Administrative			
Days between injury and first medical visit	0.40	0.25, 0.63	< 0.001
Days between first medical visit and claim receipt	0.40	0.25, 0.63	< 0.001
Psychosocial barriers to recovery			
Pain catastrophizing	0.40	0.25, 0.63	< 0.001
Fear-avoidance beliefs	0.42[3]	0.26, 0.68	< 0.001
Mental health (SF-36)	0.35	0.22, 0.57	< 0.001

Abbreviations: CI, confidence interval; OR, odds ratio.
[a]Pairwise deletion used for regression models.
[b]Categorized as White, Hispanic or Latino, and all others combined.

to 73 days for workers who saw primary care physicians. We explored patient characteristics among workers who saw chiropractors versus primary care physicians. We identified some differences between these groups, but very few differences in measures of pain, physical function, and injury severity. Previous research suggests that those who pursue chiropractic care are more likely to be White and live in rural areas [42]. Individuals who self-identified as Hispanic or Latino in our

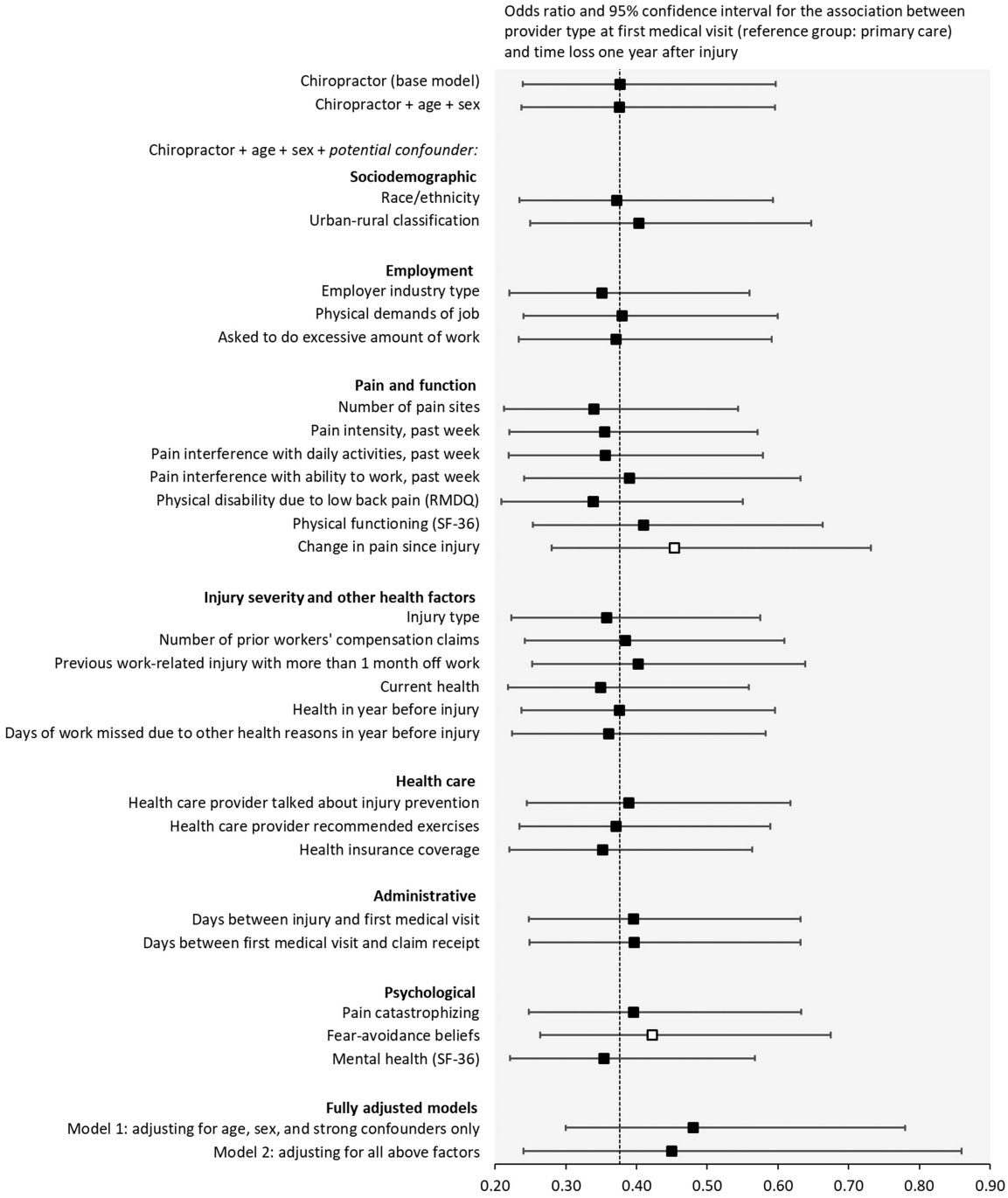

FIGURE 1 | Logistic regression model results. Forest plot illustrating the association between provider type at first medical visit and time loss one year after injury: unadjusted; adjusted for age and sex; adjusted for age and sex plus each potential confounding factor one at a time; and fully adjusted models. For the potential confounding factors, the white markers represent odds ratios with ≥ 10% change relative to the model adjusting for provider type, age, and sex. The dotted vertical line marks the odds ratio for provider type in the model adjusting for age and sex (OR = 0.38).

sample were more likely to see a chiropractor than a physician for their initial medical visit. One key difference in Washington workers' compensation is that workers have choice of providers and coverage for healthcare, unlike that available in their private pay insurance options, which often does not cover or only partially covers chiropractic care [43].

We also explored potential confounding factors of the association between provider type and time loss, but most had no impact. Only two measures (pain change since injury and fear-avoidance beliefs) changed the odds ratio between provider type and time loss by more than 10%. Whether these characteristics represent individual differences preceding treatment or were influenced by chiropractic treatment is unclear, as patient-reported assessment occurred after initiation of treatment and workers may have already experienced some recovery. Workers who saw chiropractors may have been able to initiate treatment more quickly, as evidenced by the shorter (although not statistically different) time to first medical visit in this group, which may facilitate quicker recovery from injury.

TABLE 3 | Association between provider type at first medical visit and time loss one year after injury: fully adjusted models ($N = 1219$[a]).

	Model results for the association between provider type and time loss (reference group: primary care)		
	OR	**95% CI**	***p*-value**
Model 1: adjusting for age, sex, and strong confounders only[b]	0.48	0.30, 0.78	0.003
Model 2: adjusting for age, sex, and all potential confounders in Table 2	0.45	0.24, 0.86	0.015

Abbreviations: CI, confidence interval; OR, odds ratio.
[a]Pairwise deletion used for regression models.
[b]≥ 10% change in odds ratio relative to model adjusting for age and sex.

We found that there was some attenuation of the difference in one-year disability after adjusting for patient case mix, but the association between provider type and one-year disability remained strong and statistically significant in the multivariable models. Distinctions in how providers care for back pain may have downstream effects, including a lower cost for conservative management due to less subsequent utilization of high-cost services [20]. Physician use of guideline-concordant back pain care is highly variable [44]. Despite well-known guidelines for over 25 years [45], adoption and implementation of guidelines for treating back pain in primary care are still challenging [46]. Chiropractic standards of treatment are well-aligned with conservative care guidelines for back pain [47], and consideration could be made in positioning chiropractors to aid in back pain care within larger health systems. It may be that reduction of unnecessary services not only lowers costs, but decreases treatment delays and provides faster recovery. Considerations such as patient messaging around the severity of the condition, positivity in messaging recovery, and less use of unnecessary services could all contribute to the effects seen in reduced disability. Given our findings, it may be beneficial for health care delivery systems to consider improving early access to chiropractic services for back pain patients in their care pathways, and for insurers to review policies that may create barriers to early access. Insurance policies that foster early access to chiropractic care may include allowing for sole management by the chiropractor in uncomplicated claims, reimbursing chiropractors for evaluation and management services, and covering a broad range of evidence-based treatment for back pain.

5 | Strengths and Limitations

Strengths of this study include its prospective design and large population-based cohort. We utilized administrative claim-derived measures as well as worker-reported measures, which have been frequently unavailable in previous studies [11]. In prior studies, patients seeking chiropractic care are surmised to have milder back pain [11, 13, 16], compared to those who see medical providers. However, the present study found very few differences in self-reported measures of pain and function between workers choosing primary care versus chiropractic providers.

There are also several limitations in this study. First, while our study was designed to measure a comprehensive list of factors that may predict time loss, there could be residual confounding. For example, we did not assess co-morbid health conditions, which can predict clinical outcomes or treatment effects, but any measures not included would have to be strong confounders in order to explain our results. We also did not evaluate early opioid use, which has been shown to be associated with long-term disability [48, 49]. Future studies should explore whether the effect of first provider type on disability differs by early opioid use. Second, the baseline interview was a median of 18 days after claim submission and did not vary significantly between provider type. Thus, some measures such as pain intensity and function may underestimate the levels at the time of injury. Additionally, while we treated all measured factors as confounders, it may be that they were also influenced by the initial treatment. For example, if pain or fear-avoidance beliefs were addressed in early treatment, these factors may be considered potential mediators of an association; adjusting for potential mediators would bias results toward the null. Third, we used a point prevalence measure of time loss, which may underestimate the absolute burden of work disability. However, it has been shown to have utility as a measure of the relative effectiveness of an intervention [50] and is strongly associated with important patient-reported outcomes [33]. Lastly, while one-year time loss outcomes in our cohort are similar to that seen in other studies (ranging from 7.8% to around 10% on disability benefits at one year, depending on the specific measure used [50, 51]), generalizability of our results to workers who do not file claims or to other workers' compensation systems is unknown.

6 | Conclusions

Patients with work-related back injury who initiated care with a chiropractor were less likely to be receiving time loss compensation at one year than those who saw a primary care physician. Chiropractic patients differed from primary care physician patients for some sociodemographic, employment, and health-related characteristics, but importantly these factors did not account for the differential outcome by provider type. Future studies should explore downstream costs and interventions based on the initial provider type seen. Given these findings, it may be beneficial for health care delivery systems to consider improving early access to chiropractic services for back pain patients in their care pathways, and for insurers to review policies that may create barriers to early access.

Author Contributions

Morgan Young and Deborah Fulton-Kehoe conceptualized and designed the study. Andrea Elmore conducted the data analysis. Morgan Young drafted the original manuscript, and all authors contributed critical revisions and interpretation of the results. All authors

approved the final version of the manuscript. Morgan Young agrees to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Disclosure

The authors have nothing to report.

Ethics Statement

This study was conducted at the University of Washington and approved by the University of Washington Institutional Review Board. Each participant provided verbal informed consent before engaging in any research activities.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The authors have nothing to report.

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