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Factors Associated With Early Magnetic Resonance Imaging Utilization for Acute Occupational Low Back Pain:

A Population-Based Study From Washington State Workers' Compensation

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Abstract

Study Design.—A population-based, prospective cohort study.

Objective.—To identify demographic, job-related, psychosocial, and clinical factors associated with the use of magnetic resonance imaging (MRI) within 6 weeks from injury (early MRI) among workers' compensation claimants with acute occupational low back pain (LBP).

Summary of Background Data.—Early MRI may be associated with increased use of services for treatment and costs. To understand utilization and most appropriately apply guidelines, it is important to identify factors associated with early imaging use for occupational LBP.

Methods.—Workers (N = 1830) were interviewed 3 weeks (median) after submitting a workers' compensation claim for a back injury. Demographic, work, health, clinical, and injury characteristics were ascertained from interviews, medical records, and administrative data. Modified Poisson regression analyses identified factors associated with early MRI use.

Results.—Among respondents, 362 (19.8%) received an early MRI. Multivariable regression showed that male workers were 43% more likely to receive an early MRI than female workers (incident rate ratio [IRR]: 1.43, 95% confidence interval [CI]: 1.12–1.82). Initial visit type with

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a surgeon was associated with 78% greater likelihood of receiving an early MRI than that with a primary care physician (IRR: 1.78, 95% CI: 1.08–2.92). Having a chiropractor as the initial provider was associated with a reduced likelihood of early MRI (IRR: 0.53, 95% CI: 0.42–0.66). Workers with elevated work fear-avoidance, higher Roland scores, or increased injury severity were more likely to receive early MRI than counterparts with lower levels or scores.

Conclusion.—Nearly 20% of the injured workers with LBP receive early MRI, a rate similar to that reported elsewhere. Early MRI may lead to greater subsequent interventions, potentially poorer outcomes, and increased health care expenditures. On the basis of the characteristics of patients with uncomplicated occupational LBP, providers may be able to provide tailored care, and providers and policy makers may better understand the utilization of imaging and adherence to clinical guidelines.

Keywords

low back pain; workers' compensation; diagnostic imaging; early imaging; clinical practice guidelines; MRI; population-based

Approximately one-quarter of working adults are affected by low back pain (LBP) during their career and 10% to 20% with a work-related low back injury do not return to work.[1–3] Occupational LBP accounts for approximately 30% of the workers' compensation (WC) claims, and these claims constitute a disproportionately higher percentage of total WC costs.[4,5]

Clinical practice guidelines for acute LBP recommend a conservative approach for nontraumatic cases avoiding routine spinal imaging within the first 4 to 6 weeks of symptoms (during the acute phase of LBP).[6–10] Exceptions include patients with the following red flags: age younger than 20 years, infection, history of cancer, intravenous (IV) drug use, prolonged use of corticosteroids, osteoporosis, older age (older than 50 or 70 yr, depending on the guideline), or focal neurological deficit with progressive or disabling symptoms.[9,11]

Although magnetic resonance imaging (MRI) for LBP within the first 6 weeks of symptoms is not recommended except in cases with red flags, approximately 20% receive MRI within first 4 to 6 weeks.[12] Early MRI may be associated with increased use of services for treatment and costs[13,14] and may have deleterious effects on patient's well-being, without providing additional benefit of diagnostic insight or improved health.[15] To our knowledge, no study has yet evaluated the factors associated with early MRI for occupational LBP.

Our objective was to identify demographic, job-related, psychosocial, and clinical factors associated with use of early MRI among a population-based cohort of WC claimants with acute LBP.

MATERIALS AND METHODS

Data Sources

Data were obtained from the Washington Workers' Compensation Disability Risk Identification Study Cohort (D-RISC), a population-based study designed to identify risk factors for chronic disability among workers with acute back injury (details reported elsewhere).[16–18] D-RISC combined administrative claims and medical billing data provided by the Washington State Department of Labor and Industries (L&I), which operates a WC program that provides no-fault industrial insurance and covers two-thirds of all nonfederal Washington workers (the remaining one-third workers are employed by large, self-insured companies, for whom detailed data are not available).

D-RISC study participants were limited to workers older than 18 years with a back sprain/strain, an accepted WC claim, received compensation for missing 4 or more days from work, and not hospitalized in the acute period after injury.[19]

Trained personnel conducted computer-assisted telephone interviews with participants approximately 3 weeks (median: 18 d, range: 10–58 d) after filing the claim with L&I. Interviews included questions regarding overall and injury-specific health, personal, and work characteristics. The University of Washington institutional review board approved the study, and participants provided informed consent and were paid $10.

VARIABLE DEFINITIONS

Variables were selected *a priori*, informed by health services utilization models and current literature.[20,21] The primary outcome variable for all analyses was receipt of early MRI (yes/no), defined as receiving a lumbar MRI 42 or less days after injury date. Dates of procedures from the WC medical bill payment database were used to calculate the duration between injury and MRI.

Interviews were completed approximately 1 month after injury (median: 30 d, range: 14–90 d). To account for the time lag between injury and interview, a lag variable (number of days after injury) was calculated for each worker.

Demographics

Participants provided demographic information that included race, ethnicity, education, income, and marital status.

Health Status

Workers provided self-reported health status (aside from injury) for the year before injury and concurrent with the interview (current), categorized on a Likert scale. Body mass index was categorized as normal (<25), overweight (25–29), obese (30–34), and very obese (>34). Catastrophizing, a psychosocial health measure of coping response, was categorized into 3 levels: low (<1), moderate (1–2.9), and high (3–4).[22] Work fear-avoidance was assessed by averaging responses to 2 items from the Fear-Avoidance Beliefs Questionnaire and categorized as very low (<3), low-moderate (3.1–4.9), high (5–5.9), and very high (6)[23].

Mental health status was measured using the 36-Item Short Form Health Survey version 2 (SF-36 v2) (1-wk time frame) and scored on the basis of US population norms: 2 or more standard deviations (SD) below the general population mean (<30), 1–2 SD below (30–39.9), 1 SD below (40–49.9), and at/above the mean (≥50).[24,25]

Employment

L&I administrative claims data were used to determine whether the worker had a previous compensable back claim. Workers reported overall job satisfaction and whether their employer offered accommodations for the injury (*e.g.*, change in physical environment, tasks, work-schedule, job positions, or part-time work). Employment industry was determined according to the North American Industry Classification System.[26] Physical demands were self-reported as sedentary/light, medium, heavy, or very heavy, based on the amount of lifting, carrying, pushing, or pulling loads associated with typical work activities.[17]

Type of First Medical Visit

The type of first office visit was obtained from the WC medical bill payment database. This variable was categorized as primary care physician, occupational health physician, chiropractor, surgeon, emergency department, or other provider (including specialists and physical medicine).

Injury Characteristics

Measures describing the worker's back injury included both self-report and clinical characteristics. Pain intensity refers to any pain in the last week, either from injury or from other causes, on a 0 to 10 scale, categorized as no/low pain (0–3), moderate pain (4–6), and high pain (7–10).[27] The Roland-Morris disability questionnaire assesses disability due to LBP and was categorized in 4 groups on the basis of scores 0 to 24: 0 to 6, 7 to 13, 14 to 18, and 19 to 24 (higher scores reflecting higher levels of disability).[28,29] Medical record review by occupational health nurses provided a clinical estimate of injury severity and was categorized as moderate sprain/strain, major sprain/strain, or substantial immobility/radiculopathy.[30]

STATISTICAL ANALYSIS

Workers whose medical claim reported lumbar MRI 42 or fewer days after injury date were considered to have received an early MRI. This cutoff value reflects clinical guidelines, which recommend up to 6 weeks before imaging.[6–10] Rates of radiography and computed tomography (CT) were calculated for comparison. Descriptive and inferential analyses were performed using STATA/IC 10.1 for Macintosh (Stata Corp., College Station, TX).

Univariate analyses of demographic, health status, employment, provider, and injury variables were conducted using Pearson chi-square tests. Bivariate relationships evaluated the association between each variable and early MRI. Because the prevalence of the outcome was greater than 10%, a modified Poisson approach with robust error variance was used.[31] Multivariable models estimated the likelihood of receiving an early MRI for

each factor while controlling for covariates (including a lag variable for time between injury and interview). The results of analyses were presented as incident rate ratios (IRRs) with 95% confidence intervals (CIs); IRR is the inverse of natural logarithm of β (or eβ) and demonstrates the multiplicative influence of 1 unit change in exposure on the rate of the outcome. Here, IRRs can be interpreted as relative risk of early MRI.

Chi-square analyses were used to assess multicollinearity by testing associations between pairs of related categorical variables. For pairs that were strongly associated ($P < 0.05$), each was removed sequentially from the full model to evaluate the effect on coefficients.

Seventeen percent (N = 322) received an MRI before completing the D-RISC questionnaire, which could have influenced responses to interview questions. To address this issue, a separate model excluded interview questions that may exhibit bias (*e.g.*, health status, mental health measures, pain intensity).

To evaluate whether the early MRI may be attributed to planning of subsequent spinal injection procedures, we calculated the proportion of workers who received a spinal injection in 30 days after the early MRI. Injections included caudal, facet lumbar/sacral, transforaminal lumbar/sacral, or sacroiliac joint injections.

RESULTS

From July 2002 to April 2004, 4354 workers were identified, of whom 49% agreed to participate in the D-RISC study, 27% could not be contacted, 3% were ineligible due to language limitations, and 21% declined to participate. Of the 2147 subjects who agreed to participate, 240 were excluded for lacking work disability compensation, and 22 others were excluded for other reasons. The final D-RISC sample of 1885 workers, compared with nonparticipants (N = 1776), was slightly older (age: mean [SD] 39.4 [11.2] *vs.* 38.2 [11.1] yr, $P < 0.001$) and included more women (32% *vs.* 26%, $P < 0.001$).[17] The majority of workers filed a claim within 2 months after injury (97%). Among those who did not (N = 55), claims were filed up to 9 months after injury and interviews were conducted up to a year after injury. For this study, these workers were excluded; the final study sample consisted of 1830 workers.

The median time from injury to the first medical appointment was 2 days (mean = 5, SD = 7). Among the 1830 workers, 362 (19.8%) received an MRI within 42 days of the injury (early MRI) (Table 1). Of all workers, 34.4% (N = 630) received an MRI at any time in 1 year after injury. Overall, the mean time to MRI was 60 days (SD = 67). Among those who received an early MRI, the mean time to MRI was substantially less: 21 days (SD = 11, $P < 0.001$). Compared with MRI, more workers (N = 1002, 54.8%) received at least 1 lumbar radiograph in the year after injury (884 underwent radiography within the first 6 wk of injury). Far fewer workers received a lumbar CT in 1 year (N = 64, 3.5%); 27 received CT within the first 6 weeks of injury.

The following variables were not associated with early MRI bivariately or in multivariate analyses: marital status, body mass index, past or current health status, and job satisfaction. Age, race, education, catastrophizing, job accommodations, previous compensable back

claims, and self-reported pain intensity were associated with early MRI in bivariate analyses (Table 1) but were not significant in multivariate model after adjusting other covariates (Table 2).

Multivariable regression showed that male workers were 43% more likely to receive an early MRI than female workers (IRR: 1.43, 95% CI: 1.12–1.82), and workers whose initial visit type was with a surgeon were 78% more likely to receive an early MRI than those who visited a primary care physician initially (IRR: 1.78, 95% CI: 1.08–2.92) (model 1, Table 2). Workers with a chiropractor as the initial provider were half as likely to receive an early MRI compared with workers with the same demographic and injury characteristics whose initial provider was a primary care physician (IRR: 0.53, 95% CI: 0.42–0.66). Compared with workers with Roland scores below 6, workers with scores more than 18 were nearly 6 times more likely to receive an early MRI, holding all other covariates constant (IRR: 5.87, 95% CI: 3.16–10.89). Similarly, controlling for all other factors, the risk of early MRI was 3 times higher for workers with radiculopathy than for workers with mild sprains (IRR: 3.04, 95% CI: 2.44–3.79).

Regarding potential red flags and characteristics suggesting that the workers may be at greater risk for severe LBP, 51 workers (2.8%) were younger than 20 years, 373 workers (20.4%) were older than 50 years, and 6 workers were older than 70 years. Among workers who received an early MRI, 39.8% (N = 144) received at least 1 injection in the year after injury. The mean time between MRI and injection was 105 days (SD = 84 d). Within 30 days of the early MRI, 13.5% (N = 49) received an injection.

Analyses for multicollinearity showed that the following pairs of variables were strongly associated $P < 0.05$): pain intensity/Roland, injury severity/Roland, pain intensity/injury severity, past/current health status, catastrophizing/SF-36 mental health, fear-avoidance/catastrophizing, catastrophizing/SF-36 mental health, and Roland with each of the mental health measures (catastrophizing, fear-avoidance, and SF-36 mental health). Removal of each variable from the full model did not materially change the model associations or conclusions.

The multivariable model was run with and without the lag variable, representing time between injury and interview; the model associations and conclusions did not change upon exclusion of the lag variable. Model 2 (Table 2) excluded variables that could be biased because of the timing of the interview. Risk estimates exhibit patterns similar to model 1; magnitudes of the associations did not differ substantially.

DISCUSSION

This research identifies factors associated with receiving an early lumbar MRI among workers with nonspecific, acute uncomplicated LBP. Multivariable results indicate that male sex, type of first medical visit, functional status, medically documented injury severity, and fear-avoidance are strongly associated with receiving early MRI for occupational LBP.

Although injury severity is associated with an increased likelihood of receiving advanced imaging for LBP,[32] guidelines discourage early imaging unless patients have signs,

symptoms, or characteristics suggestive of an underlying red flag condition, such as infection, tumor, or serious neurological impairment.[6,8] We found that workers with radiculopathy or more severe neurological impairments were more likely to receive early imaging. It is possible that a small minority of early MRI recipients in this group may have borne definite red flag elements that justify early imaging; however, only 21.2% of the cohort was either younger than 20 years or older than 50 years, and individuals in these age groups were not disproportionately at risk for early MRI (results not shown). Although data on history of cancer, infection, IV drug use, or human immunodeficiency virus were not available, the prevalence of these conditions is likely to be very low in a relatively young working population. Among workers who received an early MRI, fewer than 15% underwent an injection procedure within 30 days of receiving the MRI, suggesting that many early MRIs may not have been used for injection planning purposes.

Studies have shown that neurosurgeon, neurologist,[33] and orthopedic surgeon[32,34] providers are associated with increased likelihood of receiving advanced imaging (though not necessarily early). Although we were unable to assess each provider type individually due to sample sizes, our research shows that workers with an initial office visit with a surgeon provider (general, neurological, or orthopedic surgery) were highly likely to receive early MRI, independent of injury severity, suggesting that initial visit type also plays an important role in the utilization of early imaging. Early imaging should be considered a supplemental diagnostic tool for patients with red flags after the completion of a detailed medical history and physical examination.[7,35] Some providers, especially those who typically see patients with severe injuries, such as surgeon providers, may routinely image most or all patients. This may result in patients without red flags, or with less severe injuries, receiving early MRI, and these providers having higher likelihood of early MRI than others.

Chiropractic initial visits were associated with a nearly 50% lower likelihood of MRI within the first 6 weeks of LBP symptoms. Chiropractic providers are actually more likely to use radiographs[32]; however, this utilization may be less costly to L&I, because the cost of radiographs is substantially less than MRIs (L&I 2009 reimbursement rates $85 *vs.* $1131) and clinical outcomes do not differ by imaging modality.[14] Research suggests that initial chiropractic care results in significantly lower costs[36] and greater patient satisfaction.[37]

Fear-avoidance beliefs are an important psychosocial factor in the recovery of acute LBP, causing patients to avoid activities that are anticipated to cause or exacerbate pain (*e.g.*, work).[23,38] Research shows that holding elevated fear-avoidance beliefs is associated with increased health care use.[39] Our finding that workers with higher fear-avoidance beliefs were more likely to receive an early MRI than workers with low fear-avoidance beliefs is consistent with the literature. The use of early imaging may be particularly concerning for patients with elevated fear-avoidance beliefs, because they may be more predisposed to feel threatened by diagnostic labels,[40] develop chronic LBP,[41,42] be prescribed narcotics,[39] or remain on disability.[38,43]

The population-based design, large sample size, and the availability of detailed independent variables contribute to the strength and unique nature of this research. This study has several limitations. First, this cohort includes cases with 4 or more days of compensated lost work

time, so results may not be generalizable to workers with less severe or noncompensable injuries. Second, 17% of the workers received imaging before the interview was conducted (N = 322), potentially introducing bias to the study. However, eliminating potentially biased covariates did not substantially change the study results. Third, information regarding a workers' history of cancer, IV drug use, and human immunodeficiency virus status was not available for this analysis; for these red flags, early MRI would have been appropriate. Fourth, the purpose, scope, and design of this study limited its ability to assess several factors that warrant future research. This study did not incorporate information from physicians regarding the reason for ordering an MRI. It was also not possible to ascertain the appropriateness of the imaging received or whether the imaging was truly necessary for a particular patient. Finally, early imaging may influence outcomes, such as utilization, costs, health, or disability, but that analysis was beyond the scope of this study. These are important aspects in evaluating the potential overutilization of imaging and should be addressed by suitably designed, future research.

CONCLUSION

To our knowledge, this is the first study to evaluate individual-level factors, including self-reported pain and functioning, associated with early MRI for acute LBP. Results show that early MRI for LBP is a common practice, which may contribute to increased resource utilization and costs.[14,44] It is prudent for providers to be aware of clinical practice guidelines and follow recommendations to limit advanced imaging in the first 4 to 6 weeks of LBP symptoms. Given the results of this study, providers could provide more customized care, based on the characteristics of patients with uncomplicated occupational LBP, and policy makers may seek to direct patients to certain types of providers early in the course of their LBP.

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Key Points

- Among workers with occupational LBP, male sex, elevated fear-avoidance, greater Roland-Morris disability scores, greater injury severity, and type of first visit were associated with increased likelihood of receiving MRI within the first 6 weeks of injury (after controlling for confounders).
- Workers accessing chiropractic care initially were substantially less likely to receive an early MRI.
- Understanding factors that are associated with early MRI use will help inform providers and policy makers about current utilization patterns and potential strategies for addressing guideline adherence.

TABLE 1.

Demographic, Work, Clinical, and Health History Characteristics of D-RISC Workers Who Received Early MRI and Those Who Did Not

	Early MRI (N = 362)	Late/No MRI (N = 1468)	
	N (%)	N (%)	*P*
Demographics			
Age (at injury)			0.005
<24 yr	24 (6.6)	169 (11.5)	
25–34 yr	79 (21.8)	387 (26.4)	
35–44 yr	124 (34.3)	430 (29.3)	
45–54 yr	101 (27.9)	331 (22.5)	
>55 yr	34 (9.4)	151 (10.3)	
Sex			0.031
Female	99 (27.3)	488 (33.2)	
Male	263 (72.7)	980 (66.8)	
Race			0.013
White	284 (78.5)	1040 (70.8)	
Nonwhite	76 (21.0)	412 (28.1)	
Ethnicity			0.367
Non-Hispanic	306 (84.5)	1202 (81.9)	
Hispanic	54 (14.9)	249 (17.0)	
Education			0.576
Less than high school	45 (12.4)	195 (13.3)	
High school diploma/GED	133 (36.7)	491 (33.4)	
Some college	159 (43.9)	648 (44.1)	
College degree	25 (6.9)	133 (9.1)	
Household income ($)			0.031
<30,000	123 (34.0)	605 (41.2)	
30,000–45,000	96 (26.5)	362 (24.7)	
45,001–70,000	94 (26.0)	315 (21.5)	
>70,000	41 (11.3)	131 (8.9)	
Marital status			0.113
Married	192 (53.0)	742 (50.5)	
Living with partner	52 (14.4)	205 (14.0)	
Divorced	78 (21.5)	278 (18.9)	
Other	40 (11.0)	240 (16.3)	
Health characteristics			
BMI			0.190
Normal, <25	96 (26.5)	453 (30.9)	
Overweight, 25–29	142 (39.2)	560 (38.1)	

	Early MRI (N = 362)	Late/No MRI (N = 1468)	
	N (%)	N (%)	*P*
Obese, 30–34	80 (22.1)	293 (20.0)	
Very obese, >34	39 (10.8)	124 (8.4)	
Health in year before injury			0.730
Excellent	90 (24.9)	330 (22.5)	
Very good	125 (34.5)	537 (36.6)	
Good	107 (29.6)	447 (30.4)	
Fair/poor	40 (11.0)	151 (10.3)	
SF-36 mental health score *			<0.001
2 SD below population mean	84 (23.2)	184 (12.5)	
1–2 SD below population mean	105 (29.0)	289 (19.7)	
1 SD below population mean	101 (27.9)	361 (24.6)	
At or above population mean	72 (19.9)	632 (43.1)	
Catastrophizing † (0–4)			<0.001
Low (<1)	43 (11.9)	379 (25.8)	
Moderate (1–2.9)	188 (51.9)	793 (54.0)	
High (3–4)	131 (36.2)	296 (20.2)	
Work fear-avoidance ‡ (0–6)			<0.001
Low (0–2.9)	34 (9.4)	332 (22.6)	
Moderate (3–4.9)	91 (25.1)	497 (33.9)	
High (5–5.9)	143 (39.5)	405 (27.6)	
Very high (6)	94 (26.0)	234 (15.9)	
Clinical characteristics			
Type of first medical visit			<0.001
Primary care	177 (48.9)	635 (43.3)	
Occupational medicine	18 (5.0)	41 (2.8)	
Chiropractor	71 (19.6)	488 (33.2)	
Surgeon	13 (3.6)	26 (1.8)	
Emergency room/clinic	75 (20.7)	254 (17.3)	
Other	8 (2.2)	24 (1.6)	
Work characteristics			
Offered job accommodation for disability			<0.001
Yes	131 (36.2)	704 (48.0)	
No	224 (61.9)	748 (51.0)	
More than 1 previous compensable back claims			0.008
Yes	89 (24.6)	268 (18.3)	
No	273 (75.4)	1190 (81.1)	
Job satisfaction			0.563
Not at all	16 (4.4)	87 (5.9)	

	Early MRI (N = 362)	Late/No MRI (N = 1468)	
	N (%)	N (%)	*P*
Not too satisfied	30 (8.3)	131 (8.9)	
Somewhat satisfied	160 (44.2)	604 (41.1)	
Very satisfied	156 (43.1)	642 (43.7)	
Industry			0.043
Natural resources	10 (2.8)	80 (5.4)	
Construction	72 (19.9)	253 (17.2)	
Manufacturing	40 (11.0)	108 (7.4)	
Trade/transportation	80 (22.1)	366 (24.9)	
Management	65 (18.0)	232 (15.8)	
Education/health	51 (14.1)	230 (15.7)	
Hospitality	44 (12.2)	199 (13.6)	
Physical demands at work			0.010
Light	58 (16.0)	308 (21.0)	
Medium	112 (30.9)	470 (32.0)	
Heavy	80 (22.1)	354 (24.1)	
Very heavy	108 (29.8)	330 (22.5)	
Injury characteristics			
Health status at the time of interview			0.300
Excellent	70 (19.3)	290 (19.8)	
Very good	123 (34.0)	531 (36.2)	
Good	121 (33.4)	466 (31.7)	
Fair/poor	46 (12.7)	180 (12.3)	
Pain intensity the last week[§]			<0.001
Low/no pain (0–3)	38 (10.5)	409 (27.9)	
Moderate (4–6)	105 (29.0)	381 (26.0)	
High (7–10)	219 (60.5)	675 (46.0)	
Roland-Morris disability questionnaire score[¶]			<0.001
≤6	13 (3.6)	412 (28.1)	
7–12	48 (13.3)	336 (22.9)	
13–18	120 (33.1)	408 (27.8)	
≥18	181 (50.0)	312 (21.3)	
Medical record documented injury severity rating			<0.001
Mild sprain/strain and/or minor physical examination findings	98 (27.1)	906 (61.7)	
Major sprain/strain evidenced by substantial immobility	69 (19.1)	308 (21.0)	
Evidence of radiculopathy or reflexes absent	193 (53.3)	246 (16.8)	

Frequency counts do not always sum to total because of missing responses or rounding.

Values are N (%) and P values indicate χ^2 tests.

[*] SF-36v2 MH, short form-36 version 2 mental health scale.[24,25]

[†] Mean of responses to 3 questions from the Pain Catastrophizing scale.[22]

[‡] Mean of responses to 2 questions from the Fear-Avoidance Beliefs Questionnaire work scale.[23]

[§] Any pain in the last week, scale ranges from 0 to 10.[27]

[¶] Roland-Morris disability questionnaire measures physical functioning relating to back pain.[28,29]

MRI indicates magnetic resonance imaging; BMI, body mass index; SF-36, 36-Item Short Form Health Survey; D-RISC, Disability Risk Identification Study Cohort; GED, general education diploma; SD, standard deviation.

TABLE 2.

Factors Associated With the Likelihood of a Worker Receiving an Early MRI for Low Back Sprain/Strain

	Unadjusted		Model 1		Model 2	
	IRR	**95% CI**	**IRR**	**95% CI**	**IRR**	**95% CI**
Demographics						
Age (at injury)						
<24 yr	0.56	0.37–0.83	0.84	0.57–1.24	0.81	0.55–1.19
25–34 yr	0.76	0.59–0.98	0.93	0.73–1.18	0.91	0.71–1.15
35–44 yr	1.00	Reference	1.00	Reference	1.00	Reference
45–54 yr	1.04	0.83–1.32	0.95	0.77–1.17	0.97	0.78–1.21
>55 yr	0.82	0.58–1.15	1.00	0.72–1.39	0.85	0.61–1.18
Sex						
Female	1.00	Reference	1.00	Reference	1.00	Reference
Male	1.25	1.02–1.00	1.43	1.12–1.82	1.24	0.98–1.58
Race						
White	1.00	Reference	1.00	Reference	1.00	Reference
Nonwhite	0.73	0.58–0.91	0.78	0.61–1.00	0.83	0.64–1.07
Ethnicity						
Non-Hispanic	1.00	Reference	1.00	Reference	1.00	Reference
Hispanic	0.88	0.68–1.14	1.33	1.00–1.76	1.37	1.02–1.83
Education						
Less than high school	0.88	0.65–1.19	0.86	0.64–1.15	0.90	0.67–1.22
High school diploma/GED	1.00	Reference	1.00	Reference	1.00	Reference
Some college	0.92	0.75–1.14	0.84	0.70–1.02	0.83	0.68–1.00
College degree	0.74	0.50–1.10	0.79	0.54–1.16	0.77	0.53–1.13
Household income ($)						
<30,000	1.00	Reference	1.00	Reference	1.00	Reference
30,000–45,000	1.24	0.98–1.58	1.07	0.85–1.35	1.09	0.85–1.38
45,001–70,000	1.36	1.07–1.73	1.11	0.85–1.43	1.10	0.85–1.43
>70,000	1.41	1.03–1.93	1.39	1.01–1.90	1.25	0.90–1.74

	Unadjusted		Model 1		Model 2	
	IRR	95% CI	IRR	95% CI	IRR	95% CI
Marital status						
Married	1.00	Reference	1.00	Reference	1.00	Reference
Living with partner	0.98	0.75–1.29	1.09	0.84–1.42	1.04	0.80–1.36
Divorced	1.07	0.84–1.35	1.04	0.83–1.29	1.10	0.88–1.39
Other	0.69	0.51–0.95	0.84	0.63–1.14	0.76	0.56–1.02
Health characteristics						
BMI						
Normal, <25	1.00	Reference	1.00	Reference	1.00	Reference
Overweight, 25–29	1.16	0.92–1.46	1.06	0.86–1.32	1.09	0.87–1.35
Obese, 30–34	1.23	0.94–1.60	1.10	0.85–1.41	1.17	0.91–1.50
Very obese, >34	1.37	0.99–1.90	1.07	0.79–1.46	1.19	0.87–1.63
Health in year before injury						
Excellent	1.00	Reference.	1.00	Reference		
Very good	0.88	0.69–1.12	0.80	0.61–1.05		
Good	0.90	0.70–1.16	0.88	0.67–1.17		
Fair/poor	0.98	0.70–1.36	0.88	0.62–1.24		
SF-36 mental health score						
2 SD below population mean	3.06	2.31–4.06	1.34	1.00–1.81		
1–2 SD below population mean	2.61	1.98–3.43	1.24	0.94–1.64		
1 SD below population mean	2.14	1.62–2.82	1.38	1.06–1.81		
At or above population mean	1.00	Reference	1.00	Reference		
Catastrophizing						
Low (<1)	1.00	Reference	1.00	Reference		
Moderate (1–2.9)	1.88	1.38–2.57	1.00	0.73–1.36		
High (3–4)	3.01	2.19–4.13	1.15	0.82–1.61		
Work fear-avoidance						
Low (0–2.9)	1.00	Reference	1.00	Reference		
Moderate (3–4.9)	1.67	1.15–2.42	1.32	0.94–1.85		

	Unadjusted		Model 1		Model 2	
	IRR	95% CI	IRR	95% CI	IRR	95% CI
High (5–5.9)	2.81	1.98–3.99	1.73	1.24–2.41		
Very high (>6)	3.09	2.15–4.43	1.54	1.07–2.22		
Clinical characteristics						
Type of first medical visit						
Primary care	1.00	Reference	1.00	Reference	1.00	Reference
Occupational medicine	1.40	0.93–2.10	1.28	0.90–1.82	1.21	0.84–1.74
Chiropractor	0.58	0.45–0.75	0.53	0.42–0.66	0.52	0.41–0.65
Surgeon	1.53	0.96–2.43	1.78	1.08–2.92	1.51	0.95–2.42
Emergency room	1.05	0.82–1.33	0.90	0.72–1.13	0.98	0.78–1.22
Other	1.15	0.62–2.12	1.17	0.66–2.09	1.24	0.67–2.32
Work characteristics						
Offered job accommodation						
Yes	1.00	Reference	1.00	Reference	1.00	Reference
No	1.47	1.21–1.78	1.13	0.94–1.35	1.40	1.17–1.68
More than 1 previous compensable back claims						
Yes	1.34	1.08–1.65	1.12	0.91–1.36	1.15	0.94–1.42
No	1.00	Reference	1.00	Reference	1.00	Reference
Job satisfaction						
Not at all	0.79	0.50–1.27	0.66	0.43–1.00		
Not too satisfied	0.95	0.67–1.36	0.84	0.60–1.17		
Somewhat satisfied	1.07	0.88–1.30	1.09	0.91–1.30		
Very satisfied	1.00	Reference	1.00	Reference		
Industry						
Natural resources	0.62	0.33–1.15	0.70	0.40–1.24	0.65	0.37–1.15
Construction	1.24	0.93–1.64	1.13	0.86–1.48	1.26	0.96–1.64
Manufacturing	1.51	1.08–2.10	1.39	1.02–1.89	1.39	1.01–1.90
Trade/transportation	1.00	Reference	1.00	Reference	1.00	Reference
Management	1.22	0.91–1.63	1.26	0.97–1.64	1.22	0.93–1.60

	Unadjusted		Model 1		Model 2	
	IRR	95% CI	IRR	95% CI	IRR	95% CI
Education/health	1.01	0.74–1.39	1.15	0.83–1.58	1.16	0.83–1.61
Hospitality	1.01	0.72–1.41	1.11	0.83–1.47	1.15	0.85–1.56
Physical demands at work						
Light	1.00	Reference	1.00	Reference	1.00	Reference
Medium	1.21	0.91–1.62	1.14	0.88–1.48	1.17	0.90–1.53
Heavy	1.16	0.85–1.58	1.02	0.76–1.37	1.17	0.87–1.57
Very heavy	1.56	1.17–2.07	1.23	0.93–1.62	1.44	1.09–1.91
Injury characteristics						
Health status at the time of interview						
Excellent	1.00	Reference	1.00	Reference		
Very good	0.97	0.74–1.26	1.06	0.79–1.41		
Good	1.06	0.81–1.38	0.98	0.73–1.31		
Fair/poor	1.05	0.75–1.46	1.01	0.70–1.44		
Pain intensity the last week						
Low/no pain (1–3)	1.00	Reference	1.00	Reference		
Mild (4–6)	2.54	1.79–3.60	0.86	0.62–1.20		
Moderate/major pain (7–9)	2.88	2.08–3.99	0.92	0.67–1.26		
Roland-Morris disability questionnaire score						
≤6	1.00	Reference	1.00	Reference		
7–12	4.09	2.25–7.43	2.98	1.63–5.46		
13–18	7.43	4.25–12.98	4.63	2.54–8.42		
≥18	12.00	6.94–20.76	5.87	3.16–10.89		
Medical record documented injury severity rating						
Mild sprain/strain and/or minor physical examination findings	1.00	Reference	1.00	Reference	1.00	Reference
Major sprain/strain evidenced by substantial immobility	1.88	1.41–2.49	1.49	1.13–1.95	1.87	1.42–2.47
Evidence of radiculopathy or reflexes absent	4.50	3.63–5.59	3.04	2.44–3.79	4.55	3.67–5.64

All covariates listed are included in model 1. Model 2 does not adjust for health in year before injury, SF-36 mental health score, catastrophizing, fear-avoidance, job satisfaction, health status at the time of the interview, pain intensity, or Roland-Morris disability questionnaire score.

IRR indicates incident rate ratio; CI, confidence interval; SF-36, 36-Item Short Form Health Survey; BMI, body mass index; GED, general education diploma; SD, standard deviation.