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ISSLS Prize Winner: Early Predictors of Chronic Work Disability

A Prospective, Population-Based Study of Workers With Back Injuries

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Study Design. Prospective population-based cohort study.

Objective. To identify early predictors of chronic work disability after work-related back injury.

Summary of Background Data. Identification of early predictors of prolonged disability after back injury could increase understanding concerning the development of chronic, disabling pain, and aid in secondary prevention. Few studies have examined predictors across multiple domains in a large, population-based sample.

Methods. Workers (N = 1885) were interviewed 3 weeks (average) after submitting a lost work-time claim for a back injury. Sociodemographic, employment-related, pain and function, clinical, health care, administrative/legal, health behavior, and psychological domain variables were assessed *via* worker interviews, medical records, and administrative databases. Logistic regression analyses identified early predictors of work disability compensation 1 year after claim submission.

Results. Significant baseline predictors of 1-year work disability in the final multidomain model were injury severity (rated from medical records), specialty of the first health care provider seen for the injury (obtained from administrative data), and worker-reported physical disability (Roland-Morris disability questionnaire), number of pain sites, "very hectic" job, no offer of a job accommodation (*e.g.*, light duty), and previous injury involving a month or more off work. The model showed excellent ability to discriminate between workers who were/were not disabled at 1 year (area under the receiver operating characteristic curve = 0.88, 95% CI = 0.86–0.90).

Conclusion. Among workers with new lost work-time back injury claims, risk factors for chronic disability include radiculopathy, substantial functional disability, and to a lesser extent, more widespread pain and previous injury with extended time off work. The roles of employers and health care providers also seem important, supporting the need to incorporate factors external to the worker in models of the development of chronic disability and in disability prevention efforts.

Key words: back pain, injured workers, predictors, risk factors, biopsychosocial, work disability, workers' compensation, prospective cohort study. **Spine 2008;33: 2809–2818**

Although low back pain is the most prevalent and costly disabling work-related condition,[1–6] only a small fraction of workers with acute back pain progress to chronic disability and these account for the majority of costs.[4,7–10] The identification of early predictors of prolonged disability could help increase knowledge concerning why some workers become chronically disabled from back injuries whereas others do not, and lead to more effective secondary prevention efforts focused on modifiable risk factors. Knowledge of early predictors could also aid in the development of predictive models and screening tools to identify high-risk workers soon after injury so that interventions could be targeted to those workers at an early stage. However, studies of predictors of chronic back disability in workers' compensation and other settings have yielded inconsistent findings, likely reflecting differences in samples, methods, and measures.[11] Little research has examined prognostic factors assessed within a few weeks after back pain onset.[12–14] Furthermore, few studies have assessed risk factors across multiple domains in a large, population-based sample at any time within the first 3 months.[15]

With the objective of identifying early predictors of chronic work disability, we conducted a prospective cohort study of workers with recently submitted workers' compensation claims for back injuries.[16,17] Among 1068 workers enrolled in the first year of the study, characteristics in each predictor domain examined (sociodemographic, pain and disability, and psychosocial) were associated with work disability 6 months later.[17] Our previous report did not examine longer-term outcomes or factors from other potentially important domains.

The current report presents the final study results identifying early risk factors for longer-term (1 year) work disability. Guided by a concept of chronic work disability as influenced by multiple factors, we assessed potential predictors in a comprehensive set of domains. We hypothesized that variables in sociodemographic,

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employment-related, pain and function, clinical, health care, administrative/legal, health behavior, and psychological domains, assessed soon after a work-related back injury, would be significant predictors of chronic disability, and that factors from different domains would add unique information in a multivariable model predicting chronic disability.

■ Materials and Methods

Study Participants and Procedures

The Washington Workers' Compensation Disability Risk Identification Study Cohort is a prospective, population-based study to identify risk factors for chronic musculoskeletal disorder disability.[16,17] Workers with back injury claims involving at least 4 days of lost work time (the requirement for temporary total disability wage replacement) were identified through weekly reviews of the Washington State Department of Labor and Industries claims database July 2002 through April 2004, and approached *via* telephone for study enrollment and a baseline interview. We examined all claims covered by the State Fund, which insures approximately two-thirds of nonfederal Washington workers. The other third, employed by larger self-insured companies, were excluded because of insufficient administrative data.

Among 4354 claimants identified, 2147 (49.3%) enrolled and completed the baseline interview, 1178 (27.1%) could not be contacted, 120 (2.8%) were ineligible (*e.g.*, unable to complete the interview in English or Spanish), and 909 (20.9%) declined enrollment. Because the intended study population was workers who received some wage replacement compensation, we excluded from analysis 240 subjects who received no compensation in the first year. We also excluded subjects whose data were missing on age (n = 3), hospitalized for their injury (n = 16), or not confirmed to have a back injury on medical record review (n = 3). The final sample (N = 1885), compared with study nonparticipants who received work disability compensation (N = 1776), was slightly older [age mean (SD) = 39.4 (11.2) *vs.* 38.2 (11.1) years, $P = 0.001$]; included more women (32% *vs.* 26%, $P < 0.001$) and more workers receiving compensation at 1 year (13.8% *vs.* 11.3%, $P = 0.02$); and had more work disability days at 1 year [median = 17 (interquartile range, IQR, 5–104) *vs.* 13(4–60) days, $P < 0.001$].

Measures

Predictors. Baseline measures from the 8 risk factor domains (Table 1) were selected based on previous research[15,16,18,19] suggesting their potential importance. They were obtained from worker interviews, Department of Labor and Industries administrative databases, and medical record review (the injury severity rating, shown to have substantial inter-rater reliability[20]).

Outcome: Work Disability. The primary outcome was wage replacement compensation for temporary total disability ("work disability") 12 months after claim submission. Temporary total disability payments are stopped when a worker returns to work or is judged to be medically stable and able to work.

Statistical Analysis

Statistical analyses were carried out in 3 steps. First, we used logistic regression to examine bivariate associations between the baseline measures and 1-year work disability. Second, separately for each risk factor domain, variables in the domain that were associated bivariately ($P < 0.10$) with 1-year disability were entered with age and gender in a forward stepwise logistic regression analysis predicting 1-year disability. We used $P < 0.10$ as a criterion for entry in the stepwise analysis because use of the traditional 0.05 level may exclude variables that are important in multivariable models.[21] Third, we entered predictors that remained in the final step in each domain model, along with age and gender, in a multidomain logistic regression model predicting 1-year disability. The model did not change meaningfully according to inclusion or exclusion of the Spanish interviews (n = 188).

To evaluate the ability of the multidomain model to discriminate between workers who were/were not disabled at 1 year, we calculated the area under the receiver operating characteristic curve (AUC). An AUC of 0.50 indicates no discrimination, 0.70 to 0.80 indicates acceptable discrimination, and 0.80 to 0.90 indicates excellent discrimination (AUC $\geq$0.90 is rare).[21] To estimate the AUC that would be obtained in different samples, we used cross-validation methods, creating 10 mutually exclusive random 10% subsets of the sample, with each subset serving as a test sample for evaluating the model derived from the other 90% of the sample; average performance over the 10 repetitions was calculated.[22]

■ Results

Sample Characteristics

The sample (N = 1885) was predominantly male (68%) and white non-Hispanic (70%; 16% Hispanic; 14% other). The median number of days between claim submission and the baseline interview was 18 (IQR = 15–26). At 1 year, 261 (13.8%) subjects were receiving work disability compensation and the median number of work disability days among all subjects was 17 (IQR = 5–104).

Bivariate and Within-Domain Predictors of One Year Work Disability

The baseline variables in each risk factor domain and their bivariate associations with 1-year work disability are shown in Table 1. None of the health behavior domain variables (tobacco use, alcohol use, body mass index) predicted the outcome; thus, they were not analyzed further.

For each other domain, bivariate predictors were entered in an age- and sex-adjusted stepwise regression analysis. Education was the only variable in the final step of the sociodemographic domain analysis, with better outcomes for college-educated workers. Multiple variables remained in the final step for the employment-related domain: worker's industry, amount of heavy lifting, perception of job as very hectic, employer willingness to provide a job accommodation (*e.g.*, light duty, reduced hours), and employer offer of a job accommodation. Number of pain sites, pain interference with activities, pain change since injury, and Roland-Morris disability questionnaire (RDQ)[23] and SF-36 version 2 [24] role-physical and physical function scores remained in the final step of the pain and function domain analysis. In the clinical domain, the injury severity rating and self-reported pain radiating below the knee, previous work-related injury involving a month or more off work, and health in the year before injury remained in the final step. Specialty of the first health care provider seen for the

Table 1. Baseline Measures in Each of Eight Risk Factor Domains and Their Bivariate Associations With One Year Work Disability

Domain	Categories of Each Measure
Measure	
Sociodemographic	
Age, yr*	≤24, 25–34, 35–44, 45–54, ≥55
Gender	Male, female
Urban/rural residence†	Urban, suburban, large town, small town
Race/ethnicity	White non-Hispanic, Hispanic, other
Education‡	Less than high school, high school, vocational or some college, college
Marital status	Married/living with partner, other
Employment-related	
Worker's employer size§	>200, 76–200, 26–75, 11–25, 1–10 employees
Worker's industry§¶	Natural resources, construction, manufacturing, trade/transportation, management, education and health, hospitality
Employer participation in retrospective rating program (premium refunds/additional charges if claim costs are lower/higher than anticipated)§	Participating, not participating
Unemployment rate, worker's county of residence, quarter in which injured‖	Quartiles
Worker's description of job	
Heavy lifting‡	1 = not at all to 5 = constantly
Whole body vibration¶	1 = not at all to 5 = constantly
Physical demands**	1 = sedentary to 5 = very heavy
Fast pace¶	1 = strongly disagree to 4 = strongly agree
Excessive amount of work*	1 = strongly disagree to 4 = strongly agree
Enough time to do job**	1 = strongly disagree to 4 = strongly agree
Very hectic*	1 = strongly disagree to 4 = strongly agree
Able to take breaks when desired‡	1 = strongly disagree to 4 = strongly agree
Supervisor listens to my work problems*	1 = strongly disagree to 4 = strongly agree
Satisfaction with job	1 = not at all satisfied to 4 = very satisfied
Co-worker relations	0 (don't get along at all)–10 (get along extremely well)
Job type at time of injury**	Full-time, part-time
Seasonal job at injury?	Yes, no
Temporary job at injury?	Yes, no
Job duration¶	<6 mo, ≥6 mo
Employer willing to provide job accommodation (*e.g.*, light duty, reduced hr)*	Yes, no
Employer offered job accommodation*	Yes, no
Pain and function	
No. pain sites*	0–8 possible sites
Pain intensity, past wk[51]*	0–10 scale
Pain interference with daily activities, past wk[51]*	0–10 scale
Pain interference with work, past wk[51]*	0–10 scale
Roland questionnaire[23]*	0–24 scale
SF-36 v2 (1 wk)[24] PF*	>50, 41–50, 30–40, <30
SF-36 v2 (1 wk)[24] RP*	>50, 41–50, 30–40, <30
Pain change since injury*	Better, same, worse
Clinical status	
Work loss back claims, past 5 yr*§	Yes, no
Non-work-loss back claims, past 5 yr§	Yes, no
Work loss claims, any type, past 5 yr*§	Yes, no
Non-work-loss claims, any type, past 5 yr§¶	Yes, no
Injury severity[20]††	Mild sprain/strain, major sprain/strain with substantial immobility but no evidence of nerve injury/radiculopathy, evidence of radiculopathy, reflex/sensory/motor abnormalities
Pain radiates below knee*	Yes, no
Previous similar back symptoms	Yes, no
Previous injury (any type) with ≥1 mo off work*	Yes, no
No. of workers' compensation claims before this injury*	0, 1–4, >4
Work d missed because of back, previous yr¶	0, 1–7, 8–29, ≥30
Work d missed because of other problems, previous yr	0, 1–29, ≥30
No. other major medical problems**	0, ≥1
Current health aside from injury	Excellent, very good, good, fair, poor
Health, yr prior to injury**	Excellent, very good, good, fair, poor
Health care	
Specialty, first provider seen for injury*§	Primary care, occupational medicine, chiropractor, other
Health care provider recommended exercise	Yes, no
Health care provider discussed ways to prevent further injury‡	Yes, no
Health insurance‡	Through employer, through other source, none
Administrative/legal	

(*Continued*)

Table 1. Continued

Domain	Categories of Each Measure
Time from injury to first medical visit for injury‡§	0–6, 7–13, ≥14 d
Time from first medical visit for injury to claim receipt‡§	0–13, ≥14 d
Attorney for claim‡	Yes, no
Health behavior	
Tobacco use	Yes, no
Alcohol Use Disorders Identification Test-Consumption (AUDIT-C)[52]	0–12 scale
BMI	<25, 25–29, ≥30
Psychological	
Catastrophizing*‡‡	0–4 scale
Blame for injury[53]	Work, self, someone/something else, nothing/no one
Recovery Expectations[53]*	0 = not at all certain to 10 = extremely certain will be working in 6 mo
Work fear-avoidance*§§	0–6 scale
SF-36v2 (1 wk) Mental Health[24]*	>50, 41–50, 30–40, <30

*$P < 0.001$ in bivariate logistic regression analyses predicting 1-year work disability; these variables were subsequently entered in domain-specific stepwise regression analyses.
†By zipcode, using the http://www.doh.wa.gov/Data/Guidelines/RuralUrban classification.
‡$P < 0.01$, in bivariate logistic regression analyses predicting 1-year work disability; these variables were subsequently entered in domain-specific stepwise regression analyses.
§From workers' compensation database.
¶$P < 0.05$, in bivariate logistic regression analyses predicting 1-year work disability; these variables were subsequently entered in domain-specific stepwise regression analyses.
‖Obtained from http://www.workforceexplorer.com.
**$P < 0.10$, in bivariate logistic regression analyses predicting 1-year work disability; these variables were subsequently entered in domain-specific stepwise regression analyses.
††Rated by trained nurses based on medical records early in the claim.
‡‡Mean of responses to 3 questions from the Pain Catastrophizing scale.[54]
§§Mean of responses to two questions from the Fear-Avoidance Beliefs Questionnaire work scale.[55]
All measures were obtained from the worker baseline interview, except where noted otherwise. Income was assessed in the baseline interview and was not associated bivariately with 1-year work disability. A large no. of workers declined to provide income information; education (which was associated bivariately with 1-year disability) was used instead as an indicator of socioeconomic status.
BMI indicates body mass index (calculated from self-reported height and weight); PF, Physical Function; RP, Role-Physical.

injury and source of general health insurance were in the final step of the health care domain analysis. All 3 administrative/legal predictors remained in the final step: time from injury to the first medical visit for the injury, time from first medical visit to claim receipt, and attorney retention. In the psychological domain, catastrophizing, recovery expectations, work fear-avoidance, and SF-36v2[24] mental health remained in the final step.

Multidomain Model Predictors of One Year Work Disability

The final multidomain model (Table 2) included the variables in the final steps of the domain-specific stepwise regression analyses, except for a few variables that were excluded because of redundancy with other predictors (Table 2). Variables from each domain except administrative/legal and psychological contributed independently ($P < 0.05$) to the prediction of 1-year work disability. The statistically significant predictors were injury severity, RDQ score, number of pain sites, previous injury involving 1 month or more off work, specialty of first provider, offer of job accommodation, and perception of job as very hectic. The AUC (95% CI) was 0.88 (0.86–0.90). As expected, the cross-validated AUC was slightly lower (0.84).

The strongest predictor in the multidomain model, as well as bivariately, was the RDQ. Adjusting for all other predictors, workers with scores ≥18 were 7 times more likely than workers with scores <12 to receive work disability compensation at 1 year. Table 3 shows, for each category of each significant predictor in the multidomain model, the percent of workers who were disabled and the median number of work disability days at 1 year. Among workers with baseline RDQ scores <12, only 2% were disabled at 1 year and the median number of disability days was 6. Among workers with RDQ scores ≥18 (n = 624), 30% were disabled at 1 year (median number of disability days = 117).

The injury severity rating based on medical records early in the claim was also strongly associated with 1-year work disability. Compared with workers who had a mild sprain/strain, workers with a major sprain/strain did not differ significantly, but those with radiculopathy without reflex/sensory/motor abnormalities had almost twice the odds of 1-year disability and those with reflex/sensory/motor abnormalities had 3.7 times the odds, adjusting for other predictors (Table 2). At 1 year, 26% of those with radiculopathy without reflex/sensory/motor abnormalities and 39% of those with these objective findings were disabled (Table 3).

To better understand why psychological variables were not significant in the multidomain model despite being strong bivariate predictors, we conducted additional analyses. Each psychological measure contributed significantly to the multidomain prediction of 1-year

Table 2. Final Multidomain Model Predicting One Year Work Disability: Crude (Unadjusted) and Adjusted Odds Ratios (95% CI) for Baseline Predictors

Baseline Predictor	% of sample	Prediction of 1 Yr Work Disability			
		Crude OR	95% CI	Adjusted OR	95% CI
Age, yr (ref = 35–44)	31				
≤24	11	0.32	0.17–0.59	0.54	0.26–1.11
25–34	25	0.55	0.38–0.79	0.73	0.46–1.16
45–54	23	1.04	0.75–1.44	1.00	0.66–1.54
≥55	10	0.78	0.49–1.25	1.03	0.56–1.89
Gender (ref = females)	32				
Males	68	0.99	0.75–1.31	1.11	0.73–1.70
Education (ref = high school)	34				
Less than high school	13	1.18	0.80–1.73	0.92	0.55–1.54
Vocational or some college	44	0.77	0.57–1.04	0.78	0.54–1.14
College	9	0.39	0.21–0.75	0.53	0.23–1.18
Industry (ref = Trade/transportation)	25				
Natural resources	5	1.27	0.66–2.44	1.02	0.42–2.48
Construction	18	1.89	1.28–2.82	1.88	1.12–3.17
Manufacturing	8	1.66	0.99–2.77	1.98	1.04–3.77
Management	16	1.15	0.74–1.78	1.08	0.62–1.89
Education/health	15	1.00	0.63–1.60	0.92	0.49–1.74
Hospitality	13	1.24	0.78–1.98	1.05	0.58–1.91
Heavy lifting (ref = not at all/occasional)	47				
Frequent	31	1.21	0.88–1.64	0.84	0.56–1.27
Constant	22	1.66	1.20–2.30	1.20	0.79–1.83
Job is hectic (ref = disagree)	28				
Agree	45	1.90	1.32–2.75	1.84	1.16–2.91
Strongly agree	27	2.62	1.78–3.85	2.16	1.32–3.54
Job accommodation (ref = offered)	45				
Not offered	55	3.00	2.22–4.04	1.91	1.31–2.76
No. pain sites (ref = 0–2)	46				
3–4	38	5.61	3.91–8.04	1.92	1.22–3.03
≥5	16	5.47	3.60–8.31	1.71	1.01–2.92
RDQ score (ref = 0–11)	40				
12–15	17	5.47	2.72–10.99	3.11	1.45–6.63
16–17	11	13.31	6.78–26.13	5.03	2.33–10.89
18–24	33	26.10	14.39–47.35	7.01	3.44–14.29
Pain change since injury (ref = better)	68				
Unchanged	20	4.72	3.44–6.47	1.47	0.98–2.20
Worse	11	7.15	5.01–10.22	1.31	0.81–2.11
Injury severity (ref = mild sprain/strain)	55				
Major sprain/strain	20	1.95	1.35–2.84	1.28	0.80–2.03
Radiculopathy	21	4.44	3.22–6.13	1.95	1.30–2.91
Reflex/sensory/motor abnormalities	3	7.93	4.56–13.78	3.72	1.83–7.58
Previous injury with ≥1 mo off work (ref = no)	73				
Yes	27	2.42	1.85–3.17	1.62	1.14–2.31
Health, previous yr (ref = excellent)	23				
Good	67	0.71	0.53–0.96	0.64	0.44–0.95
Fair/poor	11	0.84	0.53–1.34	0.56	0.31–1.03
First provider (ref = primary care)	36				
Occupational medicine	7	2.64	1.66–4.20	1.78	0.99–3.20
Chiropractor	29	0.38	0.24–0.60	0.41	0.24–0.70
Other	29	2.21	1.63–3.01	1.93	1.31–2.84
Health insurance (ref = no insurance)	32				
Insurance, not through employer	17	0.92	0.64–1.32	0.96	0.60–1.53
Insurance through employer	50	0.61	0.45–0.81	0.66	0.44–0.99
Injury to first medical visit, d (ref = 0–6)	79				
7–13	12	1.08	0.71–1.65	0.76	0.45–1.29
≥14	9	2.04	1.38–3.01	1.09	0.66–1.78
Medical visit to claim receipt, d (ref = <14)	83				
≥14	17	1.63	1.19–2.24	1.32	0.87–1.99
Attorney for claim (ref = no)	98				
Yes	2	2.76	1.38–5.50	1.32	0.54–3.27
Catastrophizing* [ref = 0–1 (very low)]	30				
Low (>1–<2)	16	2.58	1.47–4.52	1.05	0.53–2.09
Moderate (2–<3)	30	4.58	2.85–7.36	1.06	0.58–1.93
High (3–4)	24	8.20	5.14–13.08	1.33	0.71–2.48

(*Continued*)

Table 2. Continued

Baseline Predictor	% of sample	Prediction of 1 Yr Work Disability			
		Crude OR	95% CI	Adjusted OR	95% CI
Recovery expectations [ref = 10 (very high)]	56				
Low (0–6) or declined to answer	24	4.29	3.16–5.82	1.30	0.87–1.96
High (7–9)	20	2.07	1.44–2.98	1.21	0.77–1.90
Fear-avoidance* [ref = <3 (very low)]	20				
Low-moderate (>3–<5)	32	1.83	1.11–3.04	1.38	0.73–2.62
High (5–<6)	30	3.27	2.02–5.31	1.67	0.89–3.13
Very high (6)	18	5.09	3.10–8.38	1.71	0.88–3.30
Mental health† [ref = >50 (above population mean)]	38				
41–50	25	2.70	1.80–4.05	1.11	0.66–1.87
30–40	22	3.60	2.41–5.38	0.86	0.51–1.47
<30	15	5.83	3.88–8.78	1.10	0.63–1.94

*Higher scores indicate worse psychological status.
†Higher scores indicate better psychological status.
Each baseline variable in this table was associated bivariately ($P < 0.10$) with 1-year work disability and also remained in the final step of the domain-specific stepwise logistic regression analysis (the criteria for entry in the multidomain model). Several variables that remained in the final step of the domain-specific analysis were excluded from the final multidomain model shown in this table because of conceptual and statistical redundancy. Because of collinearity of the multiple measures of disability/activity limitations (correlations between the PF, RP, RDQ, and activity interference measures ranged from $r = 0.60–0.74$), we excluded from the final model all activity limitations measures except the RDQ, which had the strongest bivariate association with 1-year work disability. Similarly, although both employer willingness to offer a job accommodation and actual offer of an accommodation remained in the final step of the employment domain model, we used only actual offer in the final multidomain model because the 2 variables were highly associated and the latter question had better measurement and statistical properties. Finally, although self-reported pain radiating below the knee remained in the final step of the clinical status domain model, it was not statistically significant when entered with injury severity in the multidomain model and was excluded from the final multidomain model because of its redundancy with the injury severity measure.
Variables in bold are significant ($P < 0.05$) predictors of one-year work disability after adjustment for all other variables in model.
ref indicates reference group.

work disability when the RDQ and the other psychological variables were not in the model (Table 4). The RDQ was correlated substantially with each psychological measure (*e.g.*, $r = 0.51$ with catastrophizing, $r = 0.54$ with mental health).

■ Discussion

This is the largest prospective, population-based study to date of risk factors for chronic work disability identified early after back injury from a large number of potential risk factors in multiple domains, assessed from multiple sources. The final multidomain model had excellent ability to discriminate workers who were disabled at 1 year from those who were not. The results support the importance of factors in multiple domains in the development of chronic work disability. Variables in 7 of the 8 domains assessed were bivariate predictors of 1-year work disability and variables in 4 domains (employment related, pain and function, clinical status, and health care) were significant in the multidomain model. Although injury severity was a strong predictor of chronic work disability, other factors were also significant after controlling for injury severity. This confirms clinical impressions that patients with similar examination and imaging findings vary in pain and disability outcomes, likely because of factors other than biologic ones.

Workers with radiculopathy had significantly worse long-term outcomes, consistent with previous findings that back pain radiating into the leg is associated with longer work disability.[13,25–33] These results support the utility of our injury severity measure (and of self-report measures of radiating leg pain when medical record review is not possible), and the need to adjust for injury severity in studies of predictors of chronic back pain disability. Further research is needed to better understand why early radicular pain predicts chronic work disability. The extent to which this is due to persistent disease and associated pain that interferes with ability to work, *versus* other factors, is unclear. For example, patients with radicular pain may be more likely to receive imaging tests with findings that increase both their and their health care providers' fear-avoidance beliefs, which in turn may lead to work and activity avoidance, thus inadvertently promoting chronic disability. Workers with objective signs of more severe radiculopathy (reflex, sensory, or motor abnormalities) had almost twice the odds of long-term disability compared with workers with radicular pain alone, suggesting the potential usefulness of differentiating these 2 groups in future research.

The strongest predictor of 1-year work disability was the RDQ (although other self-report measures of functional limitations were also significant). Previous studies have also found that self-reported physical disability is positively associated with time to return to work after back injury[11,13,26–28,34] and seems to be more important than pain intensity in predicting work disability duration.[13] Number of pain sites was also associated positively with chronic disability, consistent with previous observations that more widespread musculoskeletal pain

Table 3. Significant ($P < 0.05$) Baseline Predictors (in Final Multidomain Model) of Work Disability 1 yr After Submission of a Back Injury Work-Loss Claim: Percent Receiving Work Disability Compensation and Number of Work Disability Days at 1 Year (N = 1885)

		Work Disability D, Yr After Claim Submission	
Predictor	Disabled at 1 Yr %	Median	IQR
Injury severity			
Mild sprain/strain	8	8	3–34
Major sprain/strain	14	23	7–96
Radiculopathy	26	104	16–301
Reflex/sensory/motor abnormalities	39	94	31–368*
RDQ			
0–11	2	6	3–14
12–15	8	16	5–62
16–17	18	28	8–166
18–24	30	117	29–321
Job is hectic			
Disagree	8	14	4–62
Agree	14	17	5–114
Strongly agree	19	23	5–154
Job accommodation			
Accommodation offered	7	10	4–30
Accommodation not offered	19	35	7–200
No. pain sites			
0–2	5	8	3–27
3–4	22	40	8–223
≥5	21	46	8–236
Previous injury with more than 1 mo off work			
No	11	14	4–72
Yes	22	35	8–221
First provider for injury			
Primary care	12	14	4–77
Occupational medicine	26	70	5–259
Chiropractor	5	14	4–44
Other	23	30	5–239

*Compensation can be for days off work previous to claim submission; thus, disability days can total more than 365 in first year after claim submission.
Values shown in table are unadjusted.
IQR indicates interquartile range.

is a risk factor for worse pain and disability outcomes.[35–37]

Although the brief measures of mental health, fear-avoidance, and catastrophizing were strong predictors of chronic work disability bivariately, each was statistically significant in the multidomain model only when the RDQ was excluded. These psychological variables are strongly associated with pain-related disability; cause-effect relations are complex and likely reciprocal. Given this, it would seem prudent clinically to screen patients with back pain for these psychological factors. Use of full, standardized measures rather than abbreviated versions might have yielded stronger associations with 1-year work disability; this needs to be examined in future studies.

Workers whose first health care visit for the injury was to a chiropractor had substantially better outcomes. Patients who see chiropractors for back pain differ in important ways from those who see medical physicians[38,39] and it is possible that workers who saw chiropractors differed in prognostically favorable ways not represented in the multidomain model. It is also possible that chiropractic care was more effective in improving pain and disability and/or promoting return to work. We did not examine providers or care after the first visit; further research is needed to investigate the effects of early care on work disability.

Employer offer of an accommodation (*e.g.*, light duty, reduced hours) to facilitate return to work has been identified consistently as protective against chronic work disability.[28,34,40] Adjusting for other predictors, workers in our study who were not offered such an accommodation by about 3 weeks after submitting a lost work-time claim had almost twice the odds of chronic work disability. These findings suggest that employer offer of accommodations to facilitate working in the first few weeks after injury may play an important role in chronic disability prevention.

The study findings also highlight the importance of other job factors in work disability. Several measures of job physical and psychological demands were significant predictors bivariately; among these, worker perception of his/her job as very hectic was the strongest predictor in the multidomain model. Other studies of workers with back injuries found that similar views (that their jobs required working very hard and involved an excessive amount of work) predicted longer work disability duration.[26,31]

Some factors that were not significant predictors in the multidomain model warrant comment. These include having an attorney for the claim. Very few workers had an attorney at the time of the interview; attorney retention generally occurs later in a claim when a worker is concerned about claim closure. Older age, found to be a risk factor in many,[11,18,29,41] but not all,[13,42] previous studies, was not significant in the multidomain model. In bivariate analysis, workers younger than 35 years had lower odds of chronic work disability, whereas those in different age groups above 34 years had similar odds. Consistent with a systematic review's conclusion that there is strong evidence that a history of back pain does not predict sick leave duration,[13] history of back pain was not significant. However, history of substantial time off work because of back or other injury was significant.

Health care providers evaluating patients with recent work-related back injuries might consider radicular pain (especially with objective signs of more severe radiculopathy), substantial physical disability, widespread pain, and previous injury with time off work as risk factors for chronic disability. For patients with these characteristics, close monitoring and early intervention aimed at improving function and facilitating return to work (*e.g.*, contact with employer to discuss job modifications) may help prevent chronic work disability.

A study limitation is that not all potential participants enrolled, and participants may have differed from the larger population in ways that might have affected the results.

Table 4. Association of Each Baseline Psychological Measure With One Year Work Disability, Adjusted for All Other Variables in Final Multidomain Model Except the Roland-Morris Disability Questionnaire and the Other Psychological Measures

Baseline Psychological Measure	Adjusted OR	95% CI	Disabled at 1 Yr %	Work Disability D, Yr After Claim Submission	
				Median	IQR
Catastrophizing* [ref = 0–1 (very low)]			4	7	3–20
Low (>1–<2)	1.44	0.76–2.72	10	16	4–74
Moderate (2–<3)	1.68	0.97–2.93	16	27	7–145
High (3–4)	2.41	1.37–4.22	26	70	10–302
Recovery expectations [reference = 10 (very high)]			8	11	4–36
High (7–9)	1.45	0.95–2.23	15	21	5–129
Low (0–6) or declined to answer	1.76	1.20–2.58	27	91	13–322
Fear-avoidance* [reference = ≤3 (very low)]			6	7	3–24
Low-moderate (>3–<5)	1.60	0.87–2.95	10	12	4–45
High (5–<6)	2.02	1.11–3.69	17	31	6–183
Very high (6)	2.21	1.17–4.17	24	66	10–266
Mental health† [ref = >50 (above population mean)]			6	7	3–24
41–50	1.54	0.94–2.51	14	17	5–106
30–40	1.69	1.05–2.73	18	35	7–209
<30	2.21	1.32–3.71	26	84	18–295

*Higher scores indicate worse psychological status.
†Higher scores indicate better psychological status.
Values for percent disabled at 1 yr and number of work disability days are observed.

Further research is needed to confirm our findings with different samples in different settings. However, the consistency of our results with those in other studies supports their robustness. Another limitation is the use of abbreviated measures. This was necessary to assess a large number of constructs within an acceptable interview length, but the abbreviated measures may have psychometric properties inferior to those of longer measures. Full, validated measures might show different associations with the outcome. Strengths of the study include a large population-based sample; prospective design; risk factors across multiple domains assessed *via* worker-reported information, medical records, and administrative data obtained soon after claim submission; and objective administrative measures of work disability compensation with complete follow-up data.

The study findings support an understanding of the development of chronic disabling back pain as involving interactions of factors in domains both within and external to the patient. The biopsychosocial model of chronic pain has gained widespread acceptance, and both biologic and psychological factors have been demonstrated to play important roles in chronic pain and associated disability,[43] and in the transition from acute to chronic pain.[44,45] However, although Fordyce[46] emphasized the importance of environmental factors and the complex interplay between internal and external factors in chronic pain over a decade ago, environmental variables have received relatively little empirical attention in the study of the development of chronic disabling pain.[43,47] The typically applied biopsychosocial perspective lacks focus on health care provider, employer, and family responses, and work and economic factors, that affect disability, and has the added problem of lacking rigorous conceptual grounding. There is a need for a more robust and comprehensive conceptual framework that includes environmental influences in addition to biologic and psychological ones.

Perhaps just as there has been growing awareness of the importance of environmental (including economic and social) factors in other health conditions (*e.g.*, obesity[48,49]) that previously were viewed as having largely biologic/genetic and psychological determinants, more attention needs to be directed toward environmental factors that may interact with genetic/biologic and psychological factors in influencing patient responses to back pain. The view of the health of individuals as shaped by social, economic, and environmental conditions has resulted in consideration of new health risks and protective factors that are predictive of a wide variety of medical outcomes.[50] Such a view may well prove fruitful in the study of disabling pain. Ultimately, the societal problem of chronic disabling back pain will likely require the development of new, expanded approaches to prevention and treatment that take account of the influence of a variety of environmental factors.

■ Key Points

- Knowledge concerning early predictors of prolonged disability after back injury could help increase understanding concerning the development of chronic, disabling pain, and aid in secondary prevention efforts.

- Among 1885 workers with new workers' compensation claims for lost work-time because of back injury, injury severity, physical disability (Roland disability questionnaire), number of pain sites, description of job as "very hectic," no offer of a job accommodation to enable return to work (*e.g.*, light duty, reduced hours), previous injury involving a month or more off work, and specialty of the first health care provider for the injury were statistically significant in a multivariable model predicting receipt of work disability compensation 1 year later.
- Models of the development of chronic work disability after work-related back injury need to be broadened beyond the typically applied biopsychosocial approach to incorporate environmental factors such as workplace characteristics.

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