OCCUPATIONAL HEALTH/ERGONOMICS

Early Predictors of Occupational Back Reinjury

Results From a Prospective Study of Workers in Washington State

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Study Design. Prospective population-based cohort study.
Objective. To identify early predictors of self-reported occupational back reinjury within 1 year after work-related back injury.
Summary of Background Data. Back injuries are the costliest and most prevalent disabling occupational injuries in the United States. A substantial proportion of workers with back injuries have reinjuries after returning to work, yet there are few studies of risk factors for occupational back reinjuries.
Methods. We aimed to identify the incidence and early (in the claim) predictors of self-reported back reinjury by approximately 1 year after the index injury among Washington State workers with new work disability claims for back injuries. The Washington Workers' Compensation Disability Risk Identification Study Cohort provided a large, population-based sample with information on variables in 7 domains: sociodemographic, employment-related, pain and function, clinical status, health care, health behavior, and psychological. We conducted telephone interviews with workers 3 weeks and 1 year after submission of a time-loss claim for the injury. We first identified predictors ($P < 0.10$) of self-reported reinjury within 1 year in bivariate analyses. Those variables were then included in a multivariate logistic regression model predicting occupational back reinjury.

Results. A total of 290 (25.8%) of 1123 (70.0% response rate) workers who completed the 1-year follow-up interview and had returned to work reported having reinjured their back at work. Baseline variables significantly associated with reinjury ($P < 0.05$) in the multivariate model included male sex, constant whole-body vibration at work, previous similar injury, 4 or more previous claims of any type, possessing health insurance, and high fear-avoidance scores. Baseline obesity was associated with reduced odds of reinjury. No other employment-related or psychological variables were significant.
Conclusion. One-fourth of the workers who received work disability compensation for a back injury self-reported reinjury after returning to work. Baseline variables in multiple domains predicted occupational back reinjury. Increased knowledge of early risk factors for reinjury may help to lead to interventions, such as efforts to reduce fear avoidance and graded activity to promote recovery, effective in lowering the risk of reinjury.
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B ack pain is the costliest and most prevalent disabling occupational disorder in the United States.[1,2] Costs related to occupational back pain and injuries have increased 65% (in real dollars) in recent years.[3] Workers with back reinjuries or pain recurrences have higher costs and durations of disability[4]; however, occupational back reinjuries are rarely studied relative to initial injuries.[5] No generally agreed upon case definition of occupational back reinjury exists, challenging further research efforts in this field. In addition, reinjuries are not distinguished among general occupational injuries by the US Bureau of Labor Statistics; national reinjury statistics are unavailable.[5] Reported prevalence estimates range from 5% to 82%[6]; this wide range likely reflects the variation and inconsistency regarding definitions and data sources. In addition, few predictors of reinjury have been assessed across multiple studies and even when the same variable has been assessed in multiple studies, there have been conflicting findings.[4–12] Identification of early (in a workers' compensation claim) predictors of occupational back reinjury may assist in focusing reinjury prevention efforts on workers at high risk, with the potential to lower the risks of occupational back reinjury and long-term disability, and reduce associated medical and lost work-time costs.

We used the Washington State Workers' Compensation Disability Risk Identification Study Cohort (D-RISC) data to examine the rate of occupational back reinjury by 1 year, identify early predictors of occupational back reinjury, develop a multivariate predictive model, and evaluate the ability of the multivariate model to predict reinjury. Possible predictive variables were identified within domains of interest that were used previously for occupational injury research.[13–16] Seven domains (sociodemographic, employment-related, pain and function, clinical status, health care, health behavior, and psychological)[13] were assessed in baseline telephone interviews to identify potential risk factors for self-reported occupational back reinjury. On the basis of the previous research, we hypothesized that initial injury severity, worker fear avoidance, previous work injury, Roland-Morris Disability Questionnaire (RMDQ) score,[17] lack of offer of job accommodation, poor overall health status, and lack of provider mention of reinjury prevention strategies would be significant predictors of reinjury.[2,5,13,18,19]

MATERIALS AND METHODS

Setting and Participants

The D-RISC study has been described in previous reports.[13,14] D-RISC was a prospective, population-based study that identified workers with new occupational back injury claims in the Washington State Department of Labor and Industries (DLI) state fund claims database between June 2002 and April 2004. To be eligible for the study, workers must have received at least 1 day of temporary total disability wage replacement. All nonfederal employees in the state whose employer does not self-insure (approximately two-thirds of the nonfederal workforce) are covered by the DLI state fund. Injured workers were identified by weekly claims review.

From the claims database, 4354 potential participants were identified for D-RISC. Of those, 1178 (27.1%) could not be contacted, 909 (20.9%) declined enrollment, and 120 (2.8%) could not complete the initial phone interview in English or Spanish language. The remaining 2147 (49.3%) were enrolled in D-RISC and completed the baseline interview. The baseline interviews were conducted a median of 18 (interquartile range 15–26) days after claim submission. At the time of the baseline interview, the median number of days of time loss compensation (which begins when 4 days of work have been missed due to the injury) in the sample was 14 (interquartile range 4–24 days). A total of 94% of the sample had less than 6 weeks of time-loss compensation at the time of the baseline interview. After the baseline interview, study participants were excluded from the analysis sample if they were not eligible for wage replacement compensation (n = 240), were hospitalized for the initial injury (n = 16), were missing data on age (n = 3), or did not have a back injury according to medical record review (n = 3). Thus, 1885 (43.3%) were included in the original D-RISC analysis sample. This sample, compared those who received compensation but were not in the study, was slightly older (mean age [SD], 39.4 [11.2] vs. 38.2 [11.1] yr; P = 0.001); contained more women (32% vs. 26%; P <

0.001); and had more workers receiving wage-disability compensation after 1 year (13.8% vs. 11.3%; P = 0.02).[13]

Of the 1885, 1319 (70.0%) completed the 1-year follow-up interview. Compared with the 566 workers who did not complete the 1-year follow-up assessment, the 1319 who did complete the 1-year follow-up were slightly older on average (mean age [SD], 40.3 [11.1] vs. 37.1 [11.2] yr; P < 0.001); more educated (less than high school education: 11% vs. 19%; P = 0.006); less likely to be Hispanic (14% vs. 22%; P < 0.001); more likely to be married or living with partners (68% vs. 57%; P < 0.001); and more likely to have general health insurance (72% vs. 58%; P < 0.001). The 2 groups did not differ significantly in time-loss days by 1 year (mean time loss [SD], 85 [126] vs. 79 [119] days; P = 0.33). Of the 1319 workers, 13 declined or did not know the answer to the question in the follow-up interview indicating reinjury status, and 183 workers reported that they never returned to any paid work in the year after the baseline interview (and hence could not be reinjured while at work). Thus, 1123 injured workers (25.8% of the 4354 originally identified potential study participants) were included for our analyses.

MEASURES

Baseline Variables

One hundred eleven variables were assessed during the D-RISC structured telephone baseline interview, whereas 13 variables were obtained from DLI and patient medical records. Baseline measures were selected primarily on the basis of previous occupational back reinjury research that suggested their potential importance. Because the occupational back reinjury literature is sparse, variables were also selected on the basis of related injury or workers' compensation research, such as that predicting chronic disability as a result of occupational back injury.[13] Baseline information from the DLI included region of the workers' residence, employer size, industry type, and time from injury to first medical visit. Worker medical records were reviewed to rate injury severity.[16] Fifty-four of the 124 (43.5%) available variables were investigated in this analysis. (For more information about the baseline variables, see Table 1 and Appendix, Supplemental Digital Content 1, http://links.lww.com/BRS/A682.)

Outcome Measure

The D-RISC 1-year follow-up structured telephone interview included the following yes/no question used as the outcome variable:

"Since you filed a claim for your back injury around [claim date], have you reinjured your back at work?"

Statistical Analyses

We first conducted logistic regression analyses to examine bivariate associations between baseline variables of interest and reinjury, adjusted for age and sex. Missing, unknown, and refusal answers for each variable were combined into 1 response and included in the analysis. Variables that were associated with reinjury bivariately were examined for collinearity or redundancy before forming the multivariate model.

TABLE 1. Bivariate Associations ($P \leq 0.10$) of Baseline Variables With Occupational Back Reinjury by 1 Year After Initial Occupational Back Injury

Domain and Variables	Not Reinjured, n = 833, %(No.)	Reinjured, n = 290, %(No.)	Odds Ratio*	95% CI	P
Sociodemographic					
Sex (ref, male)	64 (531)	74 (216)			<0.01
Female	36 (302)	26 (74)	0.60	0.47–0.81	
Race/ethnicity (ref, white non-Hispanic)	72 (603)	74 (214)			0.04
Hispanic	15 (123)	10 (30)	0.64	0.41–0.99	
Other	13 (107)	16 (46)	1.26	0.86–1.86	
Employment-related					
Workers' description of job in terms of the following variables					
Heavy lifting (ref, not at all/rarely/occasionally)	51 (423)	41 (119)			0.02
Frequently	32 (264)	38 (111)	1.46	1.07–1.97	
Constantly	17 (145)	21 (60)	1.47	1.01–2.13	
Whole-body vibration (ref, not at all/rarely)	71 (592)	62 (179)			0.01
Occasionally/frequently	21 (175)	23 (67)	1.08	0.77–1.54	
Constantly	8 (64)	15 (44)	1.94	1.25–3.00	
Physical demands (ref, sedentary/light)	23 (191)	17 (49)			0.02
Medium	34 (281)	31 (89)	1.20	0.81–1.79	
Heavy	22 (186)	26 (74)	1.45	0.95–2.22	
Very heavy	20 (168)	27 (78)	1.70	1.11–2.60	
Fast pace (ref, strongly disagree/disagree)	27 (229)	21 (61)			0.04
Agree	40 (336)	41 (120)	1.36	0.95–1.94	
Strongly agree	32 (265)	37 (108)	1.66	1.14–2.40	
Excessive amount of work (ref, strongly disagree/disagree)	49 (409)	41 (120)			0.01
Strongly agree/agree	50 (417)	58 (168)	1.45	1.10–1.92	
Pain and function					
Number pain sites (ref, 0–2 sites)	53 (445)	45 (131)			0.01
3–4	34 (287)	40 (115)	1.43	1.06–1.92	
5–8	12 (101)	15 (44)	1.70	1.12–2.58	
Pain intensity, past week (0, no pain; ref, 0–3)[35]	31 (257)	25 (72)			0.08
4–5	27 (228)	28 (81)	1.36	0.94–1.96	
6–7	24 (199)	28 (81)	1.59	1.10–2.32	
8–10	18 (149)	19 (56)	1.49	0.99–2.25	
RMDQ (0 = no disability) (ref, 0–8)[19–21]	34 (287)	28 (81)			0.04

(*Continued*)

Domain and Variables	Not Reinjured, n = 833, %(No.)	Reinjured, n = 290, %(No.)	Odds Ratio*	95% CI	P
TABLE 1. (*Continued*)					
9–16	36 (301)	37 (108)	1.33	0.95–1.85	
17–24	29 (245)	35 (101)	1.55	1.10–2.20	
SF-36 v2† Physical Function (ref, >50)[24]	29 (244)	22 (65)			0.03
41–50	20 (168)	22 (64)	1.43	0.96–2.14	
30–40	25 (206)	31 (90)	1.75	1.20–2.55	
< 30	26 (215)	24 (71)	1.31	0.89–1.94	
SF-36 v2 Role Physical (ref, >50)[24]	27 (223)	21 (60)			0.10
41–50	20 (168)	19 (56)	1.29	0.85–1.97	
30–40	23 (192)	29 (83)	1.62	1.10–2.39	
<30	30 (250)	31 (91)	1.38	0.95–2.02	
Clinical status					
Previous similar back injury (ref, no)	57 (471)	42 (122)			<0.01
Yes	43 (362)	58 (168)	1.73	1.31–2.29	
Previous injury (any type) with ≥ 1 month off work (ref, no)	78 (646)	69 (200)			0.01
Yes	22 (184)	31 (89)	1.51	1.11–2.06	
Number of self-reported workers' compensation claims before current injury (ref, 0)	42 (349)	29 (83)			<0.01
1	30 (253)	28 (82)	1.33	0.93–1.89	
2–3	13 (161)	25 (73)	1.77	1.21–2.58	
≥4	8 (64)	17 (50)	2.99	1.90–4.71	
Work days missed because of other health problems, previous year (ref, 0)	40 (333)	37 (106)			0.05
1–10	50 (418)	58 (167)	1.34	1.01–1.79	
>10	8 (66)	5 (14)	0.74	0.40–1.38	
Health care					
Health insurance (ref, yes)	72 (596)	81 (236)			<0.01
No	28 (236)	19 (54)	0.59	0.42–0.82	
Health behavior					
Body mass index (ref, <25)	28 (235)	30 (86)			0.03
25–29 (overweight)	37 (312)	44 (129)	1.01	0.73–1.41	
≥30 (obese)	34 (286)	26 (75)	0.67	0.47–0.96	
Psychological					
Blame for injury[33] (ref, work)	46 (380)	53 (155)			0.06
Self	23 (190)	19 (54)	0.67	0.47–0.95	
Someone/something else	15 (124)	16 (45)	0.65	0.42–1.00	
Nothing/no one	14 (118)	11 (33)	0.90	0.61–1.34	

(*Continued*)

TABLE 1. (Continued)

Domain and Variables	Not Reinjured, n = 833, %(No.)	Reinjured, n = 290, %(No.)	Odds Ratio*	95% CI	P
Work fear avoidance (ref, <3, very low)‡	24 (203)	11 (33)			<0.01
Low-moderate (>3 to <5)	33 (272)	38 (109)	2.49	1.62–3.84	
High (5–6)	43 (358)	51 (148)	2.63	1.73–4.00	
SF-36 v2 Mental Health (ref, >50)[24]	45 (371)	39 (114)			0.06
41–50	23 (194)	30 (87)	1.49	1.07–2.08	
≤40	32 (268)	31 (89)	1.11	0.80–1.54	

Missing, "don't know," and refusal responses for each variable were combined into 1 response for each variable (results not shown).

*Odds ratios for all variables except age and sex were adjusted for age and sex.

†Physical function, role physical, and mental health scales; higher scores indicate better functioning.[24]

‡Mean of responses to 2 questions from the fear-avoidance beliefs questionnaire work scale.[23]

CI indicates confidence interval; ref, reference group; RMDQ; Roland-Morris Disability Questionnaire; SF-36 v2, 36-Item short-form health survey, version 2.

We then constructed a multivariate model for predicting reinjury that included all baseline variables that were associated ($P < 0.10$) with reinjury in bivariate analyses, along with age (as an adjustment variable). This criterion was used because a standard 0.05 P value level in a bivariate analysis may exclude variables that may be significant in a multivariate model.[13,26] Analyses were conducted using Stata version 10 (StataCorp LP, College Station, TX).[27]

To evaluate the ability of the multivariate model to distinguish between workers who did *versus* who did not report an occupational back reinjury by 1 year, we determined the area under the receiver operating characteristic curve (AUC) by using 10-fold crossvalidation to estimate the AUC in different subsamples of the D-RISC data.[28] An AUC more than 0.70 is considered acceptable.[26]

RESULTS

Sample Characteristics

The sample of workers (n = 1123) was mostly white non-Hispanic (73%; 14% Hispanic; and 14% other) and male (67%). One year after the baseline interview, 290 (25.8%) of the 1123 workers reported 1 or more occupational back reinjuries. Variables with the most missing data included region of worker residence (n = 33), time from injury to first medical visit (n = 31), source of blame for the injury (n = 24), work days missed due to nonback health problems in the previous year (n = 21), work days missed due to back problems in the previous year (n = 14), whether the supervisor listens to work-related problems (n = 12), and whether the employer offered job accommodations (n = 10).

Bivariate Analyses

Table 1 displays baseline variables that were associated ($P < 0.10$) with occupational back reinjury. (See the Appendix for the nonsignificant variables.) All domains contained at least 1

association. In the sociodemographic domain, sex and race/ethnicity were associated with reinjury. In the employment-related domain, overall amounts of heavy lifting, whole-body vibration, physical demands, fast pace, and excessive amounts of work were associated with reinjury. Neither employer-specific variable (employer size and industry) was related to reinjury.

In the pain and function domain, number of pain sites, pain intensity in the past week, the worker's RMDQ score,[17] and 36-item short-form health survey, version 2,[24] physical function and role-physical scores were associated with reinjury. Several variables in the clinical domain were associated with reinjury, including previous similar back injury, having a previous occupational injury of any type that resulted in at least 1 month off work, self-reported previous claims (any type) before the current injury, and work days missed in the previous year for nonback health reasons. In the health care domain, not having general health insurance was associated with a lower risk of reinjury. Body mass index (BMI) was the only ($P < 0.10$) predictor in the health behavior domain. In the psychological domain, the worker's source of blame for the injury, fear avoidance, and 36-item short-form health survey, version 2, mental health score were associated with reinjury. Some anticipated predictors of reinjury, including initial injury severity, lack of job accommodation offer, poor overall health status, and lack of provider mention of reinjury prevention strategies, were not associated bivariately with reinjury.

Multivariate Model

The multivariate model (Table 2) includes age, sex, and other variables that were associated with reinjury bivariately. Seven variables from 6 domains contributed significantly ($P < 0.05$) to the prediction of self-reported occupational back reinjury by 1 year. These include male sex, constant whole-body vibration, previous similar back injury, more than 3 previous workers' compensation claims of any type before this injury,

TABLE 2. Multivariate Model Predicting Occupational Back Reinjury by 1 Year From Baseline Variables

Baseline Predictor	Bivariate Analyses		Multivariate Analysis		
	OR*	95% CI	OR†	95% CI	P
Age, yr (ref, 35–44)					
≤24	0.53	0.29–0.95	0.67	0.35–1.28	0.23
25–34	1.13	0.79–1.62	1.35	0.90–2.01	0.14
45–54	1.05	0.74–1.49	1.12	0.76–1.66	0.57
≥55	0.85	0.52–1.38	1.01	0.59–1.74	0.97
Sex (ref, male)					
Female	0.60	0.47–0.81	0.68	0.47–0.99	0.04
Race/ethnicity (ref, white non-Hispanic)					
Hispanic	0.64	0.41–0.99	1.01	0.60–1.69	0.98
Other	1.26	0.86–1.86	1.38	0.91–2.11	0.13
Heavy lifting (ref, not at all/rarely/ occasional)					
Frequent	1.46	1.07–1.97	1.36	0.94–1.98	0.11
Constant	1.47	1.01–2.13	1.10	0.69–1.76	0.68
Whole-body vibration (ref, not at all/rarely/occasional)					
Frequent	1.08	0.77–1.54	0.89	0.61–1.30	0.54
Constant	1.94	1.25–3.00	1.66	1.02–2.69	0.04
Physical demands of job (ref, sedentary/light)					
Medium	1.20	0.81–1.79	0.94	0.60–1.48	0.79
Heavy	1.45	0.95–2.22	0.94	0.55–1.59	0.82
Very heavy	1.70	1.11–2.60	1.14	0.66–1.98	0.64
Fast pace (ref, strongly disagree/disagree)					
Agree	1.36	0.95–1.94	1.19	0.80–1.79	0.39
Strongly agree	1.66	1.14–2.40	1.17	0.73–1.83	0.49
Excessive amount of work (ref, strongly disagree/disagree)					
Strongly agree/agree	1.45	1.10–1.92	1.11	0.79–1.55	0.55
Number of pain sites (ref, 0–2)					
3–4	1.43	1.06–1.92	1.17	0.82–1.66	0.39
5–8	1.70	1.12–2.58	1.34	0.82–2.20	0.25
Pain intensity, past week (ref, 0–3, 0, no pain)					
4–5	1.36	0.94–1.96	1.00	0.65–1.55	1.00
6–7	1.59	1.10–2.32	1.30	0.81–2.09	0.28
8–10	1.49	0.99–2.25	1.21	0.71–2.06	0.49
RMDQ (ref, 0–8)					
9–16	1.33	0.95–1.85	0.95	0.58–1.56	0.85
17–24	1.55	1.10–2.20	1.36	0.72–2.57	0.34
SF-36 v2 Physical Function (ref, >50)					
41–50	1.43	0.96–2.14	1.08	0.66–1.78	0.76

(Continued)

TABLE 2. (Continued)	Bivariate Analyses		Multivariate Analysis		
Baseline Predictor	OR*	95% CI	OR†	95% CI	P
30–40	1.75	1.20–2.55	1.16	0.65–2.06	0.61
<30	1.31	0.89–1.94	0.79	0.40–1.53	0.48
SF-36 v2 Role Physical (ref, >50)					
41–50	1.29	0.85–1.97	1.10	0.65–1.85	0.73
30–40	1.62	1.10–2.39	1.16	0.63–2.12	0.63
<30	1.38	0.95–2.02	0.87	0.45–1.69	0.68
Previous similar back injury (ref, no)					
Yes	1.73	1.31–2.29	1.47	1.06–2.02	0.02
Previous injury (any type) with ≥ 1 month off work (ref, no)					
Yes	1.51	1.11–2.06	1.14	0.80–1.64	0.46
Number of self-reported workers' compensation claims before this initial injury (ref, 0)					
1	1.33	0.93–1.89	1.02	0.69–1.52	0.92
2–3	1.77	1.21–2.58	1.32	0.85–2.06	0.22
>3	2.99	1.90–4.71	2.29	1.34–3.92	< 0.01
Work days missed because of other problems, previous year (ref, 0)					
1–10	1.34	1.01–1.79	1.21	0.88–1.66	0.24
>10	0.74	0.40–1.38	0.52	0.26–1.01	0.06
Health insurance (ref, yes)					
No	0.59	0.42–0.82	0.62	0.43–0.89	0.01
Body mass index (ref, <25)					
25–29	1.01	0.73–1.41	0.93	0.65–1.33	0.70
≥30	0.67	0.47–0.96	0.59	0.40–0.88	0.01
Blame for injury (ref, work)					
Self	0.67	0.46–0.95	0.78	0.52–1.15	0.21
Someone/something else	0.90	0.61–1.34	0.93	0.61–1.42	0.75
No one/nothing	0.65	0.42–1.00	0.75	0.47–1.22	0.25
Fear-avoidance (ref, <3 [very low])					
Low-moderate (>3 to <5)	2.49	1.62–3.84	2.03	1.27–3.23	< 0.01
High (5–6)	2.63	1.73– 4.00	1.84	1.13–2.99	0.01
SF-36 v2 Mental Health (ref, >50)					
41–50	1.49	1.07–2.08	1.27	0.87–1.85	0.22
≤40	1.11	0.80–1.54	0.92	0.61–1.40	0.70

Missing, "don't know," and refusal responses for each variable were combined into 1 response for each variable (results not shown).

Each baseline variable included in this table was associated (P < 0.10) in bivariate analyses with occupational back reinjury by 1 year of initial occupational back injury.

*Adjusted only for age and sex. The age and sex variables were unadjusted.

†Adjusted for all other variables in the multivariate model.

CI indicates confidence interval; OR odds ratio; ref, reference group; RMDQ, Roland-Morris Disability Questionnaire; SF-36 v2, 36-Item short-form health survey, version 2.

having health insurance, obesity (BMI $\geq$ 30), and elevated work fear-avoidance scores.

Because of concern about having too many similar pain and function variables in the multivariate model (*i.e.,* collinearity), we conducted a sensitivity analysis repeating the logistic regression with only 2 baseline variables from this domain, chosen based on the past research showing their relationship to subsequent clinical outcomes[7,13]: the number of pain sites and the RMDQ score. None of the baseline measures of pain and function variables were statistically significant in either multivariate model. We had anticipated that the RMDQ score would be significant.

The crossvalidated AUC value was 0.72 (95% confidence interval [CI], 0.69–0.76), indicating a near-acceptable ability of the model to distinguish workers who reported a reinjury by 1 year from those who did not.[26]

The strongest predictors of occupational back reinjury in the multivariate model were the number of previous workers' compensation claims and the baseline fear-avoidance score. Workers who reported more than 3 previous claims had 2.29 times the odds (95% CI, 1.34–3.92) of self-reported reinjury as compared with workers who reported no previous claims. Compared with workers with low fear avoidance (score < 3), workers with high (score of 5–6) or low–moderate (3 to <5) fear-avoidance scores had approximately twice the odds of reporting a reinjury (odds ratio, 2.03 [95% CI, 1.27–3.23] and odds ratio, 1.84 [95% CI, 1.13–2.99], respectively).

DISCUSSION

To our knowledge, this is the first population-based study to examine early predictors of occupational back reinjury from multiple domains of potential risk factors across all industries. Variables from 6 domains (sociodemographic, employment-related, clinical status, health care, health behavior, and psychological) were significant early predictors of occupational back reinjury. This suggests that back reinjuries may be influenced by factors beyond aspects of clinical care and the severity of the initial injury.[13]

The strongest predictor in the final multivariate model was self report of more than 3 previous workers' compensation claims of any type, even after adjustment for a previous similar back injury. To our knowledge, the workers' history of claims has not been examined in previous occupational back reinjury literature. Further research is needed to better understand why a history of previous claims is associated with greater odds of reinjury, and how knowledge of previous claims could be used to help in preventing reinjury.

Fear avoidance has been found to be associated with occupational disability in previous studies.[13,15] However, we are not aware of previous research examining fear avoidance as a predictor of occupational back reinjury. It is notable that a variable in the psychological domain predicts reinjury even after adjustment for measures of pain and function. It is possible that workers may be accurate that their jobs will cause "reinjury" or that these beliefs may lead them to perceive any increases in pain as a reinjury after returning to work. This study contributes to the body of research support-

ing the potential value of screening patients with back injuries for psychological factors such as fear avoidance that may affect their clinical outcomes, and suggests the importance of assessing fear avoidance early after injury and addressing fear avoidance when present (*e.g.,* through education and graded activity to promote recovery).[13]

Workers' self report of whole-body vibration in job tasks (*e.g.,* using a jackhammer or driving a forklift) contributed independently to the prediction of reinjury in the multivariate model. To our knowledge, this variable has not been examined in other studies of predictors of occupational reinjury. A number of other job demands variables were predictive of reinjury when examined bivariately; similarly, previous occupational back reinjury studies have found significant predictors related to job demands, including a fast-paced environment[7,8] and physical demands.[7–9] Our results were also consistent with those of previous studies that found no association between reinjury and worker job satisfaction.[10]

Surprisingly, not having general health insurance was associated with lower odds of back reinjury. One previous study found that having general health insurance was significantly and positively associated with reporting and seeking treatment for occupational injuries.[29] It is possible that workers who have general health insurance may be more likely to self report an injury because care will be covered by insurance even if they do not have an accepted workers' compensation claim for the injury. It is also possible that this variable is a marker for another unmeasured characteristic associated with reinjury or a reflection of baseline differences between our analysis sample and other D-RISC participants who did not complete the 1-year follow-up interview.

Compared with workers of normal weight, obese participants (BMI $\geq$ 30) had lower odds of occupational back reinjury. One previous study that assessed BMI found no association with reinjury.[8] Multiple studies have observed associations between obesity and occupational back injuries, including higher rates of initial injuries.[18,30,31] Obese workers have also been found to have lower physical productivity.[32] Obese workers may be more likely to have jobs that do not have physical demands associated with reinjury; however, we are unaware of any scientific literature supporting this conjecture. In additional bivariate analyses of our data, we found that obese participants were significantly less likely to report a fast pace or excessive amount of work compared with participants of normal weight; however, no other physical job demands differences were found.

Our study has some limitations. First, the outcome was a binary yes/no question about back reinjury; we do not have information concerning the extent and severity of the reinjury. Our response rate for the 1-year follow-up interview was 70.0% of the participants who completed the baseline interview, and respondents and nonrespondents differed significantly on some baseline measures. The length of time back at work after the index injury (and hence the time in which workers could have had a reinjury) was not assessed in this study and may have varied widely across the sample. In the original D-RISC sample, 69% of workers ended

work-disability benefits within 3 months of their index claim submission (data not shown). These data suggest that most workers in the current study had been back at work at least 9 months by the 1-year follow-up interview. We did not assess some variables found in previous studies to be associated with occupational back reinjury, including a history of substance abuse,[9] the ratio of salary to wage-loss payments,[9] and the lengths of previous employment.[9] Finally, we analyzed a large number of variables, and some associations might have been significant due to chance alone. The analyses were exploratory, hypothesis generating, and intended to reveal factors that should be tested in future studies. Despite these limitations, this study has numerous strengths, including a large, population-based sample across all industries; a prospective design; several sources of baseline data; and baseline variables reflecting multiple domains of interest.

CONCLUSION

Biological, psychosocial, and environmental factors may all be involved in occupational back reinjury. Approximately 25% of our sample reported an occupational back reinjury within 1 year of initial submission of a claim involving loss of at least 4 days of work due to back injury. Understanding risk factors for occupational back reinjury may increase knowledge about why some workers are reinjured whereas others are not. This knowledge may lead to improved reinjury-prevention efforts by employees, employers, and providers.

➢ Key Points

- ❑ A total of 290 of 1123 (25.8%) of Washington State workers who returned to work after a back injury resulting in work-loss compensation reported an occupational back reinjury within 1 year.

- ❑ Baseline predictors of occupational back reinjury that were significant in a multivariate model included male sex, jobs involving constant whole-body vibration, previous workers' compensation claims of any type, previous similar back injury, possession of general health insurance, and fear-avoidance scores; obesity was protective against reinjury.

- ❑ No variables in the pain and function domain were significant in the multivariate model. Other anticipated predictors, such as injury severity, offer of job accommodation, and overall health status, also were not significant in the multivariate model.

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