Predictors of Successful Work Role Functioning After Carpal Tunnel Release Surgery

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This study identified the clinical, individual, and workplace predictors of successful work role functioning (WRF) after carpal tunnel release surgery (CTRS). A community-based cohort (n= 197) was followed for 6 months post-CTRS. Predictors of successful WRF were analyzed prospectively using ordinal logistic regression. Baseline WRF predicted successful WRF at 2 months, whereas being depressed and a workers' compensation claimant predicted being out of work. Baseline WRF, improved self-efficacy, and a supportive organization predicted 6-month successful WRF. Supportive organizations have an impact on the effectiveness of medical interventions for CTS. The significance of improved self-efficacy at 6 months and depression at 2 months postsurgery highlights the importance of psychosocial management of musculoskeletal disorders. (J Occup Environ Med. *2004;46:490–500*)

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A worker's ability to function successfully on the job as a result of medical care provided is an important end point for the employer purchasing health care, the physician providing the care, and the worker receiving the care. Traditionally, the fact that the worker returned to work after treatment was used to indicate successful functioning in assessing health outcomes. However, longitudinal studies of return to work have demonstrated this assumption is often incorrect.[1,2] Workers could return to the job when they have no remaining paid leave time, but still feel poorly as a result of pain, weakness, or medication effects.[3] Although not being at work, absenteeism, is a clear indicator of lost productivity, being at work but functioning poorly, presenteeism, is an important indicator as well.[4] Understanding how a worker is functioning on the job on return integrates health outcomes assessment with the measurement of workplace productivity.[5] Thus far, health and productivity research has focused mainly on economic gains (such as reducing wage loss benefit payments and healthcare costs) associated with disease management programs and the pharmacoeconomics of new drugs.[6–8] The lack of reliable productivity measurement has limited previous research as has the lack of work outcome measures that capture the impact of health and medical care on job functioning.[5,9]

Measuring work role functioning provides a new method to conceptualize and evaluate meaningful work outcomes in occupational health services research.[5,10] The impact of medical care in return to work programs can be measured as the worker's ability to meet work demands given his or her health and work status. Furthermore, these measures of work role functioning provide a more complete assessment of productivity beyond the simple measure of return to work or not. These measures more directly link health care to productivity. Improving worker health status affects job performance and consequently productivity.

Recent developments in measuring work role functioning were used in this study to more completely examine the impact of medical care, in this case carpal tunnel release surgery (CTRS), on successful return to work.[5] CTRS was selected as the study focus because of its prevalence and relevance in the current labor market.[11] It is estimated that 250,000 carpal tunnel releases are performed annually in the United States.[12] Changes in the occupational mix toward more upper extremity-intensive service sector jobs could put more workers at risk and in need of this procedure.[13,14] In workers' compensation, CTS claims are of longer duration and higher costs compared with many other musculoskeletal injuries.[15]

The potential work productivity impact of CTRS is significant. CTRS has been associated with a 70% to 90% symptom reduction, earlier return to work when compared with other treatments, and is most often performed on working-age individuals.[11,16–19] Research on return to work after CTRS has demonstrated the importance of the following factors: clinical status, worker characteristics, whether the person has filed for workers' compensation, employment factors such as physical demands and job control, and litigation.[18–28] This research extends previous research by incorporating a multidimensional model of the return to work process and introduces a new measure, successful return to work.[29]

From a methodologic perspective, limiting the study to CTRS eliminated treatment variability. Based on previous research, we hypothesized clinical, worker, and economic/legal factors would be important predictors of successful work role functioning at 2 months after CTRS, and job and organizational factors would be important predictors at 6 months.[17,18]

Methods

Sample

Patients were identified in 15 participating community-based physician offices (orthopedic, plastic surgical, and neurosurgical specialties). Requirements for eligibility included: physician had a diagnostic impression of CTS (symptoms of numbness or tingling in at least 2 of the first 4 fingers for at least 1 month's duration); diagnosis confirmed with nerve conduction testing; and patients were employed at least 20 hours per week at the time symptoms developed. Finally, patients must have been scheduled for CTRS. Patients were excluded if they were less than 18 years old, had previous CTRS, were pregnant, retired, or a full-time student. The study was approved by both Brigham and Women's Hospital and the University of Texas Health Science Center Institutional Review Boards.

Patients were recruited consecutively for the period April 1997 to October 1998. Participating surgeons' offices attempted to approach each eligible patient. Patients who agreed to participate were mailed questionnaires preoperatively and at 2, 6, and 12 months postoperatively. Although it is difficult to estimate the proportion of eligible patients referred by physician practices to the coordinating center, an earlier study using this community-based recruitment strategy yielded a sample representative of all eligible patients in the practices with respect to age, sex, workers' compensation status, work status, and satisfaction with surgery 18 months postoperatively.[12] One hundred ninety-seven participants completed baseline questionnaires and 181 returned at least 1 follow-up questionnaire. To be included in the analysis reported here, subjects also had to have reported data on work role functioning at baseline, 2 or 6 months after surgery. This data requirement resulted in a 2-month analysis sample of 128 and a 6-month analysis sample of 122. The 12-month results are not reported because of sample size ($n = 80$) and the attendant problems of comparability across measurement points.

Successful Health-Related Work Role Functioning

Patients who returned to work 2 or 6 months after surgery were asked to endorse the percent of time they were having problems meeting work demands as a result of their physical health and emotional problems in the past week. A subset of 15 questions was derived from a 26-item work role functioning measure (WRF) assessing 5 work functioning areas (Table 1).[5]

Item response options ranged from 1 (0% of the time have problems meeting demands) to 5 (100% of the time have problems meeting demands). Patients had the option of endorsing "does not apply to my job" if the demands were not relevant to their jobs. These responses were set to missing in the scale development. Responses were reverse-scored to reflect level of functioning instead of limitation and rescored to 0–4. A single summated average was calculated if a person was not missing more than 20% of the items and then multiplied by 25. This created a work role functioning measure that varied between 0 (difficulty meeting all 15 work demands 100% of the time) and 100 (able to meet all 15 work demands 100% of the time).

Respondents who were not working at 2 or 6 months as a result of health problems (ie, unable to function in the work role) were omitted from the WRF calculation. This

TABLE 1
Work Role Functioning Measure

Work Scheduling Demands
1. Sticking to your work routine or schedule.
2. Doing your work without needing frequents rests or breaks.

Psychological Demands
3. Concentrating on your work.
4. Remembering things having to do with your work.

Social Demands
5. Talking with people in person, in meetings or on the phone.
6. Helping others to get work done.
7. Controlling irritability or anger toward people when working.

Physical Demands
8. Lifting, carrying or moving objects at work.
9. Bending, twisting or reaching.
10. Using hand-operated tools or equipment (for example, pen, drill, sander, keyboard or computer mouse).
11. Keeping your body in one position longer than 30 minutes at a time.

Output Demands
12. Doing your work without making mistakes.
13. Satisfying those people who judge your work.
14. Finishing all your work.
15. Feeling a sense of accomplishment.

could result in underestimating the effects of some negative predictors of WRF. Because not working is the most extreme form of unsuccessful work functioning, the study sought to integrate this information into the analysis. Furthermore, the 2 or 6-month WRF measure was positively skewed (mean, 90; standard deviation, 13; range, 32–100). Thus, a 3-level outcome variable was created for analysis at 6 months postsurgery indicating whether a patient: (0) had *not* returned to work for health reasons, (1) had returned to work but was able to meet the demands of the job less than 90% of the time, WRF $<$90, and (2) had returned to work and was able to meet the demands of the job 90% or more of the time (WRF $\geq$90).

Predictor *variables* were grouped into 6 a priori analytic categories.

Demographic variables assessed at baseline included: age, gender, education ($\leq$12 or $>$12), annual household income from all sources ($\leq$\$30,000 or $>$\$30, 000), and percent of household income contributed by patient ($<$25%, 25–49%, 50–74%, 75–99%, 100%).

Clinical variables assessed at baseline and 2 months included a reduced 6-item hand/wrist symptom severity scale (Cronbach's αin this cohort = 0.83) and an 11-item upper extremity functional limitations scale (Cronbach's α= 0.91).[30,31] Change in symptom severity and functional limitations, scored as improved (1) or not improved (0) were created by subtracting 2 months from baseline measures. Baseline indicator variables were created for 2 or more nonhand/wrist musculoskeletal pain sites (forearms, elbows, shoulders, neck, and back), bilateral CTS symptoms, presence of incisional scar tenderness, endoscopic (vs. open) surgery, distal motor nerve latency greater than 6 ms, and obesity (body mass index 30 or greater).[32,33] Baseline physical health status was assessed with the SF-12 Physical Component Score (a PCS score of 48 or greater was coded 1 and baseline work role functioning; Cronbach's α= 0.91).[34] Baseline WRF ranged from 20 to 100. Those not working at baseline because of health were assigned a baseline WRF value of 0. Fourteen patients working full-time at baseline did not report WRF, and multiple regression imputation (with age, occupation, and education in the regression model) was used to impute their scores. A general baseline comorbidity count summed the number of chronic health problems: heart disease, high blood pressure, lung disease, stomach ulcer, kidney disease, thyroid disease, cancer, depression, rheumatoid arthritis, osteoarthritis, fibromyalgia, and diabetes (counts ranged from 0–5).

Psychosocial variables were assessed at baseline and 2 months. They included a 4-item self-efficacy scale (Cronbach's α= 0.82) measuring patients' confidence (0 = not confident to 6 = extremely confident) in managing symptoms and maintaining activities assessed at baseline and 2 months.[35] High was defined as greater than 3 on a summated average scale. A change in self-efficacy was the difference between 2-month and baseline scores (1 = improved; 0 = not improved). Depression was indicated by a score of less than 52 on the SF-36 MHI-5 scale at baseline and 2 months.[36] A change in depression status measure varied between -1 and 1 (-1 indicates more depressed after surgery, 0 no change, and + 1 improved). High family social support at baseline (2 items) indicated the patient felt at ease talking about concerns with a spouse or friends and relatives (Cronbach's α= 0.68). Married or living with a companion at baseline (coded as 1) was compared with widowed, separated, divorced, or never married (coded as 0). The number of children under 18 living at home at baseline was counted.

Economic/legal variables included whether, at baseline or 2 months, the patient was a workers' compensation claimant (coded as 1) and/or hired an attorney (coded as 1) because of the carpal tunnel syndrome.

Job Conditions

The degree of hand/wrist force and repetition used on the job were assessed separately with a numerical rating scale ranging from 1 (low) to 7 (high). Based on the work of Silverstein, the 2 measures were combined to create a high force–high repetition hazardous exposure group by multiplying the scores on the 2 scales and assigning a value of 1 (hazardous exposure) to those with scores of 36 or greater.[37] Psychosocial job conditions were assessed with a subset of Job Content Survey items.[38,39] Summated average rating scales were created that varied from 1 (strongly disagree) to 4 (strongly agree). High psychosocial job demands (3 items: α= 0.72), job security (1 item), and work-related social support from coworkers and supervisors (5 items; α= 0.75) were recoded 1 if the summated average was greater than or equal to 3 (ie, combining agree and strongly agree). Job control (5 items; $\alpha = 0.83$) was divided into 3 levels: (0) low control ≤ 2; (1) medium control >2 and ≤ 3; and (2) high control >3. No job condition significantly changed between baseline and 2 months so no change variables were constructed and only baseline variables were used. Because job satisfaction is a consequence of these variables, it was excluded from analysis in favor of direct job environment indicators.

Organizational Conditions

Whether the patient's employer provided job accommodation at baseline was scored 1 if any of nine accommodations was made (arranged for others to help, shortened workday, changed times work, added rest breaks, changed tasks, arranged to learn new job skills, arranged for special tools or equipment, arranged for job rotation, rearranged work space). Employer size (<50, 50–99, 100–499, >500 employees) and whether the patient was a union member (coded as 1) were collected at baseline. A measure of organizational policies and practices important for worker health and safety (people-oriented culture), safety climate (a combination of active safety leadership, safety training, and safety diligence), ergonomics policies and practices, and disability management (a combination of disability case management and proactive return to work program) was derived from Habeck.[40] Following Amick, the 11 items were combined into a single summated average (Cronbach's $\alpha = 0.88$).[41] The scale varied between 1 (low) and 5 (high). The distribution of scores captured the fact that organizations that do one thing well tend to do multiple things well. Scores were split to create 2 levels: (1) high support organization (≥ 3) and (0) low support organization (<3). Because organizational conditions were measured at baseline only, it was necessary to examine whether and when patients changed employers. Only 6 patients changed employers (3 at 2 months and 3 at 6 months). Removal of these 6 patients from the sample did not change the results.

Analysis

Chi-squared tests for trend across the 3 levels of successful work role functioning were conducted for all bivariate predictors included in any 2- and 6-month multivariate model. The ordinal logistic model building followed the strategy proposed by Hosmer and Lemeshow for logistic regression.[42] First, bivariate associations between each predictor variable and successful WRF were assessed. Only significant predictors ($P < 0.25$) were included in multivariate logistic regression analyses. In the case in which 2 variables measured a similar construct (eg, symptom severity and functional limitations), 1 was chosen. Second, separate logistic regression models were developed within each predictor domain (ie, demographic, clinical, psychosocial, economic/legal, job conditions, organizational conditions). Third, significant demographic, clinical, and psychosocial variables were combined into an individual-level model and economic/legal, job, and organizational factors into an environment-level model. Fourth, significant individual- and environment-level variables were tested in a combined model. In steps 2 through 4, significant variables ($P < 0.10$) were retained and all not significant variables were reentered individually into the model to reconsider significance and whether important interactions were missed. Finally, a reduced form of the combined individual and environmental model was estimated with nonsignificant variables ($P > 0.05$) removed. When a change variable was included in the analysis, the baseline measure was also included. Model fit was described with McKelvey and Zavonia's R^2.[43] Ordered logistic regression with robust estimation procedures for the standard error was used to estimate odds ratios (95% confidence limits).[44] The nonproportionality of odds across all levels of the ordered outcome was assessed using the Brant test and was found to be nonsignificant for 2-month (Brandt $\chi^2_{(6)} = 3.93$; $P = 0.69$) and 6-month multivariate models (Brandt $\chi^2_{(7)} = 7.83$; $P = 0.35$). This finding supports the appropriateness of using the ordinal logistic regression.[45] Analyses were performed using STATA 7.01.[46]

Results

A number of variables were not significantly associated with WRF in bivariate tests. Nonsignificant clinical variables included distal median nerve latency, endoscopic versus open surgery, and general comorbidity. Gender, marital status, family size, union membership, employer size, psychosocial job demands, job security, percent of household income provided by the patient, and job accommodation were also not significant. Hand/wrist symptom severity and upper extremity functioning were significant predictors in bivariate analyses and highly correlated (0.70). Symptom severity was chosen to advance to multivariate models on clinical grounds, because it best represented a clinically meaningful surgical success indicator.

Over 29% ($n = 45$ of 151) who responded to baseline WRF questions had a score greater than 90 and thus were functioning well at baseline.

Two-Month Results

Table 2 shows the distribution of significant predictors by level of 2-month WRF. Higher baseline scores on the following factors were significantly associated with better 2-month WRF: baseline WRF ($\chi^2 = 29.19$, $P < 0.001$), not being depressed (chi-square = 7.50, $P < 0.01$) or obese at baseline (chi-square = 3.88, $P < 0.05$), better physical health (chi-square = 11.47, $P < 0.001$), not being a workers' compensation claimant ($\chi^2 = 20.01$,

TABLE 2
Distribution of Baseline Predictors of Work Role Functioning at Two Months Following Carpal Tunnel Surgery Across Outcome Categories (n = 128)

Baseline Predictors	2 Month Work Role Functioning		
	0 % (n)	1 % (n)	2 % (n)
Baseline Work Role Functioning§	30.0 (39)	28.0 (36)	41.0 (53)
Income‡			
<30k	50.0 (19)	38.2 (13)	30.0 (15)
>30k	50.0 (19)	61.7 (21)	70.0 (35)
Obesity*			
Obese	52.8 (19)	39.4 (13)	31.2 (15)
Not Obese	47.2 (17)	60.6 (20)	68.8 (33)
Baseline Hand/Wrist Symptom Severity			
High	10.3 (4)	21.2 (7)	21.6 (11)
Low	89.7 (35)	78.8 (26)	78.4 (40)
Physical Health Status§			
Low	87.2 (34)	83.3 (30)	56.6 (30)
High	12.8 (5)	16.7 (6)	43.4 (23)
Bilateral Carpal Tunnel Symptoms‡			
No	28.2 (11)	55.6 (20)	49.1 (26)
Yes	71.8 (28)	44.4 (16)	50.9 (27)
Depression†			
Not Depressed	53.8 (21)	66.7 (24)	80.8 (42)
Depressed	46.2 (18)	33.3 (12)	19.2 (10)
Family Social Support‡			
Low	21.0 (8)	11.1 (4)	7.8 (4)
High	79.0 (30)	88.9 (32)	92.2 (47)
Workers' Compensation Claimant§			
No	15.4 (06)	41.7 (15)	62.3 (33)
Yes	84.6 (33)	58.3 (21)	37.7 (20)
Physical Work Demands*			
Low	53.8 (21)	80.0 (28)	78.4 (40)
High	46.2 (18)	20.0 (7)	21.6 (11)
Job Control†			
Low	18.0 (07)	13.9 (5)	5.7 (3)
Medium	61.5 (24)	58.3 (21)	50.9 (27)
High	20.5 (8)	27.8 (10)	43.4 (23)
Work-Related Social Support‡			
Low	64.1 (25)	48.6 (17)	44.9 (22)
High	35.9 (14)	51.4 (18)	55.1 (27)
Organizational Policies and Practices†			
Low Support	51.3 (20)	45.7 (16)	20.8 (11)
High Support	48.7 (19)	54.3 (19)	79.2 (42)

‡ $P < 0.10$ on χ^2 test for trend.
* $P < 0.05$ on χ^2 test for trend.
† $P < 0.01$ on χ^2 test for trend.
§ $P < 0.001$ on χ^2 test for trend.

$P< 0.001$), a less physically demanding job ($\chi^2= 5.95$, $P< 0.05$), high job control ($\chi^2= 7.19$, $P< 0.01$), and a worksite with more supportive organizational policies and practices ($\chi^2= 9.46$, $P< 0.01$). Similar nonstatistically significant trends were apparent for several other variables (ie, income, $\chi^2= 3.59$, $P= 0.06$; family-related social support, $\chi^2= 3.25$, $P= 0.07$; bilateral CTS, $\chi^2= 3.41$, $P= 0.06$; work-related social support, $\chi^2= 3.07$, $P= 0.08$; and baseline symptom severity, $\chi^2= 1.79$, $P= 0.18$) that met criteria for inclusion in multivariate models.

Table 3 shows the 2-month combined multivariate-ordered logistic regression results for a model with a McKelvey and Zovonia's R^2 of 0.43. Higher baseline WRF was associated with greater likelihood of transition to more successful postsurgical work role functioning status. Being depressed and being a workers' compensation claimant increased the likelihood a person would be out of work or functioning less successfully. Better physical health, less severe baseline symptoms, and a supportive work organization showed nonsignificant trends predicting better 2-month WRF. Baseline physical health was correlated with baseline WRF ($r= 0.46$, $P< 0.05$), whereas baseline symptom severity was less strongly associated with baseline WRF ($r= -0.17$, $P> 0.05$).

Six-Month Results

Table 4 shows the distribution of all significant predictor variables across the successful work role functioning levels at 6 months. In addition to the trends observed at 2 months, a greater likelihood of a transition to successful work role functioning is related to self-efficacy improvement ($\chi^2= 26.24$, $P< 0.001$), hand/wrist symptom improvement ($\chi^2= 5.08$, $P< 0.05$), income ($\chi^2= 7.51$, $P<0.01$), family social support ($\chi^2 = 6.15$, $P< 0.05$), not hiring an attorney ($\chi^2= 6.16$, $P<0.05$), and work-related social support ($\chi^2= 7.64$, $P< 0.01$). Similar nonstatistically significant trends were apparent for several other variables (ie, multiple pain sites, $\chi^2 = 3.62$, $P= 0.06$ and bilateral CTS, $\chi^2 = 2.64$, $P= 0.10$) that met criteria for inclusion in multivariate models.

Table 5 shows the 6-month combined ordered logistic regression results for a model with a McKelvey and Zovonia's $R^2$of 0.56. After adjusting for baseline WRF, only improved self-efficacy postsurgery and a supportive work organization significantly predict successful work role functioning. Multiple pain sites, physical health, and job control are all nonsignificant, but the direction of their effects suggests improvements result in increased likelihood of successful WRF. Physical health status is highly correlated with baseline WRF ($r= 0.56$, $P< 0.05$), but the presence of multiple pain sites is less highly correlated with baseline

TABLE 3
Full Models for Individual and Environmental Predictors of Two-Month Successful Work Role Functioning (n = 128)

Predictor	Univariate Models		Category		Individual/Organization Models		Multivariate Model		Reduced Model	
					INDIVIDUAL MODEL					
	Odds Ratio (95% CI)	*P*-value ≦ .25	Odds Ratio (95% CI)	*P*-value ≦ .10	Odds Ratio (95% CI)	*P*-value ≦ .10	Odds Ratio (95% CI)	*P*-value ≦ .10	Odds Ratio (95% CI)	*P*-value ≦ .05
Demographics										
Income	1.93 (0.97–3.83)	.061	1.93 (0.97–3.83)	.061	1.50 (0.66–3.41)	.331				
Clinical										
Baseline work role functioning	1.04 (1.02–1.05)	.000	1.03 (1.01–1.04)	.001	1.02 (1.01–1.04)	.007	1.02 (1.01–1.04)	.005	1.03 (1.01–1.05)	.000
Obesity	0.50 (0.25–1.00)	.052	.47 (.20–1.09)	.077	0.54 (0.23–1.26)	.153				
Baseline hand/wrist symptoms	1.75 (0.78–3.93)	.173	4.28 (1.44–12.76)	.009	4.60 (1.49–14.17)	.008	2.24 (0.85–5.89)	.101		
Physical health status	4.15 (1.79–9.64)	.001	2.69 (1.01–7.16)	.048	3.18 (1.18–8.61)	.023	2.51 (0.86–7.37)	.094		
Bilateral carpal tunnel symptoms	0.56 (0.29–1.06)	.075	0.58 (0.26–1.28)	.177						
Psychosocial										
Depression	0.37 (0.19–.76)	.006	0.46 (0.22–0.98)	.043	0.37 (0.15–.89)	.027	0.32 (0.14–0.74)	.008	0.50 (.024–1.07)	.073
Family social support	2.50 (0.89–6.99)	.081	1.71 (0.56–5.24)	.348						
					ORGANIZATION MODEL					
Economic/legal										
Workers' compensation claimant	0.21 (0.10–.41)	.000	0.21 (0.10–0.41)	.000	0.27 (0.12–.58)	.001	0.30 (0.14–0.66)	.003	0.25 (0.13–0.51)	.000
Job										
High physical work demands	0.40 (0.18–.88)	.023	0.48 (0.20–1.12)	.088	0.61 (0.26–1.41)	.245				
Job control	2.06 (1.22–3.45)	.006	1.58 (0.87–2.90)	.135	1.19 (0.58–2.44)	.642				
High work-related social support	1.79 (0.93–3.47)	.083	1.42 (0.69–2.92)	.345						
Organizational										
Supportive organization	2.92 (1.49–5.70)	.002	2.92 (1.49–5.70)	.002	1.84 (0.76–4.46)	.177	1.44 (0.67–3.09)	.349		

Combined model n = 121; McKelvey Zavonia R^2 = 0.43; Brant test for non-proportionality χ^2 (6) = 3.93.
P > .05.

TABLE 4
Distribution of Baseline and Two-Month Predictors of Work Role Functioning at Six Months Following Carpal Tunnel Surgery Across Outcome Categories (N = 122)

	6 Month Work Role Functioning		
Predictors: Baseline, Change (2m-b)	0 % (n)	1 % (n)	2 % (n)
Baseline Work Role Functioning§	15.6 (19)	26.2 (32)	58.2 (71)
Income†			
<30k	64.7 (11)	50.0 (15)	31.4 (22)
>30k	35.3 (6)	50.0 (15)	68.6 (48)
Obesity*			
Obese	44.44 (8)	63.0 (17)	27.3 (18)
Not obese	55.56 (10)	37.0 (10)	72.7 (48)
Baseline hand/wrist symptom severity			
High	16.67 (3)	17.9 (5)	17.9 (12)
Low	83.33 (15)	82.1 (23)	82.1 (55)
Hand/wrist symptom severity change*			
No improvement	50.0 (9)	17.9 (5)	19.4 (13)
Any improvement	50.0 (9)	82.1 (23)	80.6 (54)
Musculoskeletal pain sites‡			
Less than 2	68.4 (13)	87.50 (28)	88.6 (62)
Greater than or equal to 2	31.6 (6)	12.50 (4)	11.4 (8)
Physical health status†			
Low	89.5 (17)	90.6 (29)	62.0 (44)
High	10.5 (2)	9.4 (3)	38.0 (27)
Bilateral carpal tunnel symptoms‡			
No	47.4 (9)	25.00 (8)	56.3 (40)
Yes	52.6 (10)	75.00 (24)	43.6 (31)
Baseline self-efficacy			
Low	66.7 (12)	65.5 (19)	59.7 (40)
High	33.3 (6)	34.5 (10)	40.3 (27)
Self efficacy change§			
No improvement	75.0 (12)	44.4 (12)	12.9 (8)
Any improvement	25.0 (4)	55.6 (15)	87.1 (54)
Depression†			
Not depressed	52.3 (10)	53.1 (17)	78.6 (55)
Depressed	47.4 (9)	46.9 (15)	21.4 (15)
Family social support*			
Low	26.3 (5)	10.0 (3)	5.7 (4)
High	73.7 (14)	90.0 (27)	94.3 (66)
Workers' compensation claimant*			
No	31.6 (6)	31.2 (10)	53.5 (38)
Yes	68.4 (13)	68.6 (22)	46.5 (33)
Attorney*			
Did not hire attorney	68.4 (13)	96.9 (31)	93.0 (66)
Hired attorney	31.6 (6)	3.13 (1)	7.04 (5)
Physical work demands†			
Low	42.1 (8)	68.6 (22)	76.1 (51)
High	57.9 (11)	31.2 (10)	23.9 (16)
Job control§			
Low	42.1 (8)	12.5 (4)	4.2 (3)
Medium	42.1 (8)	65.6 (21)	60.6 (43)
High	15.8 (3)	21.9 (7)	35.2 (25)
Work-related social support†			
Low	79.0 (15)	61.3 (19)	44.9 (31)
High	21.0 (4)	38.7 (12)	55.1 (38)
Organizational policies and practices§			
Low support	73.7 (14)	56.2 (18)	23.9 (17)
High support	26.3 (5)	43.8 (14)	76.1 (54)

‡ $P < 0.10$ on χ^2 test for trend.
* $P < 0.05$ on χ^2 test for trend.
† $P < 0.01$ on χ^2 test for trend.
§ $P < 0.001$ on χ^2 test for trend.

WRF ($r = -0.03$, $P > 0.05$). A supportive organization was correlated with high job control ($r = 0.63$, $P < 0.05$).

Discussion

In the context of a community-based patient cohort undergoing CTRS, this study prospectively examined the relative significance of clinical, worker, family, economic/legal, job, and organizational factors in a worker's return to successful WRF. Unlike prior research, which has focused on either the fact of return to work or time until return to work, this research introduced a new outcome measure capturing how well a patient functions in the job. As hypothesized, clinical (baseline WRF), worker (depression), and economic/legal (being a workers' compensation claimant) factors were significant predictors of short-term (2 months) WRF. Functioning well in the work role before CTRS predicted successful WRF at 2 months post-CTRS, whereas either being depressed or being a workers' compensation claimant predicted not functioning well or being out of work. Improved self-efficacy predicts successful WRF at 6 months. As expected, employment conditions (working in a highly supportive organization) were important predictors of successful WRF at 6 months post-CTRS. Thus, this research underscores the importance of addressing nonclinical factors in improving work role functioning after a clinical intervention such as CTRS.

The study results suggest a set of presurgery factors identify patients who could be at risk for unsuccessful return to work. These patients could require the provision of timely and continuing supports to facilitate their successful recovery and work retention. The finding that some factors are more important in the short-term, whereas others are more important at 6 months suggests a time dependency in the predictors of the process of return to successful work role functioning. A similar time depen-

TABLE 5

Full Models for Individual and Environmental Predictors of Six-Month Successful Work Role Functioning (n = 122)

	Predictors of Successful Return to Work									
	Univariate Models		Category Models		Individual Organization Models		Combined Model		Reduced Model	
					INDIVIDUAL					
	Odds Ratio (95% CI)	*P*-value ≤ .25	Odds Ratio (95% CI)	*P*-value ≤ .10	Odds Ratio (95% CI)	*P*-value ≦ .10	Odds Ratio (95% CI)	*P*-value ≦ .10	Odds Ratio (95% CI)	*P*-value ≦ .05
Demographics										
Income	2.78 (1.33–5.85)	.007	2.78 (1.33–5.85)	.007	2.11 (0.83–5.41)	.119				
Clinical										
Baseline work role functioning	1.04 (1.03–1.06)	.000	1.04 (1.02–1.06)	.000	1.03 (1.01–1.05)	.005	1.04 (1.02–1.05)	.000	1.04 (1.02–1.05)	.000
Obesity	0.38 (0.18–0.80)	.012	.60 (.22–1.64)	.316						
Baseline hand/wrist symptom severity	0.92 (0.35–2.43)	.868	1.53 (0.46–5.04)	.488	2.19 (.046–10.47)	.327				
Change hand/wrist symptoms	2.40 (0.93–6.20)	.071	3.34 (1.09–10.21)	.034	2.20 (0.59–8.25)	.244				
Musculoskeletal pain sites	.42 (0.15–1.23)	.115	.28 (0.07–1.08)	.065	0.20 (0.06–0.62)	.006	0.37 (0.09–1.46)	.156		
Physical health status	5.43 (1.86–15.79)	.002	4.55 (1.22–16.96)	.024	7.90 (0.99–62.99)	.051	1.95 (0.49–7.75)	.345		
Bilateral carpal tunnel surgery	0.47 (0.22–1.01)	.053	1.14 (0.39–3.31)	.807						
Psychosocial										
Baseline self-efficacy	2.06 (0.80–5.28)	.133	1.62 (0.59–4.46)	.353	1.02 (0.35–2.93)	.977	0.86 (0.32–2.32)	.770	0.96 (0.36–2.62)	.943
Self-efficacy change	10.44 (4.17–26.17)	.000	10.08 (3.72–27.30)	.000	9.18 (2.92–28.89)	.000	7.11 (2.47–20.46)	.000	7.82 (2.85–21.45)	.000
Depression	0.34 (0.17–0.72)	.004	0.38 (0.16–0.93)	.035	0.45 (0.14–1.47)	.185				
Family social support	3.91 (1.13–5.77)	.031	1.49 (0.31–7.10)	.615						
					ORGANIZATION MODEL					
Economic/legal										
Workers' compensation claimant	0.25 (0.20–0.88)	.086	0.46 (0.22–1.19)	.047	0.64 (0.28–1.44)	.277				
Hired attorney	0.42 (0.05–1.21)	.022	.31 (0.06–1.53)	.151						
Job										
High physical work demands	0.38 (0.17–0.84)	.016	0.51 (0.22–1.19)	.120						
Job control	3.07 (1.54–6.14)	.001	2.30 (1.01–5.20)	.046	1.98 (0.28–4.33)	.088	.91 (0.34–2.39)	.844		
High work-related social support	2.77 (1.33–5.77)	.006	1.86 (0.82–4.20)	.136						
Organizational										
Supportive organization	5.37 (2.52–11.44)	.000	5.37 (2.52–11.44)	.000	3.87 (1.66–9.04)	.002	5.20 (1.68–16.05)	.004	4.84 (1.88–12.46)	.001

Combined Model n = 104; McKelvey Zavonia $R^2 = 0.56$; Brant test for non-proportionality χ^2 (7) = 7.83.
$P > .05$.

dency model has been developed for low back injuries.[47,48] Although depression and being a workers' compensation claimant were found to be important only early in the recovery process, prior research in Maine found both were important at 6 months.[17] Research in California found no effect for either depression or workers' compensation claim status at 18 months follow up in a population in which not all workers with CTS underwent surgery.[22] In a subanalysis, time until return to work in California workers undergoing CTRS, workers' compensation claim status predicted slower return to work.[21] The small sample of surgical CTS patients ($n = 59$) makes it difficult to compare results between the 2 studies as does the different outcome measures and study end points. Although the lack of a financial incentive to return to work when receiving income replacement could explain the observed workers' compensation effect, wage replacement was at 80% of the workers' take home income and income was not significant in multivariate models.[49,50]

Self-employed workers without workers' compensation coverage could have greater motivation to return to work. Those self-employed without workers' compensation coverage represent a small part of our sample ($n = 11$). Our results do not change when these workers are removed from the analysis.

This study highlights the importance of improving self-efficacy and creating supportive organizations in maintaining successful work role functioning. Self-efficacy is generally defined as confidence in being able to carry out a set of specified activities. It is presumed to be a consequence of the interplay of the employment situation, the medical care process, and the individual worker's health and personal characteristics. Numerous studies have shown self-efficacy to be important in chronic disease management. Although Faucett found no effect for self-efficacy on work status at 18 months follow up these data support its significance in return to work and successful work role functioning.[22,51] Differences in study design, namely our inclusion of postsurgical improvement in self-efficacy, could explain these different conclusions. Additionally, although we modified the same Stanford self-efficacy pain scale as Faucett, our modifications could have differed because we focused exclusively on pain management in return to work. Given the success of programs designed to improve self-efficacy among patients with chronic disease, efforts should be undertaken to evaluate whether similar interventions can improve work outcomes.[52]

Being employed by a highly supportive employer predicts successful WRF better than physical or psychosocial job conditions or providing job accommodation alone. The importance of supportive employer policies and practices that facilitate successful return to work and work functioning need to be more broadly disseminated to stimulate similar efforts by more employers. Despite the efficiency of using the supportive organization index to cumulate distinct dimensions of organizational policies and practices, this prevents measuring the effects of specific organizational policies and practices. For example, one important aspect of a supportive organization for back injuries is providing modified work to facilitate return to work.[53] Although this variable is included as one of the disability management items in the supportive organization index, its specific impact cannot be assessed using the 8-item measure. One solution is to develop a set of valid and reliable measures for each organizational policy and practice. A 26-item questionnaire that measures people-oriented culture, active safety leadership, safety diligence, disability management, and ergonomics policies and practices is available (contact the first author). Twenty-two patients reported changing jobs from baseline to 6 months, indicating the need for work modifications. Whether this is the result of being in a supportive or nonsupportive organization cannot be identified in this research.

This study used self-reported physical and psychosocial job exposure measures similar to other research in which significant effects were found.[18,21,22] However, because these job conditions are strongly related to organizational policies and practices, they did not advance to the final multivariate models. Certainly, organizational conditions shape job condition variability and job accommodation practices, so the absence of job-specific effects should be considered in this organizational context. Twenty-one patients reported that their requests for job accommodation were refused. Although this is not captured in the model, active nonsupport by the organization could be an equally important predictor of less successful WRF. Organizational policies and practices could be a better indicator of workplace factors important for supporting successful work functioning than specific job conditions. Because our outcome measure represents work role-related functioning, adjusting for baseline levels could reduce the likelihood of job conditions entering the model. We replicated our model-building process with baseline work role functioning removed and did not find any new effects for job conditions (data available from the first author). These findings should be confirmed in future research using multilevel designs to disentangle the mechanisms through which these organizational factors effect work role functioning. In regard to employer size, other research has found contradictory effects that could result from a different mix of employers and organizational policies and practices in each sample.[22,23]

Strengths of this study include: 1) its prospective design with data on early and longer-term post surgery work status, 2) a community-based patient recruitment strategy, 3) a new approach to measuring successful work role functioning rather than simply the fact of return to work, 4) a multidimensional model of the determinants of successful work role functioning, and 5) a new measure of organizational policies and practices. The study limitations are the small sample size and the lack of certain postsurgery clinical data (eg, distal nerve latency) that could be important. The limitations of using single item indicators to measure complex factors could have led to underestimating their effects. However, this efficient measurement model enabled the study to consider simultaneously the effects of a more holistic set of variables on an outcome that is clearly influenced by a wide range of factors as urged by Battie, Bigos and Frank.[54,55] Recruitment of patients from physician offices can lead to selection bias problems. However, in earlier research in Maine using the same patient recruitment strategy, study participants were comparable to the population of CTS patients in Maine.[12]

Assessment of work role functioning offers the medical community new opportunities to engage in the healthcare policy debate. The use of work role functioning as an outcome provides a useful connection between individual-level research on the impact of medical care on worker performance and the broader policy analyses of the impact of medical care on the economy.

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