

Return-to-Work Trajectories Following Occupational Injury: A Competing Risks Analysis Based on the ICF Model



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Objectives

- Return to work (RTW) following occupational injury is often delayed or fails even after medical recovery is complete. Moving beyond the traditional biomedical model, this study investigates the 12-month RTW trajectories after benefit termination.
- Utilizing the WHO International Classification of Functioning, Disability and Health (ICF) framework, this study evaluates how environmental factors and the mismatch between residual functional capacity and job demands (the "double burden") affect varying RTW pathways.

Participants and Methods

- We analyzed data from 3,139 injured workers using the 3rd cohort of the Panel Study of Worker's Compensation Insurance (PSWCI). The follow-up period was set to 12 months from the date of benefit termination (claim closure).
- We estimated the cumulative incidences for overall RTW and three mutually exclusive pathways: original employer (job retention), new employer-same job, and new employer-different job (path substitution).
- Cox proportional hazards models and Fine-Gray competing risks regressions were applied, progressively incorporating physical impairment, environmental factors, and job demands.

Results

- At 12 months, the overall RTW incidence was 55.9%. Returning to the original employer was the dominant pathway (33.9%), while transitions to a new employer with the same or different job were 11.7% and 10.4%, respectively (Figure 1).
- The progressive Cox model demonstrated that adding environmental factors significantly improved the model's predictive performance and fit (C-index increased, $p < 0.001$). A maintained relationship with the employer strongly promoted RTW (HR=1.57), whereas workplace discrimination significantly hindered it (HR=0.58).
- Furthermore, the Fine-Gray model revealed that severe disability combined with high physical job demands drastically reduced the incidence of returning to the original employer (SHR=0.41), confirming a significant 'double burden' effect. Extended care duration (>12 months) and non-regular employment shifted the workers' trajectories from job retention to 'path substitution' toward new employers (Table 1).

Conclusions

- RTW is not merely a product of medical cure but a dynamic, ecological process dependent on the fit between a worker's residual capacity and their environmental/job demands (Figure 2).
- The findings underscore the critical need to shift from retrospective impairment compensation to an integrated policy approach that emphasizes early workplace accommodation, effectively mitigating the double burden and preventing involuntary path downward mobility.

Table 1. Fine-Gray competing risks regression for RTW Pathways (Model 3)

Model N = 3,139 | Observed OI: 277 | N of events: 2,862 | N of censored: 1,047

Variable	Original employer (N=1,047)		New employer (same job) (N=360)		New employer (different job) (N=862)	
	SHR (95% CI)	p-value	SHR (95% CI)	p-value	SHR (95% CI)	p-value
Personal Factors						
Age Group	Ref		Ref		Ref	
10-19	1.84 (1.26-2.68)	0.002	1.23 (0.81-1.89)	0.560	0.82 (0.51-1.32)	0.420
20-29	2.37 (1.64-3.45)	<0.001	1.20 (0.82-1.77)	0.380	0.34 (0.21-0.55)	0.000
30-39	1.79 (1.24-2.49)	0.002	1.05 (0.71-1.55)	0.310	0.41 (0.25-0.65)	<0.001
40-49	1.32 (0.95-1.83)	0.100	1.04 (0.70-1.55)	0.300	0.37 (0.23-0.62)	<0.001
≥ 50	1.22 (0.79-1.89)	0.390	0.57 (0.32-1.03)	0.190	0.27 (0.12-0.61)	<0.001
Gender	Ref		Ref		Ref	
Male	0.92 (0.74-1.09)	0.360	0.85 (0.66-1.09)	0.814	1.06 (0.74-1.53)	0.760
Female	Ref		Ref		Ref	
Education	Ref		Ref		Ref	
Middle school or less	1.58 (1.29-1.94)	<0.001	0.76 (0.58-0.99)	0.042	1.13 (0.80-1.60)	0.490
High school	1.51 (1.19-1.90)	<0.001	0.72 (0.51-1.02)	0.063	1.13 (0.81-1.60)	0.180
College or higher	Ref		Ref		Ref	
Employment Status	Ref		Ref		Ref	
Married	0.76 (0.66-0.87)	<0.001	0.71 (0.58-0.87)	0.007	1.00 (0.74-1.27)	0.990
Contract	Ref		Ref		Ref	
Work Context	Ref		Ref		Ref	
Occupation Type	Ref		Ref		Ref	
Office and professional	0.85 (0.64-1.13)	0.260	1.15 (0.85-1.56)	0.410	0.97 (0.70-1.35)	0.920
Service and sales	0.82 (0.69-0.97)	0.021	0.76 (0.51-1.13)	0.170	1.03 (0.64-1.65)	0.834
Production and manual	Ref		Ref		Ref	
Employment Status	Ref		Ref		Ref	
Regular	0.27 (0.23-0.32)	<0.001	1.64 (1.28-2.09)	<0.001	1.15 (0.89-1.49)	0.290
Non-regular (Temporary/Daily)	Ref		Ref		Ref	
Injury & Impairment						
Accident Type	Ref		Ref		Ref	
Occupational accident	1.23 (0.96-1.59)	0.100	1.02 (0.79-1.36)	0.920	1.15 (0.84-1.57)	0.220
Non-occupational accident	1.34 (1.11-1.62)	0.002	1.39 (0.99-1.94)	0.053	0.72 (0.41-1.09)	0.120
Occupational disease	Ref		Ref		Ref	
Injury Site	Ref		Ref		Ref	
Head, Face, and Neck	Ref		Ref		Ref	
Arm	0.93 (0.64-1.35)	0.610	1.20 (0.75-1.93)	0.010	1.00 (0.64-1.57)	0.200
Hand	0.88 (0.65-1.19)	0.410	1.25 (0.81-1.93)	0.140	1.04 (0.74-1.44)	0.170
Clavicle	0.90 (0.59-1.38)	0.610	1.06 (0.64-1.75)	0.800	2.05 (1.11-3.81)	0.190
Lower back	0.60 (0.46-0.84)	0.002	1.17 (0.81-1.67)	0.310	1.11 (0.84-1.47)	0.220
Upper back	0.64 (0.36-1.13)	0.120	1.01 (0.65-1.57)	0.230	1.72 (1.04-2.82)	0.450
Hip	0.96 (0.71-1.31)	0.810	1.17 (0.86-1.61)	0.007	1.01 (0.71-1.46)	0.220
Leg	0.99 (0.71-1.37)	0.950	1.51 (0.75-2.24)	0.170	1.76 (0.97-3.19)	0.220
Foot	1.12 (0.64-1.96)	0.690	0.37 (0.12-1.04)	0.480	2.89 (1.73-4.89)	0.140
Other	Ref		Ref		Ref	
Disability Grade	Ref		Ref		Ref	
Mild or None	1.20 (1.04-1.37)	0.016	0.80 (0.61-1.05)	0.100	0.87 (0.64-1.18)	0.360
Moderate	1.37 (0.85-2.19)	0.200	0.63 (0.36-1.09)	0.450	0.17 (0.01-1.20)	0.002
Severe	Ref		Ref		Ref	
Pain Frequency	Ref		Ref		Ref	
Fewer or None	0.84 (0.72-0.99)	0.012	1.09 (0.84-1.41)	0.110	1.22 (0.91-1.60)	0.160
Several times a week	0.74 (0.64-0.87)	<0.001	0.79 (0.60-1.02)	0.100	0.99 (0.73-1.32)	0.920
Daily or Always	Ref		Ref		Ref	
Case Duration	Ref		Ref		Ref	
≤ 3 months	0.60 (0.34-1.07)	<0.001	1.11 (0.74-1.64)	0.620	1.09 (0.92-1.40)	0.097
3-6 months	0.66 (0.38-1.12)	<0.001	1.12 (0.75-1.67)	0.180	1.09 (1.13-1.06)	0.009
6-12 months	0.44 (0.35-0.55)	<0.001	0.92 (0.37-1.47)	0.730	2.22 (1.31-3.77)	0.003
≥ 12 months	Ref		Ref		Ref	
Environmental (ICF)						
Workplace Social Support	Ref		Ref		Ref	
Sufficient support	0.54 (0.31-0.87)	0.012	1.11 (0.65-1.90)	0.710	1.17 (0.82-1.68)	0.230
Insufficient support	Ref		Ref		Ref	
Discrimination	Ref		Ref		Ref	
No discrimination	0.55 (0.37-0.84)	0.006	0.57 (0.31-1.08)	0.085	0.96 (0.59-1.64)	0.940
Experienced discrimination	Ref		Ref		Ref	
Relationship with Employer	Ref		Ref		Ref	
Discordant	2.13 (1.14-4.00)	<0.001	0.77 (0.41-1.47)	0.025	0.69 (0.34-1.41)	0.003
Maintained	Ref		Ref		Ref	
Job Demands	Ref		Ref		Ref	
Physical Job Demands	Ref		Ref		Ref	
Low physical demand	1.02 (0.96-1.20)	0.810	1.06 (0.75-1.49)	0.740	0.98 (0.69-1.40)	0.920
High physical demand	Ref		Ref		Ref	
Emotional Job Demands	Ref		Ref		Ref	
Low emotional demand	1.00 (0.82-1.22)	0.990	1.03 (0.75-1.40)	0.870	1.11 (0.81-1.51)	0.130
High emotional demand	Ref		Ref		Ref	
Interactions	Ref		Ref		Ref	
Interaction: Disability * Physical Demand	Ref		Ref		Ref	
Moderate * High physical demand	0.91 (0.74-1.11)	0.440	1.06 (0.65-1.78)	0.770	1.04 (0.62-1.75)	0.870
Severe * High physical demand	0.41 (0.23-0.74)	0.003	0.63 (0.31-1.30)	0.480	0.68 (0.46-1.01)	0.220
Interaction: Disability * Emotional Demand	Ref		Ref		Ref	
Moderate * High emotional demand	0.74 (0.53-1.02)	0.063	1.01 (0.60-1.70)	0.960	1.29 (0.91-1.82)	0.200
Severe * High emotional demand	0.53 (0.21-1.35)	0.180	0.72 (0.33-1.50)	0.490	0.41 (0.09-1.90)	0.250

Abbreviations: CI = Confidence Interval, SHR = Subdistribution Hazard Ratio.
Note: SHR < 1 indicates a lower cumulative incidence of the specific return path.
Statistical Significance: The SHR indicates the association with the competing incidence function (CIF) for a specific path, and should not be interpreted as the speed of return (cause-specific hazard rate). Furthermore, wide confidence intervals observed in interaction terms for new employer pathways are attributable to the small number of events in these specific paths.

Table 1. Fine-Gray Competing Risks Regression Analysis for Return-to-Work Pathways Within 12 Months

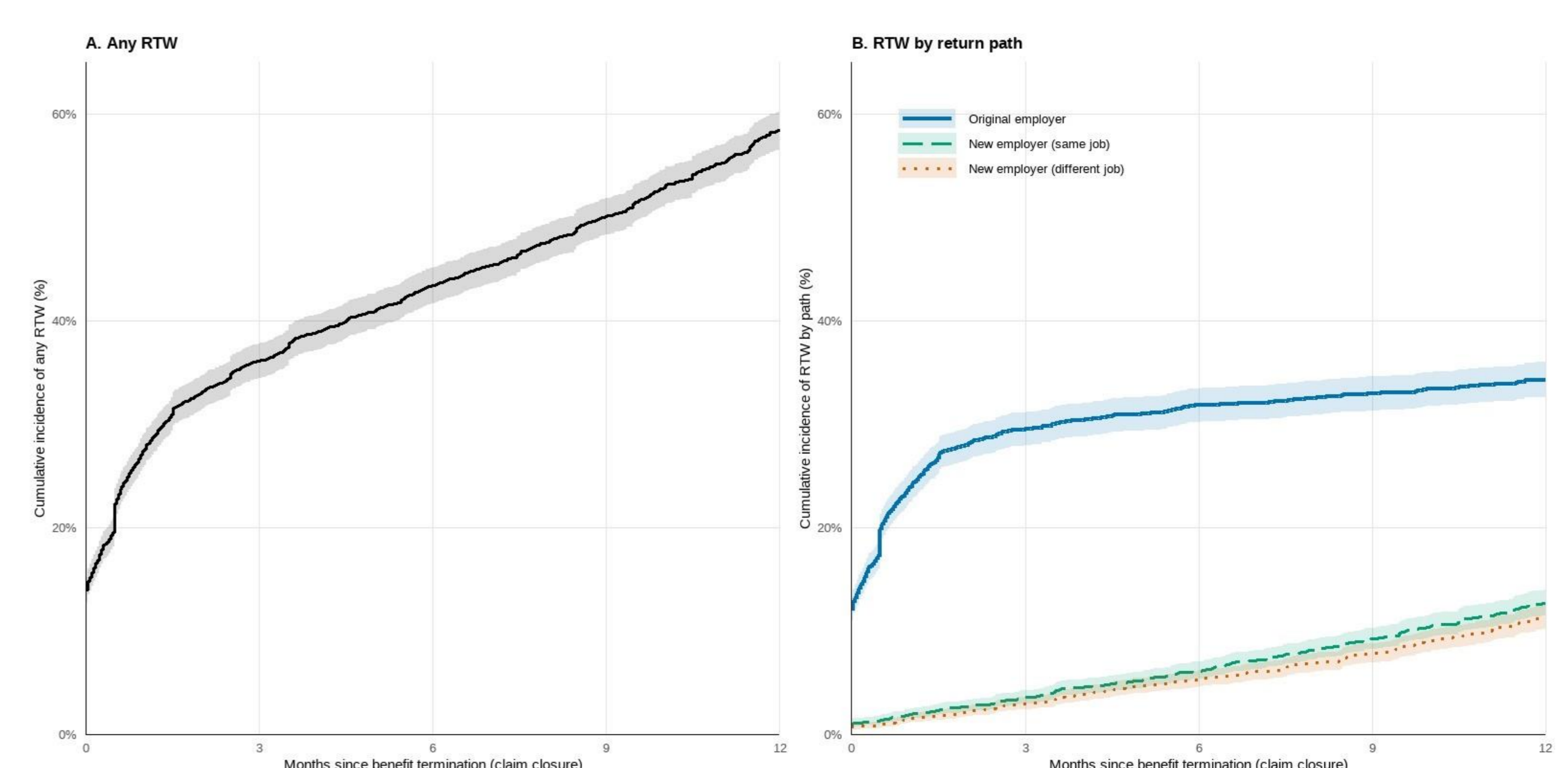


Figure 1. Cumulative Incidence of Return to Work Within 12 Months Following Benefit Termination (claim closure). (A) Cumulative incidence of any return to work (RTW). (B) Cumulative incidence of RTW by specific return pathways. Shaded ribbons indicate 95% confidence intervals. The curves in Panel B represent non-parametric cumulative incidence functions (Aalen-Johansen estimates) accounting for competing risks among the return pathways.

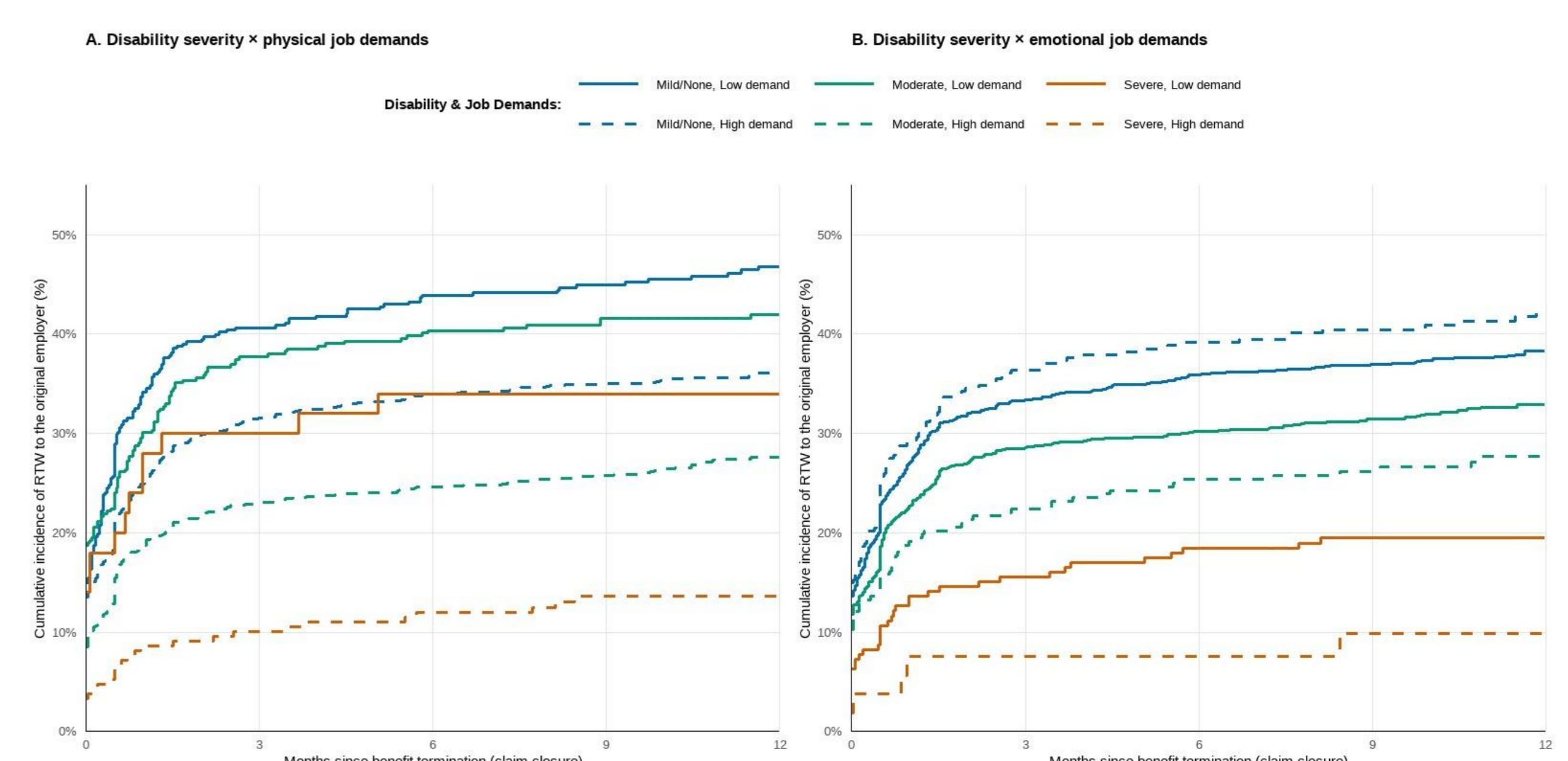


Figure 2. Cumulative Incidence of Returning to the Original Employer by Disability Severity and Job Demands. Panel A shows cumulative incidence functions (CIFs) stratified by disability severity and physical job demands; Panel B shows CIFs stratified by disability severity and emotional job demands. Time zero was benefit termination (claim closure), and follow-up was 12 months. Solid lines indicate low job demands and dashed lines indicate high job demands; colors denote disability severity.