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Transitions from Employment to Non-Employment After Return to Work: A Longitudinal Analysis in Spinal Cord injury

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Abstract

Background: Sustaining employment after returning to work (RTW) following the onset of chronic physical impairment remains challenging, as health-related limitations and changing work capacity may lead to employment exit. However, evidence on post-RTW employment transitions from a life-course perspective is limited. This study aimed to describe transitions from employment to non-employment after RTW among individuals with spinal cord injury (SCI) and to examine socio-demographic, injury-related, work-related, and policy-related factors associated with employment exit, including whether these associations varied by time since RTW and age.

Methods: We used biographical survey data from the Work-Life Study, a retrospective study investigating chronological work-life events among participants in the Swiss Spinal Cord Injury Cohort Study (SwiSCI). This study focused on working-age individuals who returned to work after SCI. Flexible parametric survival models incorporating multiple time scales were applied, with standard errors clustered at the individual level.

Results: Nearly half of individuals who returned to work (n=405) experienced at least one employment exit (n=195, 48.1%). In adjusted analyses, higher hazards of employment exit were observed among women (aHR=1.43, 95%CI:1.06-1.93), persons with lower education (p=0.02), unstable living arrangements (aHR=1.52, 95%CI:1.06–2.17), a prior history of non-employment (aHR=1.39, 95%CI:1.20–1.60), lower job match regarding interests (aHR=0.83, 95%CI:0.69–0.99), lower workplace inclusion (aHR=0.64, 95%CI:0.54–0.76), frequent sick leave due to secondary health conditions (aHR=1.17, 95%CI:1.00–1.38) and comorbidities (aHR=1.83, 95%CI:1.24–2.71), residence in the Lake Geneva region (aHR=2.32, 95%CI:1.13–4.78), and absence of a disability pension (aHR=1.54, 95%CI:1.15-2.07). Gender, sick leave due to secondary conditions or comorbidities, and prior non-employment history were not associated with employment exit immediately after RTW; however, these factors showed effects several years later. The association between frequent sick-leave due to secondary conditions and employment exit became significant from approximately 54 years of age.

Conclusions: This study identified risk factors for employment exit and critical time windows after RTW and across age. The findings highlight the need for coordinated multilevel interventions that address individual, work-related, and structural determinants of sustainable employment. Additionally, there is requirement for targeted and time-sensitive support for individuals at an elevated risk of exiting employment.

Background

Sustaining employment following return to work (RTW) after the onset of chronic physical impairment is a key goal of vocational rehabilitation, as it is associated with better physical and mental well-being, financial independence, social participation, self-esteem, and life expectancy (1–4). Maintaining employment after chronic physical impairment differs fundamentally from employment challenges in the

general population, as sudden-onset conditions such as spinal cord injury (SCI) often cause an abrupt disruption of individuals' work trajectories (5). This disruption may require substantial adaptation of vocational roles, interrupt established career pathways, and necessitate reassessment of professional goals and functional capacities (5, 6). Following initial RTW, individuals frequently experience a transition from employment to non-employment (i.e., *employment exit*) (7), indicating persistent challenges in sustaining employment across the life course. Understanding these transitions requires a life course perspective and consideration of the complex interplay between socio-demographic, health-related, work-related, and policy-related factors to inform timely and individualized interventions supporting long-term employment.

SCI can serve as a case in point for understanding these employment transitions across the life course. Following SCI, diminished work capacity and accumulating secondary health conditions may compromise sustained employment over time. RTW rates among individuals with SCI are often higher than point-in-time employment rates (8–10), suggesting that individuals may experience employment exits over the course of their working lives (11, 12). Preventing involuntary employment exit is both an individual socio-economic concern and a population-level public health priority, as employment reduces dependence on social security systems and contributes to broader social determinants of health at the socio-economic, cultural, and environmental levels (1, 2, 13). RTW after SCI marks a pivotal initial transition (14), but it is rarely the endpoint of the vocational trajectory, as individuals may move in and out of employment throughout their working lives. Such employment transitions are shaped by a complex interplay of socio-demographic (e.g., gender) (11, 15), health- and injury-related (e.g., secondary conditions) (16, 17), work-related (e.g., person-job fit) (8, 11) and policy-related factors (e.g., changes in disability policies) (16, 17). Their effects may vary over time since RTW and with age, with employment exit potentially more likely during the adjustment period immediately after RTW and later in life as health-related limitations accumulate (10, 18). Understanding when and for whom the risk of employment exit is elevated is therefore critical for developing targeted and timely vocational integration interventions.

Although substantial research has examined factors associated with employment among individuals with SCI (8, 19, 20), no study has investigated employment exit after RTW from a life course perspective. Among the few studies examining the topic, most have assessed employment exit over short follow-up periods (11), relied on small and potentially biased samples (16), or used purposive sampling restricted to individuals who had already exited post-SCI employment (17). A recent scoping review identified factors associated with sustained employment after SCI, but relied primarily on qualitative studies and lacked longitudinal evaluation of employment exit (15). Therefore, this study aims to describe transitions from employment to non-employment after RTW following SCI over the life course and to examine socio-demographic, injury-related, work-related, and policy-related factors associated with employment exit, including whether these associations vary by time since RTW and age.

Methods

Study design, setting and sample characteristics

This study used data from a Biographical Survey, a nested study embedded in the Work-Life Study. The Work-Life Study is a retrospective study investigating chronological work-life events among participants of the Swiss Spinal Cord Injury Cohort Study (SwiSCI) (21, 22). An Integrated Knowledge Translation (IKT) approach was applied, involving key stakeholders throughout all phases of the project. Detailed information on eligibility criteria, recruitment procedures, study participants, and data collection strategies of the Biographical Survey is provided in the Work-Life Study protocol (21). The Biographical Survey collected retrospective life history information, including a detailed employment history and phases of non-employment (i.e., unemployment, timeout, volunteering activities, parental leave and family care), as well as historical information on educational, social, and health-related domains.

SwiSCI is a population-based cohort study that includes Swiss residents aged 16 years or older with acquired traumatic or non-traumatic SCI. The cohort comprises a retrospective medical record study, an inception cohort collecting information during the first year after SCI onset, and periodic community surveys conducted every 5 years. Detailed descriptions of the SwiSCI study design have been published previously (22–24).

The present study focused on working-age individuals who had returned to work after SCI onset and used time-to-event analysis to investigate subsequent transitions from employment to non-employment. In Switzerland, the statutory working age is defined as 16–64 years for women and 16–65 years for men.

Measures

Outcome

Employment exit, defined as a transition from employment to non-employment, was operationalized as at least two consecutive months in a non-employment phase following RTW within the working-age period. Non-employment phases encompassed unemployment, non-paid vocational training, non-remunerative activities (e.g., timeout or volunteering), economic inactivity, early retirement, and unspecified periods of non-employment. Individuals who remained continuously employed after RTW were classified as not experiencing a transition. All employment episodes recorded after SCI and within the working-age period contributed to the time at risk. Right censoring occurred at the completion of the Biographical Survey or at the statutory retirement date, whichever occurred first. Participants reported the start and end dates of employment and non-employment phases in years and months.

Covariates

All potential predictors considered in the analysis, including their respective data sources and time-varying status, are reported in Supplementary Table 1. Covariate selection was informed by current evidence (8, 11, 15–17), the Work-Life study's conceptual framework for sustainable work (21),

consultation with rehabilitation and vocational integration experts, and input from a community panel of people with SCI. Only covariates retained in the final adjusted model are described below.

Socio-demographic covariates: Gender was categorized as men or women, and educational attainment was classified into four ordered categories: secondary education or lower, basic vocational education, advanced vocational education, and university education. Living arrangements were grouped into three categories: living alone, living with others, and repeatedly changing living arrangements. Participants self-reported their canton of residence after SCI, which were grouped into the seven major regions of Switzerland: Midland, Northwestern, Eastern, and Central Switzerland, Zurich, Ticino, and Lake Geneva (25–27). Cohabitation with children was dichotomized as yes vs. no based on participant-reported dates of residence. Time since return to work, age at RTW, and time since injury at RTW were modelled with restricted cubic splines to account for potential non-linear associations with the outcome.

Work-related covariates: Work status at SCI onset was dichotomized as working or not working. Work-related interest congruence was self-rated on a five-point Likert scale (1="not at all" to 5 ="completely"), reflecting the extent to which the job matched the participant's occupational interest. Workplace inclusion was operationalized as the mean of two need-supplies fit items assessing the extent to which participants' needs for a sense of belonging and accommodation of SCI-related needs were met at their workplace. Both items were rated on a five-point Likert scale (1 = "not at all" to 5 = "completely"). To account for lag effects of prior work history, we included prior non-employment frequency, defined as the cumulative number of non-employment phases preceding the non-employment transition, as a covariate. Employment sector, self-reported by participants, was categorized in accordance with the Swiss General Classification of Economic Activities (28) and regrouped into nine categories: manufacturing; energy supply, water supply, sewage and waste disposal and remediation; construction; hospitality/accommodation and catering; education, health and social services; financial and insurance services and real state; scientific and technical service provision; transport, telecommunication, and information technology, and other activities (agriculture and extraterritorial organizations).

Health-related covariates

SCI severity was operationalized as a composite measure combining injury completeness (complete vs. incomplete) and injury level (paraplegia vs. tetraplegia). Participants reported the onset dates of sick leave periods lasting at least three months, attributing these to secondary health conditions (SHCs) including pressure sores, urinary tract infections, respiratory tract infections, fractures, intestinal problems, pain problems, shoulder problems, autonomic dysreflexia, and others. Additionally, they associated these periods to comorbid conditions (CCs) such as cancer, diabetes, and secondary diseases, cardiovascular, mental illness, and other conditions. A binary indicator was derived to reflect whether participants had experienced any SHCs- or CCs-related sick leave. The cumulative frequency of sick leave periods was calculated as the total number of prior SHCs- or CCs-related sick leave periods per participant.

Policy-related covariates: Disability pension levels were categorized into three groups: no pension, partial pension, and full pension. Partial pensions included one-quarter, one-half, and three-quarter pensions, respectively. Calendar time was dichotomized as pre-2012 (< 2012) and post-2012 (≥ 2012) to reflect major policy reforms in the Swiss disability insurance system and the expansion of SCI-specific vocational integration measures implemented around this period (10, 29).

Analyses

All descriptive and inferential analyses were conducted using Stata (version 19.5, StataCorp LLC, College Station, TX). Descriptive statistics are presented as percentages, and transition rates to non-employment are expressed as incidence rates per 100 person-years. A multiple failure survival analysis using flexible parametric survival models, incorporating multiple timescales, was conducted using the Stata stmt command (30). Multiple events per person were accounted using clustered standard errors. Time since RTW was specified as the main timescale, while time since injury at RTW and age at RTW were incorporated as additional timescales. All timescales were modelled using restricted cubic splines with knots to account for potential nonlinear association with the outcome (30). The optimal number of knots for each timescale was determined based on the model with the lowest Akaike Information Criterion across all combinations of knots. To assess whether associations between covariates and transitions to non-employment varied over time, interactions between covariates and the timescales time since RTW and age were examined (30).

Follow-up time for time-varying covariates, including education level, living arrangements, region of residence, living with children, sick leave periods due to SHCs or CCs, disability pension level, and calendar time, was split using the Stata stsplit command (31). Missing dates were imputed using single random imputation, while missing predictor values were imputed using random forest imputation with 300 trees and five splits (32). Variable selection for predictors of transitions to non-employment was performed using the least absolute shrinkage and selection operator (LASSO) techniques. Variables retained at the optimal lambda were included in the final model. Postestimation procedures for multiple timescale models were applied to estimate predicted transition rates at selected values of the specified timescales (30).

Results

Participant characteristics and transition rates to non-employment

Of the 405 individuals who returned to work, 195 (48.1%) experienced at least one transition to non-employment during their reported post-RTW work life, with the number of employment exits per individual ranging from one to six. The most common non-employment phases were unspecified periods of non-employment (30%), early retirement (20%), non-paid vocational training (18%), unemployment

(15%), and non-remunerative activities (11%). The Kaplan-Meier event curve (Fig. 1) shows that transition rates to non-employment were highest during the first years after RTW, with a cumulative transition probability of 25% reached at approximately 4 years. A cumulative transition probability of 50% was not reached until 18 years post-RTW. The overall crude rate of transition to non-employment was 4 per 100 person-years.

Stratified analyses showed substantial variation in transition rates to non-employment across subgroups (Table 1). In particular, women, individuals in the oldest age group at RTW, those with repeated changes in living arrangements, those with frequent sick leave episodes attributable to SHCs or CCs, and those with lower work-related interest congruence and workplace inclusion had higher transition rates to non-employment than men, younger individuals at RTW, those living with others, those without SHCs- or CCs-related sick leave, and those with higher interest congruence and workplace inclusion, respectively.

Crude transition rates to non-employment across time since RTW, age, and time since injury showed a U-shaped pattern (Fig. 2). Similarly, adjusted estimates showed a U-shaped association between time since RTW and transition rates among individuals returning to work at age 20, whereas among those returning to work at age 60, the transition rates were highest during the initial period following RTW (Fig. 3).

Factors associated with transition to non-employment

In the adjusted analyses, women had a higher hazard of transitioning to non-employment than men (HR:1.43; 95% CI: 1.06–1.93) (Table 2). Similarly, individuals with repeatedly changing living arrangements had a higher hazard than those living with others (HR: 1.52; CI: 1.06–2.17). Education was overall associated with transitioning to non-employment (X^2_3=, p = 0.02), with a pattern of higher hazard among individuals with lower education levels compared with those with a university education (secondary or lower, HR:1.52; 95%CI: 0.90–2.55). Post-hoc analysis further showed that individuals with advanced vocational education had a lower hazard of transitioning to non-employment than those with lower education levels ($p < 0.05$).

Among work-related factors, greater interest congruence (HR: 0.83; CI: 0.69–0.99) and greater workplace inclusion (HR: 0.64; CI: 0.54–0.76) were associated with a lower hazard of transitioning to non-employment. A greater number of non-employment phases prior to the transition was associated with a higher hazard of transitioning to non-employment (HR: 1.39; CI: 1.20–1.60). Frequent sick leave attributable to SHCs (HR: 1.17; CI: 1.0–1.28) or CCs (HR: 1.83; CI: 1.24–2.71) was also associated with a higher hazard of transitioning to non-employment. Regions showed a marginal overall association with transitioning to non-employment (p = 0.087). The Lake Geneva region exhibited higher rate of transition to non-employment compared to other regions, particularly Central Switzerland (HR: 0.43; CI: 0.21–0.89). Finally, individuals receiving a partial disability pension (HR: 0.65; CI: 0.48–0.87) had a lower hazard of transitioning to non-employment than those receiving no disability pension.

Factors associated with transition to non-employment by time since RTW

Figure 4 illustrates the temporal variation in hazard ratios for transition to non-employment over time since RTW. The association between gender and transition to non-employment did not vary significantly over time since RTW (interaction p = 0.84), although the estimated hazard was higher among women than men between approximately 3 and 18 years post-RTW. In contrast, the associations of frequent sick leave episodes due to SHCs or CCs with transition to non-employment varied significantly over time since RTW (interaction effect, p = 0.003). The estimated hazard associated with frequent CC-related sick leave was higher from approximately 4 years post-RTW onwards, whereas frequent SHC-related sick leave was associated with a higher estimated hazard between 3 and 7 years post-RTW. The association between frequent prior non-employment phases and transition to non-employment also varied significantly over time since RTW (interaction effect: p = 0.0001), with the estimated hazard increasing particularly from approximately 4 years post-RTW onwards.

Factors associated with transition to non-employment by age

Figure 5 illustrates the temporal variation in hazard ratios for transition to non-employment over attained age. The association between gender and transition to non-employment did not vary significantly by attained age (interaction effect: p = 0.46), although the estimated hazard was higher among women than men between approximately 26 and 52 years of age. The association between frequent SHC-related sick leave episodes and transition to non-employment varied significantly by attained age (interaction effect: p = 0.03), with higher hazards observed at approximately 54 years of age and older. Similarly, the association between frequent prior non-employment phases and transition to non-employment varied significantly by age (interaction effect: p = 0.02), with higher hazards observed between approximately 20 and 50 years of age.

Table 1
Sample characteristics of individuals with and without a transition to non-employment.

Sample characteristics (missing = n [%])	Overall, n (%)	Transition to non-employment, n (%)	No transition to non-employment [a], n (%)	Crude rates of transition to non-employment per 100 person-years
Overall	405 (100)	195 (48.1)	210 (51.9)	4.1 (3.8–4.6)
Socio-demographic factors				
Gender (m = 0 [0])				
Men	297 (73.3)	138 (46.5)	159 (53.5)	3.5 (3.0–4.1)
Women	108 (26.7)	57 (52.8)	51 (47.2)	6.0 (4.9–7.2)
Nationality (m = 3[0.7])				
Non-Swiss	38 (9.5)	17 (44.7)	21 (55.3)	4.8 (3.2–7.3)
Swiss	364 (90.5)	176 (48.4)	188 (51.6)	4.1 (3.6–4.6)
Education level [b] (m = 2[0.31])				
Secondary or lower	38 (8.3)	21 (55.3)	17 (44.7)	5.0 (3.2–7.6)
Basic vocational	185 (40.5)	105 (56.8)	80 (43.2)	4.6 (3.9–5.4)
Advanced vocational	91 (19.9)	36 (39.6)	55 (60.4)	2.7 (2.0–3.7)
University	143 (31.3)	67 (46.9)	76 (53.1)	4.3 (3.5–5.3)
Age at RTW (m = 0[0])				
16–24 years	106 (26.2)	69 (65.1)	37 (34.9)	4.6 (3.9–5.5)
25–39 years	175 (43.2)	74 (42.3)	101 (57.7)	3.3 (2.7–4.0)
40–54 years	95 (16.0)	37 (39.0)	58 (61.1)	4.6 (3.4–6.1)
>=55 years	29 (71.6)	15 (51.7)	18 (48.3)	11.9 (7.2–19.8)

Sample characteristics (missing = n [%])	Overall, n (%)	Transition to non-employment, n (%)	No transition to non-employment [a], n (%)	Crude rates of transition to non-employment per 100 person-years
Living arrangement [b] (m = 23[4])				
Living alone	90 (20.7)	44 (48.9)	46 (51.1)	4.5 (3.5–5.9)
Living with others	289 (66.4)	123 (42.6)	166 (57.4)	3.4 (2.9–4.0)
Repeatedly changing living arrangements	56 (12.9)	37 (63.8)	19 (32.8)	5.8 (4.5–7.4)
Living with children [b]				
Yes	179 (36.7)	75 (41.9)	104 (58.1)	2.8 (2.1–3.6)
No	323 (64.3)	162 (50.2)	161 (49.8)	4.7 (4.1–5.4)
Geographical regions [b] (m = 31[6])				
Lake Geneva	55 (12.5)	33 (60.0)	22 (40.0)	5.1 (3.8–6.8)
Midland	103 (23.4)	51 (49.5)	52 (50.5)	3.7 (2.8–4.8)
Northwestern Switzerland	73 (16.6)	41 (56.2)	32 (43.8)	5.0 (3.7–6.6)
Zurich	80 (18.1)	44 (55.0)	36 (45.0)	5.6 (4.3–7.2)
Eastern Switzerland	63 (14.3)	29 (46.0)	33 (52.4)	3.7 (2.7–5.2)
Central Switzerland	48 (10.9)	19 (39.6)	29 (60.4)	2.4 (1.5–3.9)
Ticino	19 (4.3)	5 (26.3)	14 (73.7)	2.4 (1.2–4.6)
Work-related factors				
Pre-SCI employment status (m = 1[0.2])				
Paid work	338 (83.7)	157 (46.4)	181 (53.6)	3.7 (3.3–4.3)

Sample characteristics (missing = n [%])	Overall, n (%)	Transition to non-employment, n (%)	No transition to non-employment [a], n (%)	Crude rates of transition to non-employment per 100 person-years
No paid work	66 (16.3)	38 (57.6)	28 (42.4)	5.8 (4.6–7.3)
Work-related interest congruence [b] (m = 255[41.5])				
Not at all	9 (2.6)	7 (77.8)	2 (22.2)	29.9 (14.3–62.7)
Only a little	22 (6.4)	14 (63.6)	8 (36.4)	5.8 (2.9–11.6)
Partially	63 (18.4)	41 (65.1)	22 (34.9)	7.5 (5.3–10.4)
Mostly	151 (44.2)	88 (58.3)	63 (41.7)	3.1 (2.4–3.10)
Completely	97 (28.4)	57 (58.8)	40 (41.2)	2.6 (1.9–3.6)
Workplace inclusion [b] (m = 121[19.8])				
Not at all	7 (1.5)	5 (71.4)	2 (28.6)	64.9 (24.3–172.8)
Only a little	18 (4.0)	16 (88.9)	2 (11.1)	13.1 (7.6–22.5)
Partially	41 (9.0)	33 (80.5)	8 (19.5)	10.6 (7.1–15.9)
Mostly	150 (33.0)	80 (53.3)	70 (46.7)	4.4 (3.5–5.6)
Completely	239 (52.5)	107 (44.8)	132 (55.3)	2.3 (1.8–2.8)
Frequency of prior non-employment phases, mean (min-max)	1.4 (1–6)	1.4 (1–6)	0	9.9 (7.0–13.9)
Health-related factors				
SCI severity (m = 4[1])				
Incomplete paraplegia	161 (40.1)	77 (47.8)	84 (52.2)	4.6 (3.8–5.6)
Complete paraplegia	121 (30.2)	55 (45.5)	66 (54.5)	3.5 (2.8–4.3)
Incomplete tetraplegia	89 (22.2)	44 (49.4)	45 (50.6)	4.6 (3.6–5.9)

Sample characteristics (missing = n [%])	Overall, n (%)	Transition to non-employment, n (%)	No transition to non-employment [a], n (%)	Crude rates of transition to non-employment per 100 person-years
Complete tetraplegia	30 (7.5)	15 (50.0)	15 (50.0)	3.4 (2.2–5.3)
SCI etiology (m = 0[0])				
Traumatic	339 (83.7)	170 (50.1)	169 (49.9)	4.1 (3.6–4.6)
Non-traumatic	66 (16.3)	25 (37.9)	41 (62.1)	4.8 (3.4–6.6)
Sick leave episode related to SHCs [b] (m = 23[4.1])				
Yes	85 (18.2)	53 (62.4)	32 (37.6)	5.9 (4.3–8.2)
No	382 (81.8)	182 (47.6)	200 (52.4)	3.8 (3.3–4.3)
Sick leave episode related to CCs [b] (m = 39[5.9])				
Yes	40 (9.9)	27 (67.5)	13 (32.5)	8.3 (4.6–15.0)
No	366 (90.1)	173 (47.3)	193 (52.7)	3.8 (3.4–4.3)
Policy-related factors				
Disability pension level [b] (m = 33[6.2])				
No pension	301 (55.6)	142 (47.2)	159 (52.8)	4.9 (4.2–5.8)
Partial pension	163 (30.1)	73 (44.8)	90 (55.2)	2.8 (2.2–3.5)
Full pension	77 (14.2)	46 (59.7)	31 (40.3)	4.3 (3.2–5.9)
Calendar time [b]				
< 2012	271 (41.5)	149 (55.0)	122 (45.0)	3.2 (2.7–3.9)
>= 2012	382 (58.5)	172 (45.0)	210 (55.0)	5.1 (4.4–5.9)

[a]: Non-employment phases comprised unspecified periods of non-employment (n = 89), early retirement (n = 57), unpaid education (n = 53), unemployment (n = 43), non-remunerative activities (n = 31), economic inactivity (n = 14), and vocational integration measures (n = 2). Note that the sum across non-employment types does not equal the total N (195), as individuals can experience multiple non-employment episodes and the type of non-employment episode may vary within a person.

[b] These are time-varying covariates, and a single case may contribute to multiple cells of a given variable; therefore, cell sizes within a column may not sum up to the total N for that column.

Table 2
Unadjusted and adjusted hazard ratios for predictors of transition to non-employment

Characteristics	Unadjusted Models		Adjusted Model [a]	
	HR (95% CI)	p-value	HR (95% CI)	p-value
Socio-demographic factors				
Gender		0.001		0.020
Men	1		1	
Women	1.73 (1.24–2.41)		1.43 (1.06–1.93)	
Education level		0.36		0.018
Secondary or lower	1.04 (0.59–1.81)		1.52 (0.90–2.55)	
Basic vocational	1.03 (0.74–1.43)		1.34 (0.96–1.89)	
Advanced vocational	0.68 (0.42–1.11)		0.76 (0.49–1.18)	
University	1		1	
Living arrangement		0.047		0.057
Living alone	1.29 (0.88–1.89)		1.02 (0.70–1.49)	
Repeatedly changing living arrangements	1.65 (1.09–2.50)		1.52 (1.06–2.17)	
Living with others	1		1	
Living with children		0.37		0.76
Yes	0.87 (0.63–1.18)		0.95 (0.70–1.29)	
No	1		1	
Geographical regions		0.060		0.087
Lake Geneva	1		1	

[a]: Employment sector (NOGA classification, 9 categories) was also adjusted as a potential confounder but is not shown for brevity. The global test showed no statistically significant association with the outcome (x^2_8=10.88, p = 0.21).

Characteristics	Unadjusted Models		Adjusted Model [a]	
	HR (95% CI)	p-value	HR (95% CI)	p-value
Midland	0.63 (0.40–1.01)		0.67 (0.43–1.05)	
Northwestern Switzerland	0.89 (0.56–1.42)		0.93 (0.59–1.47)	
Zurich	1.06 (0.64–1.73)		0.97 (0.61–1.56)	
Eastern Switzerland	0.70 (0.41–1.21)		0.74 (0.45–1.21)	
Central Switzerland	0.40 (0.18–0.90)		0.43 (0.21–0.89)	
Ticino	0.55 (0.19–1.59)		0.66 (0.23–1.89)	
Health-related factors				
SCI severity		0.43		0.40
Incomplete paraplegia	1		1	
Complete paraplegia	0.79 (0.55–1.14)		1.29 (0.94–1.76)	
Incomplete tetraplegia	0.96 (0.66–1.40)		1.22 (0.85–1.74)	
Complete tetraplegia	0.75 (0.43–1.32)		1.03 (0.58–1.84)	
Work-related factors				
Pre-SCI employment status		0.026		0.41
Paid work	0.59 (0.37–0.94)		0.84 (0.56–1.27)	
No paid work	1		1	
Work-related interest congruence	0.65 (0.54–0.77)	< 0.001	0.83 (0.69–0.99)	0.038
Workplace inclusion	0.55 (0.47–0.64)	< 0.001	0.64 (0.54–0.76)	< 0.001

[a]: Employment sector (NOGA classification, 9 categories) was also adjusted as a potential confounder but is not shown for brevity. The global test showed no statistically significant association with the outcome (x^2_8=10.88, p = 0.21).

Characteristics	Unadjusted Models		Adjusted Model [a]	
	HR (95% CI)	p-value	HR (95% CI)	p-value
Frequency of sick leave episodes related to SHCs	1.28 (1.09–1.51)	0.0030	1.17 (1.0–1.38)	0.053
Frequency of sick leave episodes related to CCs	2.27 (1.64–3.15)	< 0.001	1.83 (1.24–2.71)	0.0020
Frequency of prior non-employment phases	1.56 (1.38–1.75)	< 0.001	1.39 (1.20–1.60)	< 0.001
Policy-related factors				
Disability pension level		0.035		0.010
Partial pension	0.67 (0.49–0.91)		0.65 (0.48–0.87)	
Full pension	0.94 (0.63–1.40)		0.70 (0.47–1.05)	
No pension	1		1	
Calendar time		< 0.001		< 0.001
>= 2012	1.78 (1.32–2.42)		1.70 (1.28–2.27)	
< 2012	1		1	

[a]: Employment sector (NOGA classification, 9 categories) was also adjusted as a potential confounder but is not shown for brevity. The global test showed no statistically significant association with the outcome (x_8^2=10.88, p = 0.21).

Discussion

Our study examined transitions to non-employment following RTW after SCI. Nearly half of the participants experienced an employment exit, highlighting that leaving employment is a common part of working life after RTW. However, employment exit should not inherently be viewed as negative or positive, as the meaning and experience of non-employment phases may vary substantially across individuals. At the same time, employment exits were associated with social, occupational, health-related, and policy-related factors. Women, individuals with lower educational attainment, those with unstable living arrangements, those with a history of non-employment phases, lower interest congruence or workplace inclusion, frequent sick leave due to SHCs or CCs, absence of a disability insurance pension, and residence in the Lake Geneva region were associated with a higher likelihood of employment exits. Furthermore, the associations of prior non-employment phases and SHC-related sick leave with employment exit varied by time since RTW and attained age. Together, these findings suggest

that employment transitions after RTW are shaped by a complex and dynamic interplay of individual, health-related, work-related, and policy-related factors, underscoring the importance of considering both individual circumstances and timing when supporting sustainable employment after SCI.

Socio-demographic factors

Women were more likely to exit employment than men. This association did not vary significantly over time since RTW and attained age, although the risk was higher among women than men during the middle age range showing an exception. One possible explanation is that this period may coincide with childbearing and caregiving responsibilities, which are still more often assumed by women and may contribute to employment exits. Consistent with our findings, studies in the general population have shown that women are more likely to exit employment than men (33, 34). Employment exits related to parenthood should not necessarily be viewed as undesirable outcomes but rather as transitions that may require adequate support. Flexible work arrangements and workplace accommodation, including provisions that facilitate greater paternal involvement in caregiving, may help support women's continued employment or re-entry following an employment exit. Expanding paternal leave entitlements may further contribute to a more equal distribution of caregiving responsibilities and facilitate women's re-entry into employment (35).

Lower educational attainment was associated with higher rates of employment exit compared with higher educational attainment. Previous studies in SCI have similarly found that higher educational attainment is associated with greater employment stability following SCI (15). Higher education attainment may provide individuals with a broader range of transferable skills and professional networks and may be associated with occupations that are more compatible with post-injury functional capacities, as individuals with higher educational attainment are less likely to work in physically demanding jobs (36). In contrast, individuals with lower educational attainment may be more likely to work in occupations in which reduced work capacity is more difficult to compensate for through task delegation or support from colleagues. Such occupational characteristics may increase vulnerability to employment exit.

Unstable living arrangements were also associated with a higher likelihood of employment exit. Previous studies have linked personal factors, including relationship status and living arrangements, to employment among people with SCI (37, 38). Repeated changes in living arrangements may coincide with the need to establish new routines, reorganize caregiving arrangements, or adjust to different levels of independence and support, potentially making sustaining employment more difficult. At the same time, instability in living arrangements may reflect broader instability in other areas of life, and the relationship between living arrangements and employment may therefore be bidirectional. This finding highlights the interdependence of employment and other life domains and supports vocational integration approaches that consider individuals' broader social context (39).

Regional variation in employment exit was observed, with a pattern of higher employment exit in the Lake Geneva region and a significant difference compared with Central Switzerland. Previous studies have also reported lower employment rates among people with SCI living in the Lake Geneva region (25, 26). The reasons for these regional differences remain unclear. They may relate to differences in access to SCI-specialized vocational integration services, the organization and delivery of vocational integration support, or broader differences in employment opportunities, workplace practices, and socio-economic conditions (40–42). These potential explanations were not directly examined in the present study and therefore warrant further investigation.

Work- and health-related factors: Work quality, health and employment stability

Individuals whose jobs were more closely aligned with their personal interests and who perceived themselves as included in the workplace had a lower rate of employment exit. These findings are consistent with evidence that work-related interest congruence is associated with perceived job quality (43), and that both job quality and workplace inclusion are associated with sustainable employment among people with disabilities (15, 44, 45). Work that aligns with personal interest can promote intrinsic motivation, job satisfaction, and job performance, which may in turn support sustained employment (43, 46). Workplace inclusion may similarly contribute to a sense of being valued and supported, potentially strengthening organizational commitment and facilitating sustained employment.

Frequent sick leave attributable to SHCs or CCs was associated with a higher risk of employment exit. This association was not apparent immediately following RTW but became more pronounced from approximately four years post-RTW. This temporal pattern may indicate that the implications of recurrent sick leave for employment become more apparent. Repeated absences may reflect or contribute to persistent health and functional challenges that can make sustained employment more difficult. The absence of a clear association in the early post-RTW period may also reflect an initial adjustment phase, during which periods of sick leave may be more anticipated or accommodated. Over time, however, recurrent absences may place greater demands on employees and increase frustration and loss of acceptance of the employees' problems among employers, potentially increasing the likelihood of employment exit. These mechanisms were not directly assessed in the present study and therefore remain hypotheses for future research. The association between SHC-related sick leave and employment exit also varied by attained age, with higher hazards observed from approximately age 54 onwards. This finding is consistent with evidence that SHCs tend to increase or worsen with age among people with SCI (47). Similarly, studies in the general population show that people with health problems are more likely to exit employment (i.e., retire early) (48, 49).

A history of frequent non-employment phases significantly increased the hazard of employment exit, with the association becoming more pronounced several years after RTW. The absence of a clear association immediately following RTW may reflect an initial period of adjustment, during which individuals may test their work capacity and adapt to a new or resumed job. Over time, recurrent non-

employment episodes may signal or compound underlying vulnerabilities, including health instability, reduced self-efficacy, weakened occupational identity, or insufficient continuity of support (50–53). Therefore, the temporal pattern suggests that previous employment instability may become increasingly relevant to subsequent employment retention over the longer term.

Policy-related factors: Disability pension

Individuals receiving a partial disability pension were less likely to exit employment than those receiving no disability pension. This finding is consistent with a Swiss study, which found that receipt of disability insurance benefits was associated with a 32% higher likelihood of part-time work and decreased the likelihood of full-time work by 35% (54). Together, these findings suggest that disability benefits may facilitate continued employment at reduced work hours rather than complete employment exit. Previous research has similarly shown higher employment among individuals receiving a partial disability pension compared to those receiving no disability pension (55).

Life-course evaluation of employment transitions following SCI is shaped by multiple concurrent temporal dimensions, including time since RTW, attained age, and time since injury. Our findings indicate that employment exit varies across these time scales, highlighting the importance of considering them simultaneously when examining employment after SCI from a life-course perspective. Previous studies have shown that age and age at SCI are associated with employment status following SCI (56–58). Increasing age, longer time since injury, and the accumulation of health-related challenges over the course of life may each contribute to employment exit. Multiple time-scale models allow these temporal dimensions to be considered jointly to address these interdependencies.

Employment exit following RTW should not be viewed as an inherently positive or negative outcome, as periods of non-employment may have different meanings depending on individual circumstances, experiences, and priorities. For some individuals, leaving employment may provide opportunities for rest, recovery, reflection, adjustment, further education, or pursuing personal goals beyond paid work (59–61). For others, phases of non-employment may reflect employment instability or difficulties sustaining work (60–62). Employment exit may also occur in the context of structural barriers, including inadequate workplace support, limited access to SCI-specialized vocational integration services, inflexible working conditions, discrimination, or limited access to appropriate employment opportunities. Such barriers may contribute to employment exit even when individuals wish to remain employed. Transitions to non-employment should therefore be understood within the broader personal, social, and structural contexts in which they occur, rather than evaluating them solely in terms of employment continuity.

Strengths and limitations

A key strength of this study is its life-course approach to evaluating transitions to non-employment, which captures the inherently dynamic nature of employment following RTW. The analytical framework appropriately adjusts for multiple temporal dimensions, including time since RTW, attained age, and time since injury, allowing for the examination of their potentially interrelated contributions to employment trajectories over the post-injury life course. Furthermore, the study adopted an IKT approach in research

design, involving vocational and integration experts, as well as a panel of individuals with SCI throughout the research process (21).

However, this study also had several limitations. First, the Biographical Survey included only surviving participants, introducing a potential survival bias. Individuals who sustained SCI and survived until the time of the survey may be healthier and remain more active in the labor market than those who did not survive. Consequently, their retrospective work-life accounts may result in an overestimation of the number of individuals who have not exited employment. Second, the reliance on retrospective self-reported employment histories of study participants is subject to recall bias, whereby participants reporting employment histories from the distant past can inaccurately recall the dates, durations, or sequences of employment episodes. Similarly, a study of older adults found lower recall accuracy for jobs held longer ago, shorter job episodes, and more complex employment histories (63). Third, self-reported employment status may be subject to social desirability bias, potentially affecting the reporting of employment and non-employment phases. Finally, condition-specific analyses of sick leave attributable to individual SHCs or CCs were not possible because of insufficient statistical power. The findings for sick leave should be interpreted with caution, as associations with employment exit may differ across types of SHCs or CCs.

Implications and future research

Our study identified groups at higher risk of employment exit and the critical time points at which this risk is highest, with implications for public health, vocational support services, and disability insurance policy. Employment exit should not be viewed as inherently positive or negative. Rather, support should focus on individuals who wish to remain employed and on identifying and addressing potentially modifiable barriers to continued employment. For example, the association between lower educational attainment and higher employment exit highlights the potential value of accessible vocational training and job adaptations for individuals who are unable to continue in their previous roles (16). In Switzerland, eligibility for disability insurance-funded retraining is contingent on holding a Swiss education qualification (64), which may limit access for some individuals with lower educational attainment. Ensuring equitable access to vocational retraining and support across the life course may therefore help create opportunities for sustained employment.

The associations between interest congruence and workplace inclusion with employment exit further point to the potential importance of work quality. Person-job matching tools could support vocational integration professionals in identifying occupations that better align with an individual's interests, abilities, and needs. In addition, regularly assessing workplace inclusion and other aspects of job quality may help identify emerging challenges and opportunities for workplace-based support (65). Similarly, frequent SHC- or CC-related sick leave may provide an opportunity to identify individuals experiencing health-related difficulties in sustaining employment, potentially in the context of excessive work demands. Monitoring recurrent sick leave as part of regular follow-up may therefore help identify individuals who could benefit from timely health, vocational, or workplace support. Future longitudinal

research should investigate the mechanisms linking sick leave, health conditions, and employment exit, as well as the periods during which interventions may be most beneficial (47).

Receipt of a partial disability pension reduces the risk of employment exit, which also has potential implications for disability insurance policy. Partial disability pensions in Switzerland are only available to individuals with a degree of disability of at least 40% (66). Individuals with a lower degree of disability may nevertheless experience reduced work capacity or difficulties sustaining employment while remaining ineligible for a partial pension. Future research should therefore examine whether existing forms of support adequately address the needs of individuals whose work capacity is reduced but who do not meet the threshold for a disability pension, particularly during periods of employment instability.

Since employment exit varies with time since RTW and attained age, vocational support should remain accessible across the life course rather than being time-bound. Age-sensitive approaches may be particularly relevant as individuals' health, functional capacities, and work demands change over time (67, 68). The multidimensionality of employment exit further calls for coordinated approaches that address individual circumstances, workplace conditions, and broader structural determinants (17).

Future research should prioritize prospective, long-term studies tracking post-SCI work-life trajectories, including both employment exits and re-entries, to better characterize employment sustainability over the life course. Such research should also examine the activities, motivations, and subjective experiences associated with periods of non-employment to clarify whether these transitions reflect personal choices, temporary circumstances, employment-related difficulties, or structural barriers. Understanding these different pathways will be important for identifying when employment exit represent desired transitions and when they may indicate difficulties in sustaining employment, and for determining what forms of support are appropriate in each context.

Conclusions

This study evaluated transition to non-employment following RTW after SCI and identified both at-risk groups and critical time windows of elevated non-employment transition risk. Higher hazards for employment exit were observed among women, individuals with lower educational attainment, or those with unstable living arrangements, those residing in the Lake Geneva Region, and individuals with a history of non-employment phases, lower interest congruence or workplace inclusion, frequent SHC- or CC-related sick leave, or no disability pension. Additionally, our findings highlighted that the risk of employment exit varies over time since RTW and across attained age, underscoring the importance of considering critical periods during which employment exit may be more likely. Together, these findings demonstrate that sustaining employment after SCI requires a life-course perspective that extends beyond the initial RTW period, supported by coordinated, multilevel approaches addressing individual, workplace, and policy-related determinants of employment retention.

Abbreviations

CI
Confidence Interval
CCs
Comorbid Conditions
HR
Hazard Ratios
RTW
return to work
SCI
Spinal Cord Injury
SHCs
Secondary Health Conditions
SwiSCI
Swiss Spinal Cord Injury Cohort

Declarations

Ethics approval and consent to participate

This study is part of the Work-Life study, which was evaluated by the Ethics Committee Northwest and Central Switzerland (EKNZ; Project-ID Req-2023-00069). This committee concluded that the Work-Life project does not fall within the jurisdiction of the Swiss Human Research Act (HRA Art. 2) and, consequently, does not necessitate ethics approval. Informed consent was obtained from all participants for their involvement in the biographical survey. All SwiSCI surveys received approval from the relevant ethics committees, specifically the Ethics Committee Northwest and Central Switzerland (lead), the Ethics Committee Lucerne, and the Ethics Committee Valais. The SwiSCI surveys were conducted in line with the ethical principles outlined in the Declaration of Helsinki. The Work-Life and SwiSCI studies were conducted under the institutional leadership of Swiss Paraplegic Research, Nottwil, Switzerland.

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

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Author Contribution

Conceptualization, design, and planning: MS, GAC, US and MWGB; Data analysis: MS; Data interpretation: MS, GAC, AM, MaSt, IEH, DV, SS, US, and MWGB; Writing first draft: MS, with support from GAC, US and MWGB; Expert vocational rehabilitation insight: AM, MaSt, DV, SS; Clinical expert: IEH; Writing review and editing: MS, GAC, AM, MaSt, IEH, DV, SS, US, and MWGB. All authors have read and agreed to the content of the manuscript

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Data Availability

Raw data are not publicly available to preserve individuals' privacy under the European General Data Protection Regulation and the Switzerland's New Federal Act on Data Protection. Data is available upon reasonable request to the first and corresponding author: mahesh.sarki@paraplegie.ch

References

1. Dean EE, Shogren KA, Hagiwara M, Wehmeyer ML. How Does Employment Influence Health Outcomes? A Systematic Review of the Intellectual Disability Literature. J Vocat Rehabil. 2018;49(1):1–13.
2. Brucker DL. Social Capital, Employment and Labor Force Participation among Persons with Disabilities. J Vocat Rehabil. 2015;43(1):17–31.
3. Reichard A, Stransky M, Brucker D, Houtenville A. The Relationship between Employment and Health and Health Care among Working-Age Adults with and without Disabilities in the United States. Disabil Rehabil. 2019;41(19):2299–307.
4. Taylor J, Avellone L, Brooke V, Wehman P, Inge K, Schall C, et al. The Impact of Competitive Integrated Employment on Economic, Psychological, and Physical Health Outcomes for Individuals with Intellectual and Developmental Disabilities. J Appl Res Intellect Disabil. 2022;35(2):448–59.
5. Gannon B, Nolan B. Disability and Labour Market Participation. 2004.
6. Wong J, Kallish N, Crown D, Capraro P, Trierweiler R, Wafford QE, et al. Job Accommodations, Return to Work and Job Retention of People with Physical Disabilities: A Systematic Review. J Occup Rehabil. 2021;31(3):474–90.
7. Collischon M, Hiesinger K, Pohlan L. Disability Onset and Labor Market Outcomes. Socio-Economic Rev. 2025;23(4):2033–64.
8. Bloom J, Dorsett P, McLennan V. Investigating Employment Following Spinal Cord Injury: Outcomes, Methods, and Population Demographics. Disabil Rehabil. 2019;41(20):2359–68.
9. Lidal IB, Huynh TK, Biering-Sørensen F. Return to Work Following Spinal Cord Injury: A Review. Disabil Rehabil. 2007;29(17):1341–75.
10. Staubli S, Schwegler U. Die Dropout-Rate Senken: In Der Schweiz Gelingt Die Berufliche Integration Von Menschen Mit Einer Querschnittlähmung Durch Job Coaching. Paraplegiker. 2022.
11. Karcz K, Ehrmann C, Finger ME, Schwegler U, Scheel-Sailer A, Trezzini B. Predicting Change in Labour Market Participation of People with Spinal Cord Injury (Sci): Longitudinal Evidence from the Swiss Sci Community Survey. Spinal Cord. 2022;60(11):996–1005.
12. Zarghami A, Fuh-Ngwa V, Claflin SB, van Der Mei I, Ponsonby AL, Broadley S, et al. Changes in Employment Status over Time in Multiple Sclerosis Following a First Episode of Central Nervous System Demyelination, a Markov Multistate Model Study. Eur J Neurol. 2024;31(1):e16016.
13. Frier A, Barnett F, Devine S, Barker R. Understanding Disability and the 'Social Determinants of Health': How Does Disability Affect Peoples' Social Determinants of Health? Disabil Rehabil. 2018;40(5):538–47.
14. Sarki M, Austin-Cliff G, Marti A, Stock M, Eriks-Hoogland I, Vozza D et al. Estimating Return to Work and Associated Factors Following Sudden Onset of Chronic Impairment: A Population-Based Study of Individuals with Spinal Cord Injury in Switzerland. Archives Rehabilitation Res Clin Translation. 2026:100676.
15. Karcz K, Trezzini B, Escorpizo R, Finger ME. Factors Associated with Sustaining Work with Chronic Spinal Cord Injury: A Scoping Review. Disabil Rehabil. 2022;44(24):7723–38.

16. Karcz K, Schiffmann B, Schwegler U, Staubli S, Finger ME. Facilitators and Barriers to Sustainable Employment after Spinal Cord Injury or Acquired Brain Injury: The Person's Perspective. Front Rehabilitation Sci. 2022;3:872782.
17. Murphy GC, Jackson MS. Barriers to Sustained Return-to-Work Reported by Those Returning to Work Post Traumatic Spinal Cord Injury Rehabilitation. Open Rehabilitation J. 2013;6:21–5.
18. Ottomanelli L, Goetz LL, Barnett SD, Njoh E, Fishalow J. Factors Associated with Past and Current Employment of Veterans with Spinal Cord Injury. J Spinal Cord Med. 2022;45(1):137–47.
19. Krause JS, Reed KS. Barriers and Facilitators to Employment after Spinal Cord Injury: Underlying Dimensions and Their Relationship to Labor Force Participation. Spinal Cord. 2011;49(2):285–91.
20. Nowrouzi-Kia B, Nadesar N, Sun Y, Ott M, Sithamparanathan G, Thakkar P. Prevalence and Predictors of Return to Work Following a Spinal Cord Injury Using a Work Disability Prevention Approach: A Systematic Review and Meta-Analysis. Trauma. 2022;24(1):14–23.
21. Schwegler U, Sarki M, Austin-Cliff G, Marti A, Brinkhof MWG. Translating Knowledge into Practical Guidance for Sustainable Employment across the Life Course of Individuals with Disabilities: Study Protocol and Cohort Profile of the Work–Life Study on Spinal Cord Injury. Disabilities. 2026;6(3):54.
22. Post MW, Brinkhof MW, von Elm E, Boldt C, Brach M, Fekete C, et al. Design of the Swiss Spinal Cord Injury Cohort Study. Am J Phys Med Rehabil. 2011;90(11):S5–16.
23. Fekete C, Gurtner B, Gemperli A, Gmünder HP, Hund-Georgiadis M, Jordan X, et al. Inception Cohort of the Swiss Spinal Cord Injury Cohort Study (Swisci): Design, Participant Characteristics, Response Rates and Non-Response. J Rehabil Med. 2021;53(2):2755.
24. Swiss Paraplegic Research. Swisci Medical Record Study 2025 [cited 2025 21/08/2025]. Available from: https://swisci.ch/en/research/study-design/medical-record-study
25. Sarki M, Schwegler U, Austin-Cliff G, Aparicio MG, Reuse C, Brinkhof MW. Evaluating the Disability Employment Gap and Its Determinants: Findings from a Population-Based Cohort Study in Spinal Cord Injury. Front Rehabilitation Sci. 2025;6:1572158.
26. Schwegler U, Aparicio MG, Staubli S, Austin-Cliff G, Brinkhof MW. Labor Market Participation of Persons with Spinal Cord Injury Living in Switzerland between 2012 and 2022: A Comparison to the General Population. Am J Phys Med Rehabil. 2024;103(11S Suppl 3):S310–8.
27. Federal Statistics Office. Fact Sheet: Major Regions 2026 [cited 2026 22/07/2026]. Available from: https://www.bfs.admin.ch/bfs/en/home/statistics/territory-environment/nomenclatures/grsreg.assetdetail.32627001.html
28. Federal Statistics Office. General Classification of Economic Activities: Kubb Coding Assistance Application 2026 [cited 2026 22/'7/2026]. Available from: https://www.kubb-tool.bfs.admin.ch/en/noga/2025
29. Nadai E, Lengwiler M. Introduction of Values and Utilization. Conventions on the Employment of People with Disabilities in the Economy and Welfare State. 2018. pp. 1–21.
30. Bower H, Andersson TM-L, Crowther MJ, Lambert PC. Flexible Parametric Survival Analysis with Multiple Timescales: Estimation and Implementation Using Stmt. Stata J. 2022;22(3):679–701.

31. Cleves MA. An Introduction to Survival Analysis Using Stata. Stata; 2008.
32. Stekhoven DJ, Stekhoven MDJ. Package 'Missforest'. R package version. 2013;1:21.
33. Theodossiou I, Zangelidis A. Should I Stay or Should I Go? The Effect of Gender, Education and Unemployment on Labour Market Transitions. Labour Econ. 2009;16(5):566–77.
34. Bhattacharya J. Indian Urban Workers' Labour Market Transitions. Indian J Labour Econ. 2023;66(2):471–94.
35. Dhungel B, Kachi Y, Kato T, Ochi M, Nagayoshi M, Gilmour S, et al. Association of Paternal Factors with Mothers' Employment Postchildbirth. J Occup Health. 2023;65(1):e12419.
36. Hess DW, Ripley DL, McKinley WO, Tewksbury M. Predictors for Return to Work after Spinal Cord Injury: A 3-Year Multicenter Analysis. Arch Phys Med Rehabil. 2000;81(3):359–63.
37. Roels EH, Reneman MF, Stolwijk-Swuste J, van Laake-Geelen CC, De Groot S, Adriaansen JJ, et al. Relationships between Type of Pain and Work Participation in People with Long-Standing Spinal Cord Injury: Results from a Cross-Sectional Study. Spinal Cord. 2018;56(5):453–60.
38. Gyawali B. Factors Associated with Return to Work after a Spinal Cord Injury: A Systematic Review and Meta-Analysis. 2023.
39. Nadai E, Canonica A. Labor Market Integration as a Newly Emerging Occupational Field. On the Formation of Professional Responsibilities; 2012.
40. Swiss Federal Audit Office. Evaluation of Retraining Measures of the Disability Insurance Switzerland; 2023.
41. Tschanz C, Rosenstein E. Swiss Disability Policies at the Crossroads? SozialpolitikCh. 2024;9(2):article 2.1.
42. Altwicker-Hámori S. Labour Market Integration of Disability Insurance Benefit Applicants in Switzerland. Evidence from Linked Survey and Administrative Data. Alter Eur J Disabil Res. 2023(17 – 1):69–86.
43. Aparicio MG, Mwake I, Ronca-Nützi M, Staubli S, Schwegler U. Perceived Job Quality among Persons with Spinal Cord Injury: The Contribution of Sociodemographic Characteristics, Health-Related Factors, and Person-Job Match. J Spinal Cord Med. 2024;47(5):733–43.
44. Finger ME, Karcz K, Schiffmann B, Staubli S, Hund-Georgiadis M, Escorpizo R. Factors Influencing Sustainable Employment of Persons with Acquired Brain Injury (Abi) or Spinal Cord Injury (Sci): A Qualitative Study Evaluating the Perspective of Health and Work Professionals. Front Rehabilitation Sci. 2023;3:906567.
45. Schiffmann B, Finger ME, Karcz K, Staubli S, Trezzini B. Factors Related to Sustainable Employment of People with Acquired Brain Injury or Spinal Cord Injury: The Employer's Perspective. Front Rehabilitation Sci. 2022;3:876389.
46. Michaelis C, Findeisen S. Influence of Person-Vocation Fit on Satisfaction and Persistence in Vocational Training Programs. Front Psychol. 2022;13:834543.

47. Jensen M, Truitt A, Schomer K, Yorkston K, Baylor C, Molton I. Frequency and Age Effects of Secondary Health Conditions in Individuals with Spinal Cord Injury: A Scoping Review. Spinal Cord. 2013;51(12):882–92.
48. Rice NE, Lang IA, Henley W, Melzer D. Common Health Predictors of Early Retirement: Findings from the English Longitudinal Study of Ageing. Age Ageing. 2011;40(1):54–61.
49. Pit SW, Shrestha R, Schofield D, Passey M. Health Problems and Retirement Due to Ill-Health among Australian Retirees Aged 45–64 Years. Health Policy. 2010;94(2):175–81.
50. Pedersen J, Gerds TA, Bjorner JB, Christensen KB. Prediction of Future Labour Market Outcome in a Cohort of Long-Term Sick-Listed Danes. BMC Public Health. 2014;14(1):494.
51. Milner A, Taouk Y, Disney G, Aitken Z, Rachele J, Kavanagh A. Employment Predictors of Exit from Work among Workers with Disabilities: A Survival Analysis from the Household Income Labour Dynamics in Australia Survey. PLoS ONE. 2018;13(12):e0208334.
52. Manzoni A, Mooi-Reci I. Early Unemployment and Subsequent Career Complexity: A Sequence-Based Perspective. J Contextual Economics–Schmollers Jahrbuch. 2011;131(2):339–48.
53. Knabe A, Rätzel S. Scarring or Scaring? The Psychological Impact of Past Unemployment and Future Unemployment Risk. Economica. 2011;78(310):283–93.
54. Müller T, Boes S. Disability Insurance Benefits and Labor Supply Decisions: Evidence from a Discontinuity in Benefit Awards. Empirical Economics. 2020;58(5):2513–44.
55. Schwegler U, Fekete C, Finger M, Karcz K, Staubli S, Brinkhof MW. Labor Market Participation of Individuals with Spinal Cord Injury Living in Switzerland: Determinants of between-Person Differences and Counterfactual Evaluation of Their Instrumental Value for Policy. Spinal Cord. 2021;59(4):429–40.
56. Marti A, Boes S, Lay V, Reuben Escorpizo P, Trezzini B. The Association between Chronological Age, Age at Injury and Employment: Is There a Mediating Effect of Secondary Health Conditions? Spinal Cord. 2016;54(3):239–44.
57. Krause JS, Kewman D, Michael J, Maynard F, Coker J, Roach MJ, et al. Employment after Spinal Cord Injury: An Analysis of Cases from the Model Spinal Cord Injury Systems. Arch Phys Med Rehabil. 1999;80(11):1492–500.
58. Hirsh AT, Molton IR, Johnson KL, Bombardier CH, Jensen MP. The Relationship of Chronological Age, Age at Injury, and Duration of Injury to Employment Status in Individuals with Spinal Cord Injury. Psychol Injury Law. 2009;2(3):263–75.
59. Ville I, Ravaud J-F, Work Values. A Comparison of Non-Disabled Persons with Persons with Paraplegia. Disabil Rehabil. 1998;20(4):127–37.
60. Fadyl JK, McPherson KM. Understanding Decisions About Work after Spinal Cord Injury. J Occup Rehabil. 2010;20(1):69–80.
61. Ville I, Winance M. To Work or Not to Work? The Occupational Trajectories of Wheelchair Users. Disabil Rehabil. 2006;28(7):423–36.

62. Denton M, Plenderleith J, Chowhan J. Retirement Decisions of People with Disabilities: Voluntary or Involuntary. QSEP Research Report; 2010.
63. Sonnega A, Al-Hinai M, Chen Q, Helppie-McFall B, Smith J. Can Retrospective Reports Provide Accurate Job History Information? A Comparison with Concurrent Reports in a National Prospective Study of Older Adults. Innov Aging. 2024;8(3):igae021.
64. EDI BSV. Circular on the Vocational Integration Measures of Disability Insurance (Ksbem). 2022; 2022 [cited 2026 11/09/2026]. Available from: https://sozialversicherungen.admin.ch/de/d/18459/download
65. Nützi M, Trezzini B, Staubli S, Ronca E, Schwegler U. An Interdisciplinary Approach to Job Matching: Developing an Occupation-Specific Job Matching Tool for Reintegrating Persons with Spinal Cord Injury into the Labor Market. Disabil Rehabil. 2020;42(16):2359–73.
66. Disability Insurance Information Center & Federal Social Insurance Office. Disability Insurance (Ai) Benefits 2024 [cited 2026 2/08/2026]. Available from: https://www.ch.ch/en/insurance/disability-insurance--di/iv/ai-/#who-is-entitled-to-receive-disability-insurance-benefits
67. Guízar-Sahagún G, Grijalva I, Franco-Bourland RE, Madrazo I. Aging with Spinal Cord Injury: A Narrative Review of Consequences and Challenges. Ageing Res Rev. 2023;90:102020.
68. Jetha A, Dumont F, Noreau L, Leblond J. A Life Course Perspective to Spinal Cord Injury and Employment Participation in Canada. Top Spinal Cord Injury Rehabilitation. 2014;20(4):310–20.

Figures

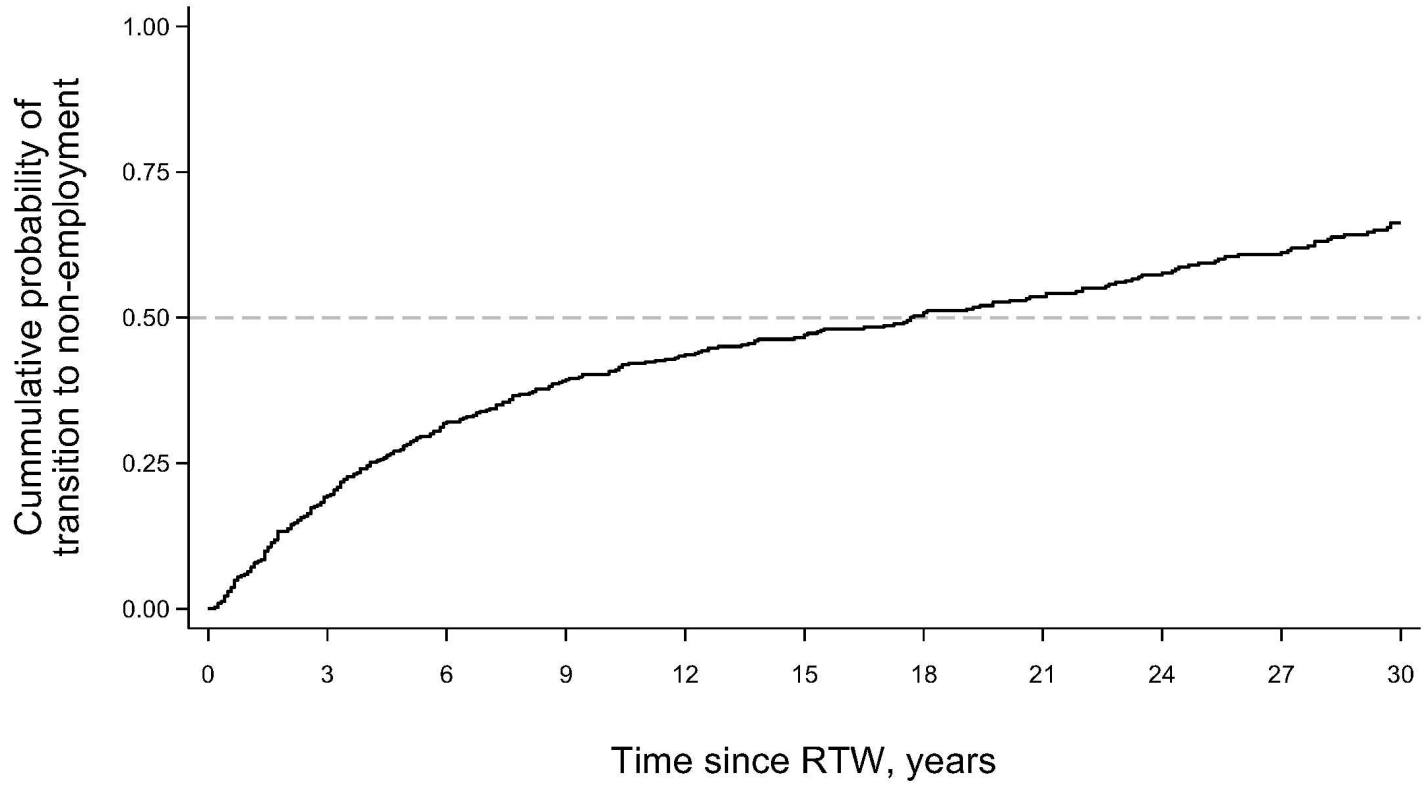

Figure 1

Figure 1

Kaplan-Meier estimate of the cumulative probability of transition to non-employment since RTW

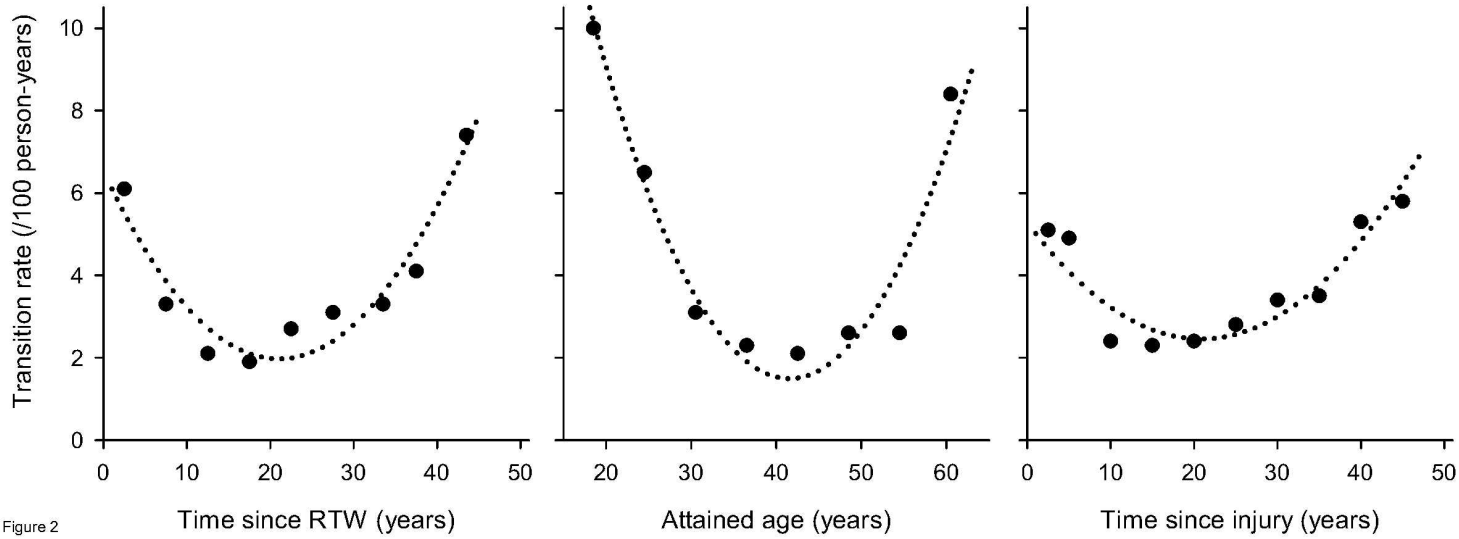

Figure 2

Figure 2

Crude rates of transition to non-employment by time since RTW, attained age and time since injury, expressed per 100 person-years. Rates were averaged over 5-year intervals and represent unadjusted

estimates that do not account for recurrent events within individuals, the other time scales (i.e., attained age and time since RTW), or covariates.

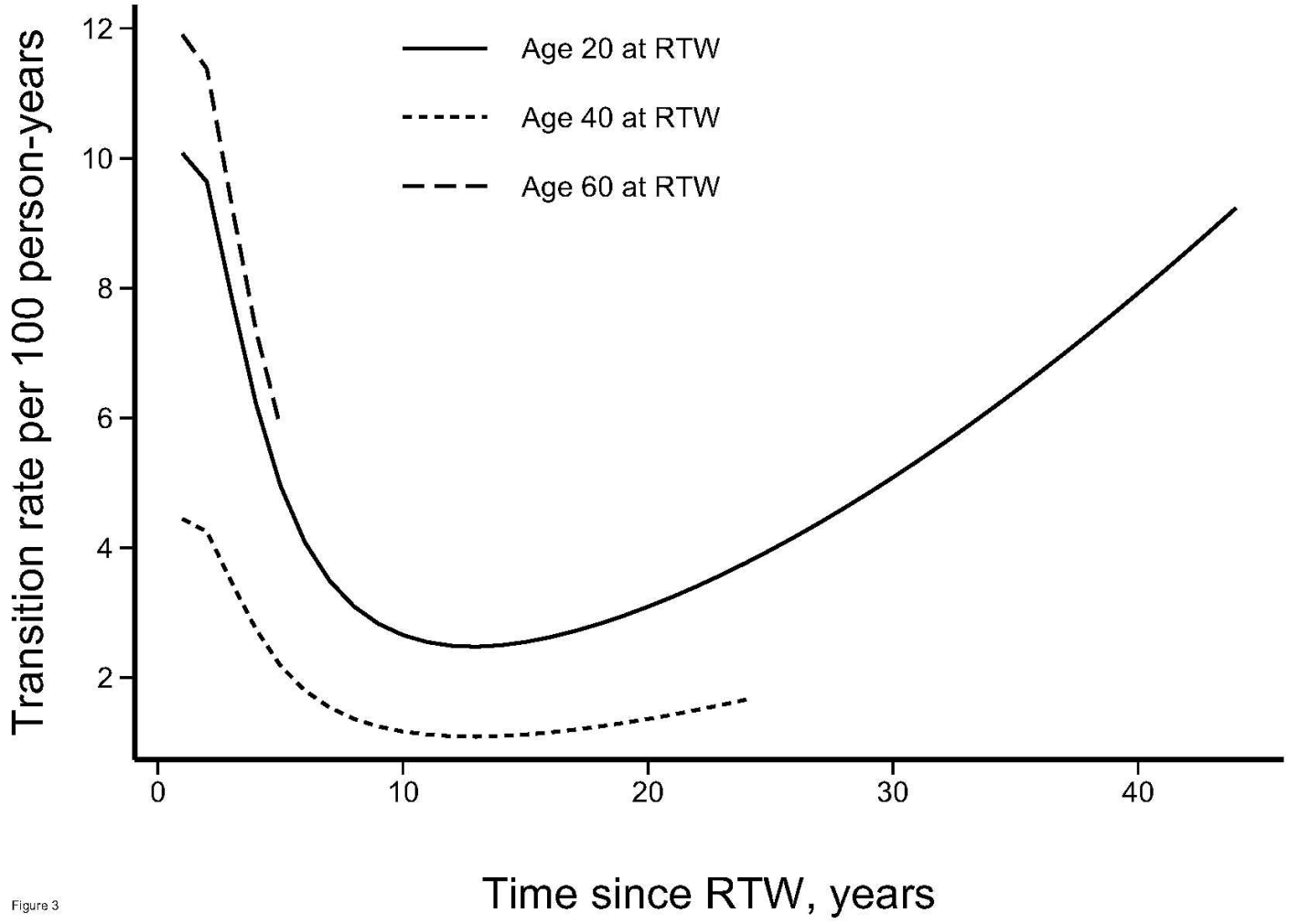

Figure 3

Figure 3

Adjusted rates of transition to non-employment per 100 person-years by time since RTW, stratified by age at RTW. Rates were adjusted for socio-demographic, work-related, health-related, and policy-related factors.

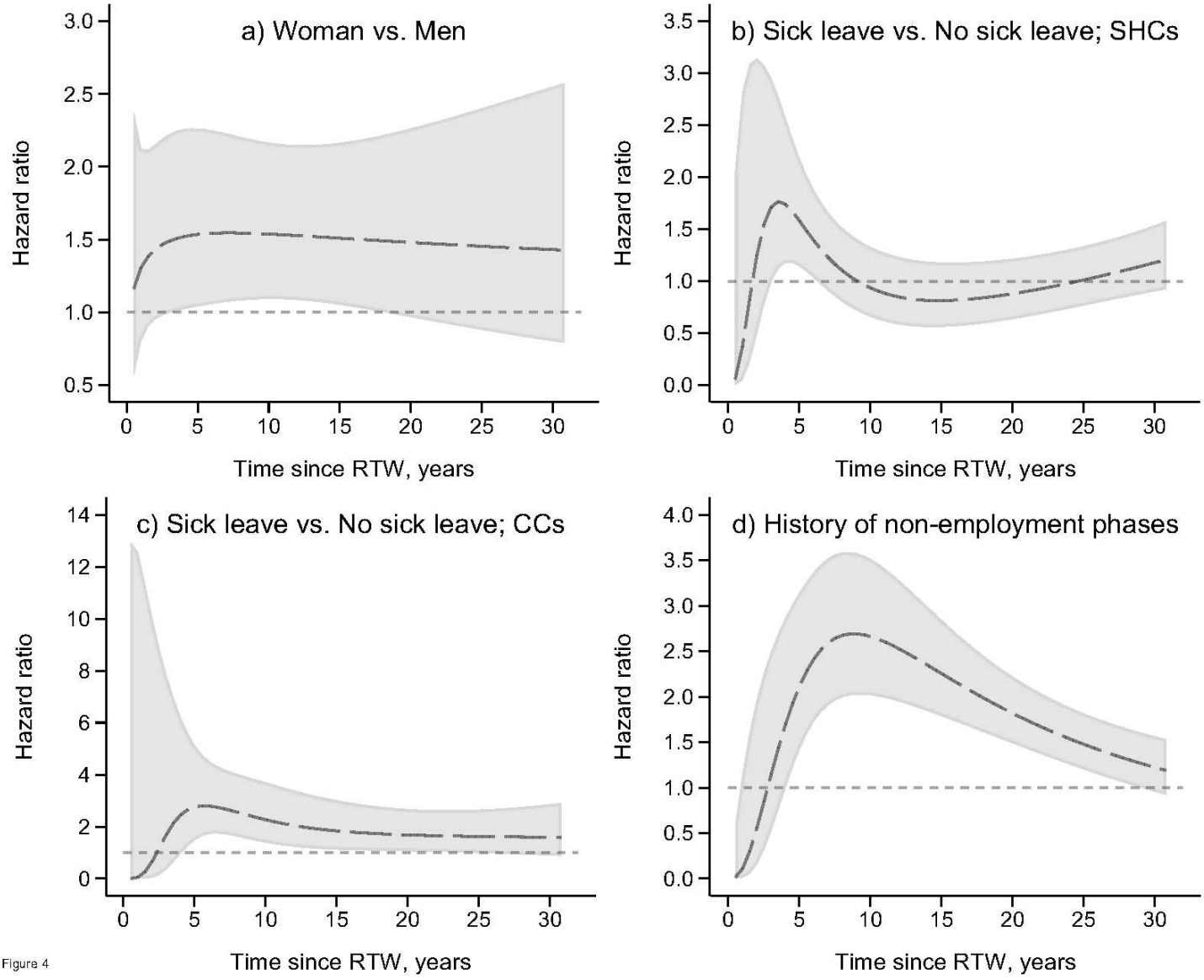

Figure 4

Figure 4

Estimated hazard ratios for transition to non-employment over time since RTW for a) women, b) those with sick leave related to secondary conditions (SHCs), c) those with sick leave related to comorbid conditions (CCs), and d) those with a history of non-employment phases.

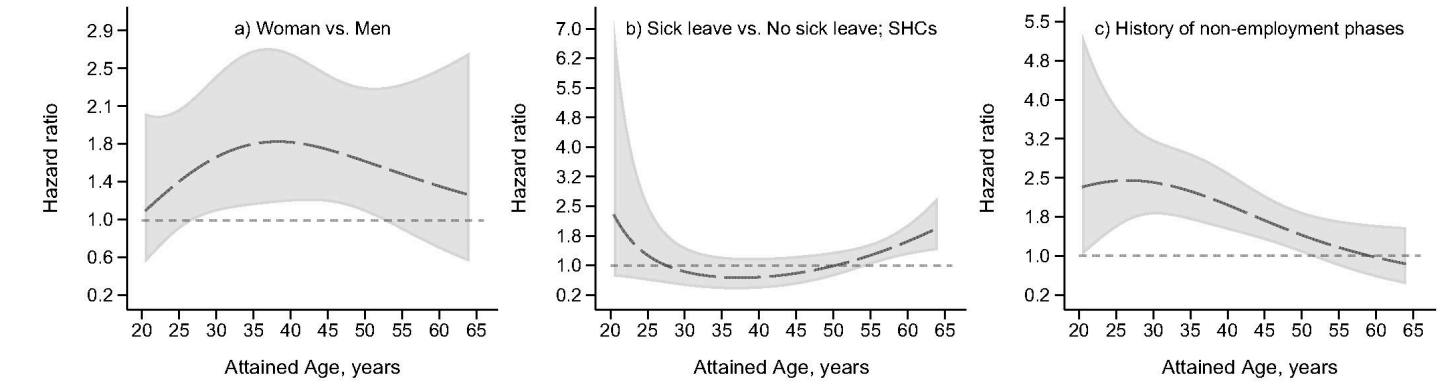

Figure 5

Figure 5

Estimated hazard ratios for transition to non-employment by attained age for a) women, b) those with sick leave related to secondary conditions (SHCs), and c) those with a history of non-employment phases.

Supplementary Files

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- SupplementaryMaterial.docx