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Return to work after traumatic spinal fractures and spinal cord injuries: a retrospective cohort study

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This study aimed to determine the factors associated with return to work (RTW) after traumatic spinal fracture and spinal cord injury. It provided a predictive model for RTW among patients with spinal fractures and spinal cord injury and determined important factors influencing the time to RTW after injury. A retrospective cohort study was conducted in Poursina Tertiary Hospital, Guilan, Iran between May 2017 and May 2020. Patients aged 18 to 65 who were hospitalized with traumatic spinal fractures and spinal cord injuries were included. Demographic and clinical data were collected from the National Spinal Column/Cord Injury Registry of Iran (NSCIR-IR). A researcher-administered questionnaire was used through a telephone interview to obtain complementary data on social and occupational variables. Kaplan–Meier survival analysis was used to estimate the average time to RTW and the predictors of RTW were determined by multivariate Cox regression model. Of the 300 patients included, 78.6% returned to work and the average time to RTW was about 7 months. The mean age of the participants was 45.63 ± 14.76 years old. Among the study variables, having a Bachelor's degree (HR 2.59; 95% CI 1.16–5.77; $P = 0.019$), complications after injury (HR 0.47; 95% CI 0.35–0.62; $P = 0.0001$), full coverage health insurance (HR 1.73; 95% CI 1.10–2.72; $P = 0.016$), opium use (HR 0.48; 95% CI 0.26–0.90; $P = 0.023$), number of vertebral fractures (HR 0.82; 95% CI 0.67–0.99; $P = 0.046$), and length of hospital stay (HR 0.95; 95% CI 0.93–0.98; $P = 0.001$) were found to be significant in predicting RTW in Cox regression analysis. Our analysis showed that wealthier people and those with high job mobility returned to work later.

Traumatic spinal fractures (TSFs) and spinal cord injuries (SCIs) are devastating conditions with a high burden of physical, emotional, and economic consequences for patients, families, and society¹. In the United States, the overall prevalence of spine fracture has been estimated to be 5.4%, increasing with age². In Iran, TSF was reported in 3.8% of trauma admissions between 1999 and 2004 using the National Trauma Registry data, and 5.8% of patients had a concurrent SCI³. Although the incidence of SCI has not changed significantly, the total number of patients with SCI is likely to be increasing due to the growth of the world's population¹. Worldwide, the average prevalence of SCI is estimated to be 1:1000, and the mean incidence is proposed to be between four and nine cases per 100,000 people per year. It varies substantially in different parts of the world. The mean incidence of SCI in developing countries is about 25.5/million/per year. The incidence of SCI in industrialized countries ranges from 15 in Western Europe to 39/million/year in the USA⁴. The annual prevalence of SCI has been reported to be ten in one million in Tehran, Iran, and more common in men and younger people⁵. In another study in Iran, TSF incidence was 16.35 (95% CI 3.4–48.0) per 100,000, and SCI was found in about half of the TSF patients⁶. The main causes of traumatic SCIs across most geographical regions are falls and road traffic accidents⁷.

The incidence of SCI peaks in young adulthood and, to a lesser extent, in old age. Recent studies showed an increase in age at the time of injury. Men are most at risk in young adulthood (20–29 years) and older age (70+).

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Women are most at risk in adolescence (15–19) and older age (60+). Studies reported a male-to-female ratio of at least 2:1 among adults⁸. In a meta-analysis, the proportion of cases with traumatic SCI in the 15–29 age group decreased from 50% (1961–1980) to 20% (2001–2020), while it increased from 9 to 35% in the 60+ age group⁹.

Since the spinal cord is the highway that allows the brain to control the rest of the body, SCIs significantly affect the patient's quality of life¹⁰. Work participation rates among people with SCI are substantially below that of the general population¹¹. The benefits of employment to a person's physical, psychological, and financial health are numerous and well documented. Employment is associated with increased social integration, better physical and mental health, and improved quality of life¹². Subsequently, worker disability and absence from the workforce are associated with significantly diminished economic, health, and psychosocial well-being¹³. RTW rates following a disability like SCI are estimated to vary from 11.5 to 74% on a global scale. Several factors are involved including differences in injury compensation, health care and support systems, legislation, as well as methodological and measurement issues¹⁴. In this study, we aimed to determine the rate of RTW after TSF/SCIs and identify the factors associated with RTW.

Materials and methods

Study design and population

This was a retrospective cohort study. The participants were TSF/SCI patients admitted to the Poursina Tertiary Hospital, Guilan Province, Iran from May 2017 to May 2020.

Patients aged between 18 and 65 years (the working-age population), hospitalized with penetrating or blunt trauma to the vertebral column were included in our study. Since January 1, 2016, the data of all TSF/SCI patients admitted to Poursina Hospital has been registered in NSCIR-IR, which is a hospital-based, and prospective observational registry of individuals who sustained TSF/SCIs¹⁵.

We extracted the patients' list and their demographic and clinical characteristics from the registry. To obtain data about social and occupational parameters, a telephone interview was conducted with each patient, so that all samples were given the same opportunity to participate in the interview.

The Exclusion criteria were as follows: (1) Patients who did not have a contact number or those who did not answer the phone after three phone calls at random hours during 2 weeks. (2) Patients whose families had reported their deaths. (3) Individuals who were not working at the time of injury (they were students, unemployed, or retired). (4) Those who did not agree to participate in the study.

Measurement

The data required for this study were collected from two sources: NSCIR-IR and telephone interview data. First, the data of the predetermined variables of NSCIR-IR were extracted. Then, a researcher-administered questionnaire was provided to collect other required data through a telephone interview. The questionnaire was given to 5 neurosurgeons and 5 neurologists to determine its validity, and the suggested amendments were applied to the questionnaire. The reliability of this questionnaire was measured by the method of internal consistency, and Cronbach's alpha coefficient was 71%.

The patients primarily answered the questions in a telephone interview, but if they did not recall the required information, a family member could help. Informed consent was obtained orally from all patients eligible for study participation. Patients' data were saved and used anonymously.

The data obtained from each source was as follows:

(1) NSCIR-IR database

Demographic factors: age, gender, marital status (single, married, widowed, and divorced), educational level (illiterate, elementary, junior high school, high school, diploma, associate graduate, bachelor, master, and uncertain).

Clinical factors: American Spinal Injury Association Impairment Scale (AIS)¹⁶, length of hospital stay, length of ICU stay, concomitant injuries (limb fracture or dislocation, burn, internal damage, and brain injury), underlying disease (hypertension, diabetes, hypothyroid, osteoporosis, and rheumatoid arthritis), neurological category (quadriplegia, paraplegia, paraparesis hemiparesis, quadriparesis, and other), number of vertebral fractures, and vertebral fracture site (cervical, thoracic, lumbar, sacral, and coccygeal).

(2) Call interview data

Social factors: sedative use (cigarette, opium, drug), insurance status (without insurance, full coverage insurance, incomplete coverage insurance), Wealth index.

Occupational factors: pre-injury occupation (housewife, daily wage worker, self-employed, government employee, private-sector employee), employment type (part-time/full-time), RTW (yes/no), time to RTW, type of RTW (return to previous job, adjusted RTW, and getting into the new job), reason for not returning to work (pain, early retirement, complications, other), job mobility (no mobility, low mobility, moderate mobility, high mobility).

Wealth index: The wealth index is based on the patient's answers to questions about owning a house and its size, type of heating system, type of television, type of sanitation, access to the smartphone, personal computer, and car, refrigerator, motorbike. Using principal component analysis (PCA), we calculate the wealth index for each household and categorize the wealth into three groups: poor, middle, and rich.

Job mobility was defined as the type of activity that is associated with a job or occupational physical activity.

Time to RTW was defined as the time interval between the injury and the first RTW. The time variable was constructed by subtracting the RTW date provided by the patient from the date of the injury as documented in the registry.

Statistical analysis

Descriptive statistics such as frequency and percentage, mean and standard deviation were used to describe the research data. The normality of the data distribution was verified using the Kolmogorov–Smirnov test. Based on RTW status, patients were divided into two groups: (1) RTW group and (2) non-RTW (NRTW) group. To compare the quantitative variables of the two groups, Independent *t* test or Mann–Whitney test was used. For the qualitative variables of the two groups, Chi-square or Fisher exact test was applied. The main variable in the analysis was the time to RTW. We performed survival analysis using Kaplan–Meier curves to estimate the average time to RTW for the whole group. Potential predictors of the time to RTW were analyzed with multivariate Cox regression. We entered all data in Stata version 14. A P-value less than 0.05 was considered significant in all tests.

Ethics declarations

The study was approved by the Human Research Ethics Committee (HREC), Guilan University of medical sciences (IR.GUMS.REC.1399.570). The study was conducted in accordance with the Declaration of Helsinki. Ethical consent was obtained from all participants to participate in the research.

Results

Data of 392 people with TSF/SCI were extracted from NSCIR-IR, of which 32 patients were excluded due to unemployment at the time of injury, 50 people were not cooperative or did not answer the phone, and 10 died after hospital discharge. Finally, 300 patients were included in the study analysis.

In total, 236 patients (78.66%) returned to work, and the average time to RTW was 6.9 ± 5.2 months. The mean age of the participants was 45.63 ± 14.76 years, and comparing the two groups, the patients in the RTW group were significantly younger ($P = 0.007$). Most patients were male (73.33%) and married (77%). The most frequent educational level in the RTW group was junior high school (26.3%), and in the NRTW group was diploma (25%), and there was no significant difference in educational level between the two groups ($P = 0.44$). The majority of participants (66%) had full coverage insurance. For pain relief, 24.66% used drugs. The sociodemographic characteristics of the two groups are summarized in Table 1.

The majority of the studied population was self-employed (52.33%), and 85% had full-time employment. Of the total subjects, 52.66% had returned to their previous jobs, and 21.33% had adjusted RTW. The reasons for not returning to work in 51.66% of cases were pain, 39% were post-injury complications, 2.3% were early

Characteristics	RTW (n = 236)	NRTW (n = 64)	P-value
Age, (mean \pm SD) years	44.28 \pm 13.90	50.60 \pm 16.79	0.007
Gender, n (%)			
Male	163 (69.1)	57 (89.1)	0.001
Female	73 (30.9)	7 (10.9)	
Marital status, n (%)			
Single	43 (18.2)	11 (17.2)	0.477
Married	179 (75.8)	52 (81.2)	
Widowed	7 (3)	0	
Divorced	7 (3)	1 (1.6)	
Educational level, n (%)			
Illiterate	29 (12.3)	15 (23.4)	0.446
Elementary	43 (18.2)	11 (17.2)	
Junior high school	62 (26.3)	13 (20.3)	
High school	17 (7.2)	4 (6.3)	
Diploma	59 (25)	16 (25)	
Associate graduate	3 (1.3)	2 (3.1)	
Bachelor	20 (8.5)	3 (4.7)	
Master	2 (0.8)	0	
Uncertain	1 (0.4)	0	
Insurance status, n (%)			
Without insurance	25 (10.6)	17 (26.5)	0.003
Full coverage insurance	165 (69.9)	33 (51.6)	
Incomplete coverage insurance	46 (19.5)	14 (21.9)	
Sedative use, n (%)			
None	119 (50.4)	22 (34.4)	0.001
Cigarettes	55 (23.3)	8 (12.5)	
Opium	11 (4.7)	11 (17.2)	
Drug	51 (21.6)	23 (35.9)	

Table 1. Comparison of sociodemographic variables in the RTW group and NRTW group.

retirement, and 7% were other causes. More than half of the patients (51.33%) had work with moderate mobility. The occupational characteristics of the participants according to RTW status are presented in Table 2.

Clinical findings

The vast majority of subjects were classified AIS E (95.8% in the RTW group vs. 82.8% in the NRTW group), and among SCI patients, AIS A was the most common classification. Most patients with TSFs did not have neurologic impairments and were considered neurologically intact. Among SCI patients, paraplegia was the most common neurological category. The most common concomitant injury was limb fracture and dislocation (18.2% in the RTW group vs. 31.3% in the NRTW group, $P = 0.020$).

The most prevalent underlying disease was hypertension (7.2% in the RTW group vs 15.6% in the NRTW group, $P = 0.040$). In terms of the number of vertebral fractures, the majority of participants had a single fractured vertebra (68.6% in the RTW group vs. 48.4% in the NRTW group), and the difference between the two groups was significant ($P = 0.004$). The most common vertebral fractures were lumbar fractures in total subjects (53.33%). There was a significant difference between the two groups in the fractures of thoracic vertebrae ($P = 0.034$) (Table 3).

Predictors of RTW

Multivariate Cox regression models were applied to find the factors that significantly affect the time to RTW. Among the study variables, having a Bachelor's degree (HR 2.59; 95% CI 1.16–5.77; $P = 0.019$), complications after injury (HR 0.47; 95% CI 0.35–0.62; $P = 0.0001$), full coverage health insurance (HR 1.73; 95% CI 1.10–2.72; $P = 0.016$), opium use (HR 0.48; 95% CI 0.26–0.90; $P = 0.023$), number of vertebral fractures (HR 0.82; 95% CI 0.67–0.99; $P = 0.046$), and length of hospital stay (HR 0.95; 95% CI 0.93–0.98; $P = 0.001$) were found to be significant in predicting RTW in Cox regression analysis (Table 4).

Kaplan–Meier survival curve demonstrated the average time to RTW, with 75% of patients returning to work within the first 10 months and approximately 90% within the first 25 months (Fig. 1).

Kaplan–Meier survival estimates indicated that wealthier people returned to work later (Fig. 2).

Finally, the Kaplan–Meier survival estimates suggested that people with high job mobility returned to work later (Fig. 3).

Discussion

In our study, approximately 79% of TSF/SCI patients returned to work in a mean time of about 7 months. Similarly, a systematic review by Lidal et al. indicated that the employment rate of patients after SCI ranged from 11.5 to 74% in different countries¹⁷. Compared with the results of similar studies in Germany (RTW rate: 42.5%)¹⁸, Switzerland (RTW rate: 53.4%)¹⁹, and Taiwan (RTW rate: 30.3%)²⁰, the rate of RTW in our study was in the high range. Among Iranian studies, the RTW rates after trauma were reported 61.2% at 3 months post-injury²¹ and 75.3% at 1 year²². Since our study comprised TSF patients with or without SCI, and most patients with TSF did not have considerable neurological impairment, the high rate of RTW in the present study seems reasonable.

The results in the current paper showed that a bachelor's degree had a significant relation with earlier RTW. This is almost congruent with the findings of the previous studies reporting educational level as a strong predictor of RTW, and higher levels of education were positively correlated to RTW^{23–25}. The possibility of re-employment

Characteristics	RTW (n = 236)	NRTW (n = 64)	P-value
Type of RTW, n (%)			
Return to previous job	158 (66.9)	–	0.001
Adjusted RTW	64 (27.1)	–	
Back to the new job	14 (5.9)	–	
Work mobility, n (%)			
No mobility	1 (0.4)	0	0.001
Low mobility	27 (11.4)	4 (6.2)	
Moderate mobility	136 (57.6)	18 (28.1)	
High mobility	72 (30.5)	42 (65.6)	
Pre-injury occupation, n (%)			
Housewife	60 (25.4)	5 (7.8)	0.004
Daily wage worker	21 (8.9)	13 (20.3)	
Self-employed	120 (50.8)	37 (57.8)	
Government employee	14 (5.9)	6 (9.4)	
Private employee	21 (8.9)	3 (4.7)	
Employment type, n (%)			
Part-time	28 (11.9)	17 (26.6)	0.005
Full-time	208 (88.1)	47 (73.4)	

Table 2. Comparison of occupational variables in the RTW group and NRTW group.

Clinical characteristics	RTW (n = 236)	NRTW (n = 64)	P-value
Length of hospital stay, median (range) day	4 (0–40)	6.5 (1–26)	0.001
Length of ICU stay, median (range) day	1 (1–44)	3 (1–36)	0.223
AIS, n (%)			
A	5 (2.1)	9 (14.1)	0.001
B	2 (0.8)	0	
C	2 (0.8)	0	
D	1 (0.4)	2 (3.1)	
E	226 (95.8)	53 (82.8)	
Neurological category, n (%)			
Paraplegia	7 (2.9)	2 (3.1)	0.040
Quadriplegia	3 (1.3)	4 (6.3)	
Paraparesis	2 (0.85)	0	
Hemiparesis	0	1 (1.6)	
Quadriparesis	1 (0.4)	0	
Others	3 (1.3)	3 (4.7)	
Concomitant injury, n (%)			
Limb fracture or dislocation	43 (18.2)	20 (31.3)	0.020
Burn	1 (0.4)	0	0.787
Internal damage	5 (2.1)	0	0.299
Brain injury	8 (3.4)	7 (10.9)	0.022
Underlying disease, n (%)			
Hypertension	17 (7.2)	10 (15.6)	0.040
Diabetes	13 (5.5)	7 (10.9)	0.101
Hypothyroid	1 (0.4)	0	0.787
Osteoporosis	0	1 (1.6)	0.213
Rheumatoid arthritis	2 (0.8)	0	0.618
Number of fractured vertebra, n (%)			
1	162 (68.6)	31 (48.4)	0.004
2	60 (25.4)	24 (37.5)	
3	8 (3.4)	3 (4.7)	
4	2 (0.8)	4 (6.3)	
5	0	1 (1.6)	
6	2 (0.8)	1 (1.6)	
Missing	2 (0.8)	0	
Vertebral fracture site, n (%)			
Cervical	74 (31.4)	15 (23.4)	0.141
Thoracic	62 (26.3)	25 (39.1)	0.034
Lumbar	125 (53)	35 (54.7)	0.459
Sacral	0	0	–
Coccygeal	0	0	–

Table 3. Comparison of clinical characteristics in the RTW group and NRTW group.

increases with educational level and education is a facilitating factor^{18,26}. Patients with higher levels of education are typically employed in less physically demanding jobs and may have access to more flexible employment opportunities. They have more personal motivation and expectations. Furthermore, higher education is associated with health-promoting behavior and improves the outcome of rehabilitation programs²⁷.

In the present study, the longer length of hospitalization had a significant relationship with delayed RTW. Previous studies have also shown that the duration of hospitalization can be a good indicator of the severity of injuries and can cause a delay in returning to work^{28,29}. Consistent with our findings, Abedzadeh-Kalahroudi et al. reported that the rate and time of RTW among trauma patients with longer hospital stays were respectively higher and longer²¹.

Our findings indicated that the number of vertebral fractures was negatively correlated with the time to RTW. Fractures often have a longer healing process, followed by waiting for surgery and longer hospital stays. Therefore, a slower return to normal function and work is expected^{30,31}.

According to the Cox regression model, there was a strong correlation between post-injury complications and time to RTW, and those with complications returned to work later. Similarly, in one study, despite good surgical

Variable	HR	SE	P-value	95% CI
Education level				
Illiterate	1.00			
Elementary	1.20	0.33	0.49	0.70–2.07
Junior high school	1.40	0.36	0.195	0.83–2.35
High school	1.07	0.38	0.838	0.53–2.16
Diploma	1.35	0.39	0.299	0.76–2.41
Associate graduate	1.31	0.89	0.689	0.34–4.97
Bachelor	2.59	1.05	0.019	1.16–5.77
Master	0.50	0.39	0.388	0.10–2.38
Uncertain	0.62	0.64	0.651	0.82–4.76
Reason of not returning to work				
Pain	1.00			
Early retirement	0.19	0.19	0.108	0.02–1.42
Complications	0.47	0.06	0.000	0.35–0.62
Others	1.31	0.31	0.240	0.83–2.09
Insurance status				
Without insurance	1.00			
Full coverage insurance	1.73	0.39	0.016	1.10–2.72
Incomplete coverage insurance	1.53	0.39	0.097	0.92–2.53
Sedative use				
None	1.00			
Cigarette	0.83	0.13	0.267	0.60–1.14
Opium	0.48	0.15	0.023	0.26–0.90
Drug	0.82	0.13	0.244	0.59–1.14
Number of vertebral fracture	0.82	0.08	0.046	0.67–0.99
Length of hospital stay	0.95	0.01	0.001	0.93–0.98

Table 4. Multivariate Cox regression of RTW predictors in patients with TSF/SCI. *HR* hazard ratio, *SE* standard error, *CI* confidence interval.

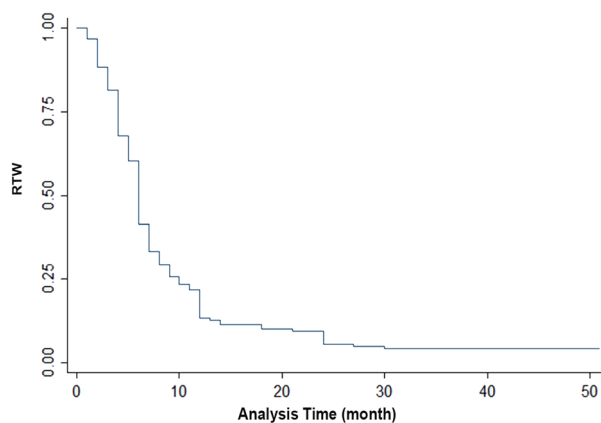


Figure 1. Kaplan–Meier survival curve showing the average time of RTW.

results, patients with higher back pain and lower ability index with longer duration of symptoms returned to work later³².

The findings of the present study demonstrated that individuals with full-coverage health insurance returned to work earlier. The role of health insurance is potentially noteworthy, as it can influence the process of post-injury treatment. Full-coverage health insurance can be associated with more use of health care and rehabilitation services. In a survival analysis, longer RTW survival rates were found among patients without insurance coverage, and those with insurance were more likely to return to their jobs²¹. Many people in Iran obtain insurance through their employers. Maintaining current insurance and the fear of losing insurance benefits can provide a considerable incentive for returning to work or looking for a job.

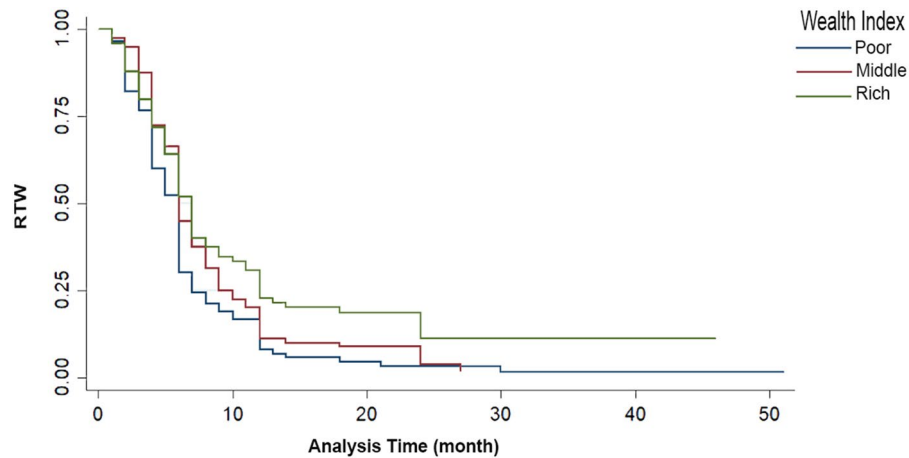


Figure 2. Kaplan–Meier survival curve indicating the correlation between RTW and wealth index.

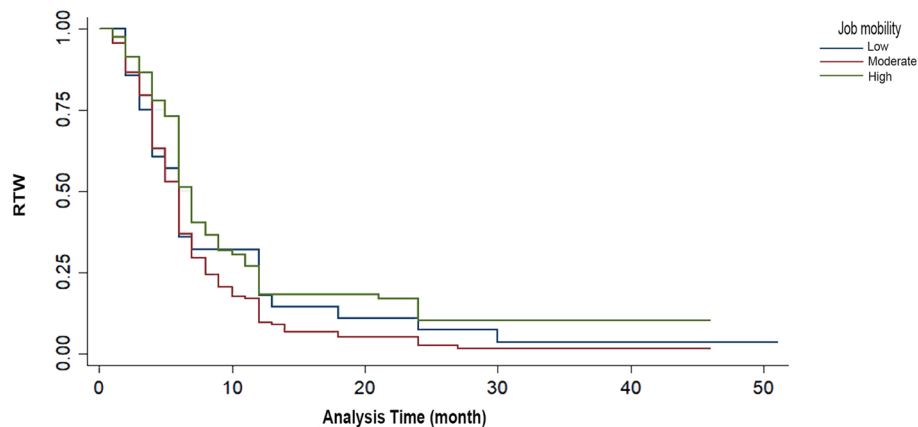


Figure 3. Kaplan–Meier survival curve indicating the correlation between RTW and job mobility.

Among sedatives, using opium was a negative predictor for returning to work, and opium users took longer to RTW. A possible explanation is that opium users usually lack job stability and may lose their jobs due to dysfunction and dependence. In a study by Abedzadeh-Kalahroudi et al., RTW time was significantly longer among drug abusers than non-abusers. However, in a multivariate analysis adjusting for confounders, drug abuse was not detected as a predictor of RTW²¹.

In the present study, job mobility was not a prognostic factor for returning to work, but people with high job mobility returned to work later. In a similar study, functional independence was a strong predictor of RTW, and it was reported that work environment modifications could improve employability after SCI. In addition, those whose previous jobs were manual had a better RTW³³. The SCI population was reported to require more assistance or intervention regarding RTW. Unmet needs and workplace issues expressed by employed people identify gaps in RTW and job satisfaction that can affect employment sustainability that need to be addressed³⁴.

Kaplan–Meier estimates showed that wealthier people returned to work later, although it was not a significant predictor. In another study, there was no significant difference in the comparative incomes of patients with different estimated RTW outcomes³⁵. Financial issues are a strong incentive for returning to work. A higher wealth index leads a person to RTW later and rest more due to the possibility of paying better living expenses³⁶. Conversely, in a study that investigated the role of insurance and income on RTW after SCI, wealthier patients returned to work earlier. A possible reason explained was the ability to purchase equipment and safe transportation and hire an assistant³⁷.

Although this study had a good sample size and the data was obtained over a long period of 3 years, there are some limitations. We conducted a single-center, not population-based study with retrospective data collection so that the results must be interpreted and generalized with caution. In addition, the time of RTW was self-reported, with the potential for retrospective recall bias. Returning to work is a dynamic and multifactorial process. In this study, we investigated some sociodemographic, and clinical aspects; it is recommended that future studies examine other potentially effective factors in a larger-scale and multi-center design.

Conclusion

Returning to work after TSF/SCI is a challenging and multifaceted issue. There are wide-ranging benefits to regaining and maintaining employment for people following spinal injuries, including financial benefits, having social contacts, life satisfaction, and a sense of purpose. Our study revealed the correlation between different factors and RTW. Possible predictors of RTW in our study were pre-injury educational level, length of hospital stay, number of vertebral fractures, using opium, having full-coverage health insurance, and post-injury complications. Identifying the modifiable factors associated with RTW can help rehabilitation professionals and health policymakers plan appropriate interventions to improve the employment status of these patients.

Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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F.K. and E.H. wrote the main manuscript text, S.S. and N.P. performed the interviews, N.K. and L.K. prepared Tables, and M.H. revised the manuscript. All authors reviewed the manuscript.

Competing interests

The authors declare no competing interests.

Additional information

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