Research Article

Pre- and post-injury job type distributions of individuals with SCI in relation to structural changes in the labor market: A comparative analysis based on findings from the Swiss Spinal Cord Injury Cohort Study

Urban Schwegler [1,2], Marina Nützi [1,2], Albert Marti[3], Bruno Trezzini [1,2], the SwiSCI study group[1]

[1]Swiss Paraplegic Research, Nottwil, Switzerland, [2]Department of Health Sciences and Health Policy, University of Lucerne, Lucerne, Switzerland, [3]Innovation and Development Unit, Swiss Paraplegic Foundation, Nottwil, Switzerland

Objective: To compare pre- and post-injury job type distributions of individuals with spinal cord injury (SCI) living in Switzerland.
Design: Cross-sectional, self-report survey.
Setting: Community.
Participants: Two hundred sixty-three individuals reporting a pre- and 677 a post-injury job title in the Swiss SCI Cohort Study community survey.
Interventions: Not applicable.
Outcome Measures: Job titles were elicited by free-text questions and classified using the International Standard Classification of Occupations (ISCO-08). Frequencies across ISCO-08 major groups were calculated and compared to Swiss labor market statistics for 1995 and 2011.
Results: Compared to pre-SCI, *Professionals* (16.3% vs 31.2%) and *Clerical Support Workers* (11.7% vs 19.1%) were more prevalent and *Crafts and Related Workers* (26.5% vs 5.4%) less common post-injury. Except for *Clerical Support Workers*, these results reflect recent structural changes in the Swiss labor market.
Conclusion: The higher post-SCI prevalence of jobs predominantly requiring cognitive and communication skills compared to rather physically oriented jobs mirrors structural changes in the labor market, except for clerical jobs. Future return-to-work strategies should not primarily target the clerical sector with its diminishing job opportunities, but promote vocational re-training towards jobs requiring higher education and assistive technology to return individuals with limited cognitive resources to physically oriented jobs.

Keywords: Spinal cord injury, Job types, Job classification, ISCO-08, Swiss labor market

Introduction

Individuals who have sustained a spinal cord injury (SCI) are often faced with a fundamental change in their job situation because the demands of their pre-injury job exceed their remaining physical capabilities. Employment rates typically decrease after SCI onset,[1] ranging internationally from 11.5% to 74%.[2] In Switzerland, a recent study reported an employment rate of 53.4% which was around 30% points lower compared to the general population.[3] Persons with SCI often struggle to maintain their jobs and perceive a lack of suitable jobs as a major barrier to employment.[2,4,5] The determination of jobs matching the affected persons' abilities, skills and interests is thus a key task of vocational rehabilitation[6] that requires knowledge on jobs that are successfully performed after SCI onset, but also on pre-injury jobs individuals are no

Correspondence to: Urban Schwegler, Swiss Paraplegic Research, Guido A. Zäch Strasse 4, CH-6210 Nottwil, Switzerland; 0041-41-9396589. Email: urban.schwegler@paraplegie.ch

DOI 10.1080/10790268.2019.1573346

longer able to pursue. The latter helps to avoid targeting jobs with inappropriate demands that would increase the risk of labor market dropouts.[7,8]

Studies from various countries show that office, administrative, academic and technical jobs are commonly performed post-SCI,[9–13] but that their prevalence differs by socio-demographic and injury-related factors such as sex, age, education, lesion severity or age at injury.[11,14,15] At the same time, the few studies available involving both pre- and post-SCI jobs are limited to the findings that a non-physically demanding pre-injury job facilitates return to work and that individuals tend to move from predominantly physically oriented to rather cognitively oriented jobs after SCI onset.[10,13,15,16] Moreover, apart from Hwang *et al.*,[14] these studies did not rely on a standardized job classification system when reporting on pre- or post-SCI jobs, which not only hampers comparisons of pre- and post-SCI job distributions across countries, but also with the general population. Yet the latter proves crucial for shedding light on the prevailing opportunity structure of the national labor market and on the prospects of individuals with SCI to return to particular job sectors.

The objective of the present study was to compare pre- and post-injury job type distributions of individuals with SCI living in Switzerland. More specifically, we aimed:

1. to classify pre- and post-injury jobs of individuals with SCI using the International Standard Classification of Occupations (ISCO-08);[17]
2. to determine and compare the frequency distributions of the classified job types, stratified by socio-demographic and injury-related factors;
3. to compare the frequency distributions of the pre- and post-SCI job types with those for the general population of Switzerland.

Methods

Design and participants

Our descriptive study used cross-sectional data from the Swiss SCI Cohort Study (SwiSCI) community survey[18] collected between the third quarter of 2011 and the first quarter of 2013. The SwiSCI survey covered Swiss residents aged 16 years and older with a traumatic or non-traumatic SCI. Persons with congenital conditions leading to SCI (e.g. spina bifida), neurodegenerative disorders (e.g. multiple sclerosis), Guillain Barré syndrome, and new SCI in the context of palliative care were excluded. The SwiSCI study protocol was approved by the responsible ethical committees. Details on the SwiSCI study design and recruitment procedures were published previously.[18,19] In brief, the survey included a starting module, a basic module and three topic-specific sub-modules (i.e. health behavior and psychological personal factors, health services and aging, and work integration) that were sent out consecutively. Each participant who completed the basic module was randomly assigned to fill in one of the three sub-modules. For the work integration module, only participants of employable age (i.e. in Switzerland between 16 and 64 for females and 16 and 65 for males) were considered. The present study included survey participants indicating a pre-SCI job title in the *work integration module* and/or a post-SCI job title in the *basic module*. We considered job titles reported by individuals involved in competitive, integrated employment as well as in other productive activities such as sheltered, unpaid and student work.

Measures

In our study, pre-SCI jobs refer to those jobs performed by participants at SCI onset, and post-SCI jobs to those at the time of the survey. *Pre-* and *post-SCI job title* information was elicited by two free-text questions: "What was the name or title of your main job at SCI onset?" and "What is the name or title of your current main job?". *Sex*, *age at survey* (in years), *lesion severity* (i.e. complete paraplegia, incomplete paraplegia, complete tetraplegia, incomplete tetraplegia) and *age at injury* (in years) were used as socio-demographic and injury-related stratification variables.

Data on the prevalence of job types in the general population, stratified by sex and age and reported using the ISCO-08, was obtained from the Swiss Federal Statistical Office.[20] For our comparative analysis, we used data from the second quarter of 1995, reflecting the mean time since SCI of those participants indicating a pre-SCI job title, as well as data from the third quarter of 2011, reflecting the beginning of the SwiSCI data collection period.

Data analysis

In a first step, the participants' pre- and post-SCI job titles were classified to the ISCO-08 that hierarchically organizes job types into ten major groups (e.g. 5 Services and sales workers), 43 sub-major groups (e.g. 51 Personal services workers), 130 minor groups (e.g. 511 Travel attendants, conductors and guides), and 436 unit groups (e.g. 5111 Travel attendants and travel stewards). Two coders assigned the job titles independently from each other to the most precise ISCO-08 level. Any disagreement on the selected job types was discussed until final agreement was achieved. Intercoder reliability was determined based on

percentage agreement at the ISCO-08 unit and major group level.

For the descriptive analyses using *SPSS version 24,* job types were aggregated to the level of the ten ISCO-08 major groups. First, frequency distributions of pre- and post-SCI job types were calculated, stratified by sex, age at survey, lesion severity, and age at injury. In addition, frequency distributions of individual transition patterns from pre- to post-SCI job types were calculated for those participants who indicated *both* a pre-SCI job title in the work module *as well as* a post-SCI job title in the basic module. Frequencies of pre- and post-SCI job types and of individual transition patterns were then compared with each other. Finally, pre-and post-SCI job type distributions were compared to the Swiss labor market statistics of 1995 and 2011, respectively, and the prevalence differences between pre- and post-SCI job types were compared to those in the Swiss labor market statistics.

Table 1 Characteristics of the study sample.

	Participants reporting pre-SCI job titles (*n* = 263) ("Work module")		Participants reporting post-SCI job titles (*n* = 677) ("Basic module")	
Parameter **[*n* missing]**	***n***	**%**	***n***	**%**
Sex [0†/0$]				
Male	192	73.0	524	77.4
Female	71	27.0	153	22.6
Age at survey [0†/0$]				
16–24 years	7	2.7	30	4.4
25–39 years	31	15.6	161	23.8
40–54 years	141	49.8	326	48.2
55–63/64 years	84	31.9	145	21.4
≥ 64/65 years	–	–	15	2.2
Education level [13/5]				
Compulsory (≤ 9 years)	18	7.0	25	3.8
Vocational (10–12 years)	58	22.5	116	17.5
Secondary (13–16 years)	139	53.9	349	52.6
University (≥ 17 years)	43	16.7	174	26.2
Lesion severity [9/1]				
Paraplegia, complete	87	33.2	245	36.7
Paraplegia, incomplete	97	37.0	237	35.5
Tetraplegia, complete	34	13.0	70	10.5
Tetraplegia, incomplete	44	16.8	116	17.4
Age at injury [12/1]				
< 16 years	2	0.8	58	8.7
16–24 years	85	32.4	265	39.8
25–39 years	110	42.0	224	33.7
40–54 years	55	21.0	95	14.3
55–63/64 years	10	3.8	21	3.2
≥ 64/65 years	–	–	2	0.3
Employment status at survey [7/0]				
Competitive, integrated work	145	55.1	617	92.1
Sheltered, unpaid or student work	118	44.9	53	7.9
Employment status at SCI onset [0/2]				
Competitive, integrated work	227	87.1	523	77.3
Sheltered, unpaid or student work	34	12.9	154	22.7
Continuous variables	Median	IQR	Median	IQR
Time since injury (years)	13	7–24	15	7–25

Note: † number of missing values in the basic module; $ number of missing values in the work module. Percentages within categories may not always sum up to 100% due to rounding differences.

Results

Sample characteristics

The SwiSCI work module ($n = 328$) included 301 participants of employable age at SCI onset, of whom the 263 (87.4%) reporting a pre-SCI job title were included in our study. Of these 263 individuals, 227 (87.1%) were involved in competitive, integrated employment and 34 (12.9%) in sheltered, unpaid or student work *at SCI onset*. The SwiSCI basic module ($n = 1,549$) comprised 1,198 participants of employable age at the time of the survey, of whom the 677 (56.5%) indicating a post-SCI job title were considered for our study. Of these 677 persons, 617 (92.1%) were involved in competitive, integrated employment and 53 (7.9%) in sheltered, unpaid or student work *at the time of the survey.* Among these samples, 148 participants reported *both* a pre-SCI job title in the work module *as well as* a post-SCI job title in the basic module. Where participants reported more than one pre- or post-injury job title, all titles were considered for the analysis, except for the analysis of the individual transition patterns where only one job title per participant (i.e. the first one mentioned) was considered. Table 1 presents the socio-demographic and injury-related characteristics of our study sample. Socio-demographic and injury-related characteristics of the entire SwiSCI study sample were published elsewhere.[19]

Frequency distributions of pre- and post-SCI job types

Overall, the 263 included work module participants reported 283 pre-injury job titles and the 677 included basic module participants 717 post-injury job titles. Of these, seven pre- and 16 post-SCI titles were not classifiable with the ISCO-08 (e.g. "employee") and thus labeled "undefinable". Reported titles were assigned to 129 different pre- and 214 different post-SCI job types at the ISCO-08 unit group level. Intercoder agreement was 80.3% at the major group and 65.2% at the unit group level.

Table 2 presents the overall frequency distributions of the pre- and post-SCI job types. *Craft and Related Workers* (26.5%) were the most common pre-injury

Table 2 Frequency distribution of the reported pre-SCI job types ($n = 283$) and post-SCI job types ($n = 717$) across ISCO-08 major groups.

ISCO-08 major groups	Pre- and post-SCI job types			
	Pre-SCI		Post-SCI	
	n	%	*n*	%
Total	283	100.0	717	100.0
1 Managers	27	9.5	105	14.6
2 Professionals	46	16.3	224	31.2
3 Technicians and Associate Professionals	36	12.7	133	18.5
4 Clerical Support Workers	33	11.7	137	19.1
5 Services and Sales Workers	30	10.6	22	3.1
6 Skilled Agricultural, Forestry and Fishery Workers	12	4.2	8	1.1
7 Craft and Related Workers	75	26.5	39	5.4
8 Plant and Machine Operators and Assemblers	11	3.9	23	3.2
9 Elementary Occupations	6	2.1	10	1.4
Undefinable	7	2.5	16	2.2

Notes: A list of the pre- and post-SCI job types on the more detailed ISCO-08 unit group level can be received from the first author upon request. Percentages may not always sum up to 100% due to rounding differences.

and *Professionals* (31.2%), *Clerical Support Workers* (19.1%), *Technicians and Associate Professionals* (18.5%) and *Managers* (14.6%) the most frequent post-injury jobs. Compared to pre-SCI, the latter four job types were much more prevalent post-SCI, while *Craft and Related Workers* and *Services and Sales Workers* were less prevalent.

Table 3 illustrates the frequency distribution of the individual transition patterns from pre- to post-injury job types across those 148 participants who reported a pre-SCI job title in the work module *and* a post-SCI job title in the basic module. While 70.4% of the individuals pre-injury working as *Professionals* and 66.7% of the pre-SCI *Managers* did not change their job type post-SCI, only 8.6% of persons pre-injury employed as *Craft and Related Workers* and 23.1% of the pre-SCI *Services and Sales Workers* remained in their occupations. Among the *Clerical Support Workers*, 57.9% remained in their job types, whereas 21.1% and 15.8% moved to the ISCO-08 groups *Managers* and *Professionals*, respectively. *Craft and Related Workers* predominantly moved to *Managers* (28.6%), *Technicians and Associate Professionals* (20.0%) and *Clerical Support Workers* (17.1%), while *Services and Sales Workers* mainly switched to *Clerical Support Workers* (38.5%) and *Professionals* (23.1%).

Table 4 indicates the prevalence of the pre- and post-SCI job types, stratified by selected socio-demographic and injury-related factors. Pre-injury, *Craft and Related Workers* (34.8%) were highly prevalent among males and *Clerical Support Workers* (23.7%), *Professionals* and *Services and Sales Workers* (both 21.1%) among females, while post-injury *Professionals* were most common among both sexes (29.4% and 37.3%). A comparably high post-SCI prevalence was also observed for *Technicians and Associate Professionals* (43.3%) and *Clerical Support Workers* (33.3%) among the youngest age group at survey. Compared to pre-injury, *Professionals* and *Clerical Support Workers* were more prevalent post-SCI in males and females, while *Craft and Related Workers* showed a lower post-SCI prevalence for males and *Services and Sales Workers* for females.

Compared to individuals with incomplete lesions, complete para- and tetraplegics worked post-SCI more frequently as *Clerical Support Workers* (22.2% and 24.3% vs 13.5% and 17.6%) and *Technicians and Associate Professionals* (18.1% and 23.2% vs 15.2% and 15.5%). Complete tetraplegics also showed a higher post-SCI prevalence of *Professionals* (45.8% vs 29.0%-33.6%) and a lower frequency of *Managers* (9.7% vs 14.7–16.0%) and *Craft and Related Workers* (1.4% vs 3.5–8.7%), going along with a much higher post-SCI prevalence of *Professionals* and a much lower frequency of *Craft and Related Workers* compared to pre-injury. Among individuals aged 16–24 years at injury, a relatively high post-SCI prevalence of *Professionals* (31.8%), *Technicians and Associate Professionals* (23.1%) and *Clerical Support Workers* (21.7%) was accompanied by a high pre-SCI frequency of *Craft and Related Workers* (40.9%).

Frequency distributions of pre- and post-SCI job types compared to the Swiss labor market

Table 5 provides the relative frequency distribution of the job types performed in the Swiss labor market as of 1995 and 2011, stratified by sex and age. Compared to 1995, our participants worked pre-SCI considerably more often as *Craft and Related Workers* (26.5% vs 17.4%). Post-SCI, they were more commonly engaged as *Professionals* (31.2% vs 22.5%), *Clerical Support Workers* (19.1% vs 9.3%) and *Managers* (14.6% vs 7.6%) and less often as *Services and Sales Workers* (3.1% vs 16.1%) and *Craft and Related Workers* (5.4% vs 13.9%) compared to the general population of 2011.

The pre-post-SCI prevalence differences in our sample (see Tables 2 and 4) show a similar pattern like the one in the Swiss labor market over the period from 1995 to 2011 (see Table 5). However, compared to the general population the prevalence changes in *Professionals*, *Technicians and Associate Professionals*

Table 3 Frequency distribution of the individual transition patterns from pre- to post-injury job types across participants who indicated a pre-SCI job title in the SwiSCI work module as well as a post-SCI job title in the basic module (*n* = 148).

		Post-injury job types (ISCO-08 major groups) (%)										
		Total	1 Managers [*n* = 32]	2 Professionals [*n* = 36]	3 Technicians and Associate Professionals [*n* = 25]	4 Clerical Support Workers [*n* = 32]	5 Services and Sales Workers [*n* = 6]	6 Skilled Agricultural, Forestry and Fishery Workers [*n* = 2]	7 Craft and Related Workers [*n* = 4]	8 Plant and Machine Operators and Assemblers [*n* = 4]	9 Elementary Occupations [*n* = 3]	– Undefinable [*n* = 4]
Pre-injury job types (ISCO-08 major groups) (%)	Total	148 (100.0)	*21.6*	*24.3*	*16.9*	*21.6*	*4.1*	*1.4*	*2.7*	*2.7*	*2.0*	*2.7*
	1 Managers [*n* = 15]	10.1	66.7	6.7	6.7	6.7	6.7	6.7	–	–	–	–
	2 Professionals [*n* = 27]	18.2	18.5	70.4	11.1	–	–	–	–	–	–	–
	3 Technicians and Associate Professionals [*n* = 19]	12.8	10.5	5.3	42.1	26.3	–	–	5.3	–	5.3	5.3
	4 Clerical Support Workers [*n* = 19]	12.8	15.8	21.1	5.3	57.9	–	–	–	–	–	–
	5 Services and Sales Workers [*n* = 13]	8.8	–	23.1	7.7	38.5	23.1	–	–	–	7.7	–
	6 Skilled Agricultural, Forestry and Fishery Workers [*n* = 6]	4.1	16.7	16.7	–	–	16.7	16.7	–	33.3	–	–
	7 Craft and Related Workers [*n* = 35]	23.6	28.6	14.3	20.0	17.1	2.9	–	8.6	2.9	–	5.7
	8 Plant and Machine Operators and Assemblers [*n* = 4]	2.7	–	–	25.0	50.0	–	–	–	25.0	–	–
	9 Elementary Occupations [*n* = 2]	1.4	–	–	100.0	–	–	–	–	–	–	–
	- Undefinable [*n* = 8]	5.4	12.5	25.0	12.5	25.0	–	–	–	–	12.5	12.5

Notes: Only one pre-injury and one post-injury job title per participant was considered for the analysis. Total percentages were calculated based on the total number of participants reporting a pre- and a post-injury job [*n* = 148], while percentage for the ISCO-08 major groups were calculated based on the total number of pre-injury job types per ISCO-08 major group, e.g. n = 15 for Managers. Percentages within categories may not always sum up to 100% due to rounding differences.

Table 4 Frequency distribution of the reported pre-SCI job types ($n = 283$) and post-SCI job types ($n = 717$) across ISCO-08 major groups, stratified by selected socio-demographic and injury-related factors.

		ISCO-08 major group (%)									
Parameter [n missing]	Total n (%)	1 Managers	2 Profes-sionals	3 Technicians and Associate Profes-sionals	4 Clerical Support Workers	5 Services and Sales Workers	6 Skilled Agricultural, Forestry and Fishery Workers	7 Craft and Related Workers	8 Plant and Machine Operators and Assemblers	9 Elemen-tary Occu-pations	– Unde-finable
Pre-injury job types	283 (100.0)	9.5	16.3	12.7	11.7	10.6	4.2	26.5	3.9	2.1	2.5
Sex [0]											
Male	207 (100.0)	9.7	14.5	13.0	7.2	6.8	5.3	34.8	5.3	1.9	1.4
Female	76 (100.0)	9.2	21.1	11.8	23.7	21.1	1.3	3.9	0	2.6	5.3
Lesion severity [1]											
Paraplegia, complete	91 (100.0)	8.8	13.2	13.2	12.1	9.9	7.7	26.4	5.5	2.2	1.1
Paraplegia, incomplete	104 (100.0)	8.6	21.9	11.4	11.4	14.3	1.9	21.0	2.9	1.9	4.8
Tetraplegia, complete	37 (100.0)	11.1	13.9	11.1	11.1	2.8	2.8	38.9	2.8	2.8	2.8
Tetraplegia, incomplete	50 (100.0)	12.0	12.0	14.0	12.0	10.0	4.0	30.0	4.0	2.0	0
Age at injury [1]											
< 16 years	2 (100.0)	0	50.0	0	0	0	0	50.0	0	0	0
16–24 years	88 (100.0)	4.5	5.7	4.5	14.8	12.5	3.4	40.9	5.7	3.4	4.5
25–39 years	114 (100.0)	10.5	20.2	19.3	10.5	9.6	5.3	20.2	1.8	1.8	0.9
40–54 years	67 (100.0)	14.9	17.9	13.4	9.0	11.9	3.0	20.9	4.5	1.5	3.0
55–64 years	11 (100.0)	9.1	36.4	9.1	18.2	0	9.1	9.1	9.1	0	0
Post-injury job types	717 (100.0)	14.6	31.2	18.5	19.1	3.1	1.1	5.4	3.2	1.4	2.2
Sex [0]											
Male	551 (100.0)	17.2	29.4	20.0	15.1	3.3	1.5	6.7	4.0	0.9	2.0
Female	166 (100.0)	6.0	37.3	13.9	32.5	2.4	0	1.2	0.6	3.0	3.0
Age at survey (years) [0]											
16–24 years	30 (100.0)	0	6.7	43.3	33.3	3.3	0	3.3	6.7	0	3.3
25–39 years	171 (100.0)	8.8	36.3	23.4	18.7	1.8	0	7.0	2.3	0.6	1.2
40–54 years	345 (100.0)	16.8	27.8	17.1	20.9	3.2	2.0	3.8	4.3	2.3	1.7
55–63/64 years	155 (100.0)	17.4	36.8	11.6	14.2	4.5	0.6	8.4	1.3	0.6	4.5
≥ 64/65 years	16 (100.0)	31.1	43.8	18.8	6.3	0	0	0	0	0	0
Lesion severity [9]											
Paraplegia, complete	259 (100.0)	14.7	29.0	23.2	24.3	1.2	0.8	3.5	1.2	0.4	1.9
Paraplegia, incomplete	252 (100.0)	15.1	29.4	15.5	13.5	6.7	0.8	8.7	5.6	2.0	2.8
Tetraplegia, complete	72 (100.0)	9.7	45.8	18.1	22.2	0	0	1.4	1.4	1.4	0
Tetraplegia, incomplete	125 (100.0)	16.0	33.6	15.2	17.6	1.6	3.2	4.0	4.0	2.4	2.4

Continued

Table 4 ***Continued***

Parameter [n missing]	Total n (%)	ISCO-08 major group (%)									
		1 Managers	2 Professionals	3 Technicians and Associate Professionals	4 Clerical Support Workers	5 Services and Sales Workers	6 Skilled Agricultural, Forestry and Fishery Workers	7 Craft and Related Workers	8 Plant and Machine Operators and Assemblers	9 Elementary Occupations	– Undefinable
Age at injury [12]											
< 16 years	61 (100.0)	11.5	32.8	19.7	27.9	1.6	0	3.3	1.6	0	1.6
16–24 years	277 (100.0)	10.5	31.8	23.1	21.7	2.5	0.4	5.4	2.5	0.7	1.4
25–39 years	237 (100.0)	18.6	29.1	15.2	19.4	3.8	1.7	5.9	3.0	2.1	1.3
40–54 years	106 (100.0)	16.0	35.8	13.2	6.6	3.8	2.8	5.7	7.5	2.8	5.7
55–64 years	22 (100.0)	18.2	31.8	18.2	18.2	4.5	0	4.5	0	0	4.5
≥ 64/65 years	2 (100.0)	100.0	0	0	0	0	0	0	0	0	0

Notes: Percentages were calculated based on the slightly inflated total frequencies of the stratification variables. This was the case because 16 work module participants reported more than one pre-SCI job title and 36 basic module participants indicated more than one post-SCI job title, and thus socio-demographic and injury-related stratification variables may have been used more than once in the analysis (which was based on the total number of job titles reported). Percentages within categories may not always sum up to 100% due to rounding differences.

A list of the pre- and post-SCI job types on the more detailed ISCO-08 unit group level can be received from the first author upon request.

Table 5 Relative frequency distribution of the job types performed in the Swiss labor market as of 1995 and 2011.

		ISCO-08 major groups (%)									
Parameter	Total n (%)	1 Managers	2 Professionals	3 Technicians and Associate Professionals	4 Clerical Support Workers	5 Services and Sales Workers	6 Skilled Agricultural, Forestry and Fishery Workers	7 Craft and Related Workers	8 Plant and Machine Operators and Assemblers	9 Elementary Occupations	- Don't know, not reported
Swiss population (2nd Q 1995)	3,748 (100.0)	4.7	17.1	16.2	15.7	14.5	4.1	17.4	4.6	4.1	1.6
Gender											
Male	2,144 (100.0)	5.8	18.9	16.7	9.8	6.9	5	26.4	6.4	2.2	1.7
Female	1,604 (100.0)	3.1	14.7	15.6	23.6	24.5	2.9	5.4	2.1	6.6	1.6
Age at survey											
15–24 years	534 (100.0)	0.6	6	13.5	21.9	19.7	2.4	26.6	3.2	3.7	2.4
25–39 years	1,426 (100.0)	4.1	19.8	17.3	14.9	13.3	3.2	16.9	5.1	3.7	1.6
40–54 years	1,245 (100.0)	6.7	19.2	16.5	15.2	13.8	3.9	15.2	4.5	3.9	1.2
55–64 years	446 (100.0)	6.1	16.6	16.6	13.7	12.8	6.3	16.4	4.9	5.6	1.1
≥ 65 years	97 (100.0)	4.1	13.4	11.3	10.3	17.5	20.6	8.2	2.1	7.2	5.2
Swiss population (3rd Q 2011)	4,371 (100.0)	7.6	22.5	18.1	9.3	16.1	3	13.9	4.2	4.6	0.6
Gender											
Male	2,395 (100.0)	9.3	22.8	16.9	5.2	10.1	3.9	21.9	6.4	3	0.5
Female	1,976 (100.0)	5.6	22.1	19.7	14.3	23.5	1.8	4.3	1.6	6.6	0.5
Age at survey											
15–24 years	586 (100.0)	1.5	10.8	17.2	11.3	23.2	2.9	25.1	3.1	4.3	0.7
25–39 years	1,377 (100.0)	7.8	26.6	19.3	8.1	14	2.4	12.9	4.5	4.1	0.4
40–54 years	1,606 (100.0)	9.4	22.9	18.6	9.3	15.7	2.7	11.6	4.4	4.9	0.3
55–64 years	666 (100.0)	8.7	22.5	16.8	10.4	15.6	3.3	12.3	4.7	5.1	0.5
≥ 65 years	136 (100.0)	6.6	27.9	11	5.9	14.7	10.3	11.8	2.9	6.6	2.2

Source: Own calculations based on data obtained by the Swiss Federal Statistical Office.[18]
Notes: Percentages were calculated based on the total frequencies of the stratification variables. Percentages within categories may not always sum up to 100% due to rounding differences.

and *Managers* (i.e. more prevalent post- than pre-SCI) as well as in *Craft and Related Workers* (i.e. less prevalent post- than pre-SCI) are more pronounced. The prevalence of *Clerical Support Workers* shows a reversed pattern, i.e. a higher post-SCI prevalence contrasts with a decreased prevalence in the general population. Similarly, the lower post-SCI prevalence of *Services and Sales Workers* contrasts with a slight increase in the general population.

Discussion

The present study compared pre- and post-injury job types of individuals with SCI living in Switzerland in relation to the general population using the International Standard Classification of Occupations (ISCO-08). Our results show that individuals with SCI tend to move away from crafts and services/sales jobs, while they remain in managerial and academic/professional occupations. Compared to pre-injury, we found a higher prevalence of academic/professional, clerical, technical, and managerial jobs at the cost of a lower prevalence of crafts and services/sales jobs. These findings must, first and foremost, be considered in light of *injury-related* changes in job opportunities for individuals with SCI. But they also reflect a *structural* change in the Swiss labor market over the past 20 years, except for clerical and, to a minor degree, services/sales jobs (e.g. cooks or shop sales assistants) that show a reversed pattern compared to the general population.

Frequency distribution of pre- and post-SCI job types

In line with the literature, academic/professional, clerical and technical jobs turned out to be the most prevalent post-SCI job types in our study.[9,11,14] Also in agreement with previous research, we found a tendency of individuals with SCI to switch from physically oriented crafts jobs (for males) and from services/sales jobs (for females) to post-injury jobs predominantly requiring cognitive and communication skills.[10,13,15] Due to this tendency, prevailing sex differences in the national labor market (i.e. predominance of males in crafts and of females in clerical and services/sales jobs) appear less pronounced after SCI onset.

The high frequency of cognitively oriented post-SCI jobs among our complete para- and tetraplegics corroborates previous results.[10,14] In particular, the prevalence of academic/professional jobs among complete tetraplegics was more prevalent post-injury, reflecting their tendency to switch towards jobs requiring higher education after SCI onset. At the same time, our results suggest that severely injured individuals tend to avoid job demands interfering with their physical limitations such as, for instance, lifting objects in crafts jobs or the limited possibility for flexible work breaks in services/sales jobs.[21]

Despite a small sample size and retrospectively collected data on pre-injury job types, a more longitudinal view on our data in terms of individuals' transition patterns from pre- to post-injury jobs suggests that individuals with predominantly cognitively oriented pre-SCI jobs tend to remain in their occupations. This is particularly true for individuals working pre-SCI in managerial and academic/professional jobs and, to a lesser extent, for persons pre-injury employed in clerical jobs. The finding that more individuals move away from clerical jobs may be attributed to a career progression towards managerial or academic/professional jobs. By contrast, persons with a pre-injury job in the services/sales sector and particularly in the crafts sector do rarely remain in their occupations suggesting that such jobs are less suitable for individuals with SCI. For individuals with a pre-injury services/sales job, it appears that they typically switch to the closely related clerical sector with jobs that are more suitable for persons with SCI. The tendency of persons pre-injury employed in crafts jobs to switch to managerial, technical and clerical jobs may be explained by job changes within the pre-injury institution (e.g. crafts workers moving to managerial or clerical jobs) or by vocational re-training efforts towards technical occupations that are closely related to crafts jobs.

Frequency distributions of pre- and post-SCI job types compared to the Swiss labor market

Generally, the prevalence differences between our participants' pre- and post-SCI job types show a similar, albeit more pronounced pattern, like the prevalence changes in the job types of the Swiss labor market between 1995 and 2011.[20] However, a reversed pattern emerged for clerical and services/sales jobs. Both findings can be explained considering injury-related changes in job opportunities for individuals with SCI.

The compared to pre-SCI much higher post-SCI prevalence of *academic/professional* jobs can be attributed to their characteristics and demands that tend to be more attuned to the functioning of persons with SCI, as evidenced by the particularly high percentage of tetraplegics who moved towards post-SCI jobs requiring higher education. The higher post-SCI prevalence of *technical* jobs might reflect a tendency of young SCI males with a pre-injury crafts job to retrain for closely

related jobs that build on pre-injury acquired skills and knowledge (e.g. a bricklayer who retrains for a job as a civil drafter).[22] The higher post-injury frequency of *managerial* jobs suggests sound career opportunities for individuals with SCI and is particularly pronounced for males and less severely injured individuals, which might be explained by switches from jobs predominantly requiring physical skills to managerial jobs within the crafts sector (e.g. from carpenter to construction manager). *Crafts* jobs were much less prevalent post- than pre-injury, especially among SCI males, which is likely a function of the high prevalence of pre-SCI crafts jobs due to the predominance of males with a young age at SCI in our sample. Among SCI females, the much lower prevalence of *services/sales* jobs post-SCI reflects a slightly reversed pattern compared to the general population and indicates that, like SCI males with a pre-injury crafts job, females working pre-injury in services/sales jobs tend to switch to jobs with demands not interfering with their SCI-specific limitations.

The compared to pre-SCI higher post-SCI prevalence of *clerical* jobs, reflecting a completely reversed pattern compared to the general population, represents our probably most noteworthy finding. A major contributor may be that clerical jobs typically require less vocational re-training and allow individuals with a rather physically oriented pre-SCI job a fast return to work (e.g. as a dispatcher at the pre-injury employer), which is also cost-saving and thus favored by the Swiss disability insurance authorities. Moreover, the particularly high post-SCI prevalence of clerical jobs among severely injured individuals points towards the potential of assistive technologies, such as speech recognition software, for compensating limited hand functions when doing computer work.

Our findings appear particularly relevant with regard to future job opportunities of individuals with SCI in the Swiss labor market. On the one hand, the increasing displacement of crafts jobs by occupations predominantly requiring cognitive and communicative skills, reflecting the growing computerization of manual tasks in the labor market, offers individuals with physical limitations additional job opportunities in the academic/professional and technical sector. This is particularly beneficial for individuals who were employed in cognitively oriented pre-injury jobs and for persons with sufficient cognitive resources to achieve a higher education post-injury. On the other hand, the decrease of clerical jobs in the labor market indicates a growing challenge for bringing severely injured individuals with a more physically oriented pre-SCI job and limited cognitive resources back to work. This is especially true for individuals with traumatic brain injury as a major co-morbidity of traumatic SCI.[23–25]

Practical and research implications

By comparing changes in the prevalence of pre- and post-SCI jobs, our study provides key information about the potential suitability of particular job types for persons with SCI. The list of specific jobs underlying the ISCO-08 major groups reported in our study could support the determination of well-matching jobs for persons with different SCI severities. However, while such a job list may serve for initial screening purposes when starting vocational rehabilitation efforts, a more precise assessment of person-job match requires an individualized approach that considers the clients' capabilities, interests and work experiences apart from their physical limitations.[21]

Our study also provides insights into how pre-post-injury job changes of individuals with SCI relate to recent developments in the national labor market. While a customized return to work requires, foremost, a target job matching a person's abilities, skills and interests, return-to-work strategies should also take into account the opportunity structure of the current labor market. They may be directed towards the growing academic and technical sector by promoting the possibility for re-training and further education instead of primarily targeting sectors with diminishing job opportunities such as the clerical one. An exception represent those individuals who have the possibility to return to a pre-injury job from the clerical sector. For severely injured persons with a physically oriented pre-SCI job and limited cognitive resources, return-to-work efforts could leverage the growing potential of assistive technology[26] in enabling these persons to find employment in the crafts sector. Moreover, work task adjustments could help to reintegrate individuals into services/sales jobs, whose prevalence remained relatively stable in the national labor market. It goes without saying that for return-to-work strategies involving assistive technologies and work task adjustments the goodwill of the employer is a crucial factor of success.[21] Beyond the collection of longitudinal data on job types performed by individuals with SCI that will generate more robust statements on the affected persons' career trajectories, future research should study the outcome of the suggested return-to-work strategies to further substantiate their potential for a sustainable return to work and employment of individuals with SCI.

Study limitations

Our study is subject to several limitations. First, we relied on two different samples for eliciting our participants' pre- and post-SCI job titles. While our findings on post-SCI jobs are quite robust thanks to the large sample size of the SwiSCI basic module, the generalizability of our results on pre-SCI jobs is limited due to the small sample size of the SwiSCI work module. Moreover, the small number of individuals reporting both a pre-SCI job title in the work module *and* a post-SCI job title in the basic module prevented a more detailed and robust analysis of our participants' individual job transition patterns. Further research should analyse the pre-post-SCI career trajectories of affected persons based on a more individualized approach.

Moreover, our analysis was limited to jobs performed by the participants at SCI onset and at the time of the survey. The SwiSCI study did not collect data on the participants' first post-SCI job nor on jobs they may have performed between SCI onset and their participation in the survey. Furthermore, there was no data on previous post-SCI jobs of individuals who were unemployed at the time of the survey. Such information would have broadened our understanding in terms of individual career trajectories and with regard to suitable and less suitable jobs for individuals with SCI. Future research should assess these aspects longitudinally and prospectively starting from SCI onset to provide a more complete picture on career trajectories of individuals with SCI.

Conclusion

The present study compared pre- and post-injury jobs of individuals with SCI in relation to the general population. Compared to pre-SCI, we found a higher post-SCI prevalence for jobs requiring mainly cognitive and communicative skills, which was mirrored by a lower prevalence of physically oriented crafts jobs and for services and sales jobs post-SCI. We also showed that individuals with physically oriented pre-SCI jobs tend to move towards cognitively oriented managerial, clerical and technical occupations after SCI onset. These results primarily indicate SCI-related job changes, but also reflect structural changes in the Swiss labor market over the past 20 years, except for clerical jobs, which were much more prevalent post- compared to pre-SCI but at the same time decreased in the general population. In order to consider the opportunity structure of the labor market and beyond the identification of target jobs matching the individual's abilities, skills and interests, return-to-work strategies for persons with SCI should not primarily target the clerical sector with its diminishing job opportunities. Instead, vocational re-training may be promoted to integrate individuals into jobs requiring higher education and the potential of assistive technology and work task adjustment may be used to return severely injured individuals with limited cognitive resources to rather physically oriented occupations or services and sales jobs.

Acknowledgements

We are grateful to all the participants of the SwiSCI survey for their time and effort spent in responding to the questions. We also thank Johannes Siegrist for his critical revision of the manuscript. We further thank the personnel of the SwiSCI study center and the members of the SwiSCI Steering Committee: Xavier Jordan, Bertrand Léger (Clinique Romande de Réadaptation, Sion); Michael Baumberger, Hans Peter Gmünder (Swiss Paraplegic Center, Nottwil); Armin Curt, Martin Schubert (University Clinic Balgrist, Zürich); Margret Hund-Georgiadis, Kerstin Hug (REHAB Basel, Basel); Thomas Troger (Swiss Paraplegic Association, Nottwil); Daniel Joggi (Swiss Paraplegic Foundation, Nottwil); Hardy Landolt (Representative of persons with SCI, Glarus); Nadja Münzel (Parahelp, Nottwil); Mirjam Brach, Gerold Stucki (Swiss Paraplegic Research, Nottwil); Martin Brinkhof (SwiSCI Study Center at Swiss Paraplegic Research, Nottwil).

Disclaimer statements

Contributors None.

Funding The present study was part of a project funded by the Swiss National Science Foundation (grant No. 153033) and has been financed in the framework of the Swiss Spinal Cord Injury Cohort Study (SwiSCI, www.swisci.ch), supported by the Swiss Paraplegic Foundation.

Conflicts of interest The authors declare no conflict of interest.

ORCID

Urban Schwegler http://orcid.org/0000-0002-2844-0812
Marina Nützi http://orcid.org/0000-0001-5500-4373
Bruno Trezzini http://orcid.org/0000-0002-0441-5153

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