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Psychosocial resources and chronic pain in individuals with spinal cord injury: evidence from the second Swiss national community survey

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Abstract

Study design Cross-sectional.

Objective To investigate the associations of a set of psychosocial resources with pain and pain-related factors in individuals with spinal cord injury (SCI) and chronic pain.

Setting Community, Switzerland.

Methods Data from 1,064 individuals with chronic pain who participated in the second community survey of the Swiss Spinal Cord Injury Cohort Study (Survey 2017) were analyzed. Multiple linear regression modeling was performed to test the hypotheses that higher levels of psychosocial resources (self-efficacy, self-esteem, purpose in life, optimism, hope, social support, sense of belonging) are negatively associated with pain intensity, pain interference and depressive symptoms.

Results Higher self-esteem, optimism and hope were related to less pain interference and all psychosocial resources under study were negatively associated with depressive symptoms in final models. However, neither of the psychosocial resources was related to pain intensity when models were adjusted for pain interference and depressive symptoms.

Conclusions These findings strengthen the evidence that psychosocial resources can have an impact on pain interference and depressive symptoms as pain-related factors, and support the notion that psychosocial resources might be promising targets for pain interventions in individuals with SCI.

Introduction

Chronic pain is one of the most burdensome problems of individuals with a spinal cord injury (SCI) [1]. In a population-based survey in Switzerland, 74% of individuals with SCI reported experiencing chronic pain [2], a high

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prevalence, comparable with international rates ranging from 41 to 81% [3]. Pain has been defined as chronic when it lasts or recurs for longer than three months [4]. Chronic pain in SCI leads to reduced participation in productive, leisure and sociocultural activities, more depressive symptoms and worse quality of life [5]. Moreover, studies on general populations have documented that chronic pain has societal costs, such as reduced productivity at work and high health care expenditures [6]. Given that a complex interaction of biological, psychological and social factors is known to contribute to the chronicity of pain [7], long-term benefits on pharmacological interventions are, in most cases, insufficient [8] and psychosocial factors are important to be considered in order to inform a comprehensive management of chronic pain.

Previous research, focusing on psychological and social factors in relation to pain, supports the notion that strengthening psychosocial resources can have beneficial effects on pain and related factors [9–11], thus presenting potential targets for interventions. Psychosocial resources

are considered to be strengths of an individual including cognitions (e.g., self-efficacy, optimism), feelings (e.g., pleasure, love), and behaviors (e.g., acts of kindness) and positive interactions with the social environment (e.g., helpful social support) [12] (for detailed description of concepts see Supplementary Table S1). When experiencing chronic pain, the affective, cognitive and behavioral reactions to pain, which may serve a protective function in the acute pain situation (e.g., fear of movement), can become maladaptive in the long-term, contributing to an exacerbation of pain [7]. Psychosocial resources may help individuals to interrupt those maladaptive affective reactions (e.g., depressive symptoms), cognitions (e.g., catastrophizing) and behavioral patterns (e.g., avoidance of activity) by altering emotional and cognitive states. In detail, using psychosocial resources increases a person's experience of positive emotions and changes a person's focus of attention, which can alter the perceived unpleasantness and intensity of the pain [13]. Furthermore, by broadening attention towards positive stimuli and increasing engagement in valued activities despite pain, psychosocial resources may increase recovery from the negative consequences of pain on physical and emotional functioning, thus allowing adaptation to chronic pain [14].

Evidence from observational studies in individuals with SCI shows that various psychosocial resources are linked to pain (i.e., pain intensity) and pain-related factors (i.e., pain interference, depressive symptoms). Previous SCI studies demonstrated that higher self-efficacy was related to lower pain intensity, less pain interference and fewer depressive symptoms [15] and that higher self-esteem was associated with less pain interference [16] and fewer depressive symptoms [16, 17]. Moreover, having a purpose in life was associated with lower pain intensity, less pain interference [18], and fewer depressive symptoms [19] and helpful social support was related to less pain interference and fewer depressive symptoms [16, 20]. While the effect of positive expectations (i.e., optimism, hope) on pain and pain-related factors is well studied in other chronic pain populations [21, 22], little evidence exists for community-dwelling individuals with SCI [10, 23]. Overall, evidence on the association of certain psychosocial resources with pain interference and depressive symptoms is available for SCI populations, however evidence is limited for pain intensity and for some psychosocial resources, such as hope or sense of belonging, which have not been investigated yet.

The objective of this study is therefore to investigate associations of psychosocial resources that were assessed in the second community survey of the Swiss Spinal Cord Injury Cohort Study (SwiSCI), i.e., self-efficacy, self-esteem, purpose in life, optimism, hope, social support, sense of belonging, with pain and pain-related factors in individuals who report having chronic pain. The

psychosocial resources that were measured in SwiSCI were selected in order to capture the psychological–personal perspective in SCI research [24]. The present study considers three core outcome domains of chronic pain recommended by the Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials (IMMPACT) [25]: pain (assessed by pain intensity), physical functioning (assessed by pain interference), and emotional functioning (assessed by depressive symptoms). We hypothesized that higher levels of each of the above-mentioned psychosocial resources are associated with lower pain intensity, less pain interference and fewer depressive symptoms.

Methods

Study design

This study uses cross-sectional data collected from the second community survey of SwiSCI (Survey 2017), carried out between 03/2017 and 03/2018. The survey included two questionnaires that were sent to participants with an interval of four to 6 weeks. Data were collected using different response modes (i.e., online, paper–pencil, telephone/face-to-face interview). Further details on the design of the Survey 2017 are given elsewhere [26].

Participants

The sample of the present study includes individuals who participated in the Survey 2017. Included were Swiss residents aged over 16 years with a traumatic or non-traumatic SCI. Excluded were individuals with "congenital conditions leading to SCI (e.g., spina bifida), those with neurodegenerative disorders (e.g., multiple sclerosis or amyotrophic lateral sclerosis) and Guillain-Barré syndrome" [26]. Participants were recruited in collaboration with the four specialized SCI rehabilitation centers in Switzerland, the national organization of persons living with SCI (Swiss Paraplegic Association) and an SCI-specialized home care institution (ParaHelp). Out of 3959 eligible individuals, 1294 completed questionnaire 1 and 2 (response rate 32.7%). As this study focuses on individuals with chronic pain, 209 individuals indicating not having any pain in the last three months [4] were excluded. Chronic pain was assessed with one item of the SCI Secondary Conditions Scale (SCI-SCS) [27] asking participants about the frequency and severity of pain in the past three months on a four-point Likert-scale with response options from "not existing or insignificant problem' (0) to "significant or chronic problem' (3). Furthermore, 21 individuals with missing values for all study variables were excluded from analyses, leading to a final set of $N = 1064$ participants and

$N = 968$ for analyses with pain interference, respectively. The different sample sizes are the result of the fact that the items on pain interference were conditional on having had pain in the past week (pain intensity ≥1). Persons who indicated having had pain in the past 3 months but not in the last week were excluded from analyses with pain interference. Details on survey participation and non-response are describe elsewhere [26].

Measures

Definitions of the concepts listed below as well as an overview on measures, relevant references and internal consistency of the scales that were used to assess these concepts can be found in supplementary Table S1. The Survey 2017 can be found online [28].

Pain and pain-related factors

Pain intensity was assessed with a single item of the International SCI Pain Basic Data Set (ISCIPBDS). Participants were asked to rate the average pain intensity of their worst pain problem in the past week on a numeric scale ranging from 0 'no pain' to 10 'pain as bad as you can imagine'. Intensity was grouped into no pain (0), mild (1–3), moderate (4–6) and severe (7–10) for descriptive statistics.

Pain interference was measured with three validated items of the ISCIPBDS, assessing the extent to which pain interfered with general activities, mood and sleep in the past week (0 'no interference' to 10 'strong interference'). A mean score ranging from 0 to 10 was calculated.

Depressive symptoms were measured with the seven-item depression subscale of the Hospital Anxiety and Depression Scale (HADS-D), validated in SCI. Participants were asked to respond to different statements, such as "I still enjoy things I used to enjoy" using a four-point Likert scale with response options 'definitely' (0), 'not so much' (1), 'only a little' (2) and 'not at all' (3). A sum score ranging from 0 to 21 was calculated, with a higher score indicating higher level of depressive symptoms. For descriptive statistics, level of depressive symptoms was grouped into no symptoms (≤7), mild (8–10), moderate (11–14) and severe symptoms (15–21).

Psychosocial resources

The psychosocial resources that were measured in SwiSCI 2017 were selected in order to capture different categories identified as essential to assess the psychological–personal perspective in the SCI literature [24]. The psychological–personal factors domain set for the SwiSCI community survey was identified through review of the

scientific SCI literature. Seven categories were revealed as relevant: sociodemographic personal characteristics; position in the immediate social and physical context; personal history and biography; feelings; thoughts and beliefs; motives; patterns of experience and behavior [24]. For the purpose of this study, constructs from the categories position in the immediate social and physical context (social support), feelings (sense of belonging), thoughts and beliefs (self-efficacy, self-esteem), motives (purpose in life) and patterns (optimism, hope) were suitable as they reflect psychosocial resources.

Self-efficacy was assessed using a modified version of the General Self-Efficacy Scale (GSES). The GSES showed satisfactory reliability and validity in individuals with SCI. Participants were asked to respond to five statements about their general confidence in their abilities to overcome difficulties, on a four-point Likert scale ranging from 1 'not true' to 4 'exactly true'. A sum score was calculated ranging from 5–20, with a higher score indicating higher self-efficacy.

Self-esteem was measured with four items of the Rosenberg Self-Esteem Scale (RSES), validated in the general population. Participants were asked to indicate whether different statements (e.g., "I consider myself a valuable person") applied to them, using a four-point Likert scale from 0 'does not apply at all' to 3 'is absolutely true'. A higher sum score, ranging from 0–12, indicates higher self-esteem.

Purpose in life was assessed with the short form of the Purpose in Life Test (PIL-SF). The PIL-SF showed good reliability and validity in people with SCI. It evaluates the extent of perceived purpose in life by asking participants to rate four statements about presence of life goals, life being meaningful, life goal completion and presence of purpose in life, on a seven-point Likert scale. The total score ranges from 4 to 28, with a higher score indicating higher purpose in life.

Optimism was captured with one item drawn from the Swiss Household Panel (SHP) Survey asking "How often do you feel full of power, energy and optimism?". Response options ranged from 0 'never' to 10 'always'.

Hope was assessed with a single question from the WHO's (World Health Organization) Model Disability Survey (MDS) asking "Do you think that you can realize your dreams, hopes and desires?". A higher score on a five-point Likert scale ranging from 1 'not at all' to 5 'completely' indicates being more hopeful.

Social support was measured with three items on instrumental and three items on emotional support taken from the SHP. Participants were asked to rate the extent of instrumental and emotional support they receive from their partner, family, and friends if needed, on a numeric scale ranging from 0 'not at all' to 10 'very much'. The scale

included the option to indicate if a source of support was unavailable (e.g., not having a partner). A mean score ranging from 0 to 10 was calculated from scores of social support sources available, with higher mean score indicating higher level of social support.

Sense of belonging was captured by three items from the UCLA (University of California, Los Angeles) loneliness scale, validated in people with SCI. Participants were asked to indicate on a five-point Likert scale ranging from 1 'not at all' to 5 'completely' whether they feel included in company with others, whether they miss social contacts and whether they feel excluded. The original scoring of the items was reversed in order to make higher scores indicating belongingness instead of loneliness. A sum score (range 3–15) was created.

Confounding variables

Potential confounding variables were selected based on theoretical considerations and previous evidence [2, 18]. Directed acyclic graphs (DAGs) were then used to identify the minimal sufficient adjustment set of variables in order to prevent overparameterization of models [29]. Specifically, confounding variables were only considered relevant if they were thought to be a cause of the predictor (psychosocial resources) as well as of the outcome (pain and pain-related factors). The confounding variables were: age, gender, years of education, secondary health conditions, functional independence, financial hardship, adverse life events and pain treatment. Gender, age, and years of education were assessed using MDS items (for reference see supplementary Table S1). Secondary health conditions were assessed by the SCI Secondary Conditions Scale (SCI-SCS) [27], which asks participants to report the frequency and severity of 15 SCI-specific health conditions, on a four-point Likert-scale with response options from 'not existing or insignificant problem' (0) to 'significant or chronic problem' (3). A sum score ranging from 0 to 45 was calculated, excluding the item on chronic pain. Functional independence in daily activities was assessed by the self-report version of the Spinal Cord Independence Measure [30]. Financial hardship was captured with a 4-point Likert scale item on problematic financial situation in the last four weeks (none to massive; dichotomizing none vs. any financial hardship). Adverse life events was assessed with one item asking participants whether they had experienced a major adverse life event in the past year (yes; no). Pain treatment was assessed with one item of the SCI-SCS [27] asking participants to indicate whether they received any treatment for pain in the past three months (yes; no).

In order to describe the study population, information on the lesion characteristics, including lesion type (paraplegia, tetraplegia), completeness of lesion (complete, incomplete),

time since injury in years and etiology (traumatic, non-traumatic) is provided. A categorical variable was created to indicate lesion severity (incomplete paraplegia, complete paraplegia, incomplete tetraplegia, complete tetraplegia). Given that lesion characteristics were not related to the predictors and outcomes under study, they were not included as confounding variables in multivariate analysis.

Statistical analysis

All analyses were carried out using STATA version 14.0 for Windows (College Station, TX, USA). First, descriptive statistics for cases without missing values on the relevant variable are presented to describe basic characteristics of participants. Mean and standard deviations are reported for continuous variables, and number of cases and percentages for dichotomous and categorical variables. Second, Spearman correlations were calculated to show associations of psychosocial resources with pain and pain-related factors, as well as between pain and pain-related factors. Correlation coefficients were classified as weak ($r \geq 0.10$), moderate ($r \geq 0.30$) and strong ($r \geq 0.50$) [31]. Given the sample size of 1064, a satisfactory power to show bivariate associations was assumed (e.g., statistical power for a correlation of $r = 0.1$ ($\alpha = 0.05$) was 0.9).

Third, multivariate analyses were performed using linear regression. Gauss–Markov assumptions were validated, indicating linear relationships, randomly sampled data, non-collinearity, normally distributed and independent residuals, and homoscedasticity in the data. Separate models were calculated for each psychosocial resource in order to avoid bias arising from over-adjustment. Three sets of regressions were computed with stepwise inclusion of confounding variables. This approach was chosen in order to detect whether the inclusion of confounding variables changes the association of psychosocial resources with pain and pain-related factors. Model 1 was adjusted for confounding variables mentioned above. Model 2 was adjusted for confounding variables included in Model 1 and for pain intensity as confounding variable (if the outcome was pain interference or depressive symptoms) or for pain interference (if the outcome was pain intensity or depressive symptoms). Model 3 was adjusted for confounding variables included in Model 2 and for depressive symptoms as confounding variable (if the outcome was pain intensity or pain interference). The resulting coefficients (B) and 95% confidence intervals (CI) are reported. Analyses with the variable pain interference were restricted to participants who reported pain in the past week as items on 'pain interference' were conditional on having had pain in the past week (pain intensity ≥ 1).

Following best practice guidelines, item non-response was addressed using multiple imputation by chained

equations (MICE) [32]. As recommended by Enders [32], data were imputed at item level for all variables that were in the analysis models, including variables without missing values (age, gender, inverse probability weights) to improve the imputations. Inverse probability weights were included to account for survey non-response [26]. Given that the items on 'pain interference' were conditional on having had pain in the past week, data for 'pain interference' were only imputed if participants indicated pain in the past week. Twenty imputed data sets were generated and analyzed separately. The resulting estimates were finally combined to overall estimates. Sensitivity analysis comparing results of complete case analysis and results generated based on imputed datasets revealed no difference in main findings (results not shown).

Results

Characteristics of study participants are presented in Table 1. On average, they were 56.9 years old, predominantly male and had lived 19 years with SCI. The most frequent type of lesion was incomplete paraplegia (42.7%) and the main cause of SCI was a traumatic event. Mean pain intensity reported was 5.1 (SD 2.7; scale 0–10), one third had experienced high pain intensity (7–10) in the past week and more than half had received treatment for pain in the last three months. Participants reported a mean score of 4.4 (SD 2.3; scale 0–10) for pain interference; the highest mean was observed for interference with general activities. The mean score for depressive symptoms was 4.8 (SD 3.9; scale 0–21), <10% reported a moderate or severe level of depressive symptoms.

In bivariate analyses psychosocial resources were consistently negatively associated with pain and pain-related factors. Table 2 shows weak relationships between psychosocial resources and pain intensity, weak to moderate relations between psychosocial resources and pain interference and strong relations between psychosocial resources and depressive symptoms. Analyses using the subscales of pain interference showed that psychosocial resources were most strongly correlated with pain interference in mood (r between -0.14 and -0.36), followed by interference in sleep (r between -0.13 and -0.27) and in general activities (r between -0.09 and -0.28).

Results from multivariate analyses are displayed in Table 3. Firstly, none of the psychosocial resources, aside from self-efficacy and hope, were related to pain intensity when models were adjusted for pain interference (Model 2) and depressive symptoms (Model 3). Secondly, all psychosocial resources were associated with pain interference when the results were adjusted for pain intensity (Model 2).

Table 1 Basic characteristics of study participants, $N = 1064$.

Variables [n missing values]	n (%)	M (SD)
Sociodemographic characteristics		
Male gender [0]	739 (69.4)	
Age in years [0]		56.9 (14.2)
Education in years [51]		14.2 (3.5)
Financial hardship last 4 weeks [32]	260 (25.2)	
SCI and health-related characteristics		
Time since injury in years [63]		19.1 (13.0)
Lesion severity [113]		
Incomplete paraplegia	406 (42.7)	
Complete paraplegia	271 (28.5)	
Incomplete tetraplegia	205 (21.5)	
Complete tetraplegia	70 (7.4)	
Traumatic etiology [11]	843 (80.0)	
Functional independence, scale 0–100 [129]		74.2 (11.1)
Secondary conditions, scale 0–45 [295]		13.6 (6.7)
Adverse life events in past year [30]	328 (31.7)	
Pain treatment last 3 months [137]	533 (57.4)	
Pain and pain-related factors		
Pain intensity, scale 0–10 [20]		5.1 (2.7)
No pain (0)	89 (8.5)	
Low (1–3)	239 (22.9)	
Middle (4–6)	332 (31.8)	
High (7–10)	385 (36.8)	
Pain interference, scale 0–10 [29]		4.4 (2.3)
Activities, scale 0–10 [14]		4.7 (2.6)
Sleep, scale 0–10 [16]		4.2 (3.0)
Mood, scale 0–10 [21]		4.2 (2.6)
Depressive symptoms, scale 0–21 [15]		4.8 (3.9)
Mild (8–10)	154 (14.7)	
Moderate (11–14)	59 (5.6)	
Severe (15–21)	24 (2.4)	
Psychosocial resources		
Self-efficacy, scale 5–20 [26]		15.6 (2.8)
Self-esteem, scale 0–12 [28]		9.0 (2.2)
Purpose in life, scale 4–28 [24]		21.3 (4.7)
Optimism, scale 0–10 [21]		6.4 (2.0)
Hope, scale 1–5 [15]		2.1 (1.1)
Social support, scale 0–10 [17]		7.8 (1.9)
Sense of belonging, scale 3–15 [20]		9.3 (2.7)

However, when additionally adjusting for depressive symptoms (Model 3), only self-esteem, optimism and hope remained associated with pain interference. Lastly, associations between psychosocial resources and depressive symptoms were observed in all models (Model 1–3).

Table 2 Psychosocial resources, pain and pain-related factors: spearman correlation coefficients (r_S), $N = 1064$.

Variables	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. Pain intensity	–												
2. Pain interference	**.69**	–											
3. Pain interference activity	**.68**	**.84**	–										
4. Pain interference mood	**.59**	**.86**	**.66**	–									
5. Pain interference sleep	*.48*	**.83**	**.50**	**.56**	–								
6. Depressive symptoms	.27	*.45*	*.37*	*.46*	*.32*	–							
7. Self-efficacy	−.12	−.28	−.17	−*.31*	−.23	−**.54**	–						
8. Self-esteem	−.21	−*.34*	−.25	−*.36*	−.25	−**.64**	**.60**	–					
9. Purpose in life	−.16	−*.30*	−.21	−*.32*	−.22	−**.61**	**.52**	**.64**	–				
10. Optimism	−.19	−*.34*	−.28	−*.35*	−.25	−**.60**	**.50**	**.52**	**.62**	–			
11. Hope	−.16	−*.33*	−.26	−*.30*	−.27	−**.57**	*.44*	*.46*	**.56**	*.49*	–		
12. Social support	−.04	−.15	−.09	−.14	−.13	−*.36*	.27	*.33*	*.37*	*.31*	.24	–	
13. Sense of belonging	−.13	−.26	−.19	−.29	−.19	−**.52**	*.42*	*.48*	*.43*	*.38*	*.34*	*.42*	–

All correlations were significant ($p < 0.05$). Fonts highlight strength of associations: normal font represents weak relationships ($r_S \geq 0.10$), cursive font indicates a moderate relation ($r_S \geq 0.30$) and bold font shows a strong relation ($r_S \geq 0.50$).

Discussion

This study provides evidence for the hypothesis that psychosocial resources are associated with the pain-related factors pain interference and depressive symptoms. However, no support was found for the hypothesized associations of psychosocial resources with pain intensity.

As hypothesized, all psychosocial resources were strongly associated with depressive symptoms, which is consistent with current evidence [15–17, 19, 20]. Psychosocial resources are linked to positive emotions, which may protect individuals from depressive symptoms [33]. According to the broaden-and-build theory [33], positive emotions broaden an "individual's thought–action repertoire" instead of narrowing perception and cognitions down, as is the case when experiencing negative emotions. This broader mindset can then further build psychosocial resources. For example, if people are highly optimistic or feel socially included they are more likely to experience positive emotions and in turn are more open to new experiences and active engagement in social communities. Further research may look at the causal pathways through which psychosocial resources influence depressive symptoms, addressing both direct and indirect effects.

In line with the hypothesis and with findings from studies on SCI or chronic pain populations [10, 16], individuals experiencing higher self-esteem, more optimism and more hope report less pain interference. It is likely that those psychosocial resources enhance a persons' capability to cope with pain in terms of feeling less limited by pain. Contrary to the hypothesis, self-efficacy, purpose in life, social support and sense of belonging were not related to pain interference after adjustment for depressive symptoms.

The inconsistency with the results of other studies [18, 20, 21] might arise from the fact that their authors did not adjust for depressive symptoms. It may be that high levels of psychosocial resources protect individuals with chronic pain from pain interfering with their life through these resources' effect on depressive symptoms. Moreover, inconsistencies with the findings of other studies may partly be explained by differences in measures and type of self-efficacy or social support studied.

Contrary to our hypothesis, the results suggest that most psychosocial resources were not related to pain intensity after adjustment for pain interference. It seems that high levels of psychosocial resources are not protective against high pain intensity; however, evidence from chronic pain as well as SCI populations is inconsistent [21, 22]. Differences in findings might be due to differences in populations and in type of pain investigated. Evidence derived from chronic pain populations addresses mainly nociceptive pain, while other types of pain, such as neuropathic pain, were not assessed. If one considers that about 50% of the SCI population experiences neuropathic pain [2], recent findings from chronic pain populations [21, 22] might not be transferable to other types of pain. Furthermore, results may vary depending on the timing of measurement. For example, freshly induced optimism might impact pain intensity in the short term, whereas persistent optimistic cognitions probably do not protect from high pain intensity in the long term [21].

Clinical implications

The study provides promising findings for the planning of clinical interventions. Although the results do not prove a causal link between psychosocial resources and pain, they

Table 3 Multiple regression analysis on associations of psychosocial resources with pain and pain-related factors: Unstandardized coefficients (B) and its 95% confidence intervals (CI), $N = 1064$.

Predictors	Outcomes			
	Scale	Pain intensity (scale 0–10) B (95% CI)	Pain interference (scale 0–10) B (95% CI)	Depressive symptoms (scale 0–21) B (95% CI)
Model 1				
Self-efficacy	5–20	−0.04 (−0.10–0.02)	**−0.13 (−0.18–−0.08)**	**−0.69 (−0.76–−0.62)**
Self-esteem	0–12	**−0.16 (−0.26–−0.07)**	**−0.30 (−0.38–−0.21)**	**−1.15 (−1.27–−1.04)**
Purpose in life	4–28	**−0.05 (−0.08–−0.01)**	**−0.10 (−0.13–−0.07)**	**−0.49 (−0.53–−0.45)**
Optimism	0–10	**−0.17 (−0.25–−0.08)**	**−0.27 (−0.34–−0.20)**	**−1.07 (−1.17–−0.98)**
Hope	0–10	**−0.21 (−0.36–−0.06)**	**−0.48 (−0.61–−0.35)**	**−1.60 (−1.79–−1.41)**
Social support	0–10	−0.01 (−0.10–0.07)	−0.07 (−0.15–0.00)	**−0.60 (−0.71–−0.48)**
Sense of belonging	0–12	**−0.08 (−0.15–−0.02)**	**−0.15 (−0.21–−0.10)**	**−0.72 (−0.79–−0.64)**
Model 2				
Self-efficacy	5–20	**0.06 (0.02–0.10)**	**−0.12 (−0.15–−0.08)**	**−0.63 (−0.70–−0.56)**
Self-esteem	0–12	0.06 (−0.01–0.13)	**−0.21 (−0.28–−0.15)**	**−1.04 (−1.16–−0.92)**
Purpose in life	4–28	0.02 (−0.00–0.05)	**−0.08 (−0.10–−0.05)**	**−0.45 (−0.49–−0.41)**
Optimism	0–10	0.05 (−0.01–0.11)	**−0.19 (−0.24–−0.13)**	**−0.97 (−1.07–−0.88)**
Hope	0–10	**0.15 (0.04–0.26)**	**−0.37 (−0.48–−0.27)**	**−1.44 (−1.64–−1.25)**
Social support	0–10	0.04 (−0.02–0.10)	**−0.07 (−0.13–−0.01)**	**−0.56 (−0.67–−0.46)**
Sense of belonging	0–12	0.03 (−0.01–0.08)	**−0.11 (−0.15–−0.07)**	**−0.64 (−0.72–−0.57)**
Model 3				
Self-efficacy	5–20	**0.06 (0.01–0.11)**	−0.03 (−0.08–0.01)	
Self-esteem	0–12	0.04 (−0.04–0.12)	**−0.08 (−0.16–−0.01)**	
Purpose in life	4–28	0.02 (−0.01–0.05)	−0.02 (−0.05–0.01)	
Optimism	0–10	0.04 (−0.04–0.11)	**−0.07 (−0.14–−0.00)**	
Hope	0–10	**0.14 (0.02–0.26)**	**−0.20 (−0.32–−0.09)**	
Social support	0–10	0.03 (−0.03–0.09)	0.02 (−0.04–0.07)	
Sense of belonging	0–12	0.02 (−0.03–0.07)	−0.02 (−0.07–0.03)	

Separate models were calculated for each psychosocial resource. Bold results indicate significant associations ($p < 0.05$).

Model 1: adjusted for age, gender, education, financial hardship, adverse life events, SCI related conditions, functional independence and pain treatment.

Model 2: Model 1 additionally adjusted for pain intensity and/or pain interference.

Model 3: Model 2 additionally adjusted for depressive symptoms.

suggest a list of psychosocial resources that could be addressed in pain management. Optimism, hope and self-esteem may present important targets for intervention to decrease pain interference and lower depressive symptoms. Moreover, the findings suggest that supporting individuals by strengthening psychosocial resources might not reduce the intensity of pain but may improve the ability to live with chronic pain. This strategy could be especially relevant for persons dealing with pain for whom current treatments are insufficient, as can be the case with neuropathic pain [8].

Interventions based on positive psychology and cognitive behavioral therapy (CBT) have proved effective in strengthening psychosocial resources in order to improve pain and pain-related factors [10, 11, 34]. For example, optimism and hope can be increased in the short term by a positive psychology exercise asking individuals to write about their best possible future self [34], as well as in the long term by identifying barriers to automatic pessimistic thoughts and coming up with alternative optimistic thoughts as part of CBT interventions [10]. Also, self-esteem can be increased with CBT interventions that include education on the role of self-esteem in pain and techniques for appropriate goal-setting [11] or by positive psychology exercises asking participants to count blessings or to express gratitude to another person [34].

Limitations and strengths

Several limitations need to be considered when interpreting the results of this study. First, as this study uses cross-

sectional data, the assumptions of causality cannot be empirically tested. Second, the statistical models were unable to depict the complex interplay between psychosocial resources, as the different resources were tested in separate models to avoid overadjustment. More detailed analysis for each psychosocial resource taking into account potential biasing and mediating paths through other resources are needed to more fully understand their interplay and their impact on pain-related factors. Third, evidence from chronic pain populations points out that potentially important constructs, such as acceptance or pain catastrophizing, might be missing in this study as they were not assessed in the Survey 2017. Finally, the sample might not be representative in terms of the main study variables. As no information on pain and pain-related factors in the SwiSCI 2017 survey's non-responders exists, non-response bias related to these variables cannot be assessed.

However, this study has several strengths and contributes to current knowledge on the associations of psychosocial resources with pain and pain-related factors, using a large population-based sample of individuals with SCI. With validated measures for most constructs, a broad set of psychosocial resources was investigated, of which sense of belonging and hope were investigated for the first time in SCI research, to our knowledge. Moreover, this study includes different chronic pain outcome domains recommended by the IMMPACT guidelines [25]. Furthermore, the study sample showed good representativeness regarding basic sociodemographic and lesion characteristics of the source population of individuals living with SCI in Switzerland [19]. State-of-the art statistical methods were used and multivariate models were developed based on the DAG approach [29], taking into account relevant confounding variables.

Conclusion

Individuals with SCI and chronic pain experience on average fewer depressive symptoms and less pain interference, but not lower pain intensity, if they report higher levels of psychosocial resources. With regards to comprehensive pain management, the findings support the notion that psychosocial resources are promising targets for interventions to tackle chronic pain in individuals with SCI.

Data archiving

Owing to our commitment to SwiSCI study participants and their privacy, datasets generated during the current study are not made publicly available but can be provided by the SwiSCI Study Center based on reasonable request (contact@swisci.ch).

Compliance with ethical standards

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