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Sense of coherence and changes over six years among older adults aging with long-term spinal cord injury

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STUDY DESIGN: Cross-sectional and longitudinal.**OBJECTIVES:** To (i) describe sense of coherence (SOC) and changes over six years in older adults aging with long-term spinal cord injury (SCI) and (ii) investigate how changes in SOC are associated with injury characteristics and changes in sociodemographics and secondary health conditions (SHCs; bowel-related and bladder-related problems, pain and spasticity).**SETTING:** Community in Southern Sweden.**METHODS:** From the initial 123 participants in the Swedish Aging with Spinal Cord Injury Study (SASCIS), 76 individuals (33% women, median age 66 years, median time since injury 30 years, AIS A-D, 30% complete) responded to the 13-item SOC scale (range 13–91) twice with a 6-year interval. Data were analyzed with multivariable hierarchical regression.**RESULTS:** The participants rated a strong SOC at both assessments (median 73 and 76.5, respectively) which significantly increased over time. Overall, their marital status and vocational situation remained stable whereas SHCs increased. A change from not having a partner to having one was the only significant explanatory factor for a positive change in SOC.**CONCLUSIONS:** The present study describes, for the first time, changes in SOC over time and associated factors in older adults aging with long-term SCI. They generally maintain a strong ability to understand, handle, and being motivated when dealing with stressful events arising in their lives as a result of their SCI. The associations emphasize the importance of the social context for successful adaptation to living with SCI along the aging process.*Spinal Cord* (2021) 59:1278–1284; <https://doi.org/10.1038/s41393-021-00713-6>

INTRODUCTION

Sustaining a spinal cord injury (SCI) is a major life event that often requires extensive adjustment to a new life situation. With increasing age, many people with SCI experience a process of constant re-adjustment, which is imposed by a combination of the neurological injury and age-related changes affecting body systems, the performance of daily activities and participation in society [1]. To support active and healthy aging after SCI in a long-term perspective, an increased knowledge of psychological and personal factors associated with adaptation and well-being is needed.

A person's global approach towards his or her disability is important for successful adaptation and mental well-being [2]. The salutogenic concept sense of coherence (SOC) has been associated with favorable physical and psychological health outcomes [3]. SOC was developed by Aaron Antonovsky in 1979 [4] and represents a shift from investigating factors that make people ill to factors promoting health and well-being. SOC infers that people's orientation towards life determines their ability to preserve good health despite external strains. People with a strong SOC are able to view life events as comprehensible, manageable, and meaningful [4], and mobilize their available resources to handle strains [5]. The concept thus consists of a cognitive dimension involving the ability to perceive inner and outer stimuli as rationally understandable, a dimension involving

problem solving and personal resources, and an emotional dimension involving motivation to invest in challenges instead of interpreting them as burdens that must be avoided [4]. Antonovsky also defined a number of "general resistance resources", such as intelligence, social support, cultural stability and wealth, that reduce the tension caused by stressors and thereby strengthen SOC. According to Antonovsky, SOC develops during childhood, adolescence and early adulthood, and thereafter remains relatively stable [4]. However, more recent studies show that SOC develops during a person's whole life and can increase with age [6–8]. Moreover, the stability of SOC seems to rely on the absence of radical and lasting changes in a person's life situation [9].

SOC has been found to facilitate both the adjustment to and the acceptance of disability [9]. For example, a strong SOC has been associated with a greater life satisfaction in persons with Parkinson's disease, post-polio and traumatic brain injury [10–12]. SOC can therefore be regarded as an important component in rehabilitation supporting persons with lifelong disabilities to successful adaptation.

In persons with SCI, SOC has been associated with psychological adjustment and mental health, both in cross-sectional [5, 13] and short-term (1-year follow-up) longitudinal studies [9]. We have previously reported on a strong SOC among older adults with

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long-term SCI, and a significant association between a strong SOC and fewer depressive symptoms [14]. Factors contributing to a strong SOC in the context of SCI and other lifelong disabilities are older age, social support, physical independence, longer time since onset of disability, and fewer disability-related symptoms [2, 12, 15]. However, little is known about how the aging process influences SOC after SCI, and how changes in a person's overall life situation interacts with changes in SOC. To the best of our knowledge, no study has focused on SOC and changes over time among older adults aging with long-term SCI. An increased understanding of psychological adjustment, changes over time and associated factors in this population can be used in the long-term follow-up to support successful adaptation, and thereby facilitate healthy and active aging.

The aims of this study are to (i) describe SOC and changes over 6 years in older adults aging with long-term SCI, and (ii) investigate how changes in SOC are associated with injury characteristics and changes in sociodemographics and secondary health conditions (SHCs; bowel-related and bladder-related problems, pain and spasticity).

METHODS

Research design

This study is based on data from the large longitudinal, population-based cohort study the Swedish Aging with Spinal Cord Injury Study (SASCIS) [16]. Data were collected at the initial assessment (years 2011–2012) and after on average 6 years (second assessment; years 2017–2018). The SASCIS is the first longitudinal study in Northern Europe aiming to provide knowledge of factors associated with healthy aging in people with long-term SCI [14, 16–19]. We have now continued with studies from the second assessment [20] and will conduct follow-up assessments every 6 years.

Data were collected from the participants' medical records, and through structured interviews and assessments during home visits. In total, 12 (eight generic and four SCI-specific) widely used and internationally validated assessment tools were used, together with a study-specific questionnaire (for details, see Jørgensen et al. [16]). A subset of the data was used to address the aims of the present study. The SASCIS follows the STROBE (Strengthening the reporting of observational studies in epidemiology) recommendations on reporting of cohort studies [21].

Participants

Participants in the SASCIS were community-dwelling and recruited from databases at the SCI Unit at Skåne University Hospital in Lund, Sweden. The SCI Unit covers a catchment area of 1.9 million people in southern Sweden and provides primary rehabilitation to persons with newly acquired SCI in this area. The two main inclusion criteria of the SASCIS were: (i) aged 50 years or older and (ii) at least 10 years after a traumatic or an acquired, non-progressive, non-traumatic SCI. In addition, participants were required to understand Swedish and reside in the southern part of Sweden. Due to the explorative and descriptive design of the SASCIS, no power calculation was made.

Data collection

Sociodemographics, injury characteristics, and secondary health conditions. Data on gender, age, marital status (dichotomized as married/co-habiting/partner or single), vocational situation (dichotomized as working full-time/part-time or disability pension/old age pension), injury characteristics (age at injury, time since injury, and cause of injury (dichotomized as traumatic or non-traumatic), and level and severity of injury) were collected through a study-specific questionnaire and retrieved from the initial data collection. Based on the International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI) [22], three different groups of SCI level and severity were formed: (i) tetraplegia AIS A-C, (ii) paraplegia AIS A-C and (iii) all AIS D.

The participants were asked about the occurrence (yes/no) of recurring bowel-related and bladder-related problems (e.g., incontinence, constipation, diarrhea, and frequent urinary tract infections) and spasticity. They were also asked to rate the greatest intensity of nociceptive and neuropathic pain experienced in daily life on a standard visual analog scale for pain (0–100 mm between "no pain" and "the worst pain imaginable"). According to Jensen et al., pain was categorized into mild (5–44 mm), moderate (45–74

mm), and severe (75–100 mm) [23] and dichotomized into no/mild pain or moderate/severe pain. In this study, pain was considered to be present if a participant reported moderate or severe pain. The number of SHCs were collated to generate a total number of SHCs for each participant.

Sense of coherence (SOC). Data on SOC were collected using the Swedish version of the 13-item SOC scale (SOC-13) [4, 24]. The SOC-13 captures the three dimensions of SOC: comprehensibility (i.e., the ability to understand the surrounding environment, five items), manageability (i.e., the ability to manage a given situation, four items) and meaningfulness (i.e., the ability to find a situation meaningful, four items). The participants were asked to rate their agreement with the 13 statements on a 7-point Likert scale. Item scores are summed to a total score ranging from 13 to 91. Greater scores indicate a stronger SOC but there are no cut-off values defining a strong or weak SOC. The scale has shown acceptable face validity and high internal consistency with Cronbach alpha ranging from 0.70 to 0.92 [8]. Cronbach's alpha in the SASCIS sample was 0.84 [14]. The SOC-13 is available in various languages, and there are Swedish reference values for comparison with mean SOC-13 scores ranging from 64 to 68.5 points [6, 25].

Statistical methods

Data analyses were performed using the Statistical Package for Social Sciences (SPSS) Software version 25 (IBM Corporation, Armonk, NY, USA). Data on sociodemographics, injury characteristics, SHCs and SOC are presented using percentages (%), median (25th–75th percentiles; Tukey's hinges), minimum, and maximum. We investigated changes over time in marital status (from not having a partner to having a partner, from having a partner to no partner, and no change in marital status), vocational situation (from working part-time/full-time to not working, and no change in the vocational situation) and SHCs (increase or decrease in the number of SHCs, and no change in the number of SHCs) using descriptive statistics. Due to the ordinal nature of the SOC scale and non-normal distributions, the Wilcoxon signed-rank test was used to analyse changes in SOC and in the total number of SHCs from the initial to the second assessment. Effect sizes were calculated as $r = Z\text{-value}/\text{square root of } n$ ($n = \text{total number of observations}$) [26].

To investigate factors associated with changes in SOC, a hierarchical multivariable linear regression model was computed. A change score was calculated for each participant, where the total SOC-13 score at the initial assessment was subtracted from the score at the second assessment, and was used as the dependent variable in the analyses. The selection of independent variables was based on previous research [2, 4, 6–8, 12, 15] and the aims of the study. The order of entry was: (i) age at the second assessment and gender, (ii) time since injury at the second assessment, level and severity of injury (tetraplegia AIS A-C and paraplegia AIS A-C with all AIS D as reference category), and cause of injury (non-traumatic injury with traumatic injury as reference category), (iii) change in the vocational situation (with no change in the vocational situation as reference category), change in marital status (with no change in marital status as reference category), and change in the number of SHCs (with no change in the number of SHCs as reference category). The final model exhibited no residual outliers, no influential cases, no multicollinearity, no heteroscedasticity, and the residuals were normally distributed. Adjusted R^2 is used as a measure of explained variance. For the significant explanatory variables, we calculated the median SOC change score for each of the categories used in the regression analysis. Throughout, a p -value of less than 0.05 was considered statistically significant.

RESULTS

Participants

The study sample at the initial assessment (years 2011–2012) included 123 participants, out of 184 eligible participants. In total, 101 persons from the original sample were alive at the time of the second assessment (years 2017–2018), and 23 declined to participate further.

Sociodemographics, injury characteristics and secondary health conditions, and changes over 6 years

From the original SASCIS study sample ($n = 123$) [16], 76 participants had completed the SOC-13 at both assessments and were included in the present study. Data on their sociodemographics, injury characteristics and SHCs are presented in Table 1.

Table 1. Sociodemographics, injury characteristics and secondary health conditions among older adults aging with long-term spinal cord injury ($n = 76$).

	<i>n</i> (%) / median (25th–75th percentiles); min–max
<i>Gender</i>	
Men	51 (67)
Women	25 (33)
Age (years)	66 (61.5–72.5); 55–88
Age at time of injury (years)	35.5 (22–51); 7–71
Years since injury	30 (20–38.5); 15–55
<i>Cause of injury</i>	
Traumatic ^a	48 (63)
Non-traumatic ^b	28 (37)
<i>Level and severity of injury</i>	
Tetraplegia AIS A–C	12 (16)
Paraplegia AIS A–C	25 (33)
All AIS D	39 (51)
<i>Marital status</i>	
Married/co-habiting/partner	45 (59)
Single	31 (41)
<i>Vocational situation</i>	
Working full-time/part-time	24 (32)
Disability pension/old age pension	52 (68)
<i>Secondary health conditions</i>	
Bowel-related problems ^c	36 (47)
Bladder-related problems ^c	38 (50)
Spasticity	48 (63)
Moderate/severe nociceptive pain ^{c,d}	39 (51)
Moderate/severe neuropathic pain ^{c,d,e}	34 (45)
Total number of secondary health conditions	2 (1–3); 1–5

AIS American Spinal Injury Association (ASIA) Impairment Scale.

^aTraffic/transportation, fall, workplace accident, diving accident, gunshot/assault/torture, other traumatic.

^bSpinal tumor, spinal disk herniation, spinal arteriovenous malformation, spinal infarction, and spinal infection.

^cNumber of participants reporting occurrence of (yes/no) bowel-related and bladder-related problems (i.e., urinary incontinence, constipation, diarrhea, bowel irregularity, hemorrhoids, flatulence, urinary urgency, frequent urinary tract infections), spasticity and moderate/severe pain.

^dPain intensity categorized according to Jensen et al. [23].

^e $n = 75$.

Data on changes over time in marital status, vocational situation and SHCs are presented in Table 2. At the first assessment, 44 of the 76 participants (58%) had a partner. Over time, four participants changed from not having a partner to having one, three participants changed from having a partner to no partner, whereas 69 participants did not report a change in marital status.

At the first assessment, 34 of the 76 participants (45%) were working full-time or part-time. Over time, ten participants changed from working full-time or part-time to not working, whereas 66 participants did not report a change in their vocational situation.

Regarding SHCs, 74 participants reported on their SHCs at both assessments. Thirty-five participants experienced an increase in SHCs over time, 17 experienced a decrease, whereas 22 did not

Table 2. Changes in marital status, vocational situation and secondary health conditions over 6 years among older adults aging with long-term spinal cord injury ($n = 76$).

	Participants
<i>Marital status</i>	
Married/co-habiting/partner at both assessments	41
Single at both assessments	28
Married/co-habiting/partner at the first assessment and single at the second assessment	3
Single at the first assessment and married/co-habiting/partner at the second assessment	4
<i>Vocational situation</i>	
Working full-time/part-time at both assessments	24
Not working at both assessments	42
Working full-time/part-time at the first assessment and not working at the second assessment	10
Not working at the first assessment and working full-time/part-time at the second assessment	0
<i>Secondary health conditions^{a,b}</i>	
No change in secondary health conditions	22
Increase in secondary health conditions	35
Decrease in secondary health conditions	17

^aNumber of participants reporting the occurrence of (yes/no) bowel-related and bladder-related problems (i.e., bowel and urinary incontinence, constipation, diarrhea, bowel irregularity, hemorrhoids, flatulence, urinary urgency, frequent urinary tract infections), spasticity and moderate/severe nociceptive and neuropathic pain (categorized according to Jensen et al. [23]).

^b $n = 74$.

experience a change in SHCs. The total number of SHCs increased from median 2.0 to median 3.0 between the two assessments ($r = 0.24$; $p = 0.002$).

Sense of coherence and changes over 6 years

Data on SOC and changes from the initial to the second assessment are presented in Table 3. There was a significant increase in SOC over time from median 73 to median 76.5 ($r = 0.21$; $p = 0.011$).

Each participants' SOC at the initial and the second assessment are illustrated in Fig. 1. A majority of the participants had a SOC score between 60 and 91 at both assessments. Four participants had a SOC score below 50 at both assessments. A majority ($n = 44$) had a greater SOC score at the second assessment (i.e., above the 45-degree line), five participants had the same SOC score and 27 participants had a lower SOC score at the second assessment.

Changes in sense of coherence and the association with injury characteristics and changes in sociodemographics and secondary health conditions

The multivariable hierarchical regression analysis investigating factors associated with changes in SOC is presented in Table 4. The first two models, including non-modifiable sociodemographics (i.e., age and gender) and injury characteristics, did not reach statistical significance. Adding changes in the vocational situation, marital status and SHCs, the final model explained a significant 13% of the variance. A change in marital status from not having a partner to having one was significantly associated with a greater positive change in SOC over time as compared to no change in marital status. Further descriptive analyses of this relationship revealed a median change score of 12.5 for participants changing from not having a partner to having one, a median change score of -7.0 for those changing from having a

Table 3. Sense of coherence among older adults aging with long-term spinal cord injury at the initial and the second assessment ($n = 76$).

	Initial assessment median (25th–75th percentiles); min–max	Second assessment median (25th–75th percentiles); min–max	Effect size; p -value ^a
SOC-13 scale (13–91)	73 (63.5–80.5); 37–91	76.5 (66–84), 27–91	0.21; 0.011

SOC-13 scale, 13-item Sense of Coherence Scale: greater scores indicate a stronger SOC.

^a p -value for the difference between the initial and the second assessment, analysed with the Wilcoxon signed-rank test. Effect sizes were calculated as $r = Z$ -value/square root of the total number of observations.

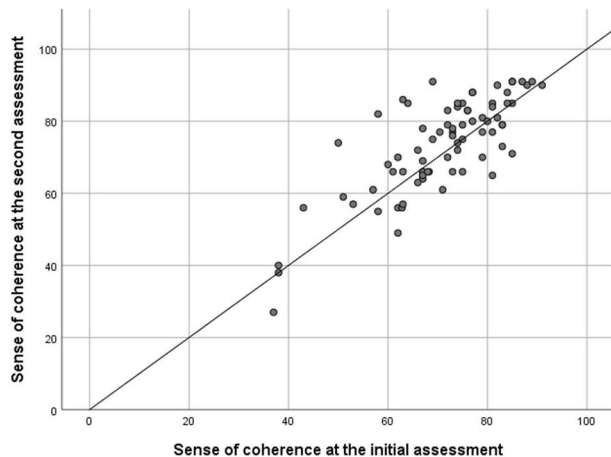


Fig. 1 Changes in sense of coherence from the initial to the second assessment. Scatter plot with each participant's rating of sense of coherence (SOC-13 scale, range 13–91; a higher score indicates a stronger SOC) at the initial and the second assessment.

partner to no partner, and a median change score of 2.0 for those reporting no change in marital status.

DISCUSSION

The present study describes, for the first time, changes in SOC over time and associations with injury characteristics, and changes in sociodemographics and SHCs in older adults aging with long-term SCI. This population presented with a generally strong SOC, as compared to Swedish reference values of 64 to 68.5 points [6, 25], and the SOC score among our participants increased significantly over 6 years. Overall, their marital status and vocational situation remained stable, whereas SHCs increased over time. Only modifiable sociodemographics contributed to explaining the variance in the change in SOC. A change from not having a partner to having one was the only significant explanatory factor for a positive change in SOC over time.

Changes in sociodemographics and secondary health conditions

More than half of the participants had a partner, very few became single and some participants found a partner during the 6-year period. The stability in marital status in our sample may reflect that the participants have lived on average 30 years with their injury. A SCI can have a negative impact on partner relationships [27] but these effects are probably most prominent early after injury. If a couple together can manage the challenges of the acute injury, it is plausible that their relationship will deepen and be maintained over many years.

Relatively few participants changed from being vocationally active to not working. Indeed, the proportion of SASCIS participants being vocationally active was similar at both assessments (35% at the first assessment [16] and 32% at the second assessment). We do not know if the participants left work

involuntarily or because of retirement, and there is no data on the reason for a change in marital status. Taken together, these findings indicate that aging with long-term SCI is not a barrier to partner relationship or an active vocational situation.

We found an increase in the number of SHCs which may indicate that specialized follow-up of bowel and bladder management, spasticity, and pain should be performed more frequently than every 6 years. Our results are consistent with Krause et al., who report a rapid and substantial health decline over time among persons who have lived at least 40 years with SCI [28]. Thorough assessments of changes in SHCs will be the focus of an upcoming study from the SASCIS.

Sense of coherence and changes over 6 years

SOC was generally strong among the participants, indicating that they have the ability to understand and manage external strains, and to stay motivated when they occur. Our participants rated on average a stronger SOC than a sample of about 2000 Swedes from the general population (mean age 44 years, mean total SOC-13 score 65 for men and 64 for women) [25]. A more recent Swedish study [6] including 43,600 individuals reported average SOC scores of 70.5–72 among persons aged between 60 and 85 years, results comparable to our study.

Our participants rated their SOC somewhat higher than in previous studies of people with SCI [29], Parkinson's disease and traumatic brain injury [10, 11], and similar to persons living with late effects of polio [2]. The differences are probably multifactorial, but the progressive nature of Parkinson's disease and the cognitive impairment in traumatic brain injury could make it more difficult to successfully adapt to a lifelong disability. The most plausible explanation is, however, the difference in mean age between these populations, where all, except persons with late effects of polio, were younger than our participants. Together, these findings strengthen the assumption that SOC increases with age.

The strong SOC among our participants may also reflect positive psychological changes occurring after injury [30]. We have previously reported on a relatively high life satisfaction in the SASCIS sample [17]. Moreover, the SASCIS participants report a high and stable health-related quality of life, and a low occurrence of probable depression [14, 20]. We have also reported that SOC is strongly and positively related to life satisfaction in people with Parkinson's disease, traumatic brain injury, and late effects of polio [10–12]. We found no study investigating changes in SOC over time after SCI, but Krause et al. concluded that over 40 years, persons with SCI rate a stability in their psychological adjustment [28]. Thus, the strong SOC and positive changes over time in the present study were not unexpected. Living with SCI for many years means constantly being confronted with new challenges that require an ongoing adjustment process, and our participants seem to be well adjusted to their long-term SCI.

Although the median rating of SOC can be considered high, there was a quite large variability in SOC. About a third of the participants reported a decrease in SOC and a few had quite low SOC-13 scores at both assessments. These individuals need to be identified in clinical practice and provided with adequate counseling. Interdisciplinary, goal-oriented rehabilitation that empowers people to mobilize and reflect upon their available

Table 4. Hierarchical multivariable regression analysis of changes in sense of coherence and the association with injury characteristics and changes in sociodemographics and secondary health conditions among older adults aging with long-term spinal cord injury ($n = 76$).

Model	Independent variables	β	<i>B</i>	95% confidence interval for <i>B</i>	<i>p</i> -value
1	Age	0.06	0.06	-0.19–0.32	0.85
	Female gender	-0.03	-0.62	-4.90–3.67	0.78
<i>p</i> -value; R^2 adjusted		0.86; -0.02			
2	Age	-0.09	-0.01	-0.093–0.69	0.13
	Female gender	-0.14	-2.46	-6.88–1.96	0.27
	Time since injury	-0.14	-0.19	-0.32–0.10	0.32
	Tetraplegia AIS A-C ^a	0.23	5.26	-0.76–11.29	0.086
	Paraplegia AIS A-C ^a	0.07	1.15	-4.04–6.35	0.66
	Non-traumatic injury	0.29	4.98	-0.33–10.29	0.066
<i>p</i> -value; R^2 adjusted		0.22; 0.034			
3	Age	0.09	0.10	-0.17–0.37	0.47
	Female gender	-0.11	-1.92	-6.24–2.40	0.38
	Time since injury	-0.10	-0.08	-0.29–0.14	0.48
	Tetraplegia AIS A-C ^a	0.23	5.28	-0.57–11.13	0.076
	Paraplegia AIS A-C ^a	-0.03	-0.56	-5.90–4.77	0.83
	Non-traumatic injury	0.15	2.60	-2.70–7.90	0.33
	Change from working full-time or part-time to not working ^b	0.14	3.44	-2.39–9.26	0.24
	Change from no partner to partner ^c	0.31	11.41	2.76–20.05	0.011
	Change from partner to no partner ^c	-0.20	-8.46	-18.38–1.47	0.093
	Increase in secondary health conditions ^d	-0.10	-1.73	-6.20–2.74	0.44
	Decrease in secondary health conditions ^d	-0.06	-1.19	-6.83–4.45	0.67
<i>p</i> -value; R^2 adjusted		0.048; 0.13			

β standardized regression coefficient, *B* unstandardized regression coefficient. *p*-values <0.05 are indicated in bold.

AIS American Spinal Injury Association (ASIA) Impairment Scale.

^aReference category: All AIS D.

^bReference category: No change in vocational situation.

^cReference category: No change in marital status.

^dReference category: No change in the number of bowel-related and bladder-related problems (i.e., bowel and urinary incontinence, constipation, diarrhea, bowel irregularity, hemorrhoids, flatulence, urinary urgency, and frequent urinary tract infections), spasticity and nociceptive and neuropathic pain (range 1–5).

resources in stressful life events could be used to strengthen SOC over time [31].

Changes in sense of coherence and the association with injury characteristics and changes in sociodemographics and secondary health conditions

A change in marital status from no partner to having one contributed significantly to a positive change in SOC. The association was driven by only four participants, indicating that a change in marital status can have a major impact on the development of SOC over time. A partner relationship can be associated with a sense of belonging and being needed, and provide financial security and emotional support. A partner may also be a trusted caregiver able to anticipate needs for assistance [32].

Our results are well in line with Antonovsky's assumption that social support is important for a strong SOC [4]. The results also corroborate previous research on different aspects of psychological wellbeing in persons with disability [10–12], including studies from the SASCIS [14, 17, 18]. Thus, clinicians should be attentive to changes in a person's close relationships to facilitate favorable adaptation over time.

Given the strong relationship between SOC and health-related outcomes [3, 4], it might be somewhat unexpected that we did not find any relationship between SOC and SHCs. Although the SHCs were self-reported, the perceived impact of these SHCs in daily life was not investigated. It may be that the perception of the impairments is more important for SOC than the actual physical disability.

Our multivariable model explained only a small amount of variance in the change in SOC between the two assessments. This study can thus serve as a starting point for future research identifying other factors associated with changes in SOC. The participants most likely have experienced other changes in their lives during this 6-year period that we were not able to determine using quantitative methods. We have also collected qualitative data regarding changes over time, consequences thereof and how the participants have handled these changes. Upcoming qualitative studies from the SASCIS will therefore contribute with much-needed knowledge on adaptation processes over time as one ages with long-term SCI.

Strengths and limitations

We have previously reported on several strengths of the SASCIS, such as the representative study sample, the use of internationally established assessment tools and the consistency of the data collection [16]. The longitudinal design of the present study allows us to investigate the interaction between the aging process and changes in SOC. The SASCIS includes participants with varying levels and severity of injury, which entails a generalizability of the results. However, the heterogeneous population and the small groups based on level and severity of injury may also have limited our ability to detect small between-group differences. Another limitation is the relatively small sample size. In the future, larger prospective studies including a power calculation, would allow us to make stronger and more detailed inferences. There might also be other sociodemographics, injury characteristics or SHCs

associated with changes in SOC that were not taken into account in this study. Lastly, it is possible that participants with weaker SOC were lost to follow-up, but data protection regulation prevented us from eliminating such bias.

CONCLUSIONS

Older adults aging with long-term SCI exhibit a strong SOC which increases over time. Thus, they generally maintain a strong ability to understand, handle, and being motivated when dealing with stressful events and problems arising in their lives as a result of their SCI. The stability in marital status and vocational situation indicates that living with a long-term neurological disability is not a barrier to maintaining close relationships and participation in meaningful activities. The associations emphasize the importance of the social context for successful adaptation to living with SCI along the aging process. Further research, incorporating qualitative methods, is needed to identify additional modifiable factors that strengthen SOC over time in older adults aging with long-term SCI.

DATA ARCHIVING

All data were archived according to the Swedish Act concerning the Ethical Review of Research Involving Humans and are available from the corresponding author upon reasonable request.

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AUTHOR CONTRIBUTIONS

The SASCIS was initiated and designed by SJ and JL. SJ managed and performed the data collection in the SASCIS and is responsible for the SASCIS database. SJ and JL designed the present study, SJ performed the data analyses and drafted the manuscript in collaboration with EL and JL. All authors critically revised the manuscript and all authors have read and approved the final version of the manuscript.

COMPETING INTERESTS

The authors declare no competing interests.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The SASCS was approved by the Regional Ethical Review Board in Lund (No. 2010/692, initial assessment, and No. 2016/911, second assessment) and the study was conducted in accordance with the Declaration of Helsinki for research on humans. All participants received oral and written information about the study procedures, provided written informed consent to participate and were informed about their right to withdraw at any time without giving a reason. We certify that all applicable institutional and governmental regulations concerning the ethical use of human volunteers were followed during the course of this research.

ADDITIONAL INFORMATION

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