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Socioeconomic consequences of traumatic and non-traumatic spinal cord injuries: a Danish nationwide register-based study

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STUDY DESIGN: A nationwide population-based register study.
OBJECTIVES: To investigate the socioeconomic consequences of traumatic (tSCI) and non-traumatic (ntSCI) spinal cord injuries (SCI) in relation to health care costs, risk of job loss, and divorce.
SETTING: Denmark.
METHODS: All survivors admitted for specialized SCI rehabilitation from 2008 to 2018 were included ($n = 1751$), together with their relatives ($n = 3084$). Control groups for the SCI group ($n = 8139$) and their relatives ($n = 15{,}921$) were identified. Data on socioeconomics up to 2 years before and up to 4 years after the injury year were included.
RESULTS: Survivors of tSCI and ntSCI had significantly increased health care costs 2 years before injury compared to their controls, and increased health care cost was maintained 4 years after the injury (all p values < 0.0001). The SCI group had significantly increased risk of job loss (OR = 9.26; 95% CI: 7.70–11.15) and higher risk of divorce (OR = 1.44; 95% CI: 1.08–1.87) the 3 following years after injury compared to controls, but risk of divorce was only significant for the ntSCI group (OR = 1.58; 95% CI: 1.09–2.29). No significant differences on health care cost and job loss between the group of relatives of SCI survivors and their controls were found, except for the relatives ($n = 1604$) of SCI survivors <18 years old, where a higher risk of job loss was found (OR = 1.43, 95% CI 0.97–2.1).
CONCLUSION: These results emphasize that socioeconomic consequences for survivors of both tSCI and ntSCI are pervasive and long-lasting.

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INTRODUCTION

A spinal cord injury (SCI) is a complex condition often followed by a wide range of physical and psychological consequences, including paralysis, sensory and autonomic dysfunction [1, 2]. SCI can be caused by traumatic injuries (tSCI) or a range of diseases termed non-traumatic SCI (ntSCI). A tSCI is typically caused by falls, traffic or sport and leisure injuries, or violence [2], whereas a ntSCI usually involves an underlying pathology such as degeneration (e.g., spinal stenosis, prolapsed discs), tumors, vascular disorders, infections, or inflammation [3]. In recent years survival after SCI has increased substantially in high-income countries because of improvement in technologies and effective health and rehabilitation interventions [2]. Incidence rates on country-level for tSCI vary from 13 to 53 individuals per million inhabitants [2, 4], and the incidence of ntSCI has recently been reported higher than the incidence of tSCI in some countries [3, 5].

When assessing the economic consequences of SCI, both health care costs and productivity costs of SCI should be considered [2, 6]. Health care costs include costs in relation to health care systems, rehabilitation services, medicine, transportation, and personal assistance, whereas productivity costs include loss of productivity and other labour market consequences [2]. Health care costs are generally highest in the first year after injury and decrease over time [7, 8], whereas productivity costs can have long-term consequences and exceed the health care costs [2]. Health care costs are of significant magnitude, and the lifetime health care costs for a person injured at age 25 was estimated to be between 2.3 and 4.6 million USD (value in 2013) depending on the completeness and neurological level of the injury, and health care costs were found to be three to six times higher five years after injury compared to controls without SCI [7].

Another consequence of SCI is lost productivity or change in employment status. Employment is important for most people, also because employment is associated with better mental health and satisfaction with life [2, 9–12], but acquiring or returning to a job after SCI can be challenging [2, 10, 13–15]. The employment rate after tSCI was found to decrease from 87% before injury to 35% after injury for people in the productive age [16]. A global average rate of current employment after SCI was found to be 37% [17], ranging from 21 to 61% [18] depending on severity of injury, age at injury [12, 19–21] and level of pre-injury education [2, 13, 22–27], but environmental factors also affected

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employment status [2, 28] including discrimination and lack of accommodation at work [2, 29, 30].

SCI also poses a significant burden on the close relatives of the survivor, as the family must adapt to a changed life-situation [31–35]. High emotional burden and lower quality of life [31, 36, 37] can threaten relationships [38–40]. Consequently, risk of divorce can be a consequence of SCI [39, 41–47]. Divorce rates among couples where one partner had an SCI have been reported ranging from 8 to 48% [44]. Some studies reported that risk of divorce declined to the normal rate for divorce for the general population after an initial high-risk period [44], whereas others found increasing rates of divorce up to 5 years after injury [42, 43]. Age and duration of marriage affected risk of divorce, with higher age and longer duration of marriage as protecting factors [2, 39, 42, 43].

The aim of the present national register-based study was to investigate the socioeconomic consequences of tSCI and ntSCI for all Danish survivors, who at some point during 2008–2018 were admitted for specialized SCI rehabilitation. The socioeconomic consequences of SCI were also investigated for the relatives of SCI survivors. The objectives were to investigate the consequences of SCI in relation to health care costs, risk of job loss, and risk of divorce up to four years after the injury for the SCI survivors and their relatives.

METHODS

Design and participants

This is a nationwide register-based study linking several Danish national registers [48]. In Denmark, all citizens have equal access to a health care system free of charge [49]. In addition, the Danish social security system provides social benefits for people not able to support themselves. All contacts to the health care system, demographic information, socio-economics, including social benefits, are registered in nationwide registers and can be linked using the unique social security number [48]. This enabled a comparison of a large cohort of survivors of SCI (both tSCI and ntSCI) and relatives of SCI survivors with specific matched controls.

SCI group. During 2008–2018 all SCI survivors with the treatment code ZDW80A were identified. This code refers to admission for initial SCI rehabilitation at one of the two specialized SCI centres in Denmark [50]. The two national centres receive all patients with non-progressive multifaceted impairment (motor, sensory, urinary bladder and bowel) due to SCI either of traumatic or non-traumatic aetiology and provide inpatient hospitalization and outpatient life-long follow-up [51]. The *tSCI population* included those admitted to a hospital with an injury prior to admission into the rehabilitation facility. Injuries were defined as one of the following ICD-10 diagnosis codes as primary or secondary diagnosis: S12, S13, S14, S22, T093, S24, S32, S34, M501, M511, G831 [52]. The *ntSCI population* consisted of the remaining part of the SCI population. i.e., without records of the above injury diagnoses [52].

Control groups. Prior to analysis, the control groups were identified by a data manager, using propensity score matching [53]. The matching was conducted separately from the project and included data on age, gender, marital status, five geographical regions, labour market affiliation (competitive employment, supported employment, unemployment or no labour market affiliation), and months of education. All variables were retrieved from national population-based registers in Statistics Denmark, on demography, education and transfer incomes [54]. Matching was conducted prior to the analysis and it was not possible to include new variables in the algorithm at later stages. Each survivor of tSCI or ntSCI were matched with five controls by means of a propensity score matching algorithm in SAS™, using nearest neighbour and no replacement.

SCI relatives and control relatives. The closest relatives of SCI survivors and their respective controls were also identified in the Danish registers and were defined as living parents and cohabiting family members (children and partners) [54]. All age groups were included.

Outcome measures

The outcome measures were health care costs, job loss, and divorce. Data on these three outcome measures for each group (SCI total, tSCI, ntSCI, controls, the relatives of SCI survivors and their controls), were retrieved from the Danish registers [52, 54–58] at baseline (being the year before injury), at the index year (being the year of admission to the specialized SCI centres) and up to 4 years from the index year [48]. In addition, health care costs were investigated up to 2 years before the index year. Health care costs were not adjusted for comorbidities or other characteristics that may drive a difference, because the attributable cost approach was applied. SCI survivors were identified in each of the years 2008–2018 and followed for as long as possible. Thus, not all SCI survivors had 4 years follow-up, and those acquiring their SCI in 2008 had no baseline year. The registers were accessed at a secure research server at Statistics Denmark [59]. An overview of the registers used is showed in Table 1 [60].

Statistical analyses

For all statistical analyses STATA MP version 16 was used and p values < 0.05 were considered statistically significant.

Baseline characteristics. Frequencies for the groups were used when presenting descriptive statistics. Categorical data were tested for equal distribution using Wilcoxon chi-square. Differences in comorbidity before the index year were analyzed by calculating the average Charlson Comorbidity Index (CCI) [61] for both SCI survivors and controls, and testing for equality by means of a t-test. CCI was calculated up to 8 years before the index year, using data from the National Patient Register [52] on primary and secondary diagnoses in the Charlson algorithm [61].

For the three outcome measures, the following statistical analyses were used:

Health care costs. *Health care costs* were compared between the two SCI groups and their respective control groups, and between the two groups of SCI relatives and their control groups. Generalized linear models (GLM) (log link, gamma family) were used for analyzing the differences in health care costs between the groups up to 4 years after the index year. GLM was considered suitable because of the non-normal distribution of health care costs. Health care costs both 1 and 2 years before index year were assessed, as both tSCI and ntSCI could occur several months before identification as identification was linked to admission at the specialized SCI rehabilitation facility.

Risk of job loss. A logit model was used for assessing risk of job loss for the SCI groups. SCI survivors and controls were included in this analysis only if they were affiliated with the labour market at baseline. In the logit model, job loss was modelled as a function of age, gender, and group assignment. To capture any effect that business cycles or policy changes could have had on the labour market, the index year was the same for the survivors of SCI and for the controls. Furthermore, it was analyzed if injuries had any consequences on employment status for the closest relatives. A similar logistic regression model was used for relatives.

Risk of divorce. Only participants who were married at baseline were included. Risk of divorce after SCI was assessed by comparing the two SCI groups with their control groups using a logistic regression model adjusted for age, gender, having children living at home, and receipt of social benefits.

RESULTS

Baseline characteristics

In total, 1751 survivors of SCI were included (838 with tSCI (47.9%) and 913 with ntSCI (52.1%)). Of these, 74 survivors of SCI were <18 years old. For both the tSCI group and the ntSCI group the majority were between 40 and 66 years old and most were men (Table 2). The ntSCI group was 4.5 years older (average age: 56.3 years) than the tSCI group (average age: 51.8 years).

A total of 8139 matched controls for the SCI group were selected by means of propensity score matching (Table 2).

A few differences between the SCI group and their controls were found (Table 2). The age distribution between SCI and controls was different, however the statistical significance was not found in the subgroups tSCI and ntSCI. This could relate to lack of statistical power, but also to the propensity score matching procedure, which was conducted for the two groups separately and which may not have given much weight to age. Annual

personal income was significantly different for both the tSCI and the ntSCI group, indicating that on group level, survivors of tSCI and ntSCI earned less than their controls in the baseline year. Furthermore, national origin was significantly different for the ntSCI group but not for the tSCI group, with more immigrants or descendants from Western and Non-western countries in the ntSCI group compared to their controls. A borderline significant difference was found on marital status, but only for the tSCI group compared to their controls.

A significant difference between the SCI group and the control group was found on comorbidities calculated by the CCI [61], indicating that both the tSCI and ntSCI survivors had more diseases before admission into the SCI rehabilitation facility compared to their controls (all p values < 0.0001) (Table 2).

For the total SCI group 3084 relatives (average age: 47.9) were included, and the matched control relatives group consisted of 15,921 (average age: 46.8).

For both survivors of tSCI and ntSCI health care costs were significantly higher than for their respective control groups. For the total SCI group and the matched SCI control group, there were significant differences both at baseline and the following 5 years, but the difference in health care costs decreased during the follow-up (all p values < 0.0001). Even 2 years before the index year health care costs among SCI survivors were significantly higher than among their controls. Health care costs for survivors of SCI were highest in the index year (Table 3).

The average annual health care costs for the SCI group, the tSCI group, the ntSCI group and the SCI control group at baseline and the following five years are depicted in Fig. 1. The tendency for health care costs in the control group to decline is primarily due to controls with above average health care costs deceasing during the period.

No significant differences on health care costs at baseline or at the following 5 years were found between the group of relatives of survivors with tSCI ($n = 1513$) and ntSCI ($n = 1571$) and their controls ($n = 7786$ for the tSCI control groups relatives and $n = 8135$ for the ntSCI control groups relatives) (all p values > 0.05).

Risk of job loss increased when acquiring an SCI. The survivors of SCI who were in the labour market at the index year had nine times higher risk of losing their job compared to their matched controls during the 3 years after index year (Table 4). Both the tSCI and the ntSCI group were in high risk of losing their job compared to their controls, but the risk was higher for the tSCI group (OR = 13.76; 95% CI: 10.54–17.97) than for the ntSCI group (OR = 5.94; 95% CI: 4.57–7.72). Gender was not a risk factor, but older (40–66 years) age was statistically significant risk factor of job loss, compared to age group <40 years old (Table 4). The oldest age group (>66) was excluded from this analysis, because most people in that age group are retired in Denmark (retirement age is flexible and the official threshold decreases with age in Denmark).

For the group of SCI relatives, no higher risk of job loss was found when compared to their matched control group of relatives (OR = 1.11; 95% CI: 0.96–1.27; $p > 0.157$). However, a subgroup analysis showed that relatives ($n = 1604$) to SCI survivors <18 years old had a borderline significant higher risk of job loss (OR = 1.43, 95% CI 0.97–2.1; $p > 0.071$).

Acquiring an SCI increased risk of divorce during the 3 years after index year. In addition, women had a significant higher risk of divorce in general, suggesting that women with SCI are at high risk of divorce. Furthermore, individuals <40 years old were also associated with increased risk of divorce compared to older age. Dependent children living at home was on the other hand a protecting factor against divorce. Receiving transfer income in the index year was not a significant risk factor of divorce (Table 5). When investigating the tSCI and the ntSCI group separately, we only found a significant risk of divorce for the ntSCI group (tSCI: $p = 0.262$; OR = 1.27; 95% CI: 0.84–1.91; ntSCI: $p = 0.016$; OR = 1.58; 95% CI: 1.07–2.29).

DISCUSSION

Our results confirm previous findings of high health care costs in the index year and then decreasing the following years, although remaining higher than the controls' health care costs [2, 7, 8]. Prior studies have primarily focused on the tSCI population, but it has been argued that health care cost associated with ntSCI was in general lower when compared with tSCI, as tSCI survivors often are injured at a younger age [2]. In the years before the index year we found as expected that the ntSCI group had higher health care

Table 1. An overview of the Danish national registers used, their contents, and the outcomes extracted.

Register name	Contents	Outcome measure
Danish National Patient Register (DNPR) [53]	Somatic and psychiatric in- and outpatients hospital contacts in Denmark	Health care costs[a]
The National Patient Register with Diagnose Related Group (DRG) tariffs [57]	A copy of the somatic DNPR with DRG-tariffs, which is based on the Danish Diagnose Related Group-system. Hospital services which was valued using the Danish DRG tariffs (diagnosis related groups)	Health care costs[a]
The Danish National Health Service Register [58]	Contacts to primary health care (general practitioners and practicing specialists) in Denmark was valued using the national tariffs for primary health care	Health care costs[a]
Danish Register for Evaluation of Marginalization (DREAM) [59]	Social public transfer payments and data on Danish citizens >18 years old, including weekly data on received transfer incomes: protected employment, unemployment benefit, early retirement, disability pension, old age pension, welfare benefits and long-term sick leave. Data on sickness benefits is available from 4th week of sickness	Job loss[b]
Danish Population Register (DPR) [55]	Demographics: age, gender, marital status, national origin, including civil registration numbers of relatives (spouses, parents and children)	Divorce[c]

[a]Health care costs were measured in Danish kroner (DKK) and converted to USD with an exchange rate of 1USD = 6.32DKK, which was the average exchange rate in the year 2018.
[b]Individuals were considered employed if they were in protected employment or if they received no transfer income (self-sufficiency). Job loss was defined as a change in employment status from before to after the index year, specified as a change from self-sufficiency to supported employment, unemployment, or other transfer income. Only individuals who were employed in the baseline year were included in this analysis.
[c]Risk of divorce was investigated using data on marital status from the Danish Population Register, including cohabitation status, which was dichotomized into two groups, (1) married/cohabitating, (2) living alone, including single, divorced, and widow. Only participants who were married at baseline were included in this analysis.

Table 2. Descriptive for the spinal cord injury group and the control group.

		SCI group total[a]	Control group SCI total[b]	Test for equal distribution SCI total vs. control P[c]	tSCI group	Control group tSCI	Test for equal distribution tSCI vs. control P[c]	ntSCI group	Control group ntSCI	Test for equal distribution ntSCI vs. control P[c]
		1751	8139		838	3938		913	4201	
Age	<40	22%	24%	0.036	26%	28%	0.231	18%	19%	0.139
	40–66	46%	49%		47%	49%		46%	49%	
	>66	30%	27%		25%	22%		34%	31%	
	Missing age	2%	1%		2%	1%		2%	0%	
Gender	Male	63%	65%	0.505	72%	73%	0.714	55%	57%	0.612
	Female	35%	35%		26%	26%		43%	42%	
	Missing gender	2%	1%		2%	1%		2%	0%	
Annual personal income[d]	$0–20,000	10%	8%	<0.001	11%	9%	<0.001	9%	8%	0.009
	$20–40,000	38%	34%		35%	30%		41%	38%	
	$40–60,000	24%	24%		25%	24%		22%	24%	
	$60,000+	23%	29%		26%	33%		21%	26%	
	Missing income (including children[d])	5%	5%		4%	5%		6%	5%	
Marital status the previous year	Married	46%	49%	0.060	44%	49%	0.052	48%	49%	0.366
	Divorced and widow(er)	23%	21%		21%	18%		25%	23%	
	Single	29%	30%		33%	33%		26%	28%	
	Missing marital status (including children[e])	2%	1%		2%	1%		2%	0%	
National origin	Danish	88%	91%	0.034	89%	90%	0.816	88%	91%	0.006
	Immigrant or descendant from Western country	4%	3%		3%	3%		4%	2%	
	Immigrant or descendant from Non-western country	6%	5%		6%	5%		6%	5%	
	Missing national origin	2%	2%		2%	2%		3%	1%	
Comorbidity	Average Charlson comorbidity index[f]	0.74	0.27	<0.000[g]	0.61	0.25	<0.000[g]	0.83	0.29	<0.000[g]

SCI spinal cord injury, *tSCI* traumatic spinal cord injury, *ntSCI* non-traumatic spinal cord injury.
[a]SCI group total includes tSCI and ntSCI group.
[b]Control group SCI total includes tSCI and ntSCI control group.
[c]Test for equal distributions are Pearson's chi-squared tests among non-missing observations.
[d]1USD = 6.32DKK 2018 average (2018 price level) income in the baseline year.
[e]No information on income and marital status is available for children (age < 18 years).
[f]The Charlson Comorbidity Index (CCI) was calculated up to 8 years before the index year on the somatic hospital contacts.
[g]*p* values are obtained by *t*-test.

Table 3. Health care costs among the survivors of spinal cord injury and controls (in USD)[a].

Health care costs, year[b]	SCI group total[c] (n = 1751)	Control group SCI total[d] (n = 8139)	tSCI group (n = 838)	Control group tSCI (n = 3938)	ntSCI group (n = 913)	Control group ntSCI (n = 4201)
Two years before index year	7327	3176	5622	2872	8815	3448
Baseline (year before index year)	23,688	3250	21,813	2901	25,408	3577
Index year	159,006	3741	173,364	3396	145,827	4064
First year after index year	34,002	3793	36,750	3573	31,479	3999
Second year after index year	16,199	3192	17,692	2959	14,828	3410
Third year after index year	11,975	2892	12,831	2681	11,190	3090
Fourth year after index year	9053	2314	9489	2125	8653	2492

SCI spinal cord injury, *tSCI* traumatic spinal cord injury, *ntSCI* non-traumatic spinal cord injury.
[a]1USD = 6.32DKK (2018 average price level).
[b]The probability of difference of means being 0 was calculated in a generalized linear model. Probability of equality of means for Control vs. SCI total, for Control vs. tSCI, and for Control vs. ntSCI calculated for each year were all significant (all p values < 0.0001).
[c]SCI group total includes tSCI and ntSCI group.
[d]Control group total includes tSCI and ntSCI controls.

costs, as they in general were a little older and expected to have a disease which for some already may have been under treatment [2]. However, we found that health care costs at baseline was more than seven times higher for both groups, when compared with their matched controls, which probably partly is due to the method for data extraction from the registers, as SCI were identified by the unique procedure code for admission at a specialized SCI centre. Therefore, an SCI occurring toward the end of the year would incur high health care costs due to hospital treatment in that year, which would become the baseline year, because the index year would be the year after the patient was admitted to the SCI centre. But, this does not explain the high health care cost 2 years before the index year, where health care cost was found to be almost 2 times higher for the tSCI group and 2.5 times higher for the ntSCI group when compared to their controls (both significant). These results are on the other hand supported by the CCI [61], which revealed that both tSCI and ntSCI survivors had significantly more somatic hospital contacts in the years before the index year compared to their matched controls. This could for the ntSCI group be explained as part of their ongoing disease for some individuals, i.e., symptoms which leads up to admission to the SCI centre during the index year. For the tSCI group, a possible reason could be that these individuals are more accident prone, which likewise is supported by a similar finding for traffic accidents [62].

Employment after SCI have been investigated in several studies [16–19], but a direct comparison is difficult due to different definitions of current employment and difference in social welfare, which enables different types of employment (e.g., sheltered employment, in general work force) [2]. Many studies have documented that employment was associated with better mental health, satisfaction with life, and having a meaningful life, but that acquiring or returning to an employment was challenging for an SCI survivor [2, 13, 14]. Our results support that survivors of SCI are at higher risk of job loss. We observed that the risk was much higher for individuals of older age (40–66 years), which is in agreement with previous findings, as employment after SCI is known to be correlated with younger age [19–21]. There are divergent findings on gender as a determinant for employment status after SCI [2, 13, 26], and our results do not support gender as a risk factor.

For the relatives of SCI survivors, only a borderline significant higher risk of job loss was found if the SCI survivors were <18 years old. This may be because parents to a child with SCI are more inclined to stay home to take care of their child and thus not available in the work force.

Increased risk of divorce was found for survivors of SCI compared to their matched controls, but when investigating tSCI and ntSCI groups separately, we only found a significant risk of divorce for the ntSCI group. Most previous studies only investigated the tSCI population and found an association with increased risk of divorce and SCI [41–45], but our tSCI population was older than in previously reported studies, which may be a reason why we did not find a difference. On the other hand, the ntSCI survivors were even older, but the aetiology is different, and they may have had specific challenges over a longer period before which have been the reasons for the divorce. However, the association is not clear, and the small population renders conclusions in this context ambiguous. Having dependent children was found to be a protecting factor as well. In the present study risk of divorce was significant 3 years after the index year. Kreuter et al. found that divorce rates tended to decline to the rate for the general population after an initial period of high risk [44], but these information are about 20 years old, and since then only scant research has been conducted in relation to divorce or separation. The novel element of the present study when quantifying the consequences of SCI on marital relationship is the inclusion of a matching control group.

Strengths and limitations

Strengths of this study is the a nationwide register-based design which enables the investigation of a large cohort of both tSCI and ntSCI compared to non-SCI matched controls with inclusion of all survivors of SCI in Denmark, who had been admitted to specialized SCI rehabilitation from 2008 to 2018. This study is the first investigation on the socioeconomic consequences of SCI for the survivors and the closest relatives compared to non-SCI matched controls. Further, the Danish registers used are considered to have high validity [52], and the register-based design prevented loss to follow-up. Due to the nationwide design and completeness of the data, the results can be considered generalizable for the Danish population of individuals with a newly contracted SCI.

Limitations include that few patients with SCI may not have been admitted for initial SCI rehabilitation at one of the two SCI centres. This will most often be due to their continuous need for intensive care not possible at the SCI rehabilitation centres. It is estimated that this is the case for only a few SCI survivors each year. Second, using these registers no information regarding severity of the SCI were available. Consequently, information on severity in relation to the outcome in the present study was not available. Third, generalizations and cross-country comparisons should be made with caution as differences in relation to disease understanding, health care systems, welfare, and social security and support do exist in and between countries. There are no user charges for the patient in most of the Danish health care sector [49], which means that all residents have free and equal access to hospital care and rehabilitation and in addition, and labour market agreements cover sickness benefits and disability pensions. Finally, it appeared that individuals with SCI had higher health care costs even before their injury. This could have been corrected by matching on baseline health care costs, if they were truly exogenous. However, this assumption could not be tested, and the matching was completed prior to project initiation, consequently a new matching was not possible. In addition to baseline health care costs, also income and national origin could have been included in the match.

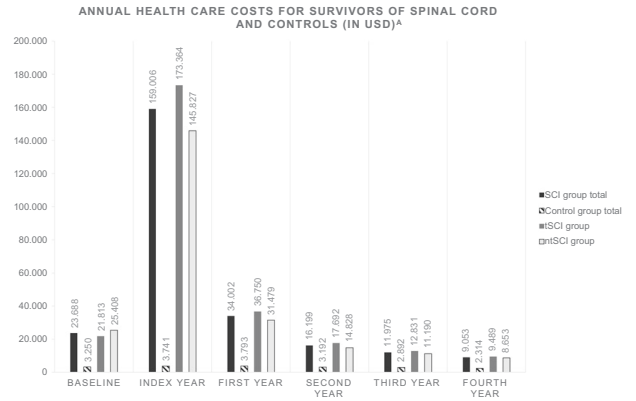

Fig. 1 SCI spinal cord injury, tSCI traumatic spinal cord injury, ntSCI non-traumatic spinal. SCI group total includes tSCI and ntSCI group. Control group total includes tSCI and ntSCI controls. cord injury. [A] 1USD = 6.32DKK (2018 average price level).

Main conclusion and future research

This study contributes with novel knowledge as the first study to investigate the socioeconomic consequences of both tSCI and ntSCI on both survivors and their closest relatives including non-SCI matched controls, which is valuable when quantifying the consequences. The study documented significantly higher risk of socioeconomic consequences for both tSCI and ntSCI survivors up to 4 years after the index year compared to their matched controls, as well as higher health care costs in the years prior to the SCI. No significantly higher risk of socioeconomic consequences for the relatives of SCI survivors was found, when compared to their matched controls. Consequently, the results of this study emphasized how SCI is a long-term disorder leading to higher risk of both job loss and divorce. This indicates how the

Table 4. Risk of job loss 3 years following spinal cord injury ($n = 4952$ SCI survivors and controls).

Variable	Comparison	Odds ratio	Standard error	z	P > | z|	95% Confidence interval
Group	SCI group total[a] vs. control group SCI total[b]	9.26	0.87	23.57	<0.000	7.70–11.15
Gender	Female vs. Male	0.96	0.07	−0.60	0.546	0.83–1.10
Age	Age group <40 years vs. age group 40–66 years	0.65	0.04	−6.34	<0.000	0.57–0.74
Constant		0.46	0.05	−7.67	<0.000	0.38–0.56

SCI spinal cord injury.
[a]SCI group total includes tSCI and ntSCI group.
[b]Control group SCI total includes tSCI and ntSCI control group.

Table 5. Risk of divorce 3 years following spinal cord injury ($n = 4440$ SCI survivors and controls).

Variable	Comparison	Odds ratio	Standard error	z	P > | z|	95% Confidence interval
Group	SCI group total[a] vs. control group SCI total[b]	1.44	0.20	2.51	0.012	1.08–1.87
Gender	Female vs. male	1.40	0.16	2.86	0.004	1.11–1.76
Age	Age group <40 vs. age >66	2.79	0.65	4.40	<0.000	1.77–4.49
	Age group 40–66 vs. age >66	1.08	0.16	0.53	0.598	0.81–1.44
Children	Dependent children vs. no dependent children	0.72	0.12	−2.05	0.041	0.52–0.99
Transfer	Receiving transfer income vs. not	1.19	0.18	1.18	0.238	0.89–1.59
Constant		0.06	0.01	−16.19	<0.000	0.04–0.08

SCI spinal cord injury.
[a]SCI group total includes tSCI and ntSCI group.
[b]Control group SCI total includes tSCI and ntSCI control group.

consequences are not only seen immediately after the injury or dysfunction. This indicates how SCI survivors need long-term care and continuous treatment and maintenance training in order to limit adverse events and continuous complications.

Future studies are warranted to investigate the similarities and differences between the tSCI and the ntSCI group on the socioeconomic consequences in lager cohorts. Furthermore, a larger sample would enable further investigation of the risk of divorce for SCI survivors and the influence of other diseases. Lastly, future studies are warranted to investigate the consequences on families with children with SCI separately.

DATA AVAILABILITY

Data at individual level are not available due to confidentiality reasons. Metadata will be made available through European open science cloud, https://digital-strategy.ec.europa.eu/en/policies/open-science-cloud.

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AUTHOR CONTRIBUTIONS

MK retrieved data from the registers and performed the data analysis. PLS wrote the drafts of the paper under the supervision of AN, MK and FBS. All authors contributed significantly to revising the paper, and all authors read and approved the final version of the paper.

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COMPETING INTERESTS

The authors declare no competing interests.

ETHICAL APPROVAL

This current study was approved by University of Southern Denmark legal services with the ref.no. 10.070. It was approved as a research project complying with section 10 in the Danish Act on Data Protection.

ADDITIONAL INFORMATION

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