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ORIGINAL RESEARCH

Prevalence and Determinants of Pain in Spinal Cord Injury During Initial Inpatient Rehabilitation: Data From the Dutch Spinal Cord Injury Database

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Abstract

Objective: To describe the prevalence and characteristics of spinal cord injury (SCI)-related pain during initial inpatient rehabilitation and to investigate relationships with demographic and lesion characteristics.

Design: Cohort during inpatient rehabilitation.

Setting: Eight specialized SCI rehabilitation centers in the Netherlands.

Participants: Patients with newly acquired SCI admitted for inpatient rehabilitation between November 2013 and August 2019 (N=1432).

Interventions: Not applicable.

Main Outcome Measures: Presence of pain at admission and discharge. Logistic regression analyses were used to study the prevalence of pain related to sex, age, etiology, completeness, and level of injury.

Results: Data from 1432 patients were available. Of these patients 64.6% were male, mean age was 56.8 years, 59.9% had a nontraumatic SCI, 63.9% were classified as American Spinal Cord Injury Association Impairment Scale (AIS) D and 56.5% had paraplegia. Prevalence of pain was 61.2% at admission (40.6% nociceptive pain [NocP], 30.2% neuropathic pain [NeuP], 5.4% other pain) and 51.5% at discharge (26.0% NocP, 31.4% NeuP, 5.7% other pain). Having NocP at admission was associated with traumatic SCI. AIS B had a lower risk of NocP than AIS D at admission. Having NocP at discharge was associated with female sex and traumatic SCI. AIS C had a lower risk of NocP at discharge than AIS D. Having NeuP at admission was associated with female sex. Having NeuP at discharge was associated with female sex, age younger than 65 years vs age older than 75 years and tetraplegia.

Conclusions: SCI-related pain is highly prevalent during inpatient rehabilitation. Prevalence of NocP decreased during inpatient rehabilitation, and prevalence of NeuP stayed the same. Different patient and lesion characteristics were related to the presence of SCI-related pain. Healthcare professionals should be aware of these differences in screening patients on presence and development of pain during inpatient rehabilitation.

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Spinal cord injury (SCI) results in varying degrees of function loss distal to the level of the injury.[1] Besides motor and sensory function loss, SCI is often accompanied by secondary conditions that affect quality of life.[2,3] Pain is one of the secondary conditions that is frequently reported by patients with SCI. The prevalence of SCI-related pain is estimated at 61%, with a large amount of

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heterogeneity in studies. Pain is one of the most challenging symptoms to manage.[4] The prognosis of SCI-related pain is poor, with many patients reporting the pain to remain the same or even worsen over time.[5] In addition, SCI-related pain is known to have a severe negative effect on quality of life.[2,6]

SCI-related pain is classified by the International Association of the Study of Pain into 2 main types: nociceptive pain (NocP) and neuropathic pain (NeuP).[5] Nociceptive pain is caused by tissue damage[2,6] and is divided in 2 main categories: musculoskeletal pain and visceral pain.[7] Examples of musculoskeletal pain include pain resulting from joint arthritis, spinal fractures, muscle injury, rotator cuff tendinopathy, and muscle spasms.[7] Examples of causes of visceral pain are constipation, urinary tract infection, ureteral calculus, and fecal impaction.[7] Neuropathic pain is caused by damage or dysfunction of the nervous system.[8,9] In SCI, NeuP can be located above, at, or below injury level.[2] Pain above injury level is often not because of the SCI itself but caused by concomitant compression neuropathy or by regional pain syndromes.[2] Pain at injury level can be caused by damage or disease of the nerve root or spinal cord.[2,7] Pain below injury level is caused directly by injury of the spinal cord.[2,7]

The treatment of SCI-related pain remains a challenge.[10-12] Pharmacologic treatment strategy for NocP is based on the stepped care of paracetamol, nonsystemic anti-inflammatory drugs, and opioids in accordance with the World Health Organization Cancer Pain Relief.[13,14] For NeuP, pregabalin and gabapentin are the most evidence based treatment options and have shown a significant reduction in pain intensity in multiple studies but with limited evidence on long-term effects.[11,12,15] Besides pharmacologic interventions, frequently used nonpharmacologic treatments, such as acupuncture, exercise programs, cranial electrotherapy stimulation, and psychological therapies such as cognitive behavioral therapy are used.[15,16] Little evidence is found on the effectiveness of these treatments on pain relief.[15,16]

It is important to gain a better understanding of SCI-related pain during inpatient rehabilitation to improve future treatment. Presence of SCI-related pain tends to change over time; therefore, studies on pain in community-dwelling patients with SCI might not relate to pain at inpatient rehabilitation.[3] Large studies on the presence of pain during inpatient rehabilitation are scarce and do not report the type of pain[17] or do not relate the patient and lesion characteristics to the type of pain.[18] Finding patient and lesion characteristics associated with SCI-related pain and type of pain can identify which patients are at risk for developing pain and facilitate patient screening during inpatient rehabilitation. Addressing pain at an early stage could potentially benefit treatment in the long-term. The objective of this study is to describe the prevalence of SCI-related pain during inpatient rehabilitation, describe the characteristics of such pain, and investigate possible associations to different patient and lesion characteristics.

List of abbreviations:

AIS	**American Spinal Cord Injury Association Impairment Scale**
DSCID	**Dutch Spinal Cord Injury Database**
NeuP	**neuropathic pain**
NocP	**nociceptive pain**
NRS	**numeric rating scale**
SCI	**spinal cord injury**

Methods

Participants

This study uses data from the Dutch Spinal Cord Injury Database (DSCID).[19] The DSCID is a joint effort of the 8 SCI specialized Dutch rehabilitation centers. This study used data of the DSCID collected between November 2013 and August 2019. Patients were included in the current study if data on presence of pain (yes or no) were available at both admission and discharge, patients did not object to the sharing of deidentified data, and time between onset of SCI and admission to the rehabilitation center was within 9 months (to exclude readmissions).

Procedure

This study was conducted according the principles of the Declaration of Helsinki. Informed consent varies between centers. Some centers ask for written informed consent in advance, whereas other centers inform patients with oral and written information about the use of anonymous data for research purposes. Patients can decline the use of these data, including the data of the DSCID. Clinical data of patients with SCI were collected at admission and discharge. A designated member of the clinical staff is responsible for data collection at each center. Information is either retrieved from the electronic medical record retrospectively or added prospectively at admission of the patient to the rehabilitation center and entered into the DSCID anonymously. The notation in the electronic medical record or the admission to the rehabilitation center is always supervised by a SCI rehabilitation physician. In this way, entering NocP or NeuP is similar in all rehabilitation centers.

Instruments

The DSCID contains data on age, sex, etiology of SCI, various secondary conditions of SCI, functional status, and quality of life. American Spinal Cord Injury Association Impairment Scale (AIS) classification and neurologic level of injury were assessed according to the International Standards for Neurological Classification of Spinal Cord Injury, revised version of 2011.[20] Data on pain were collected according to an amendment to the Spinal Cord Injury Pain Basic Data Set, which was a shorter version.[21] Information on the presence of pain; the type of pain divided into NocP (which were subdivided into musculoskeletal and visceral pain), NeuP (which was divided into above level, at level and below level of injury, where at level pain extends to 3 levels below the level of injury), and other pain; intensity of pain on the 11-point numeric rating scale (NRS); treatment of pain; and type of treatment (oral medication, physiotherapy, psychology, other) was available from the DSCID.

Analysis

The statistical analyses were performed using SPSS Version 26.[a] Frequencies were reported on the sociodemographic characteristics of the included patients and the characteristics of pain. Independent samples *t* tests were used to compare means for continuous variables, and chi-square tests were used to compare categorical variables on baseline characteristics of patients included and excluded from the DSCID. An independent samples

t test was used to compare mean time since onset between patients with pain and without pain. Logistic regression analyses were performed to examine whether a prediction on the prevalence of pain could be made using the variables age, sex, etiology, AIS classification, and level of injury for which unadjusted and adjusted odds ratios were calculated. Little's Missing Completely at Random tests were used to evaluate whether missing data were distributed randomly.

Results

From a total of 2700 patients registered in the DSCID, 1432 were included in the analysis. A flow diagram of inclusion of patients is shown in fig 1. Patient characteristics at admission of the included and excluded patients are shown in table 1. The included group contained less patients with AIS A and more patients with AIS D than the excluded group. Exclusion of patients readmitted to the rehabilitation center (time since onset >9 months) resulted in a significant difference in time since onset between included and excluded patients. Among the included patients, most common causes of traumatic SCI were falls (54.5%), traffic collisions (22.3%), and sports-related accidents (14.3%). Most common causes of nontraumatic SCI were vascular (22.4%), benign or malignant tumor growth (21.8%), degeneration (20.8%), and inflammation (15.9%). Most patients had an incomplete SCI in which AIS D occurred most frequently.

Prevalence of pain is reported in table 2. Pain was reported in 61.1% at admission and in 51.5% at discharge. NocP was reported in 40.4% of the patients at admission and in 26.1% at discharge. NeuP was reported in 30.5% of the patients at admission and in 31.7% at discharge. Change in pain is reported in table 3. Characteristics of NocP and NeuP are shown in tables 4 and 5, respectively. Above-level NeuP was described as other NeuP. This occurred in 3 patients, of which 2 had a combination with at-level and below-level NeuP.

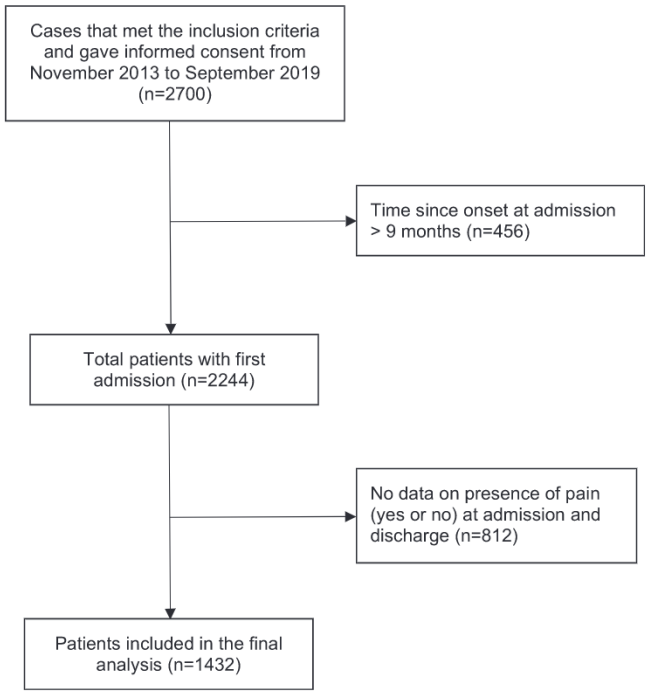

Fig 1 Flow diagram.

Time since onset of SCI was not significantly different in the group with pain and without pain in the total sample (mean, 38.1 days and 38.2 days; *P*=.96 at admission and mean, 130 and 126 days; *P*=.39 at discharge, respectively) nor in the subgroups with nociceptive pain (mean, 44.8 and 47.6 days; *P*=.47 at admission and mean, 126 and 129 days; *P*=.56 at discharge, respectively) and neuropathic pain (mean, 38.7 and 37.3 days; *P*=.63 at admission and mean, 132 and 136 days; *P*=.25 at discharge, respectively).

Patient characteristics on pain

The odds ratios of NocP and NeuP in relationship to patient characteristics is shown in tables 6 and 7, respectively. At admission, patients with AIS B had a lower risk of having NocP than those with AIS D. Patients with traumatic SCI had a higher risk of having NocP. At discharge female patients and patients with traumatic SCI had a higher risk of having NocP, and patients with AIS C had a lower risk of having NocP than those with AIS D. Sex, age, etiology, and level of injury showed significant relations to the prevalence of NeuP. At admission, female patients had a higher risk of having NeuP. At discharge female patients, patients younger than 65 years compared with those older than 75 years, and patients with tetraplegia had a higher risk of having NeuP.

Missing data

Little's Missing Completely at Random tests showed that missing data were distributed randomly and did not occur more frequently in specific subgroups.

Discussion

In our population of 1432 patients with newly acquired SCI, pain is highly prevalent. The prevalence of NocP decreased during inpatient rehabilitation, and prevalence of NeuP stayed the same. Female patients and patients having traumatic SCI had a higher risk of having NocP. Female patients, younger patients, and patients with tetraplegia had a higher risk of having NeuP.

The prevalence of pain reported in this study is lower than reported in the current literature. One study performed in Switzerland on pain during inpatient rehabilitation reported a pain prevalence of 87% at admission and 74% at discharge.[17] This study did not make a distinction between different types of pain. Another study performed in Italy on pain at inpatient rehabilitation showed a prevalence of 72% during inpatient stay, with a prevalence of NocP and NeuP of 52% and 48%, respectively.[18] Most studies report the presence of pain in community-dwelling patients with SCI, which is different from pain prevalence at inpatient rehabilitation. In a recent meta-analysis, with large variation in time since onset, the pooled prevalence of musculoskeletal pain was 56%, and the pooled prevalence of visceral pain was 20%.[22] The differences in prevalence between the studies can also be explained by the different patient characteristics of the studies. Musculoskeletal pain could develop in long-term wheelchair users (range, 5-56 years) because of overuse of the upper extremity, spasticity, and muscle contractures.[23] During inpatient rehabilitation there seems to be a decrease in NocP. Table 3 shows that 296 patients ceased to have NocP during inpatient rehabilitation, while 104 developed

Table 1 Patient characteristics at admission

Characteristic	Included Participants=1432	Excluded Participants=1268	*P* Value
Sex, n (%)			.474
Female	507 (35.4)	465 (36.7)	
Male	925 (64.6)	801 (63.3)	
Missing	0	2	
Age (y)			.334
Mean ± SD	56.8±16.5	57.3±16.8	
Median (IQR)	60 (22)	61 (23)	
Missing	10	6	
Time since onset at admission (d)			<.001*
Mean ± SD	38.2±45.9	564±2301	
Median (IQR)	22 (26)	30 (56)	
Missing	0	340	
Length of stay (d)			.595
Mean ± SD	92.4±78.7	90.38±65	
Median (IQR)	70 (84)	72 (74.5)	
Missing	43	547	
AIS classification, n (%)			<.001*
AIS A	159 (12.3)	160 (18.4)	
AIS B	125 (9.7)	92 (10.6)	
AIS C	183 (14.2)	127 (14.6)	
AIS D	825 (63.9)	492 (56.5)	
Missing	140	397	
Etiology of SCI, n (%)			.060
Traumatic	566 (40.1)	417 (36.5)	
Nontraumatic	846 (59.9)	727 (63.5)	
Missing	20	124	
Tetraplegia/paraplegia			.070
Tetraplegia	557 (43.5)	412 (47.5)	
Paraplegia	722 (56.5)	455 (52.5)	
Missing	153	401	

Abbreviations: IQR, interquartile range.
* Significant difference between groups.

NocP. This could be explained by pain resulting from the trauma or surgery disappearing over time. It is also possible that intensive physical treatment from a physical therapist during inpatient rehabilitation has a positive effect on managing NocP symptoms as has been described for SCI-related shoulder pain in those using wheelchairs for over 1 year.[24] Increased use of physical therapy as a treatment for NocP during inpatient rehabilitation is also described in table 4, where 28.2% of patients with NocP use

Table 2 Prevalence of pain at admission and discharge

Total Participants=1432 Pain, n (%)	Admission	Discharge
Total pain		
Yes	877 (61.2)	737 (51.5)
No	555 (38.8)	695 (48.5)
Nociceptive pain		
Yes	556 (40.6)	352 (26.0)
No	814 (59.4)	1002 (74.0)
Missing	62	78
Neuropathic pain		
Yes	411 (30.2)	436 (31.4)
No	951 (69.8)	952 (68.6)
Missing	70	44
Other pain		
Yes	74 (5.4)	78 (5.7)
No	1296 (94.6)	1293 (94.3)
Missing	62	61

Table 3 Change in pain during inpatient rehabilitation

Pain, n (%)	At Discharge Yes, n (%)	No, n (%)
Total pain at admission		
Yes	580 (66.1)	297 (33.9)
No	157 (28.3)	398 (71.7)
Nociceptive pain at admission		
Yes	230 (43.7)	296 (56.3)
No	104 (13.4)	673 (86.6)
Missing*	129	
Neuropathic pain at admission		
Yes	240 (59.4)	164 (40.6)
No	176 (19.0)	748 (81.0)
Missing*	104	
Other pain at admission		
Yes	9 (12.9)	61 (87.1)
No	66 (5.3)	1180 (94.7)
Missing*	106	

* Missing data on type of pain at admission and/or discharge.

Table 4 Characteristics of nociceptive pain

Pain	Patients With Nociceptive Pain at Admission (n=556)	Patients With Nociceptive Pain at Discharge (n=352)
Pain intensity		
NRS, mean ± SD (min-max)	4.37±2.15 (0-10)	4.19±2.12 (0-10)
NRS, median (IQR)	4 (3)	4 (3)
Missing	244	102
Type of pain, n (%)		
Musculoskeletal pain	448 (90.7)	250 (92.3)
Visceral pain	26 (5.3)	12 (4.4)
Other	20 (4.0)	9 (3.3)
Missing	62	81
Treatment, n (%)		
Yes	486 (93.6)	291 (85.6)
No	33 (6.4)	49 (14.4)
Missing	37	12
Type of treatment, n (%)*		
Oral medication	475 (91.5)	270 (79.4)
Physiotherapy	77 (14.8)	96 (28.2)
Psychotherapy	1 (0.2)	4 (1.2)
Other	13 (2.5)	16 (4.7)

Abbreviations: IQR, interquartile range.
* % of included patients with nociceptive pain and with data on treatment. Multiple treatments or no treatment can be used in 1 patient. Therefore, total percentages can exceed or be lower than 100%.

Table 5 Characteristics of neuropathic pain

Characteristic	Patients With Neuropathic Pain at Admission (n=411)	Patients With Neuropathic Pain at Discharge (n=436)
Pain intensity		
NRS, mean ± SD (min-max)	4.69±2.15 (0-10)	4.38±2.29 (0-10)
NRS, median (IQR)	5 (4)	4 (3)
Missing	156	84
Level of pain, n (%)		
At level	82 (22.3)	85 (21.9)
Below level	214 (58.2)	223 (57.3)
At and below level	65 (17.7)	70 (18.0)
Other	7 (1.9)	11 (2.8)
Missing	43	47
Treatment, n (%)		
Yes	291 (72.6)	352 (82.7)
No	110 (27.4)	74 (17.3)
Missing	10	8
Type of treatment, n (%)*		
Oral medication	287 (71.6)	346 (80.8)
Physiotherapy	17 (4.2)	41 (9.6)
Psychotherapy	1 (0.2)	5 (1.2)
Other	5 (1.2)	14 (3.3)

* % of included patients with nociceptive pain and with data on treatment. Multiple treatments or no treatment can be used in 1 patient. Therefore total percentages can exceed or be lower than 100%

physical therapy as a treatment compared with 14.8% at admission. Inactivity during hospitalization could also explain the higher pain levels of NocP at admission and decrease at discharge because training with a physical therapist increases during inpatient rehabilitation. The fact that inpatients start using wheelchairs, however, could explain the portion of patients that develop NocP during inpatient rehabilitation because rotator cuff pathology occurs more frequently in manual wheelchair users with SCI.[25]

The prevalence of NeuP reported in this study is lower than other studies report. A wide range of percentages on the prevalence of NeuP exist in current literature, varying between 32% and 92%.[26-33] Meta-analyses published in 2017 and 2021 estimated the pooled prevalence of NeuP to be 53% and 58%, respectively.[8,22] This study collected information during inpatient rehabilitation and therefore did not examine the prevalence of NeuP over a longer period of time. As shown in table 3, the number of patients that develop NeuP during inpatient rehabilitation is similar to the number of patients that cease to have NeuP (176 vs 164, respectively). NeuP mostly develops in a few years' time, and prevalence increases after 1 year.[8,26,28] Most patients reported NeuP to be present below level of lesion. Other studies also report NeuP to be mostly present below neurologic level of injury.[28,30-32,34,35] In the meta-analysis of Burke et al, pooled prevalence of at-level NeuP in patients with SCI was 19%, whereas pooled prevalence of below-level NeuP was 27%.[8] In this study, the prevalence of NeuP can only be generalized to patients with SCI during inpatient rehabilitation and not the entire population with SCI. Long-term follow-up at inpatient rehabilitation and after discharge would be useful to study the change in pain over time.

Demographic characteristics in this study were comparable with other studies on SCI. Mean age at admission was 57 years. The mean age in other studies on SCI range from 40-62 years.[3,36-42] The majority of patients (64.6%) in this study are male, which is similar to other studies.[4,37,43] Etiology of SCI is comparable with many other studies that include both traumatic and nontraumatic SCI.[37,42,43] A minority of the patients in this study had a complete SCI (AIS A). This low number of complete SCI is in accordance to other SCI studies.[3,36,37] There are differences on demographics in different parts of the world, for example, traumatic SCI is more prevalent in Northern America than Western Europe.[44]

The mean pain intensity of NocP and NeuP reported in this study is comparable with other studies reporting pain during inpatient rehabilitation.[17,45] It is lower than in other studies reporting on pain in the 5-8 years post injury, where pain ranged from 5.7-5.8 on the NRS in musculoskeletal pain, 6.6 in visceral pain, and 5.7-6.4 in NeuP.[3,35] This difference could be explained by pain worsening over time, as described before.[5] It is likely that assessment in other studies focus solely on pain, which could have led to a higher score on the NRS because of selection bias. Patients included in the current study were assessed on multiple questions regarding their SCI. This could have led to the large amount of missing data on NRS because the priority might not have been on pain during their inpatient rehabilitation.

A meta-analysis performed on determinants of pain in SCI did not find a relationship between pain and patient or lesion characteristics.[4] In this study women and patients having a traumatic SCI had a higher risk of having NocP, and female patients, patients younger than 65 years, and patients with tetraplegia had a higher risk of having NeuP. Other studies also found sex influenced SCI-related pain, where pain is related to female sex.[26,46,47] This could also be explained by the different presentation of pain in sex, unrelated to SCI.[48] In accordance with results on this study, Siddall et

Table 6 Prevalence of nociceptive pain in relationship to patient and lesion characteristics

	Admission			Discharge		
		Patients With Pain vs Without Pain			Patients With Pain vs Without Pain	
Variable	Patients With Pain (n=556), n (%)*	Unadjusted OR (95% CI)	Adjusted OR† (95% CI)	Patients With Pain (n=352), n (%)*	Unadjusted OR (95% CI)	Adjusted OR† (95% CI)
Sex						
Female	199 (41.3)	1.05 (0.84-1.31)	1.10 (0.86-1.41)	138 (29.2)	1.28 (1.00-1.65)	1.37 (1.04-1.82)‡
Male	357 (40.2)	1.00	1.00	214 (24.3)	1.00	1.00
Missing	0			0		
Age (y)						
≤44	135 (44.7)	1.17 (0.80-1.71)	1.04 (0.68-1.59)	78 (25.7)	1.07 (0.69-1.66)	1.05 (0.64-1.73)
45-54	99 (44.4)	1.16 (0.78-1.73)	1.07 (0.69-1.66)	60 (27.0)	1.15 (0.72-1.82)	1.05 (0.63-1.76)
55-64	106 (35.2)	0.79 (0.54-1.16)	0.78 (0.51-1.18)	81 (27.6)	1.18 (0.76-1.82)	1.20 (0.74-1.96)
65-74	142 (39.4)	0.95 (0.65-1.37)	0.96 (0.65-1.44)	89 (24.9)	1.03 (0.67-1.58)	1.05 (0.66-1.68)
≥75	71 (40.8)	1.00	1.00	41 (24.4)	1.00	1.00
Missing	3			3		
AIS classification at admission						
AIS A	74 (47.7)	1.32 (0.94-1.87)	1.02 (0.70-1.50)	45 (29.2)	1.19 (0.81-1.74)	1.01 (0.65-1.58)
AIS B	40 (33.3)	0.72 (0.48-1.08)	0.64 (0.42-0.98)‡	23 (19.3)	0.69 (0.43-1.12)	0.69 (0.42-1.14)
AIS C	65 (36.9)	0.85 (0.60-1.19)	0.71 (0.50-1.01)	34 (20.2)	0.73 (0.49-1.10)	0.60 (0.38-0.93)‡
AIS D	323 (40.9)	1.00	1.00	202 (25.8)	1.00	1.00
Missing	54			48		
Etiology of the SCI						
Traumatic	262 (48.2)	1.68 (1.35-2.10)‡	1.98 (1.50-2.62)‡	157 (29.5)	1.35 (1.05-1.71)‡	1.53 (1.12-2.09)‡
Nontraumatic	287 (35.6)	1.00	1.00	191 (23.8)	1.00	1.00
Missing	7			4		
Level of injury						
Tetraplegia	220 (40.7)	1.00 (0.80-1.26)	0.83 (0.64-1.07)	129 (24.6)	0.97 (0.75-1.26)	0.95 (0.68-1.24)
Paraplegia	279 (40.7)	1.00	1.00	173 (25.1)	1.00	1.00
Missing	57			50		

Abbreviations: CI, confidence interval; OR, odds ratio,
* Percentage of pain within subgroup.
† Adjusted for sex, age, time since onset, AIS classification, etiology of SCI, and level of injury.
‡ Statistically significant (CI≠1.00).

al described patients with tetraplegia to have a positive correlation to having NeuP.[3] A study in the Swiss population found that chronic pain, with no distinction between types of pain, was more prevalent in the oldest age group (61 years or older) than in the youngest age group (16-30 years).[46] Another study at inpatient rehabilitation also found that having pain was related to older age.[18] These studies did not differentiate between types of pain. The relationship between age and specifically having NeuP has not been described in previous research.

This study found a lower risk for NocP for patients with AIS B and AIS C. There was no relationship between the presence of NeuP and injury severity. Until now, only few studies have investigated the influence of injury severity on pain, mostly on the presence of NeuP. Different studies show conflicting results on the relationship between injury severity and pain. Norrbrink Budh et al reported that patients with AIS D had a significantly higher prevalence of SCI-related pain than patients with other AIS classifications.[47] In contrast, Werhagen et al showed patients with complete SCI (AIS A) had more below-level NeuP than patients with incomplete SCI.[31] Another study of Werhagen showed no difference between injury severity and the prevalence of NeuP in nontraumatic SCI.[32] Siddall et al reported that allodynia was more present in patients with incomplete lesions.[49] A better understanding of the relationship between pain and injury severity can possibly be achieved if the pathophysiology of pain is further explained or a more in depth assessment of pain characteristics is performed.

Study limitations

Several limitations of this study deserve to be mentioned. First, this study only reports on pain during initial inpatient rehabilitation. Therefore the prevalence of pain can only be generalized to patients during inpatient rehabilitation, with a short time since onset of SCI. Second, this study describes presence on pain, type of pain, type of treatment, and NRS but does not report on further information such as type of medication or burden caused by pain. Third, the DSCID has a high percentage of missing data. Because data collection is either done prospectively at admission or by extracting information from the electronic medical record, the amount of missing data could have been caused by a lack of information in the electronical medical record. Also, in most cases there is a delay in entering data in the DSCID, making it difficult to retrieve missing data from the patient. Future funding could possibly create time in which data are collected routinely prospectively in the different centers. This could enhance data completeness and accuracy as has been described before.[19] Last, there is a significant difference in AIS classifications in the

Table 7 Prevalence of neuropathic pain in relationship to patient and lesion characteristics

	Admission			Discharge		
		Patients With Pain vs Without Pain			Patients With Pain vs Without Pain	
	Patients With Pain (n=411) n (%)*	Unadjusted OR (95% CI)	Adjusted OR† (95% CI)	Patients With Pain (n=436), n (%)*	Unadjusted OR (95% CI)	Adjusted OR† (95% CI)
Sex						
Female	158 (32.6)	1.20 (0.94-1.52)	1.35 (1.04-1.76)‡	183 (37.2)	1.51 (1.19-1.90)‡	1.69 (1.30-2.20)‡
Male	253 (28.8)	1.00	1.00	253 (28.2)	1.00	1.00
Missing	0			0		
Age (y)						
≤44	103 (34.6)	1.59 (1.04-2.41)‡	1.56 (0.98-2.48)	98 (31.7)	1.50 (0.98-2.29)	1.89 (1.16-3.07)‡
45-54	82 (35.7)	1.66 (1.07-2.58)‡	1.54 (0.96-2.47)	83 (36.6)	1.86 (1.19-2.89)‡	2.23 (1.35-3.67)‡
55-64	84 (28.3)	1.18 (0.77-1.81)	1.07 (0.67-1.70)	102 (33.8)	1.64 (1.08-2.51)‡	2.08 (1.29-3.37)‡
65-74	96 (27.0)	1.11 (0.73-1.68)	0.98 (0.62-1.53)	108 (29.4)	1.34 (0.89-2.04)	1.55 (0.97-2.48)
≥75	43 (25.0)	1.00	1.00	41 (23.7)	1.00	1.00
Missing	3			4		
AIS classification at admission						
AIS A	47 (30.1)	0.98 (0.68-1.43)	0.82 (0.54-1.24)	54 (34.0)	1.18 (0.82-1.70)	1.08 (0.71-1.65)
AIS B	31 (25.8)	0.79 (0.51-1.23)	0.74 (0.47-1.17)	38 (30.9)	1.03 (0.68-1.55)	1.02 (0.66-1.58)
AIS C	50 (28.4)	0.91 (0.63-1.30)	0.85 (0.58-1.24)	53 (30.5)	1.01 (0.71-1.44)	0.86 (0.58-1.27)
AIS D	239 (30.5)	1.00	1.00	243 (30.3)	1.00	1.00
Missing	44			48		
Etiology of the SCI						
Traumatic	176 (32.7)	1.22 (0.96-1.55)	1.31 (0.98-1.77)	194 (35.3)	1.34 (1.06-1.69)‡	1.31 (0.98-1.74)
Nontraumatic	229 (28.5)	1.00	1.00	238 (29.0)	1.00	1.00
Missing	6			4		
Level of injury						
Tetraplegia	168 (31.1)	1.13 (0.89-1.45)	1.09 (0.83-1.44)	185 (34.1)	1.30 (1.02-1.65)‡	1.32 (1.00-1.74)‡
Paraplegia	194 (28.5)	1.00	1.00	201 (28.6)	1.00	1.00
Missing	49			50		

Abbreviations: CI, confidence interval; OR, odds ratio,
* Percentage of pain within subgroup.
† Adjusted for sex, age, time since onset, AIS classification, etiology of SCI, and level of injury.
‡ Statistically significant (CI≠1.00).

included and excluded group. Patients with complete SCI were less likely to have data on presence of pain at both admission and discharge. This could be explained by the fact that patients with complete SCI are admitted longer to the rehabilitation center and the information at discharge is not yet collected. In addition, there are more patients with AIS D in the analysis, which could have led to an overestimation of the prevalence of NocP because participants with AIS D were more likely to have NocP than those with AIS B and C.

Conclusions

This study showed that SCI-related pain is highly prevalent during initial inpatient rehabilitation. Prevalence of NocP decreased during inpatient rehabilitation, and prevalence of NeuP remained the same. Pain intensity was similar for different types of SCI-related pain, with a score on the 11-point NRS with means ranging from 4.19 (NocP at discharge) to 4.69 (NeuP at admission) . Female patients and patients with traumatic SCI have a higher risk of having NocP, and female patients, patients younger than 65 years, and patients with tetraplegia have a higher risk of having NeuP. Patients with AIS B and C have a lower risk of having NocP than those with AIS D. These differences in pain prevalence between different groups of patients with SCI are important in screening patients on having pain and developing pain during inpatient rehabilitation.

Suppliers

a. SPSS Version 26; IBM, Armonk NY.

Keywords

Neuralgia; Nociceptive pain; Pain; Rehabilitation; Spinal cord injuries

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