



PAIN CORRELATES WITH SOCIAL INTEGRATION IN INDIVIDUALS WITH TRAUMATIC SPINAL CORD INJURY: A CROSS-SECTIONAL SURVEY

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Objective: To describe the relationship between pain and social integration following spinal cord injury using comprehensive evaluation of pain-related clinical characteristics and different aspects of social integration.

Design: A cross-sectional study.

Participants: A total of 318 participants with American Spinal Cord Injury Association Impairment Scale (AIS) Grades A, B, C or D and >3 months post-injury.

Methods: All participants completed the survey relating to demographics, pain characteristics, and the Craig Handicap Assessment Reporting Technique Social Integration scores.

Results: Individuals who were younger, those 3–6 years after injury, and those with a grade of AIS grade A (odds ratio (OR) 8.32, 95% confidence interval (95% CI) 1.83–12.07) or B (OR 3.25, 95% CI 0.91–7.63) were more likely to report neuropathic pain. Significant inverse correlations were found between pain intensity and social integration ($R = -0.597$, $p = 0.019$). Brief Pain Inventory interference scores were negatively associated with 5 (friends, living situation, business, strangers and family) of 6 domains of Craig Handicap Assessment Reporting Technique social integration ($p < 0.001$). Pain type and only one domain (strangers) showed a significant negative relationship ($B = -1.47$, $p = 0.02$).

Conclusion: Chronic pain after spinal cord injury is negatively associated with Craig Handicap Assessment Reporting Technique social integration. Brief Pain Inventory Pain interference, to a greater extent than pain type, best predicts social integration after spinal cord injury.

Key words: spinal cord injury; pain; social integration; neuropathic pain; nociceptive pain.

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Pain is a common, and sometimes severe, complication of spinal cord injury (SCI) (1, 2). A number of studies have investigated the prevalence of chronic pain following SCI, and most indicate a prevalence of approximately 65%. Furthermore, after SCI, many individuals have severe pain, with approximately

LAY ABSTRACT

After spinal cord injury, pain is a common and sometimes severe complication. Social integration has been linked to positive outcomes including better physical health. This study aimed at exploring the association between pain and social integration post-spinal cord injury. Our results showed that those with neuropathic pain presented more severe pain. The presence of pain negatively impacted social integration post injury. Pain interference was the best pain item to predict social integration in those who reported pain.

one-third of people describing the pain as severe or excruciating (3, 4). The pain tends to persist, and even worsen, with time, especially if it begins within 6 months after injury. Despite numerous classifications proposed, there is no single widely accepted scheme for SCI pain. The main classifications include the International Spinal Cord Injury Pain and Cardenas classifications (5, 6). Most subjects after SCI share 2 basic categories of pain: nociceptive and neuropathic.

Pain takes a toll on an individual's activity levels and mental health status, reducing their quality of life (QoL). Chronic pain is associated with poorer psychological functioning and lower QoL (7–10). Social integration is an important factor for health-related QoL after critical illness (11). The role of social relationships, especially integration, has been emphasized as a buffer against negative health effects and, furthermore, it is argued that social integration maintains or sustains the organism by promoting adaptive behaviour of neuroendocrine responses in the face of stress or other health hazards. More socially isolated or less socially integrated individuals are less healthy, both psychologically and physically (11).

Some studies have evaluated pain patterns, complaints, and the associations with QoL in individuals with SCI (7–9). However, to date, few studies have examined the association between chronic pain and social integration after SCI. The purpose of the current study was to determine: (i) the percentage of persons with pain; (ii) the demographics of individuals with pain; and (iii) the relationship between pain and social integration in a sample of participants with SCI. It was hypothesized that individuals with SCI would commonly experience pain and that pain interference would be associated with lower social integration.

METHODS

Study design and population

The study was designed as an observational, non-interventional, cross-sectional survey. Inclusion criteria were: age at least 18 years; diagnosis of traumatic SCI at least 3 months prior to enrolment in the study; being treated at the Department of Rehabilitated Medicine, and Department of Orthopedic Surgery, the First Affiliated Hospital of Chongqing Medical University as inpatients or outpatients from 2012 to 2017. Participants with neurological function restored normally at the time of follow-up were excluded. A final total of 318 individuals (242 males and 76 females; mean age 41 years) were included.

Procedures

The data used in this study required no extra clinical tests, or treatments than those given regularly. The cross-sectional study was approved by the local ethics committee, in accordance with the Declaration of Helsinki, and all participants (or their legal representatives) gave signed informed consent for the collection, storage and analysis of the data, with guarantees of confidentiality.

Demographic and clinical characteristics were collected at either initial hospitalization or follow-up. Data on impairment level, sex, race, and educational status were collected at initial hospitalization. Data on pain and social integration were collected either during face-to-face follow-up or during a subsequent following phone interview.

Data collection

Demographic characteristics recorded included age, sex, educational status, mobility status, employment status and relationship status. SCI characteristics recorded included mechanism of injury, time since injury, neurological level of injury, and American Spinal Injury Association Impairment Scale (AIS) grade.

Participants were asked about chronic pain, defined as continuous or daily recurring pain that had been present for >3 months. Participants with chronic pain rated their mean pain intensity using the 0–10 numerical rating scale. Pain intensity scores of 0–3 were classified as mild, 4–6 as moderate, and 7 or more as severe.

Participants rated the extent to which overall pain interfered with functioning within 7 domains: general activity, mobility, normal work, relations with others, mood, enjoyment of life, and sleep, on a numerical rating scale ranging from 0 (no interference) to 10 (extreme interference) using the modified Brief Pain Inventory (BPI) (7, 12). The BPI total interference score was calculated as the mean of the 7 domains; the BPI activity interference score was calculated as the mean of the following items: general activity, mobility and work; and the BPI affective interference score was calculated as the mean of the following items: mood, relationships and enjoyment of life, while sleep was assessed separately (13).

The 7-item Douleur Neuropathique 4 Questions (DN4) questionnaire was used to record whether the reported pain was neuropathic in presentation (14). The selection of at least 3 of the 7 pain descriptors (burning, painful cold, electric shocks, tingling, pins and needles, numbness, and itching) is suggestive of neuropathic pain (NP) (15).

Social integration was measured with the Social Integration Index from the Craig Handicap Assessment Reporting Technique (CHART) (16). However, the current information society is significantly different from when the CHART was published. Social

integration scores were modified by changing once a month into once every 2 weeks. The CHART social integration index is a 6-domain instrument that is commonly used to quantify the effects of injuries and other conditions on activities of daily living. Each domain is scored on a 100-point scale, with a score of 100 representing a level of performance typical of a non-disabled person.

The CHART Social Integration Index was skewed, with 77% of participants having a score of 80–100. The classification method of Roach MJ was used, through which the index was transformed into a 3-category social integration measure (low 0–50; medium 51–79; high 80–100) (17). This categorization was based on the distribution of CHART scores. At scores of 51 and 80, there was observable separation of participants, and therefore these scores were used as categorization cut-off points.

Statistical analysis

Participant characteristics were reported using descriptive statistics. Continuous variables were expressed as means (standard deviations (SD)) and categorical variables as numbers and percentages. Comparison of categorical variables (pain locations, pain descriptors, pain intensity category in SCI individuals with nociceptive and NP) were conducted using the χ^2 test or Fisher's exact test, as appropriate. Numerical data (BPI interference score between nociceptive pain and NP) were analysed using an unpaired *t*-test or the Mann–Whitney *U* test, as appropriate. For comparisons of CHART social integration scores between 3 groups (participants with no pain, NP, and nociceptive pain) 1-way analysis of variance (ANOVA) was used with Bonferroni multiple comparison tests to analyse the differences in CHART social integration scores outcome. Binary logistic regression, Spearman's correlations and linear regression was used to analyse the factors associated with different pain types and the relationships between pain and social integration measures.

Data were analysed using IBM® SPSS® statistics software, version 24 (IBM SPSS Statistics for Mac, version 24.0., IBM Corp., Armonk, NY, USA). A *p*-value <0.05 was considered statistically significant.

Statement of ethics

The authors certify that all applicable institutional and governmental regulations concerning the ethical use of human volunteers were followed during the course of this research. The ethics committee of the First Affiliated Hospital of Chongqing Medical University approved the study (2018019).

RESULTS

Patient characteristics

Of 403 individuals with SCI who were screened, 351 were recruited and contacted. A total of 318 surveys were completed and returned (response rate 91%).

The age range was 19–77 years, mean age 41 years (SD 13); 242 participants (76%) were male, and 76 (24%) were female. The most common causes of traumatic SCI were other traumatic (composed mainly of collision with falling objects and being crushed by heavy objects) in 126 (40%), followed by falls (35%) and motor vehicle accidents (20%). Most injuries were reported as incomplete. The most common neurologi-

cal levels of injury were incomplete tetraplegia (38%, $n=122$) and incomplete paraplegia (30%, $n=95$). Individuals with AIS grade C (37%, $n=117$) were the most common, followed by AIS grade A (32%, $n=102$). At the time of interview 63% of participants (200/318) reported pain in the previous week. The mean CHART social integration index was 74 ± 20 . Individuals with medium social integration (72%, $n=229$) were the most common. Further details of subjects' characteristics are summarized in Table I.

Table I. Demographic and clinical characteristics of studied patients ($n=318$)

Characteristics	
Age at injury, mean (SD)	41 (13)
<35 years	64 (20)
35–65 years	229 (72)
>65 years	25 (8)
Time post-injury, mean (SD)	4 (2)
<3 years	133 (42)
3–6 years	121 (38)
>6 years	64 (20)
Sex, n (%)	
Male	242 (76)
Female	76 (24)
Educational status, n (%)	
<High school	213 (67)
High school	95 (30)
>High school	10 (3)
Mechanism of injury, n (%)	
Sport or leisure	10 (3)
Assault	7 (2)
Traffic accident	64 (20)
Fall	111 (35)
Other traumatic	126 (40)
Level of injury, n (%)	
Complete paraplegia	41 (13)
Incomplete paraplegia	95 (30)
Complete tetraplegia	60 (19)
Incomplete tetraplegia	122 (38)
AIS grade, n (%)	
A	102 (32)
B	64 (20)
C	117 (37)
D	35 (11)
Operation, n (%)	
Yes	267 (84)
No	51 (16)
Mobility status, n (%)	
Wheelchair dependent	232 (73)
Walking with aid	60 (19)
Walking independently	24 (8)
Employment status at interview, n (%)	
Not working	302 (95)
Working/student	16 (5)
Pain, n (%)	
Yes	200 (63)
No	118 (37)
Relationship status, n (%)	
Married/co-habitation	226 (71)
Single/separated/widowed	86 (27)
Not reported	6 (2)
Social integration index, mean (SD)	74 (20)
Social integration, n (%)	
Low	57 (18)
Medium	229 (72)
High	32 (10)

AIS: American Spinal Injury Association Impairment Scale (AIS) grade; SD: standard deviation.

Pain

Chronic pain was reported by 63% (200/318) of subjects. The DN4 was completed by those who reported pain, and on analysis, 45% ($n=90$) scored 3 or more for their worst pain, indicating a NP presentation, the remainder (55%, $n=110$) scored less than 3, indicating a nociceptive pain presentation. As summarized in Fig. 1a, those with NP ($n=39$, 43%) and nociceptive pain ($n=56$, 51%) reported the back as the most common painful area. NP occurred significantly more frequently in the lower extremities (36%) compared with nociceptive pain (28%). As anticipated, a significantly higher proportion of those with NP identified DN4 descriptor items (see Fig. 1b).

A significantly higher percentage of severe pain (34%) and lower percentage of mild pain (18%) were observed in those with NP, compared with those with nociceptive pain. Moderate pain was similar between groups (see Fig. 2a).

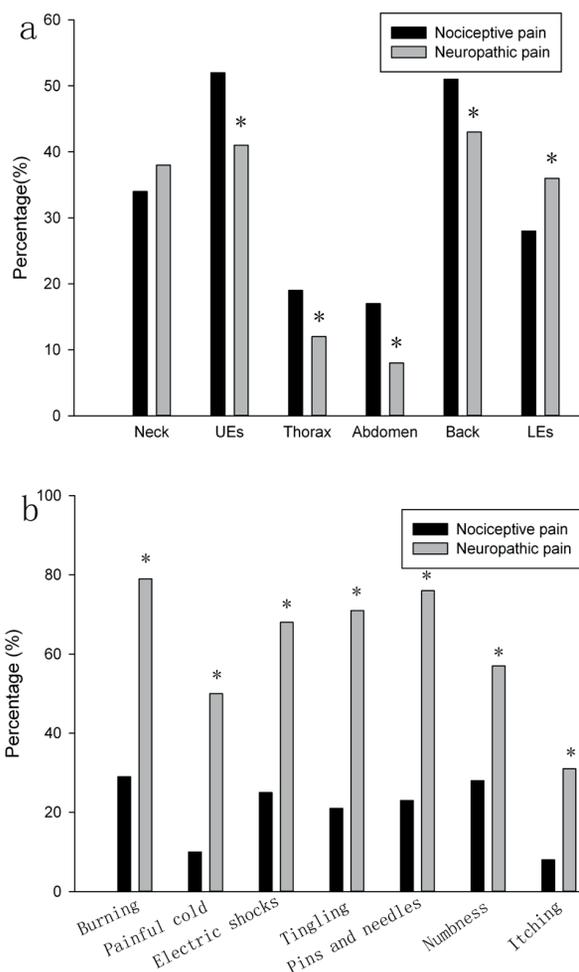


Fig. 1. (a) Pain locations and (b) pain descriptors in spinal cord injured individuals with nociceptive and neuropathic pain. UEs: upper extremities; LEs: lower extremities. *Significant difference with respect to nociceptive pain ($p < 0.05$).

BPI Interference scores for overall pain are shown in Fig. 2b. Interference scores for affective-related functions (mood, relationships with others and enjoyment of life), sleep and the total mean interference were significantly higher in subjects with NP than in those with nociceptive pain, except for activity-related functions (general activity, mobility and work).

Craig Handicap Assessment Reporting Technique social integration

The participants were classified into 3 groups as follows: no pain ($n=118$), NP ($n=90$), and nociceptive pain ($n=110$). There was a slight, but statistically significant, difference in CHART social integration among the 3 groups. Multiple comparison of the CHART social integration was performed using the Bonferroni correction test, and social integration scores were significantly different between any 2 groups. The individuals with no pain (86 ± 17.2) had the highest social integration scores, followed by those with nociceptive

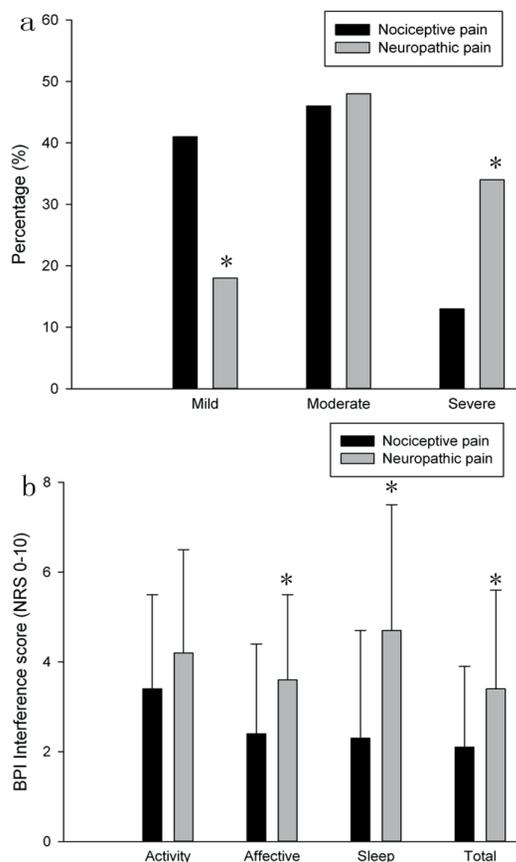


Fig. 2. Comparison of: (a) pain intensity category and (b) pain interference by pain type. *Significant difference with respect to nociceptive pain ($p < 0.05$).

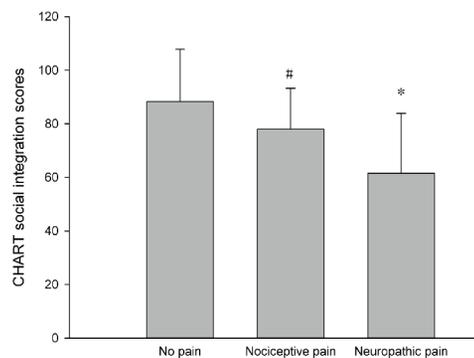


Fig. 3. Comparison of Craig Handicap Assessment Reporting Technique (CHART) social integration scores by pain type. *Significant difference with respect to no pain or nociceptive pain ($p < 0.05$). #Significant difference with respect to no pain or neuropathic pain ($p < 0.05$).

pain (78.2 ± 15.5), whereas those with NP (61.8 ± 20.2) had the lowest social integration scores (see Fig. 3).

Factors associated with neuropathic pain and nociceptive pain

Binary logistic regression analyses (see Table II) were used to examine associations between the different pain types and the variables of some demographic and clinical characteristics, according to primary statistical analysis and our clinical experience. The results indicated that those with grade AIS A had a reduced risk of nociceptive pain involvement (OR 0.39, 95% CI 0.16–2.91, $p < 0.01$). The odds of nociceptive pain increased by a factor of 1.94 for subjects aged over 56 years, by 3.22 for having more than 6 years after injury, by 6.02 for incomplete paraplegia, and by 3.97 for incomplete tetraplegia. Conversely, NP was independently associated with 3–6 years after injury (OR 2.38, 95% CI 1.15–8.01, $p < 0.05$), AIS A and B (OR 8.32, 95% CI 1.83–12.07, $p < 0.01$; OR 3.25, 95% CI 0.91–7.63, $p < 0.05$, respectively). Age over 56 years, incomplete paraplegia or tetraplegia decreased the odds of NP (OR 0.35, 95% CI 0.02–0.88, $p < 0.05$; OR 0.41, 95% CI 0.16–1.25, $p < 0.05$; OR 0.37, 95% CI 0.08–1.01, $p < 0.01$, respectively).

Association between pain intensity and 3-category social integration

Spearman's correlation coefficients are shown in Table III. The CHART social integration index was transformed into a 3-category social integration measure (low 0–50; medium 51–79; high 80–100). Pain intensity and social integration were strongly, negatively and significantly correlated with high Spearman's correlation coefficients (-0.597 ; $p = 0.019$).

Table II. Summary of the logistic regressions for different pain types

	OR	95% CI
<i>Nociceptive pain</i>		
Age, years		
[36–55] vs [<35]	0.78	0.10–3.42
[>56] vs [<35]	1.94*	0.61–4.32
Time since SCI, years		
[3–6] vs [<3]	0.32	<0.1–3.83
[>6] vs [<3]	3.22*	1.30–7.81
Educational status		
[high school] vs [<high school]	3.02	1.50–9.01
[>high school] vs [<high school]	1.63	0.27–5.12
Mechanism of injury		
[Sport or leisure, assault] vs [Other traumatic]	3.12	1.13–8.39
[Traffic accident] vs [Other traumatic]	1.66	0.74–1.83
[Fall] vs [Other traumatic]	1.23	0.90–1.61
Level of injury		
[Incomplete paraplegia] vs [Complete tetraplegia]	6.02*	1.50–11.06
[Complete paraplegia] vs [Complete tetraplegia]	3.41	1.08–6.97
[Incomplete tetraplegia] vs [Complete tetraplegia]	3.97**	0.91–7.10
AIS grade		
[A] vs [D]	0.39***	0.16–2.91
[B] vs [D]	1.64	0.61–3.07
[C] vs [D]	6.10	2.19–9.02
Operation		
[Yes] vs [No]	2.17	0.35–6.22
<i>Neuropathic pain</i>		
Age, years		
[36–55] vs [<35]	1.91	0.87–3.01
[>56] vs [<35]	0.35*	0.02–0.88
Time since SCI, years		
[3–6] vs [<3]	2.38*	1.15–8.01
[>6] vs [<3]	4.25	1.86–7.21
Educational status		
[High school] vs [<High school]	0.91	0.27–2.02
[>High school] vs [<High school]	1.23	0.34–4.01
Mechanism of injury		
[Sport or leisure, Assault] vs [Other traumatic]	2.48	0.03–8.13
[Traffic accident] vs [Other traumatic]	3.02	2.39–3.65
[Fall] vs [Other traumatic]	1.21	0.93–1.67
Level of injury		
[Incomplete paraplegia] vs [Complete tetraplegia]	0.41*	0.16–1.25
[Complete paraplegia] vs [Complete tetraplegia]	6.04	1.20–11.09
[Incomplete tetraplegia] vs [Complete tetraplegia]	0.37***	0.08–1.01
AIS grade		
[A] vs [D]	8.32**	1.83–12.07
[B] vs [D]	3.25*	0.91–7.63
[C] vs [D]	2.03	1.87–6.89
Operation		
[Yes] vs [No]	3.21	2.21–6.06

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.
 SCI: spinal cord injury; AIS: American Spinal Injury Association Impairment Scale grade; OR: odds ratio; 95% CI: 95% confidence interval.

Pain variables as predictors of Craig Handicap Assessment Reporting Technique social integration

The linear regression models (Table IV) identify the pain variable (pain interference and pain type) that best predicts each domain of the CHART social integration

Table III. Spearman's correlations among pain intensity (NRS) and 3-category social integration ($n = 318$)

Spearman's rho	Pain intensity scores (NRS)	Social integration (low/medium/high)
Pain intensity scores (NRS)	$r = 1$	$r = -0.597$
Social integration (low/medium/high)	-	$p = 0.019$
		$r = 1$

NRS: numeric rating scale.

Table IV. Linear regression models with social integration domains as dependent variables

Social integration domains	Pain interference				Pain type			
	B	SE	β	p -value	B	SE	β	p -value
Friends	-3.52	0.41	-0.62	<0.001	-1.16	1.52	-0.03	0.41
Living situation	-4.10	0.62	-0.32	<0.001	-1.76	1.70	-0.07	0.52
Business	-4.62	0.79	-0.28	<0.001	-2.83	1.97	-0.05	0.28
Strangers	-5.87	0.82	-0.42	<0.001	-1.47	1.94	-0.04	0.02
Family	-1.36	0.08	-0.34	<0.001	-0.06	0.07	-0.09	0.27
Romantic	-0.73	0.04	-0.14	0.39	-0.08	0.06	-0.01	0.19

B: regression coefficient, SE; standard error, β : standardized regression coefficients.

and those that make a unique and significant contribution to the model. Pain interference and 5 of the 6 domains of CHART social integration (friends, living situation, business, strangers and family) were found to have a significant negative relationship ($B = -3.52, -4.10, -4.62, -5.87$ and -1.36 , respectively, $p < 0.001$). Pain type and only 1 domain (strangers) of CHART social integration showed a significant negative relationship ($B = -1.47, p = 0.02$). However, there was no relationship between pain type and the remaining 5 separate domains (friends, living situation, business, family and romantic).

DISCUSSION

This study revealed that chronic pain is a common problem after SCI, and that NP is more often associated with severe pain and high pain inference compared with nociceptive pain. Chronic pain negatively impacts social integration after SCI. BPI pain interference can act as a predictor of CHART social integration.

This cross-sectional study examined the prevalence of pain in a cohort of individuals with SCI. The overall prevalence of pain (63%) was similar to that reported by many other studies (18), with a relatively high proportion of persons describing their pain as nociceptive. The current study used a classification system set out by the International Association for the Study of Pain (IASP) and the International Spinal Cord Injury Pain (ISCIP) classification (5, 19, 20). Classification of pain is performed primarily according to pain descriptors, and studies are currently in progress to determine the reliability of the classification system.

Nociceptive pain is the most common, but least severe, type of pain, and usually presents late after injury. In line with a previous prospective study there was a high prevalence of nociceptive pain at 5 years following a decline in the first 6 months after injury (4). In other words, a substantial proportion of subjects have late-onset musculoskeletal pain. This is presumably due to the development of chronic musculoskeletal pain associated with problems such as degenerative skeletal changes secondary to trauma and abnormal

use of the spinal column, as well as chronic muscular pain secondary to postural abnormalities and overuse syndromes.

Participants with pain DN4 score ≥ 3 , which suggests the presence of NP, reported higher pain intensity and pain interference and had a lower satisfaction with their life situation and mental health than those with pain and a DN4 score < 3 . Burning (79%), pins and needles (76%) and tingling (71%) were the most common pain descriptors.

A previous study reported that individuals with an AIS grade of B experienced more intense NP than those with other grades (9). A relationship between completeness of injury and prevalence of pain was also reported previously (21). In contrast, our study found that individuals with AIS grades A and B showed a trend to more NP than individuals with other AIS grades. The reason why individuals with AIS grades A and B had the greatest pain in our study seems to be because there are several proposed mechanisms for the origin of NP after SCI. Pain may arise from a combination of generators: peripheral, spinal, and supra-spinal (22). Peripheral sources may include impingement of nerve roots, resulting in radicular-at-level NP. Spinal pain may be due to an "irritated focus" or "neural pain generator" located at the injury site, as there are cases of spinal blockade with anaesthetics abolishing pain (22).

Many studies have examined the association of chronic pain after SCI with QoL (8, 10, 19, 23). Significantly poorer QoL was observed in the NP group in comparison with those reporting no pain or nociceptive pain. Individuals with moderate to significant chronic pain participate less, are more restricted in, and less satisfied with, participation, and have higher levels of depressive symptoms, and lower QoL than individuals with no or mild chronic pain (10).

This study conducted qualitative analysis to examine the relationship between chronic pain and social integration in individuals with SCI. These analyses suggested that chronic pain is negatively associated with social integration among participants with SCI. Furthermore, we found that pain interference can act as predictor of CHART social integration. Pang et al. (24) also showed that pain interference and depressive symptoms are significantly associated with disease management self-efficacy in people with SCI. These findings are important and add to our understanding of the relationship between chronic pain and social integration after SCI.

More importance should be attached to the management of pain after SCI. Clinicians should raise the awareness of pain and ensure early detection, diagnosis and treatment, in order to reduce adverse effects on QoL and social integration in individuals with SCI. Secondly, implementing enhanced patient education

is necessary to improve the prognosis of pain post-SCI, and to maximize efficiency of health care for the physician and the patient. Finally, individuals with SCI are at risk of poor outcomes in terms of social integration. Lack of social support is a barrier to good mental health. There is a need for tailored health promotion initiatives in the everyday lives of individuals with SCI.

The CHART Social Integration subscale score was used in this analysis. This score employed 6 questions to quantify the extent to which individuals fulfil various social roles. In the initial CHART social integration questionnaire the frequency of keeping in touch with friends, business and family was reported as instances per month, and with strangers as instances in the preceding month. However, we modified these intervals by the substitution of once every 2 weeks, and in the preceding 2 weeks for once a month, preceding 2 weeks, respectively. This modification was made because the current information age is significantly different from when the CHART was initially developed; interpersonal contacts and exchanges are increasingly frequent.

The main limitation of the present study is the small size of the samples and relatively short duration (the majority ≤ 6 years) after SCI. This could have led to a slight bias in the analysis of the pain and social integration scores. This study is based mainly on questionnaires. Self-reporting is always accompanied by the possibility that some individuals provided inaccurate answers. In addition, the current study was not extended to assess effect of at-level and below-level NP on social integration.

In conclusion, individuals with NP presented more severe pain than those with nociceptive pain. The presence of pain impacted negatively on social integration after injury. Pain interference was the best pain item to predict social integration in those who reported pain.

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