The experience of low back pain in people with incomplete spinal cord injury in the USA, UK and Greece

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Abstract

Aims/Background: To investigate the prevalence of low back pain in people with incomplete spinal cord injury and compare these characteristics among three countries.

Methods: A cross-sectional, primarily internet based survey, was conducted in the USA, UK and Greece. The Short Form McGill Pain Questionnaire was the main measure used. In addition, data were collected on the presence, onset, duration and frequency of low back pain.

Findings: A total of 219 questionnaires were included in the analysis. Anytime low back pain was 74% (95% confidence interval [CI] 67, 79) and current low back pain was 66% (95% CI 59, 72). People with paraplegia were 2.75 times more likely to report low back pain anytime post incomplete spinal cord injury than people with tetraplegia (95% CI 1.38, 5.47). Thirty-three percent of participants reported low back pain onset immediately post incomplete spinal cord injury and 44% reported daily low back pain with people from UK reporting the highest percentage (59%). The more low back pain days felt in a month the worse its quality and intensity. Low back pain is described as 'discomforting' with moderate intensity and people from the UK reported the worst low back pain. Finally, people from Greece reported better results for the sensory component of their low back pain.

Conclusions: Despite some differences in profile and injury characteristics of the groups from the three nations, low back pain presence in incomplete spinal cord injury is reported highly for all people in the countries investigated.

Key words: ■ Cross-national ■ Incomplete ■ Low back pain ■ Prevalence ■ Spinal cord injury

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INTRODUCTION

Spinal cord injury (SCI) is one of the conditions that have a high impact on the individual's life and a great economical cost to the society (Ma et al, 2014). The prevalence of pain in SCI is very common and can range from 26% to 96% (Dijkers et al, 2009). Its influence on the lives of people living with pain is well documented for causing distress, stress, and anxiety (Rintala et al, 1998; Cruz-Almeida et al, 2005), affecting mood and relating to depression (Ataoğlu et al, 2013). Pain has also been found to interfere with sleep (Cruz-Almeida et al, 2005) or activities (Ströud et al, 2006) and decreases quality of life (Nicholson et al, 2009).

In a previous publication (Michailidou et al, 2014) the authors discussed the importance of examining specific pain locations in more detail, such as low back pain, which is also recommended by the International Spinal Cord Injury Basic Data Set (Widerström-Noga et al, 2014). The prevalence of low back pain in people with an SCI was found to be 37% (95% confidence interval [CI]: 33–42%) (Michailidou et al, 2014), suggesting that this can be a major problem for this population. Research on this topic is gradually emerging (Miró et al, 2014).

The fundamental difference between a complete and an incomplete spinal cord injury (iSCI) is that the former results in motor and sensory loss below the level of injury, whereas in the latter sensory function is maintained (Kirschblum et al, 2011). As such, all people with iSCI are able to feel pain in areas including the lower back when the injury is above that level, which is not the case with a complete injury. Furthermore, studies have shown that life expectancy and pain characteristics can differ in people with complete and incomplete spinal cord injuries (Mannion et al, 2001; Felix et al, 2007). Despite this, most studies pool together people with complete and incomplete injuries in their statistical analysis (Widerström-Noga et al, 2001; Ullrich et al, 2008; Miró et al, 2014). In addition, there are fewer studies in people with iSCI compared with complete SCI.

We conducted a generic online search using the terms 'complete spinal cord injury' and 'incomplete spinal cord injury' and the number of papers returned for 'complete spinal cord injury' were about ten times more than those for 'incomplete spinal cord injury'. If pain presence is more frequent for people with incomplete spinal cord injury than those with compete spinal cord injury then, by pooling their data together, the actual problem may be masked, impacting awareness and affecting rehabilitation.

Most of the studies examining pain in SCI are conducted in only one country, though often comparisons of different cultural backgrounds of people living in one country are made (Turner et al, 2001; Markogiannakis et al, 2006; Ströud et al, 2006; Felix et al, 2007; Ullrich et al, 2008). The importance and the need to conduct cross-national research have been discussed in the literature (Kohn, 1987). Some cross-national studies examining pain in the general population exist and some are emerging in the SCI population (Breivik et al, 2006; Divanoglou et al 2010; Baron et al, 2017). A lot of work is conducted on SCI in both the USA and UK, whereas on the other hand, few studies are carried out in Greece.

This study investigated, in detail, a troubling and common pain location for the general population—that of the lower back—and examined how substantial this problem may be for people living with an iSCI. It also examined similarities or differences across three countries. In more details, the main aims were to:

- Investigate the prevalence, and general characteristics of low back pain in people with iSCI who participated in this study
- Examine the injury and demographic characteristics of people with low back pain and iSCI
- Explore how people with iSCI describe their low back pain
- Compare the findings between the participants from the three countries: Greece, UK and USA.

METHODS

Design

A cross-sectional, primarily internet-based survey, was conducted in the USA, UK and Greece. The study was advertised on various websites including the Spinal Injury Association (SIA), the National Spinal Cord Injury Association (NSCIA) and 'Disability Now'. In addition, data were collected via screening the medical records of patients in two hospitals in Greece, and eligible participants were invited to complete the questionnaire. Questionnaires were also distributed at a medical centre in Greece. The data collection took place between 2008 and 2009. Participants had the choice of completing the questionnaire online or on paper, with anonymity being secured.

For the online data collection, a web-based survey was used. The same questionnaire was distributed online separately for each of the three countries, adjusting for language differences. All questionnaires were piloted for language accuracies and the Greek questionnaire was translated following international translation procedures including forward and backwards translation (Michailidou, 2012). Questionnaires were placed on all websites/hospitals/clinics that were approached and approved of the study.

Completion and return of the questionnaire was considered as giving informed consent. The pre-study sample size calculation required a total number of 185 participants.

Ethical approval

The SHSSC Research Ethics Committee, Brunel University, UK, provided ethical approval to conduct

the study in the UK, USA and Greece (A01/08/PHD/01). Local approvals were also given by the two participating hospitals and the medical centre in the cities of Thessaloniki and Kavala (regions of Macedonia, Greece) and the various websites where the study was advertised; including the SIA, the NSCIA and 'Disability Now'.

Participant selection

Completed questionnaires were included in the study if they fitted the following inclusion criteria were:

- Participants to be at least 18 years old
- To live in the UK, USA or Greece
- To report a diagnosis of iSCI.

The completeness of the injury was based on each participant's response on the following options given:

- Complete paraplegia
- Incomplete paraplegia
- Complete tetraplegia
- Incomplete tetraplegia
- I do not know.

Only people who answered either incomplete tetraplegia or incomplete paraplegia were included.

<u>Measures</u>

Pain-related data: Information gathered on low back pain included presence, onset, duration and frequency. The presence of low back pain was established for four time periods:

- At any time post injury
- At the time of completing the questionnaire (current prevalence of sample)
- Over the last month
- Over the last three months.

<u>Short Form McGill Pain Questionnaire</u>

The McGill Pain Questionnaire (MPQ) is a widely used measure to assess pain (Melzack and Katz, 1992), which has been translated into many languages (Melzack and Katz, 1992) including Greek (Georgoudis et al, 2001; Mystakidou et al, 2002). Both the MPQ and the Short Form McGill Pain Questionnaire (SF-MPQ) have been used in studies to assess self-reported pain in adults with an SCI (Rintala et al 1998; Turner et al, 2001; Cardenas et al, 2002; Burke et al, 2017). The SF-MPQ has a component called the Pain Rating Index, which gives information on the affective dimension of pain (how the respondent feels) and the sensory dimension (which is the sensation the respondent has). Each of the 15 descriptors on the Pain Rating Index is scored from zero to three and they were added to give a total score for each category (sensory, affective and total). These items describe low back pain quality and hereafter the Pain Rating Index results will be referred to as the 'low back pain quality' results. The SF-MPQ also has a Present Pain Intensity numeric rating scale to measure current pain. We included a question regarding the usual low back pain intensity. Due to a technical error, some data on the intensity of low back pain using the Numeric Rating Scale (0–100) was not collected. However, the total number of responses collected for the intensity of low back pain still formed a large enough group for analysis (ranging from 121–124).

<u>Statistical analysis</u>

Analysis was conducted using Stata version 13 (StataCorp, 2013). Demographic, injury and pain characteristics were analysed descriptively, with between country statistical tests using chi square or one way analysis of variance, as appropriate. Modelling the association between prevalence of low back pain and demographic and injury related factors was carried out using logistic regression, mutually adjusting for all variables. Linear regression was carried out on the scores and indices that came from the SF-MPQ. Unadjusted and adjusted coefficients are shown for low back pain quality and intensity in relation to demographic factors. Relationships between low back pain quality and timing of pain onset and pain days are presented unadjusted only. Only data from the UK and USA were included in the intensity models because of the large amount of missing data from the Greek sample.

RESULTS

A total of 282 completed questionnaires were returned and 219 (78%) were included in the analysis. Of the 63 questionnaires excluded, 28 were from people with complete SCI, 20 from people who did not know the type of their injury, 10 from people from countries other than the 3 involved in the study (6 from Canada, and 1 from each of Australia, Hungary, Namibia and Zimbabwe), 2 from people who did not have SCI and 3 had more than 50% of data missing, which was the preset acceptable level of missing data for a questionnaire to enter data analysis. Per country, the excluded questionnaires were 28 from the USA, 13 from Greece, and 12 from the UK.

Of the 219 questionnaires that were analysed, 122 were respondents from the USA (56%), 52 were from the UK (24%) and 45 were from Greece (21%). The total group consisted mainly of males (62%), with a mean age of 50 (standard deviation [SD]: 14) years. Time since injury was 12 (SD: 11) years and the main cause of injury was traumatic (71%). People from the UK had the highest level of education above high school (74%). Just over half of the participants (55%) remained in work or education, with people from the USA showing a significantly high percentage (62%). People from the Greek group were significantly older than those from the other two groups. The Greek group were injured at an older age and had a higher percentage of non-traumatic cause of injury (Table 1).

<u>Low back pain presence</u>

In our sample, the prevalence of low back pain at any time post iSCI was 74%, (95% confidence interval [CI] 67, 79). The prevalence of current low back pain was 66% (95% CI 59, 72), over the past month was 66% (95% CI 60, 72) and over the past 3 months was 67% (95% CI 60, 73). There were no significant differences between countries (Table 2). There were no gender differences in the presence of low back pain for the total group or between countries. Among people who reported having low back pain at any time after their iSCI, the percentage of current low back pain was 88% (95% CI 82, 92), low back pain over the past month was 88% (95% CI 71, 83) and over the last 3 months was 90% (95% CI 84, 94).

A total of 33% of participants reported onset of their low back pain immediately post iSCI and 44% between a month and a year post injury. The Greek participants reported a slightly lower percentage of low back pain onset immediately post iSCI, but 90% of this population had low back pain within 1 year of injury (Table 2). Nearly half of respondents (44%) reported daily low back pain with 59% of participants from the UK reporting daily low back pain (Table 2). Low back pain was persistent; 39% of people never had a low back pain free week, with those from the UK reporting the highest percentage of constant low back pain (52%). It was found that, the earlier the onset of low back pain the more the days with low back pain in the month ($P=0.002$) and this was particularly the case for the USA group ($P=0.001$).

People with a non-traumatic injury and females tended to have low back pain more often, but these results did not reach statistical significance. People with paraplegia, however, were significantly more likely to report low back pain post iSCI at all time points measured compared to people with tetraplegia (Table 3).

Low back pain description

Respondents used all 15 SF-MPQ descriptors to portray their low back pain. The most infrequently used descriptor was ‘splitting’ (30%) and the most frequently used was ‘aching’ (76%). ‘Aching’ was most commonly ranked as moderate severity (by 36% of respondents), followed by ‘tiring-exhausting’, which was also rated primarily as moderate severity (by 27% of respondents). A total of 41% from the UK described their pain as severe. People from Greece reported ‘gnawing’ as the most frequent type of pain (65%), which was commonly described as mild pain (42%). People from the UK used the most low back pain descriptors, followed by those from the USA.

People with paraplegia reported significantly higher adjusted mean scores on the sensory dimension of their low back pain quality by 4.58 points (95% CI 2.09, 7.07) and the total low back pain quality by 4.74 (95% CI 1.27, 8.22) compared to those with tetraplegia (Table 4). People from Greece, in general, reported better low back pain quality and in the case of the sensory low back pain this was significantly better than people from the USA (-3.66, 95% CI -6.75, -0.56) unadjusted (no other variables in the model apart from country – the variable of interest), though this was not sustained when adjusted for other demographic and injury factors (Table 4). People with paraplegia reported significantly higher adjusted levels of low back pain intensity for current low back pain (coefficient 13.46, 95% CI 2.16, 24.76), low back pain over the past month (Coefficient 15.15, 95% CI 4.70, 25.61) and over the past 3 months (Coefficient 16.66, 95% CI 6.29, 27.03) compared to those with tetraplegia (Table 5). Increased number of low back pain days a month was significantly related with worse low back pain quality (Table 6). The more frequent the low back pain, the significantly worse the low back pain quality, particularly for the sensory dimension and total quality (Table 6). The intensity of low back pain, for all time periods, was of moderate level and mainly described as discomforting. There were no significant differences between the USA and UK with regard to low back pain intensity. Similar to the results for the quality of low back pain, the more low back pain days felt in a month the significantly worse the low back pain intensity.

DISCUSSION

Using a cross-sectional study, mainly conducted online, the prevalence and characteristics of low back pain in people with iSCI who participated in this study, for the total sample and between countries, was investigated. Some differences in the demographic profiles between countries existed for current age, age at injury, employment status and educational attainment. Most people had a traumatic iSCI. The prevalence of low back pain following an iSCI, in the group participating in this study, was very high at all time points and similar across nations. Anytime post iSCI prevalence, among the total group of participants, was 74% and current prevalence was 66%. These percentages are higher than those found in the authors’ previously published systematic literature review (Michailidou et al, 2014), where the prevalence of chronic low back pain was found to be 37% (95% CI 33–42%) increasing to 49% (95% CI: 44–55%) among people with SCI and pain in general. One factor that may have affected this is that only people with iSCI participated in our study. Previous studies on low back pain in SCI (Raissi et al, 2007; Molton et al, 2008; Ullrich et al, 2008) reported lower low back pain prevalence but pooled data from people with complete and incomplete injuries. This cannot be conclusive, but it may have contributed to the difference found in the presence of low back pain. The completeness of injury is one of the SCI features that needs to be considered when studying pain in SCI as it could be of importance for health professionals when planning treatment and setting targets for rehabilitation. Other factors that we did not directly examine may have contributed to the higher presence of low back pain in our study. For example, the presence of lordosis or scoliosis, which can be found in iSCI (Bergström et al, 1999; Parent et al, 2011) and they are known to contribute to low back pain (Roussouly et al, 2002; Sato et al, 2011). No significant differences in the prevalence of low back pain between the three participating countries were found.

The nature of low back pain cannot be identified from our results, though most people described their pain as 'aching', which is one of the factors to imply a musculoskeletal pain according to the updated International Spinal Cord Injury Pain Classification (Bryce et al, 2012). The literature has shown that people with SCI have conditions that can be risk factors for mechanical low back pain (Ravenscroft et al, 2000; Parent et al, 2011) suggesting that pain in the lower back could be of musculoskeletal origin. Future studies should investigate the nature of low back pain as described by people with iSCI as it can affect pain (Cardenas and Jensen, 2006) and response to treatment (Widerström-Noga et al, 2001), which can differ if pain is of neuropathic or nociceptive origin.

We followed recommendations and conducted comparisons between males and females when examining pain (Greenspan et al, 2007); however, we did not find any gender difference in the presence of low back pain for the total group or between countries. People with paraplegia were significantly more likely to report low back pain than people with tetraplegia. The presence of pain by the level of injury has been a matter of debate in the literature as, on the one hand, people with lower-level injuries have an increased risk of pain (Rintala et al, 1998) but, on the other hand, no such differences have been found (Turner et al, 2001). We report, to our knowledge, the first findings about the presence of low back pain by the reported level of injury in iSCI alone.

Participants reported a moderate intensity of low back pain, which remained relatively stable over 3 months and was characterised as 'discomforting'. This finding confirms a previous report on low back pain intensity in SCI (Ullrich et al, 2008). Another study found a little lower low back pain intensity in spinal cord injury (Miró et al, 2014). People from the UK reported slightly higher low back pain intensity than people from the USA, but this was not significantly different. For people with paraplegia the intensity of low back pain was significantly higher for all time points measured, which is in agreement with Ullrich et al (Ullrich et al, 2008). It is important to study the intensity of pain when managing SCI (Miró et al, 2014) as it helps health professionals understand what type of treatment may be needed and if it is likely to be effective (Bryce and Dijkers, 2006). Though there are no other studies describing low back pain quality in iSCI alone, the mean Pain Rating Index (which measures low back pain quality) did not differ much from that found by Cardenas et al (2002) for mechanical spinal pain in SCI. Likewise, it did not differ from the low back pain description in the general population (Norris and Matthews, 2009). Participants in this study primarily used the word 'aching', a sensory descriptor, followed by 'tiring-exhausting', an affective descriptor. These are the most frequently used descriptors for mechanical spinal pain (Cardenas et al, 2002). Using verbal descriptors helps classify pain and 'aching' is often used when describing back pain (Roussouly et al, 2002) or musculoskeletal pain (Widerström-Noga et al, 2001; Burke et al, 2017) in SCI or low back pain in the general population (Boissonnault and Fabio, 1996).

The findings from this study show that people with iSCI describe low back pain similarly despite sociocultural differences; thus similar clinical pathways for rehabilitation could be implemented across nations. However, two differences are worth noting; respondents from the UK reported slightly worse low back pain quality and intensity, and respondents from Greece used fewer words to describe similar low back pain quality. The latter may be affected by cultural influences as respondents from Greece were found elsewhere to use fewer descriptors to portray their pain (Mystakidou et al, 2002).

There were no significant differences between countries for the time of onset of low back pain following iSCI. Generally, there is an early low back pain onset after iSCI and the earlier the onset the more persistent low back pain and this was a significant result for the total group, and the USA group individually. These findings agree with reports on the persistence of pain in SCI (Widerström-Noga et al, 2001; Cruz- Almeida et al, 2005) or early pain onset (Barrett et al, 2003; Modirian et al, 2010). It is important for clinicians to know that low back pain may start early post iSCI in order to assess and consider low back pain prevention and management techniques, including patient education, early in treatment. Future studies should include the examination of potential risk factors for the onset of low back pain following iSCI, such as pain in other areas of the body or psychosocial factors.

This study showed that the level of injury and possibly the completeness of injury are iSCI-related characteristics that need to be taken into consideration when addressing low back pain in iSCI. To be able to generalise this result, future studies should include physical examination of the participants. In the literature, low back pain has often been attributed to be musculoskeletal in nature and more studies are required to verify this finding in iSCI. Low back pain in iSCI is of moderate intensity, which increases with more persistent low back pain. The general similarities across nations in sensory, affective and cognitive dimensions may be an indication that there is a biological or biopsychological mechanism (Greenspan et al, 2007) of developing low back pain in iSCI that needs further investigation.

ISCI is expected to rise among new spinal cord injuries (DeVivo, 2012), thus, there is a need for a multidisciplinary approach to early diagnosis and treatment. We agree that prevention and early treatment (Finnerup, 2013) are important, therefore clinicians should aim for more efficient and faster rehabilitation, a multidimensional assessment and a well-established treatment plan. As pain intensity in the lower back is found to be associated with pain interference and psychological functioning (Miró et al, 2014) the multidisciplinary team should include doctors using medication, pain specialists or cognitive behavioural therapists addressing the cognitive dimension of pain and physiotherapists working on, for example, strengthening of the postural muscles, stiffness or instability (Siddall and Middleton, 2015).

LIMITATIONS

There are a number of limitations to this study, which need to be considered. First, no random selection of participants was made, therefore it is possible that those who took part were more interested in the subject and/or were more amenable to research. However, the sex distribution is similar to the population of people with SCI (Turner et al, 2001; Molton et al, 2008). In addition, the groups from UK and Greece were smaller than the group from the USA, which may have accounted for some results not reaching significance. Whether there were any pain risk factors before iSCI that may have affected pain presence after iSCI, such as the presence of lordosis, was not investigated. Finally, the level and the completeness of injury were, in most of the cases, based on the reports given by the respondents themselves and no physical or medical record examination was made except for the cases from the Greek group were the hospital medical records were studied.

CONCLUSIONS

This is the first study, to our knowledge, to examine the presence of low back pain in people with incomplete spinal cord injury alone and to compare findings across three nations. Pain is a subjective experience and despite this current study not being able to or intending to discuss causality of low back pain, it can confirm its high presence. The fact that the reported low back pain prevalence in the current group is higher than that found in the general population could be because there is greater risk of developing low back pain in incomplete spinal cord injury, a topic that requires further examination. Future studies should include physical examination of their participants and examine the nature and risk factors of low back pain in iSCI. Investigating for any biological or biopsychological mechanisms in the presence of low back pain in iSCI could help both its prevention and its treatment. Future qualitative study designs could also help examine in-depth the personal experience of living with iSCI and low back pain.

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Ataoğlu E, Tiftik T, Kara M, Tunc H, Ersoz H, Akkus S. Effects of chronic pain on quality of life and depression in patients with spinal cord injury. Spinal Cord. 2013;51(1):23–26. http://dx.doi.org/10.1038/sc.2012.51

Baron R, Maier C, Attal N, et al. Peripheral neuropathic pain: a mechanism-related organizing principle based on sensory profiles. Pain. 2017;158(2):261–272. http://dx.doi.org/10.1097/j.pain.0000000000000753

Barrett H, McClelland JM, Rutkowski SB, Siddall PJ. Pain characteristics in patients admitted to hospital with complications after spinal cord injury. Arch Phys Med Rehabil. 2003;84(6):789–795.

Bergström EM, Short DJ, Frankel HL, Henderson NJ, Jones PR. The effect of childhood spinal cord injury on skeletal development: a retrospective study. Spinal Cord. 1999;37(12):838–846. http://dx.doi.org/10.1038/sj.sc.3100928

Boissonnault W, Fabio RP. Pain profile of patients with low back pain referred to physical therapy. J Orthop Sports Phys Ther. 1996;24(4):180–191. http://dx.doi.org/10.2519/jospt.1996.24.4.180

Breivik H, Collett B, Ventafridda V, Cohen R, Gallacher D. Survey of chronic pain in Europe: prevalence, impact on daily life, and treatment. Eur J Pain. 2006;10(4):287–333. http://dx.doi.org/10.1016/j.ejpain.2005.06.009

Bryce TN, Biering-Sørensen F, Finnerup NB, et al. International spinal cord injury pain classification: part I. Background and description. Spinal Cord. 2012;50(6):413–417. http://dx.doi.org/10.1038/sc.2011.156

Bryce TN, Dijkers MPJM. Assessment of pain after SCI in clinical trials. Top Spinal Cord Inj Rehabil. 2006;11(3)50–68. http://dx.doi.org/10.1310/BMQ9-WVPA-JU7U-JPN0

Burke D, Fullen BM, Lennon O. Pain profiles in a community dwelling population following spinal cord injury: a national survey. J Spinal Cord Med. 2017 [epub ahead of print]. http://dx.doi.org/10.1080/10790268.2017.1351051

Cardenas DD, Jensen MP. Treatments for chronic pain in persons with spinal cord injury: a survey study. J Spinal Cord Med.2006;29(2):109–117. http://dx.doi.org/10.1080/10790268.2006.11753864

Cardenas DD, Turner JA, Warms CA, Marshall HM. Classification of chronic pain associated with spinal cord injuries. Arch Phys Med Rehabil. 2002;83(12):1708–1714. http://dx.doi.org/10.1053/apmr.2002.35651

Cruz-Almeida Y, Martinez-Arizala A, Widerström-Noga EG. Chronicity of pain associated with spinal cord injury: a longitudinal analysis. J Rehabil Res Dev. 2005;42(5):585–594. http://dx.doi.org/10.1682/JRRD.2005.02.0045

DeVivo MJ (2012) Epidemiology of traumatic spinal cord injury: trends and future implications. Spinal Cord. 2012;50(5):365–372. http://dx.doi.org/10.1038/sc.2011.178

Dijkers M1, Bryce T, Zanca J. Prevalence of chronic pain after traumatic spinal cord injury: a systematic review. J Rehabil Res Dev. 2009;46(1):13–29.

Divanoglou A, Westgren N, Bjelak S, Levi R. Medical conditions and outcomes at 1 year after acute traumatic spinal cord injury in a Greek and a Swedish region: a prospective, population based study. Spinal Cord. 2010;48(6):470–476. http://dx.doi.org/10.1038/sc.2009.147

Felix ER, Cruz-Almeida Y, Widerström-Noga EG. Chronic pain after spinal cord injury: what characteristics make some pains more disturbing than others? J Rehabil Res Dev. 2007;44(5):703–715. http://dx.doi.org/10.1682/JRRD.2006.12.0162

Finnerup NB. Pain in patients with spinal cord injury. Pain. 2013;154:S71–S76. http://dx.doi.org/10.1016/j.pain.2012.12.007

Georgoudis G, Oldham JA, Watson PJ. Reliability and sensitivity measures of the Greek version of the short form of the McGill Pain Questionnaire. Eur J Pain. 2001;5(2):109–118. http://dx.doi.org/10.1053/eujp.2001.0246

Greenspan JD, Craft RM, LeResche L, et al. Studying sex and gender differences in pain and analgesia: a consensus report. Pain. 2007;132(Suppl 1): S26–S45. http://dx.doi.org/10.1016/j.pain.2007.10.014

Kirshblum SC, Burns SP, Biering-Sorensen F, et al. International standards for neurological classification of spinal cord injury. J Spinal Cord Med 2011;34(6):535–546. http://doi.org/10.1179/204577211X13207446293695

Kohn ML. Cross-national research as an analytic strategy. American Sociological Association, 1987 Presidential address. Amer Soc Rev. 1987;52(6):713–731. http://dx.doi.org/10.2307/2095831

Ma VY, Chan L, Carruthers KJ. Incidence, prevalence, costs, and impact on disability of common conditions requiring rehabilitation in the United States: stroke, spinal cord injury, traumatic brain injury, multiple sclerosis, osteoarthritis, rheumatoid arthritis, limb loss, and back pain. Arch Phys Med Rehabil. 2014;95(5):986–995. http://dx.doi.org/10.1016/j.apmr.2013.10.032

Mannion AF, Taimela S, Muntener M, Dvorak J. Active therapy for chronic low back pain part 1. Effects on back muscle activation, fatigability, and strength. Spine. 2001;26(8):897–908.

Markogiannakis H, Sanidas E, Messaris E, et al. Motor vehicle trauma: analysis of injury profiles by road-user category. Emerg Med J. 2006;23(1):27–31. http://dx.doi.org/10.1136/emj.2004.022392

Melzack R, Katz J. The McGill Pain Questionnaire: appraisal and current status. In: Turk DC, Melzack R, eds. Handbook of pain assessment. New York: The Guilford Press; 1992: 152–168.

Michailidou C. Low back pain, quality of life and function in people with incomplete spinal cord injury in USA, UK and Greece. (Unpublished PhD thesis). London: Brunel University; 2012.http://bura.brunel.ac.uk/handle/2438/7041

Michailidou C, Marston L, De Souza LH, Sutherland I. A systematic review of the prevalence of musculoskeletal pain, back and low back pain in people with spinal cord injury. Disabil Rehabil. 2014;36(9):705–715. https://doi.org.10.3109/09638288.2013.808708

Miró J, Gertz KJ, Carter GT, Jensen MP. Pain location and functioning in persons with spinal cord injury. Amer Acad Phys Med Rehabil. 2014;6(8):690–697. http://dx.doi.org/10.1016/j.pmrj.2014.01.010

Modirian E, Soroush M, Karbalaei-Esmaeili S. Original research articles chronic pain after spinal cord injury: results of a longterm study. Pain Med. 2010;11(7):1037–1043.

Molton IR, Jensen MP, Nielson W, Cardenas D, Ehde DM. A preliminary evaluation of the motivational model of pain self-management in persons with spinal cord injury-related pain. J Pain. 2008;9(7):606–612. http://dx.doi.org/10.1016/j.jpain.2008.01.338

Mystakidou K, Parpa E, Tsilika E et al. Greek McGill Pain Questionnaire: validation and utility in cancer patients. J Pain Symptom Manage. 2002;24(4):379–387. http://dx.doi.org/10.1016/S0885-3924(02)00495-5

Nicholson PK, Nicholas MK, Middleton J. Spinal cord injury-related pain in rehabilitation: a cross-sectional study of relationships with cognitions, mood and physical function. Eur J Pain. 2009;13(5):511–517.

Norris C, Matthews M. The role of an integrated back stability program in patients with chronic low back pain. ComplementTherap Clin Pract 2009;14(4):255–263. http://dx.doi.org/10.1016/j.ctcp.2008.06.001

Parent S, Mac-Thiong JM, Roy-Beaudry M, Sosa JF, Labelle H. Spinal cord injury in the pediatric population: a systematic review of the literature. J Neurotrauma. 2011;28(8):1515–1524. http://dx.doi.org/10.1089/neu.2009.1153

Raissi GR, Mokhtari A, Mansouri K. Reports from spinal cord injury patients: eight months after the 2003 earthquake in Bam, Iran. Amer J Phys Med Rehabil 2007;86(11):912–917. http://dx.doi.org/10.1097/PHM.0b013e3181583abc

Ravenscroft A, Ahmed YS, Burnside IG. Chronic pain after SCI. A patient survey. Spinal Cord. 2000;38(10):611–614. http://dx.doi.org/10.1038/sj.sc.3101073

Rintala DH, Loubser PG, Castro J, et al. Chronic pain in a community based sample of men with spinal cord injury: prevalence, severity, and relationship with impairment, disability, handicap, and subjective well-being. Arch Phys Med Rehabil. 1998;79(6):604–614. http://dx.doi.org/10.1016/S0003-9993(98)90032-6

Roussouly P, Transfeldt E, Schwender J et al. Sagittal morphology and equilibrium of pelvis and spine in normals. Spine J. 2002;2(5):61–62. http://dx.doi.org/10.1016/S1529-9430(02)00299-1

Sato T, Hirano T, Ito T, et al. Back pain in adolescents with idiopathic scoliosis: epidemiological study for 43,630 pupils in Niigata City, Japan. Eur Spine J. 2011;20(2):274–279.

Siddall PJ, Middleton JW. Spinal cord injury-induced pain: mechanisms and treatments. Pain Manag. 2015;5(6):493–507. http://dx.doi.org/10.2217/pmt.15.47

StataCorp. Stata Statistical Software: Release 13. College Station, TX: StataCorp LP; 2013.

Ströud MW, Turner JA, Jensen MP et al. Partner responses to pain behaviors are associated with depression and activity interference among persons with chronic pain and spinal cord injury. J Pain. 2006;7(2):91–99. http://dx.doi.org/10.1016/j.jpain.2005.08.006

Turner JA, Cardenas DD, Warms CA, et al. Chronic pain associated with spinal cord injuries: a community survey. Arch Phys Med Rehabil. 2001;82(4):501–509. http://dx.doi.org/10.1053/apmr.2001.21855

Ullrich PM, Jensen MP, Loeser JD et al. Pain intensity, pain interference and characteristics of spinal cord injury. Spinal Cord. 2008;46(6):451–455. http://dx.doi.org/10.1038/sc.2008.5

Widerström-Noga E, Biering-Sørensen F, Bryce T, et al. The international spinal cord injury pain basic data set (version 2.0). Spinal Cord. 2014;52(4):282–286. http://dx.doi.org/10.1038/sc.2008.64

Widerström-Noga EG, Felipe-Cuervo E, Yezierski RP. Relationships among clinical characteristics of chronic pain after spinal cord injury. Arch Phys Med Rehabil 2001;82(9):1191-1197.

Wright KD, Asmundson GJ, McCreary DR. Factorial validity of the short-form McGill pain questionnaire (SF-MPQ). Eur J Pain 2001;5(3):279-284.

Table 1: Demographic profile characteristics for total group and across nations

Variable	Overall		USA n=122		UK n=52		Greece n=45		p-value*
	n/N	%	n/N	%	n/N	%	n/N	%	
Male	134/215	62	81/122	66	30/52	58	23/41	56	0.366
Age years, mean (SD)	50	(14)	46	(11)	51	(13)	61	(18)	**<0.001**
Marital status									0.301
Married/Living with partner/in a relationship	143/215	67	76/120	63	37/51	73	30/44	68	
Separated/Divorced/Widowed	34/215	16	17/120	14	8/51	16	9/44	20	
Single	38/215	18	27/120	23	6/51	12	5/44	11	
Employment									**<0.001**
Employed/student	120/219	55	77/121	62	24/52	46	19/45	42	
Unemployed/Homemaker	64/218	29	40/121	33	17/52	33	7/45	16	
Retired	34/218	16	4/121	3	11/52	21	19/45	42	
Education above high school	141/216	65	85/122	70	37/50	74	19/44	43	**0.002**
Time since injury years, mean (SD)	12	(11)	11	(11)	14	(12)	11	(8)	0.209
Age at injury years, mean (SD)	38	(16)	34	(14)	37	(17)	50	(16)	**<0.001**

*Between country comparisons

Table 1 continued: Demographic profile characteristics for total group and across nations

Variable	Overall		USA n=122		UK n=52		Greece n=45		p-value*
	n/N	%	n/N	%	n/N	%	n/N	%	
Cause of injury									**<0.001**
Traumatic	156/219	71	95/122	78	42/52	81	19/45	42	
Non-traumatic	63/219	29	27/122	22	10/52	19	26/45	58	
Type of injury									0.082
Incomplete tetraplegia	101/217	47	64/122	52	22/50	44	15/45	33	
Incomplete paraplegia	116/217	53	58/122	48	28/50	56	30/45	67	
Level of injury									0.130
Cervical	103/219	47	64/122	53	24/52	46	15/45	33	
Thoracic	34/219	34	39/122	32	19/52	37	16/45	36	
Lumbar	19/219	19	19/122	15	9/52	17	14/45	31	

*Between country comparisons

Table 2: Prevalence, onset, average presence per month and LBP free periods

	Overall		USA		UK		Greece		p-value*
	n/N	%	n/N	%	n/N	%	n/N	%	
Prevalence									
Any time since SCI	161/219	74	89/122	73	39/52	75	33/45	73	0.961
Currently	144/219	66	77/122	63	36/52	69	31/45	69	0.653
In last month	145/219	66	77/122	63	37/52	71	31/45	69	0.539
In last 3 months	146/219	67	78/122	64	37/52	71	31/45	69	0.612
Onset of LBP timing									
Immediately after SCI	47/142	33	27/77	35	12/34	35	8/31	26	0.093
Within the 1st month post SCI	22/142	15	11/77	14	6/34	18	5/31	16	
Between 1 and 6 months post SCI	27/142	19	15/77	19	3/34	9	9/31	29	
Between 6 months and 1 year post SCI	14/142	10	7/77	9	1/34	3	6/31	19	
After 1 year post SCI	32/142	23	17/77	22	12/34	35	3/31	10	
Average LBP days per month									
1-9 days per month	41/156	26	21/87	24	8/37	22	12/32	38	0.008
10-20 days per month	28/156	18	15/87	17	3/37	8	10/32	31	
21-30 days per month	18/156	12	9/87	10	4/37	11	5/32	16	
Have pain every day	69/156	44	42/87	48	22/37	59	5/32	16	
1 week or more of LBP free period									
Yes, most of the time	17/123	14	9/64	14	2/29	7	6/30	20	<0.001
Yes frequently	9/123	7	0/64	0	2/29	7	7/30	23	
Yes, sometimes	14/123	11	5/64	8	2/29	7	7/30	23	
Yes, but not very often	11/123	9	3/64	5	2/29	7	6/30	20	
Yes, but rarely	24/123	20	16/64	25	6/29	21	2/30	7	
No, I always have pain	48/123	39	31/64	48	15/29	52	2/30	7	

*Between country comparisons. People with no LBP or those who could not remember their LBP onset, average days per month or LBP free periods were removed from this analysis. LBP: low back pain; iSCI: incomplete spinal cord injury

Table 3: The relationship between LBP and injury or demographic profile characteristics

	Any time since SCI	Currently	Last month	Last 3 months
	OR (95% CI)	**OR (95% CI)**	**OR (95% CI)**	**OR (95% CI)**
Male	Reference	Reference	Reference	Reference
Female	1.47 (0.72, 3.01)	1.38 (0.71, 2.65)	1.31 (0.68, 2.53)	1.37 (0.71, 2.67)
Age	0.99 (0.96, 1.01)	1.00 (0.98, 1.03)	1.01 (0.98, 1.03)	1.00 (0.98, 1.02)
Cause of injury				
Traumatic	Reference	Reference	Reference	Reference
Non-traumatic	1.94 (0.79, 4.77)	2.04 (0.90, 4.63)	1.92 (0.85, 4.33)	1.86 (0.82, 4.25)
Level of injury				
Tetraplegia	Reference	Reference	Reference	Reference
Paraplegia	2.75 (1.38, 5.47)	2.52 (1.34, 4.72)	2.33 (1.24, 4.39)	2.90 (1.52, 5.52)
Time since injury	1.01 (0.98, 1.04)	1.00 (0.97, 1.03)	1.00 (0.98, 1.03)	0.99 (0.96, 1.01)

The reference category is the comparison category for categorical variables. Sometimes, this is presented in tables as an odds ratio of 1.0. OR: odds ratio, CI: confidence interval

Table 4: Pain rating index per demographic characteristics

	Sensory – Pain Rating Index (S-PRI) (range 0-33)		Affective – Pain Rating Index (A-PRI) (range 0-12)		Total Pain Rating Index (PRI) (range 0-45)	
	Unadjusted Coefficient (95% CI)	Adjusted* Coefficient (95% CI)	Unadjusted Coefficient (95% CI)	Adjusted* Coefficient (95% CI)	Unadjusted Coefficient (95% CI)	Adjusted* Coefficient (95% CI)
Male	Reference	Reference	Reference	Reference	Reference	Reference
Female	-0.83 (-3.35, 1.69)	-0.65 (-3.06, 1.76)	-0.20 (-1.36, 0.97)	-0.07 (-1.27, 1.13)	0.59 (-3.97, 2.79)	-0.52 (-3.88, 2.83)
Age	-0.11 (-0.19, 0.03)	-0.12 (-0.22, -0.03)	-0.03 (-0.07, 0.01)	-0.04, (-0.09, 0.01)	-0.14 (-0.25, -0.03)	-0.19 (-0.33, -0.06)
USA	Reference	Reference	Reference	Reference	Reference	Reference
UK	2.25 (-0.63, 5.13)	1.83 (-1.02, 4.67)	0.46 (-0.91, 1.83)	0.41 (-1.01, 1.83)	1.26 (-2.69, 5.21)	1.74 (-2.24, 5.72)
Greece	-3.66 (-6.75, -0.56)	-2.64 (-6.20, 0.93)	-0.85 (-2.33, 0.62)	-0.56 (-2.33, 1.22)	-4.46 (-8.63, -0.29)	-2.69 (-7.65, 2.26)
Cause of injury						
Traumatic	Reference	Reference	Reference	Reference	Reference	Reference
Non-traumatic	0.46 (-2.13, 3.05)	1.75 (-1.05, 4.55)	0.37 (-0.84, 1.57)	0.71 (-0.68, 2.11)	1.50 (-1.95, 4.95)	3.14 (-0.77, 7.04)
Level of injury						
Tetraplegia	Reference	Reference	Reference	Reference	Reference	Reference
Paraplegia	3.87 (1.48, 6.27)	4.58 (2.09, 7.07)	1.06 (-0.09, 2.21)	1.23 (-0.01, 2.47)	4.10 (0.78, 7.42)	4.74 (1.27, 8.22)
Time since injury	0.06 (-0.05, 0.17)	0.09 (-0.01, 0.20)	0.01 (-0.04, 0.06)	0.02 (-0.03, 0.08)	0.11 (-0.03, 0.26)	0.15 (0.01, 0.30)

*Each variable is adjusted for all other variables in this table. PRI: Pain Rating Index; LBP: low back pain; CI: confidence interval

Table 5: Demographic characteristics and intensity of LBP

	Intensity of current LBP (range 0-100)		Intensity of LBP over last month (range 0-100)		Intensity of LBP over last 3 months (range 0-100)	
	Unadjusted Coefficient (95% CI)	Adjusted* Coefficient (95% CI)	Unadjusted Coefficient (95% CI)	Adjusted* Coefficient (95% CI)	Unadjusted Coefficient (95% CI)	Adjusted* Coefficient (95% CI)
Male	Reference	Reference	Reference	Reference	Reference	Reference
Female	-0.22 (-10.78, 10.34)	1.88 (-9.46, 13.22)	4.16 (-6.01, 14.32)	6.37 (-4.13, 16.87)	5.51 (-4.60, 15.62)	5.04 (-5.38, 15.46)
Age	0.00 (-0.46, 0.47)	-0.12 (-0.62, 0.38)	0.18 (-0.27, 0.63)	0.11 (-0.37, 0.58)	0.11 (-0.34, 0.56)	0.10 (-0.37, 0.57)
USA	Reference	Reference	Reference	Reference	Reference	Reference
UK	5.64 (-5.75, 16.59)	1.75 (-10.17, 13.67)	6.59 (-4.29, 17.47)	0.63 (-10.63, 11.89)	6.79 (-3.99, 17.57)	1.49 (-9.69, 12.66)
Cause of injury						
Traumatic	Reference	Reference	Reference	Reference	Reference	Reference
Non-traumatic	1.99 (-9.75, 13.72)	0.53 (-12.22, 13.27)	5.67 (-5.67, 17.01)	2.75 (-9.25, 14.74)	5.72 (-5.52, 16.96)	2.63 (-9.27, 14.53)
Level of injury						
Tetraplegia	Reference	Reference	Reference	Reference	Reference	Reference
Paraplegia	11.50 (1.21, 21.79)	13.46 (2.16, 24.76)	13.84 (4.11, 23.56)	15.15 (4.70, 25.61)	16.38 (6.92, 25.84)	16.66 (6.29, 27.03)
Time since injury	0.23 (-0.20, 0.66)	0.28 (-0.17, 0.73)	0.19 (-0.22, 0.60)	0.21 (-0.21, 0.63)	-0.03 (-0.44, 0.38)	-0.00 (-0.42, 0.41)

*Each variable is adjusted for all other variables in this table. LBP: low back pain; CI= confidence interval

Table 6: PRI and LBP intensity per LBP onset, LBP days felt and LBP free periods

	Sensory – Pain Rating Index (S-PRI) (range 0-33)	Affective – Pain Rating Index (A-PRI) (range 0-12)	Total Pain Rating Index (PRI) (range 0-45)	Intensity of current LBP* (range 0-100)	Intensity of LBP over last month* (range 0-100)	Intensity of LBP over last 3 months* (range 0-100)
	Coefficient (95% CI)	**Coefficient (95% CI)**	**Coefficient (95% CI)**	**Coefficient (95% CI)**	**Coefficient (95% CI)**	**Coefficient (95% CI)**
Onset of LBP timing						
Immediately after SCI	Reference	Reference	Reference	Reference	Reference	Reference
Within the 1st month post SCI	-0.00 (-4.00, 4.00)	0.65 (-2.43, 1.12)	-1.44 (-6.64, 3.76)	3.33 (-13.55, 20.21)	1.78 (-14.13, 17.69)	-2.34 (-18.00, 13.32)
Between 1 and 6 months post SCI	-4.79 (-8.51, -1.06)	-2.34 (-4.00, -0.69)	-6.69 (-11.46, -1.92)	-13.95 (-30.10, 2.20)	-13.23 (-28.78, 2.32)	-10.75 (-26.06, 4.56)
Between 6 months and 1 year post SCI	-4.34 (-8.97, 0.30)	-3.15 (-5.21, -1.09)	-7.05 (-12.97, -1.12)	-11.91 (-33.48, 9.65)	-19.66 (-39.96, 0.63)	-22.56 (-42.51, -2.61)
After 1 year post SCI	-3.30 (-6.94, 0.34)	-1.58 (-3.20, 0.04)	-5.65 (-10.36, -0.94)	-19.54 (-33.61, -5.47)	-20.67 (-33.95, -7.40)	-23.12 (-36.21, -10.03)
Average LBP days per month						
1-9 days per month	Reference	Reference	Reference	Reference	Reference	Reference
10-20 days per month	-0.40 (-3.99, 3.20)	-0.30 (-2.03, 1.44)	-0.69 (-5.52, 4.14)	2.42 (-12.69, 17.54)	15.94 (1.77, 30.12)	13.56 (-1.27, 28.39)
21-30 days per month	3.21 (-0.86, 7.28)	2.28 (0.31, 4.24)	5.48 (0.02, 10.95)	29.35 (13.50, 45.20)	35.49 (20.23, 50.75)	35.56 (19.61, 51.51)
Have pain every day	7.00 (4.16, 9.84)	2.38 (1.01, 3.75)	8.60 (4.76, 12.45)	35.86 (25.03, 46.68)	39.19 (28.97, 49.41)	34.72 (23.96, 45.48)
1 week or more of LBP free period						
Yes, most of the time	-6.70 (-10.75, -2.64)	-2.97 (-4.98, 0.95)	-8.78 (-14.31, 3.25)	-38.77 (-56.73, -20.82)	-48.80 (-64.12, -33.49)	-48.56 (-65.44, -31.68)
Yes frequently	-7.34 (-12.32, -2.37)	-1.50 (-3.98, 0.98)	-7.96 (-14.74, -1.18)	-47.27 (-82.76, -11.79)	4.98 (-25.20, 35.15)	-1.81 (-33.48, 29.86)
Yes, sometimes	-6.90 (-11.18, -2.61)	-2.76 (-4.89, -0.62)	-8.77 (-14.61, -2.93)	-29.61 (-50.96, -8.25)	-27.19 (-45.39, -8.99)	-30.81 (-49.91, -11.71)
Yes, but not very often	-7.44 (-12.02, -2.86)	-1.47 (-3.75, 0.81)	-8.03 (-14.27, -1.79)	-33.77 (-56.93, -10.61)	-21.42 (-41.15, -1.70)	-18.81 (-39.51, 1.89)
Yes, but rarely	-4.16 (-7.63, -0.68)	-1.18 (-2.91, 0.55)	-4.46 (-9.21, 0.29)	-21.09 (-33.91, -8.28)	-14.61 (-25.59, -3.64)	-10.58 (-22.10, 0.93)
No, I always have pain	Reference	Reference	Reference	Reference	Reference	Reference

*Greek participants excluded from analyses of LBP intensity variables. LBP: low back pain; PRI: Pain Rating Index, iSCI: incomplete spinal cord injury