QUALITY OF LIFE AFTER SPINAL CORD INJURY:

THE IMPACT OF PAIN

Quality of life post-SCI: the impact of pain.

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Background: Pain is a common complication after spinal cord injury (SCI). A mixture of nociceptive and neuropathic pain (NP) can present. Limited studies have investigated the impact of different pain phenotypes on quality of life (QoL) post-SCI.

Methods: Members registered to a national support group for those with SCIs were surveyed (n=1,574). The survey comprised questions relating to demographics and SCI characteristics, The Douleur Neuropathique 4 (DN4) (interview), the International SCI Pain Basic Data Set recording the worst pain and the World Health Organisation Quality of Life BREF (WHOQOL-BREF). An ANCOVA model with post hoc analysis explored between group factors of pain

type and intensity of pain categories on QoL, controlling for additional confounding variables. Significance was set $p<0.05$. A linear regression explored whether pain intensity, type or interference best predicted QoL.

Results: The response rate was 41% (n=643), 70% (n=447) were male. The mean age of respondents was 52 years (sd 14.2) and mean time from SCI was 17 years (sd 12.4). In the previous week, 71% (n=458) experienced pain, 37% (n=236) of which had NP as defined in the study. Respondents experiencing NP demonstrated significantly poorer QoL than those without pain ($p<0.001$) or nociceptive pain ($p<0.05$). Those reporting high pain intensity had significantly lower QoL than those with moderate or no pain ($p<0.001$). Pain interference consistently and best predicted domains of QoL ($p<0.001$).

Conclusion: High intensity pain and NP negatively impacts QoL post-SCI. However pain interference more than intensity or type best explains the variance in QoL reported.

Significance: Neuropathic pain type and severe pain intensities negatively impact QOL after SCI. Pain interference items better predict reported QoL than either pain type or intensity, suggesting better pain management strategies are warranted.

Introduction

Survival rates following a spinal cord injury (SCI) have improved over the last 30 years with a 40% reduction in mortality within the first two years (Strauss *et al.*, 2006). Although patients have a greater chance of survival, secondary health complications (SHCs) can impinge on quality of life (QoL). Reported QoL

33 improves over time post-injury with little differences noted when considered by severity or injury level (Lidal *et al.*, 2008; Tavakoli *et al.*, 2016). Instead
34 factors shown to negatively impact QoL include pressure ulcers, spasticity, bladder and bowel problems, pain, mood, mobility, income and family support
35 (Anke *et al.*, 1995; Lidal *et al.*, 2008; Mortenson *et al.*, 2010; Adriaansen *et al.*, 2013; Erosa *et al.*, 2014; Andresen *et al.*, 2016).

36 Chronic pain is one of the most debilitating SHCs (Ataoglu *et al.*, 2013; Erosa *et al.*, 2014), presenting in up to 60% of patients (van Gorp *et al.*, 2015).
37 Commonly a mixed neuropathic and nociceptive pain (musculoskeletal, visceral) presentation is recorded. Neuropathic pain with a prevalence rate of 53%
38 (Burke *et al.*, 2017) is often deemed the most severe pain (Siddall *et al.*, 2003), presenting at and/or below the neurological injury level (Bryce *et al.*, 2012).
39 Prevalence rates recorded for musculoskeletal pain are 49% (Michailidou *et al.*, 2014), and from 3-30% for visceral pain (Finnerup *et al.*, 2014). More severe
40 pain presentations have been found to have a greater negative impact on QoL (Valtonen *et al.*, 2006; Finnerup *et al.*, 2016; Craig *et al.*, 2017; Lundstrom *et*
41 *al.*, 2017).

42 Evidence of the impact of pain phenotype on QoL is conflicting. One study demonstrated a weak, independent association between QoL and nociceptive
43 pain only (Adriaansen *et al.*, 2013). A second study found that those with NP had significantly lower QoL compared to those reporting no pain or nociceptive
44 pain (Andresen *et al.*, 2016). A third study found no extensive relationship between pain phenotype and QoL although the study population comprised
45 patients with a major depressive disorder, limiting interpretation of the results (Richardson *et al.*, 2016). Limitations in studies to date include failure to
46 employ a detailed QoL measure and that data were not drawn from in a national population sample.

47 The aim of the current study is to obtain by national survey, data relating to the QoL in adults with SCI and to investigate the impact of pain on QoL by
48 comparing reports of those with no pain, nociceptive pain and NP. Our primary hypothesis is that those reporting NP would have significantly lower QoL

than those with no pain or nociceptive pain. Our secondary hypothesis is that those reporting higher pain intensity, independent of pain type, would have significantly lower QoL than those with lower or zero pain intensity. Finally, exploratory analysis in those reporting pain, will establish which variable related to pain (pain type, pain intensity or pain interference) best predicts the domains of QoL and which variables, when controlling for the others makes a unique and significant contribution to the model.

Methods

Ethical approval for this study was granted by the UCD Human Research Ethics Committee (LS-E-14-152-Burke-Lennon on 24/11/14). All adult members discharged from sub-acute rehabilitation (n=1,574) aged 18 years and older, registered to the Spinal injuries Ireland (SII) - a national support group for those with a SCI, were surveyed. This SII database is the most comprehensive national database of individuals with a SCI in Ireland and can be considered representative of the Irish SCI population.

The questionnaire pack mailed to members included an information sheet, a questionnaire and a prepaid return envelope. An online version of the survey was also provided to facilitate members with limited upper limb function. Surveys were coded, protecting the anonymity of members, with the master sheet of codes inaccessible to the researchers. Non-respondents from the first mailing round received a second survey pack after eight weeks, with an email reminder sent to remaining non-responders via SII four weeks later.

Questionnaire

The questionnaire recorded demographics and SCI characteristics, pain profiles where present, and QoL.

i) Demographics and SCI Characteristics

Demographic characteristics recorded included age, gender, mobility, employment status and relationship status. Spinal cord injury characteristics recorded included aetiology of injury, time since injury, the neurological level of injury (NLI), the American Spinal Injury Association Impairment Scale (AIS) (Kirshblum *et al.*, 2011), and a further question related to the completeness of injury as a dichotomous category of complete or incomplete.

ii) Pain Profile

International spinal cord injury basic pain data set (ISCIBPDS) (version 1.0). (Widerstrom-Noga *et al.*, 2008)

The dataset is validated for self-reported use in the SCI population and records pain intensity using the numeric rating scale (NRS) (0-10) and pain frequency and location (33). Pain intensity scores of zero to six were classified as mild to moderate, and those with a score of seven or more was classified as severe (Felix *et al.*, 2007). The dataset includes six pain interference items (sleep, mood and activity limitations in the previous week) scored from zero (no interference) to six (extreme interference), with a mean summary score of the six items calculated. Originally designed to investigate respondents' three worst pain problems, to reduce respondent burden, the dataset was reduced to report the worst pain only.

iii) Neuropathic Pain

Neuropathic pain was defined and classified using the IASP definition (Jensen *et al.*, 2011) and the ISCIP classification (Bryce et al., 2012). The DN4 (interview) (Bouhassira *et al.*, 2005) was used to record whether the worst pain reported was neuropathic in presentation. This DN4 tool has been validated with high diagnostic accuracy in the SCI population (Hallstrom & Norrbrink, 2011), the DN4 (interview) is validated for postal use (Bouhassira *et al.*, 2008) and has been utilised in a population with SCI (Andresen *et al.*, 2016). A score of three or more of these seven descriptor items indicates probable NP

(Bouhassira *et al.*, 2005; Bouhassira *et al.*, 2008). The DN4 (7 interview items) have shown sensitivity of 70% and a specificity of 67% in NP pain diagnosis (Timmerman *et al.*, 2017).

iv) Quality of Life

The World Health Organisation (WHO) Quality of Life Assessment Instrument WHOQOL-BREF (WHOQOL Group, 1998a) was utilised to document respondent's QoL. This self-report questionnaire is validated for use in SCI (Jang *et al.*, 2004) and recommend as the optimal measures post-SCI (Hill *et al.*, 2010). The scale includes 26 questions and scores are calculated into four weighted domains of physical health, psychological health, social relationships, and environment. Each item is rated using a five-point Likert scale, with higher scores indicating better QoL (WHOQOL Group, 1998a). Scores from the four domains are transformed linearly to a 0-100 scale, generated using a coded syntax in the Statistical Package for Social Sciences (SPSS), provided by the WHO. Where less than 80% of questions are completed, scores are not calculated (WHOQOL Group, 1998b). There are a further two items in WHOQOL-BREF which assess overall perception of QoL and health, these items are reported separately.

For comparison with healthy population normative values, domain scores were compared against published mean scores from a large Danish sample (Noerholm *et al.*, 2004), as no data exists currently for the Irish population. Denmark is comparable to Ireland based on population size and economic performance (OECD, 2016a).

Analysis

All demographic data and questionnaires scores were entered into SPSS (Version 20) and subsequently cleaned. Participant characteristics were reported using descriptive statistics [mean (sd), median (range), frequency (percentage)]. Preliminary multiple regression models evaluated the predictive power of independent variables [age, gender, time post injury, level of injury (paraplegia or tetraplegia), functional status (walking or wheelchair user), employment status (employed or unemployed), relationship status (in a relationship or single)] on QoL domains. Variables were assessed for multi-collinearity. An ANCOVA model then explored two main factors of pain type (no pain, nociceptive pain and NP) and pain intensity/severity by NRS scores (categorised as no pain=0, mild/moderate pain <7 and severe pain ≥7) on QOL when controlling for additional confounding variables (factors and covariates) identified in the preliminary multiple regression models. The interaction effect between pain severity and pain type was explored prior to main effects being considered. Post hoc analysis with Bon Ferroni correction explored the differences in QoL between categories of pain presentation and between categories of pain severity. Sub-analysis in the NP pain category only, between QoL for at-level NP versus below-level NP presentations was further explored. Similarly, sub-analysis in the nociceptive pain category explored differences in QoL in those reporting pain in the head, neck and shoulder regions when compared to other body sites identified from the ISCIPBDS.

Spearman's correlation coefficients explored the relationship between number of DN4 item identified and each QoL domain scores to identify if the impact of NP on QoL was related specifically to NP characteristics in the SCI population. A correlation co-efficient rho > 0.3 was considered to show a moderate or stronger linear relationship between these variables. (Cohen, 1988). Significance level was determined at $p<0.05$.

Finally, in only respondents who reported pain, linear regression models, with each QoL domain as the dependent variable, explored the unique contribution of pain type (NP or nociceptive), pain intensity (NRS) and pain interference (MPI) to the predictive ability of the model.

Results

From 1,574 posted surveys, 643 surveys were completed and returned giving an overall response rate of 41%. In total 698 were returned (44%), however 27 were returned with an incorrect address, 18 were incomplete and therefore not included, and 10 were returned where SII members were deceased since the database was last updated.

i) Respondent Characteristics

The mean age of respondents was 52 years (sd 14.3) and 70% (n=447) were male. The mean time since injury was 17 years (sd 12.4; range 1-68). The majority of SCI were traumatic in origin (71%, n=456) with road traffic accidents (28%, n=181) and falls (26%, n= 168) the predominant mechanisms of injury. Neurological levels of injury (NLI) were most common in the lower cervical region (C5-7) (20%, n=128) and the thoracolumbar region (T6-L5) (35%, n=225). Half of all injuries were reported as incomplete (50%, n=321) and reported AIS classifications were low with only 10% (n=63) of AIS scores reported. Respondent characteristics are summarised in greater detail in Table 1.

ii) Pain Prevalence and Intensity

A total of 71% (n=458) respondents reported the presence of pain in the previous week. The DN4 was completed by 97% (n=442) of those who reported pain, and on analysis 53% (n=236) scored three or more for their worst pain, indicating a NP presentation, the remainder (47%, n=206) scored less than three indicating a nociceptive pain presentation.

As summarised in Table 2, those with NP (n=137, 58%) and nociceptive pain (n=89, 43%) reported the upper and/or lower back as the most common, painful area. Excluding the head and neck/shoulder areas, those with NP presented with significantly more pain locations throughout the rest of the body. As anticipated, a significantly higher proportion of those with NP identified DN4 descriptor items.

A total of 98% (n=433) of those who completed the DN4 also completed the NRS. Fifty eight percent (n=137) of those with NP reported their pain intensity as severe (NRS ≥7) compared to 34% (n=70) of those with nociceptive pain; 40% (n=95) of those with NP documented mild to moderate pain intensity (NRS 0-6) compared to 64% (n=131) of those with nociceptive pain. The mean NRS pain intensity score for NP was 7 (sd 2.1) and for nociceptive pain was 6 (sd 2.2). Onset of NP occurred most frequently immediately post injury (43%, n=102) and at greater than six months for those with nociceptive pain (26%, n=54). The mean pain interference score from the ISCIPBDS six interference items for those with NP was 4 (sd 1.4) and 3 (sd 1.4) for those with nociceptive pain, out of a worst possible score of six.

iii) Quality of Life

a) Comparison with normative data

The WHOQOL-BREF was attempted by 98% (n=630) of respondents. Due to missing items of 20% or more, a further 3% (n=22) precluded score calculation and were excluded. Thus, a total of 608 (95%) responses were included in the analysis. The four WHOQOL-BREF domain scores (using mean scores for comparison) for (i) the total Irish SCI sample; (ii) the normative comparator data drawn from a Danish sample; (iii) respondents with no pain; (iv) those with nociceptive pain (scoring <3 on the DN4) and (v) those with NP (scoring ≥3 on the DN4) as summarised in Fig. 1.

Mean scores for the total SCI sample were lower in all four QOL domains when compared to the Danish population sample, with lowest scores recorded in the physical domain [57 (sd 21) when compared to 77 (sd 17)]. Interestingly, respondents documenting no pain reported domain scores comparable to the Danish mean scores, and notably scored higher on the psychological domain [77 (sd 17) compared to 72 (sd 21)]. Those reporting nociceptive pain had the lowest score recorded in the psychological domain 56 (sd 20) when compared to the Danish sample 72 (sd 21). Respondents reporting NP had the lowest scores in all domains when compared to the Danish mean scores, with the greatest difference noted in the physical domain [46 (sd 19) compared to 77 (sd 17)].

iv) Exploration of predictors of QoL after SCI and the role of pain type and pain intensity category.

From preliminary multiple regression models, where each domain of the WHOQOL-BREF acted as the dependent variable, the following independent variables were found to be predictive of QoL in one or more domains; age, level of injury, time post injury and relationship status (Table S1). Controlling for other variables in the models, gender, functional status or employment status did not make a unique and significant contribution to any model.

a) Impact of Pain Type and Pain Intensity on QoL

No significant interaction between pain type and pain intensity category extrapolated from the NRS was found across the WHOQOL-BREF domains tested [Physical $F=(1,447)= 44.12$, $P=0.70$, Psychological $F=(1,447)= 0.004$, $P=0.95$, Social $F=(1,448)= 3.09$, $P=0.08$, Environmental $F=(1,449)= 0.52$, $P=0.47$, Question 1 $F=(1,457)= 0.11$, $P=0.74$, Question two $F=(1,456)= 0.36$, $P=0.55$)].

The main effect for pain type in each of the four QoL domains when controlling for the effects of age, time post injury, relationship status, level of injury and pain severity are summarised in Table 3. Post hoc comparisons with Bon Ferroni correction between no pain, nociceptive pain and NP type are included. Significantly poorer QoL was observed in the NP group in comparison to those reporting no pain or in those reporting nociceptive pain.

The main effect for pain intensity category in each QoL domain, controlling for pain type and confounding variables and including post hoc comparison with Bon Ferroni correction between no pain, mild-moderate and severe pain categories are summarised in Table 4. Those reporting severe pain, independent of pain type recorded the lowest QoL across all domains ($P<0.001$).

b) Sub-Group Analysis

Additional analysis on respondents with NP tested the effect of at-level or below-level pain on each QoL domain and questions one and two. No significant main effect for at-level or below-level pain was noted in any of the 4 domains or in items one and two of the WHOQOL-BREF respectively ($P>0.005$).

Similarly additional analysis in respondents with nociceptive pain tested the effect of head and/or neck/shoulder pain location in comparison to other body locations in the ISCIPBDS. No statistically significant main effect for body location was noted in any of the four QoL domains or in questions one and two of the WHOQOL-BREF respectively ($P>0.005$).

iv) Association between number of DN4 descriptors identified and QoL scores

When DN4 descriptor items were considered, no relationship between the number of DN4 items identified and any of the four QoL domains or questions one and two was noted (rho ≤ 0.3).

v) Pain variables as predictors of QoL.

Table 5 summarises the regression models which identify the pain variable that best predicts QoL in each domain of the WHOQOL-BREF and those that continue to make a unique and significant contribution to the model. Each model was significant $p<0.001$, explaining 45% of the variance in the physical domain , 20% of variance in psychological domain, 7% in social domain, 18% in environmental domain, 26% in question one and 24% in question two. Here it is interesting to observe that pain interference records the highest beta value in each QoL domain and that pain type is not seen to make a unique and significant contribution to any model once interference and intensity are controlled for.

Discussion

This study investigates the impact of pain phenotype on the physical, psychological, social and environmental health of adults with a SCI using the internationally recommended measure for recording QoL post-SCI (WHOQOL-BREF) and data drawn from a national database. Respondents with no pain reported the highest QoL, similar to normative published data. The presence of pain negatively impacted QoL post injury across all WHOQOL-BREF domains, with the greatest reductions in QOL noted in those reporting NP. Of note, those with more severe pain presentations also presented with poorer QOL, independent of pain type. Interestingly, pain interference was the best pain item to predict QoL in those who reported pain.

Whilst many studies have addressed QOL post SCI there have been discrepancies in the measures used limiting comparisons (Hill *et al.*, 2010). Quality of life measures are classified based on whether they employ an objective (measured by an external appraiser) or subjective (determined by the individual) approach (Dijkers, 2003). Measures which include a subjective approach are optimal as they take into account an individual's life satisfaction in the context of their own expectations and achievements (Dijkers, 2003; Hill *et al.*, 2010). The WHOQOL-BREF (WHOQOL Group, 1998a) which uses both approaches has been identified as the most appropriate measure for use post-SCI (Hill *et al.*, 2010). Future studies using standardised QoL measures are required to allow for the pooling of international data throughout the lifespan following SCI.

The current study is the first national record of QoL of those with a SCI in Ireland. To account for the lack of Irish data, normative values for the WHOQOL-BREF in Denmark were used for comparison. Denmark has a similar economic status and population size compared to Ireland (OECD, 2016b). Furthermore the annual incidence and cause of traumatic SCI in both counties is similar (O'Connor & Murray, 2006; Bjornshave Noe *et al.*, 2015). In line with previous studies comparing QoL in SCI and non-SCI populations, in the current study those with a SCI had lower scores overall than the general population with the

greatest difference recorded for physical health (Westgren & Levi, 1998; Jang *et al.*, 2004; Lidal *et al.*, 2008; Migliorini *et al.*, 2011). However a unique finding in the current study was that respondents with no pain recorded similar scores to the Danish sample, highlighting the potential for improved QoL post injury should the impact of pain be reduced.

Quality of life scores have previously been found to be lower in those with a NP presentation compared to those without in the general population (Attal *et al.*, 2011), and in other chronic pain conditions including diabetic polyneuropathy (Van Acker *et al.*, 2009) and low back pain (Hiyama *et al.*, 2015). A recent Danish study reported that those who developed NP as a result of a traumatic SCI had significantly lower QoL compared to those reporting non-NP (Andresen *et al.*, 2016). The current study builds on these findings, by comparing for the first time QoL based on pain phenotypes post-SCI (including both traumatic and non-traumatic) using a detailed QoL measure. As hypothesised, scores across all QoL domains in the WHOQOL-BREF were lower for those reporting NP compared to those with no pain or nociceptive pain, when controlling for pain intensity and other confounding variables. However, in contrast to the Attal et al., (2011) findings, no direct relationship was found between the number of DN4 descriptor items identified and the QoL recorded (Attal *et al.*, 2011).

The deleterious effect of pain intensity (NRS) on QoL, independent of pain type, was notable in the current study, indicating the inadequacy of current pain management strategies employed. First line treatment for NP includes medication management which has been shown to be partially effective, although the accompanying negative side effects result in many patients opting not to take them (Heutink *et al.*, 2011; Hagen & Rekand, 2015). It is noteworthy that despite this established association between pain intensity and QOL (Gutierrez *et al.*, 2007; Cruz-Almeida *et al.*, 2009; Finnerup *et al.*, 2016) recent clinical trials investigating the effectiveness of interventions for pain have failed to include QoL as an outcome measure (Agarwal & Joshi, 2017; Nardone *et al.*,

2017). Future studies incorporating a biopsychosocial approach to pain treatment, investigating and assessing the impact on QoL are required (Jensen *et al.*, 2007). The establishment of the minimal clinically important difference score for the WHOQOL-BREF would further allow interventional studies determine whether improvements in chronic pain presentations are deemed clinically significant to the patient receiving the treatment.

For respondents in the current study who reported pain, it is interesting to note that pain interference was the best pain item to predict QoL, negating the predictive ability of pain type completely and of pain intensity in psychological, social and environmental domains in the models employed. Muller et al., (2017) (Muller *et al.*, 2017) using structural equation modelling, recently identified the mediating role of participation restriction in the relationship between pain intensity and that of both depressive symptoms and QoL. This is important to consider now in relation to the findings in this study in the context of pain management strategies and their potential to positively impact on QoL. While the intensity of the pain clearly plays a role and has potential to be modified, belief systems relating to pain, fear avoidance behaviours and kinesophobia which restrict participation may be avenues to explore further in this regard (Guy *et al.*, 2016). Previous cognitive behavioural therapy pain management programmes (CBT-PMPs) for SCI chronic pain, while not reporting changes in pain intensity, have reported improvement in mood profiles, pain interference and life participation (Perry *et al.*, 2010; Heutink *et al.*, 2012; Burns *et al.*, 2013) highlighting the value of this intervention to improve coping with SCI pain.

Previously NP type has been considered the most severe pain experienced post injury (Siddall *et al.*, 2003; Hearn *et al.*, 2015), however here we must now consider that those with high pain intensity scores and high pain interference items, irrespective of pain type, are the most severely impacted in terms of QoL and should be prioritised for targeted management.

The current study should be considered in light of the following limitations. The 41% response rate, whilst low does reflect other cross-sectional studies in this cohort with published response rates below 50% (Heutink et al., 2011; Andresen et al., 2017). Although members of SII with no pain presentations were encouraged to complete the survey, it is possible in the absence of pain individuals may not have been as motivated to respond. However the pain prevalence rate in the current study (71%) is in line with other studies (Haisma et al., 2007; Adriaansen et al., 2013). In an effort to reduce respondent burden only the worst pain presentation was identified in the DN4 which may have led to the under-reporting of NP prevalence where concomitant nociceptive pain was present of greater severity. It should be noted that the DN4 was not originally developed for SCI NP but was chosen in this study as it has been shown to have acceptable psychometric properties when applied in a SCI population (Hallstrom & Norrbrink, 2011) and the DN4 (Interview) had been validated for use as a postal survey instrument (Bouhassira *et al.*, 2008). The Spinal Cord Injury Pain Instrument (SCIPI) represents the only screening tool for NP specifically developed and validated in SCI. At the time the survey was conducted, while it showed promising psychometric properties (Bryce *et al.*, 2014) its transferability to an unbiased SCI population remained in question. The SCIPI has more recently again shown high sensitivity, specificity and diagnostic accuracy in diagnosing SCI NP and should now be considered for inclusion in future prevalence studies in this population (Franz *et al.*, 2017). Finally, whilst a full clinical examination to confirm a NP presentation is the gold standard, it was not feasible given the study design and a probable diagnosis of NP was thus conferred. The Neuropathic Pain Special Interest Group (NeuPSIG) algorithm for NP diagnosis (Haanpää *et al.*, 2011) state that a definite diagnosis of NP is attained if the patient has a diagnostic test confirming a lesion of the somatosensory system and negative or positive sensory signs, within the innervation territory of the lesion. A probable diagnosis of NP is recorded if one of these criteria is satisfied. After a spinal cord injury in Ireland, the lesion is confirmed by an MRI, making any NP descriptors in and around the SCI lesion probable NP in this study. Sensory descriptors of NP were recorded in this study which further strengthens the probable diagnosis of NP.

In conclusion, this cross-sectional study highlights the significant and negative impact of pain, particularly NP or pain of a high perceived intensity on QoL after SCI and identifies pain interference as the single best pain item to explain QoL across domains of physical, psychological, social and environmental health. Interestingly, when no pain is present, QoL scores in SCI are similar to those of the general population. This highlights the potential for improved QoL post injury, in line with population norms, if pain can be proactively managed and its impact reduced.

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Author contributions

Burke, D. designed the study, cleaned, entered and analysed the data and composed the manuscript. Lennon, O. designed the study, discussed statistical analysis, reviewed and revised the manuscript. Fullen, B.M. collaborated on the concept of the study, discussed statistical analysis, reviewed and revised the manuscript.

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Supplementary Figures

Mean domain scores of the WHOQOL-Bref in the Danish normative sample, the total Irish SCI sample and the Irish SCI sample presenting with no pain, neuropathic pain and nociceptive pain

Tables

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493 Table 5. Linear regression models with Quality of Life Domains as dependent variables

494 **Table 1.Demographics of Respondents**

Variable	**All (n=643)**
Age	
Mean (sd)	52.11 (14.3)
Not reported n (%)	25 (4)
	n (%)
Gender	
Male	447 (70)
Female	175 (27)
Not reported	21 (3)
Relationship Status	
Single / Separated/ Widowed	280 (43)
In a relationship	352 (55)
Not reported	11 (2)
Employment Status	
Working	194 (30)
Not working	428 (67)
Not reported	21 (3)
Mobility Status	
Wheelchair dependent	378 (59)
Walking with aid	134 (21)
Walking independently	128 (20)
Not reported	3 (1)
Time post SCI (years)	
Mean (sd)	16.71 (12.4)
Not reported N (%)	43 (7)
Cause of SCI	
Traumatic	456 (71)
Road traffic accident	181 (28)
Fall	168 (26)

Other traumatic SCI	107 (17)
Non-Traumatic	165 (26)
Not reported	22 (3)
Level of SCI	
Cervical	218 (34)
Thoracic	219 (34)
Lumbar	78 (12)
Not Reported	128 (20)
Completeness of SCI	
Complete	172 (27)
Incomplete	321 (50)
Not reported	150 (23)

SCI;Spinal cord injury, n;number, sd;standard deviation, %;percentage

Table 2. Pain locations and DN4 items of respondents with nociceptive and neuropathic pain.

	Nociceptive Pain n=206	Neuropathic Pain n=236		
			χ^2	P
Pain locations n (%)				
Head	8 (4)	18 (8)	2.82	0.09
Neck / shoulders	76 (37)	91 (39)	0.16	0.69
Arms/ hands	39 (19)	76 (32)	10.01	0.001
Torso (chest, abdomen, pelvis, genitals)	28 (14)	51 (22)	4.91	0.03
Back (upper and/or lower back)	89 (43)	137 (58)	10.01	0.02
Upper legs/ thighs	31 (15)	86 (37)	26.14	<0.001
Hips/ buttocks/ anus	35 (17)	77 (33)	15.51	<0.001
Lower legs/ feet	51 (25)	127 (54)	39.11	<0.001
Not reported	0 (0)	1 (0)		
DN4 Items n (%)				
Burning	68 (33)	167 (71)	63.00	<0.001
Painful Cold	23 (11)	109 (46)	64.41	<0.001
Electric shock	56 (27)	146 (62)	53.31	<0.001
Tingling	38 (18)	166 (70)	118.42	<0.001
Pins and needles	34 (17)	162 (69)	120.41	<0.001
Numbness	43 (21)	158 (67)	93.48	<0.001
Itching	7 (3)	55 (23)	36.14	<0.001
Total mean (sd)	1.31 (0.80)	4.08 (1.18)		

Table 3. Comparison of Quality of Life Domain Scores by Pain Type

Domains of WHOQOL-BREF (adjusted mean, standard error)	No Pain n=185	Nociceptive n=206	Neuropathic n=236	Main effect statistics	1[a] P value Mean Difference	2[b] P value Mean Difference	3[c] P value Mean Difference
Physical	73.54 (1.53)	55.14 (1.40)	47.66 (1.32)	F (1,447)=14.71, P<0.001	P<0.001 18.40	P<0.001 25.88	P<0.001 7.48
Psychological	72.13 (1.55)	62.34 (1.49)	55.60 (1.35)	F (1,447)=11.44, P<0.001	P<0.001 9.79	P<0.001 16.53	P=0.002 6.74
Social	65.36 (1.93)	58.78 (1.86)	51.29 (1.67)	F (1,448)=9.13, P=0.003	P=0.04 6.58	P<0.001 14.07	P=0.008 7.48
Environmental	73.09 (1.46)	64.77 (1.40)	59..27 (1.27)	F (1,449)=8.65, P=0.003	P<0.001 8.32	P<0.001 13.82	P=0.01 5.50
Q1. Quality of Life	4.02 (0.08)	3.46 (0.08)	3.13 (0.07)	F (1,457)=10.25, P=0.001	P<0.001 0.57	P<0.001 0.90	P=0.004 0.07
Q2. General Health	3.87 (0.09)	3.07 (0.08)	2.73 (0.08)	F (1,456)=9.35, P=0.002	P<0.001 0.80	P<0.001 1.14	P=0.007 0.34

1[a] No Pain V Nociceptive Pain
2[b] No Pain V Neuropathic Pain
3[c] Nociceptive Pain V Neuropathic Pain
Random effects: relationship status and level of injury.
Co-variates: age and time post injury.

Table 4. Comparison of Quality of Life Domain Scores by Pain Intensity Category

Domains of WHOQOL-BREF (adjusted mean, standard error)	No Pain n=185	Mild-moderate n=223	Severe n=210	Main effect statistics	1[a] P value Mean Difference	2[b] P value Mean Difference	3[c] P value Mean Difference
Physical	73.50 (1.55)	60.31 (1.29)	42.26 (1.42)	F (2,455)=113.64, P<0.001	P<0.001 13.19	P<0.001 31.23	P<0.001 18.05
Psychological	72.14 (1.57)	63.71 (1.31)	54.19 (1.45)	F (2,455)=35.71, P<0.001	P<0.001 8.43	P<0.001 17.94	P<0.001 9.52
Social	65.32 (1.96)	66.27 (1.24)	57.31 (1.36)	F (2,456)=14.19, P<0.001	P<0.00 17.56	P<0.001 14.22	P<0.001 6.66
Environmental	73.08 (1.48)	66.27 (1.24)	57.31 (1.36)	F (2,457)=31.44, P<0.001	P<0.001 6.81	P<0.001 15.76	P<0.001 8.96
Q1. Quality of Life	4.02 (0.08)	3.63 (0.07)	2.94 (0.07)	F (2,466)=52.22, P<0.001	P=0.001 0.40	P<0.001 1.09	P<0.001 0.69

1[a] No Pain V Mild/Moderate Pain
2[b] No Pain V Severe Pain
3[c] Mild/Moderate Pain V Severe Pain
Random effects: relationship status and level of injury.
Co-variates: age and time post injury.

Table 5. Linear regression models with Quality of Life Domains as dependent variables

WHOQOL-BREF domains	Pain intensity				Pain Interference				Pain Type			
	B	SE	β	p	B	SE	β	p	B	SE	β	p
Physical	-0.993	0.417	-.109	0.02	-8.231	0.648	-0.587	<0.001	-1.163	1.583	-0.029	0.46
Psychological	0.169	0.477	0.020	0.72	-5.768	0.736	-0.436	<0.001	-1.828	1.806	-0.048	0.31
Social	0.453	0.627	0.043	0.47	-4.289	.973	-0.264	<0.001	-3.314	2.382	-0.071	0.17
Environmental	-0.528	0.460	-0.064	0.25	-4.586	0.710	-0.364	<0.001	-1.332	1.731	-0.037	0.44
Q1. Quality of Life	-0.060	0.023	-0.137	0.01	-0.275	0.035	-0.407	<0.001	-0.054	0.087	-0.028	0.53
Q2. General Health	-0.110	0.026	-.224	<0.001	-.233	.040	-.311	<0.001	-.089	.099	-.041	0.37

B, regression coefficient; SE, standard error; β, standardized regression coefficients; p, p-value.

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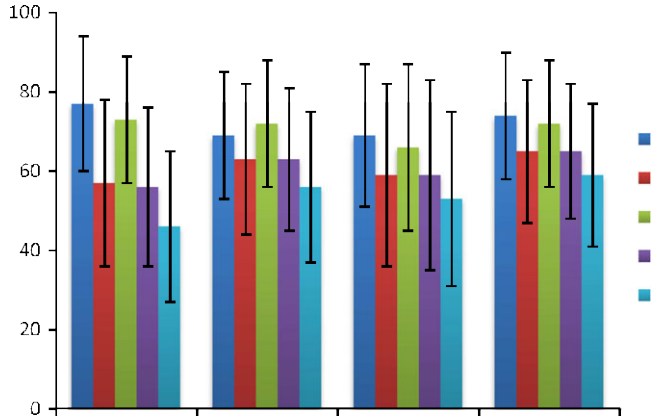
571 Figure 1 Mean WHOQOL-BREF domain scores across groups.



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