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Original Article

Pain classification following spinal cord injury: The utility of verbal descriptors

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Objectives: To determine the predictive utility of verbal descriptors to distinguish between pain types following spinal cord injury (SCI).
Design: Cross-sectional.
Setting: USA.
Methods: Participants ($n=29$) completed the Short Form – McGill Pain Questionnaire (SF-MPQ) for each pain site reported. A total of 64 pain sites were reported with 80% of the sample reporting multiple pain sites. Each pain site was categorized using three different SCI pain classification schemes. The predictive utility of verbal descriptors to distinguish between pain types was examined statistically using (1) each word separately, (2) a combination of words (ie, the SF-MPQ total subscales, the number of words chosen on each scale), and (3) discriminant function analysis.
Results: There was a substantial overlap in the use of verbal descriptors across pain types. Few differences across pain types were found for endorsement of individual words, and differences across pain types were not found for any of the word combination scores. The majority of the verbal descriptors did not enter the step-wise discriminant functions for each SCI pain classification scheme, however, 'tingling' and 'aching' showed modest predictive utility for neuropathic and musculoskeletal pain, respectively. Correct classification was in the low range (ie, 39% to 82%, average = 60%, with a 33% chance level). All three pain classification schemes showed the same general pattern of results.
Conclusion: In general, verbal descriptors alone offered marginal utility with regard to identifying specific pain types following SCI. Future directions alone and implications are discussed.
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Keywords: spinal cord injury; pain; verbal descriptors; assessment; classification, pain type

Introduction

Unfortunately, pain is a common secondary complication following spinal cord injury (SCI) with prevalence estimates ranging from 18% to 96%.[1–5] Although there is general agreement regarding the importance of research in this area, there is relatively little agreement regarding how to classify the different types of pain following SCI. Indeed, review of the SCI literature produced a total of 29 proposed pain classification schemes (note: Siddal and colleagues were considered as three separate schemes) describing between two and 12 different types of pain.[2,3,6–32] At least part of the disparity in the SCI pain classification literature may be attributable to the divergent approaches to pain assessment.

In general, pain classification schemes involve some combination of two complementary approaches. The mechanistic approach tends to emphasize the underlying pathophysiology associated with the different types of pain as a means to classify pain, whereas the descriptive approach classifies the different types of pain based on the presenting symptomotology and pain behavior. Table 1 presents a summary of the most common characteristics used to categorize the different types of pain across the 29 classification schemes reviewed. As can be seen, verbal descriptors were the most common characteristic (96% of the

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Table 1 Pain classification schemes for individuals with spinal cord injury

Characteristic	n	*%*
Verbal descriptors	27	93
Duration	14	48
Onset	12	41
Mitigating factors	12	41
Aggravating factors	20	69
Mechanistic etiology (eg, over-use)	26	90
Location	26	90
Types of pain	Range: 2 to 15 types	

Note: Twenty-nine total classification schemes considered

Table 2 The use of verbal descriptors for each pain type across classification schemes

Verbal label	*Mechanical* %	*Neuropathic* %	*Visceral* %
Aching	78	46	8
Burning	–	100	23
Cramping	11	8	38
Dull	78	15	38
Electric	–	35	–
Fullness	–	–	31
Shooting	–	31	–
Stabbing	–	31	–
Tingling	–	54	–

Note: Only those labels used in 30% or more of the classification schemes for at least one pain type are listed. Verbal labels not reaching 30% criteria: crushing, deep, heavy, hot, lancinating, numbness, pins and needles, pinching, pressure, pricking, sharp, shock, spastic, stinging, throbbing. The number of classification schemes for each pain type: Mechanical = 9; Neuropathic = 26; Visceral = 13. Neuropathic classification included; radicular, neuropathic, root, neural, spinal cord, cauda equina, and nerve root entrapment

classification schemes) used to classify pain following SCI. Using the 29 different classification schemes, the different types of pain were separated into three general categories (ie, mechanical, neuropathic, visceral), and the verbal descriptors associated with each pain category were counted. Table 2 presents a summary of the proportion of scales in the literature using the most common verbal descriptors across pain types. With few exceptions, the results showed that there was (1) little agreement on which verbal descriptors are associated with a particular pain type, and (2) considerable overlap for the use of a specific verbal descriptor across pain types. For instance, the only verbal descriptor with complete agreement across the various pain classification schemes was 'burning' as an indicator of neuropathic pain. However, the verbal descriptor 'burning' was also used as an indicator of visceral pain in 23% of the classification schemes. Although verbal descriptors are commonly accepted as an important criterion for classification of pain following SCI, there have been no studies, to the authors' knowledge, that have examined the predictive validity of verbal descriptors to classify pain following SCI.

Previous research examining the utility of verbal descriptors for distinguishing between different types of pain has been mixed. For instance, accurate pain classification rates using verbal descriptors, primarily from the McGill Pain Questionnaire,[33] have shown considerable promise in some studies (ie, about 65% to 90% accurate classification),[34–40] even between closely related diagnostic groups (eg, trigeminal neuralgia, *vs* atypical facial pain).[41–45] In contrast, others have found little or no benefit from the use of verbal descriptors to classify pain associated with different disease states.[46–52] The inconsistent results within this area of research can be attributed to, in part, several methodological limitations. Of primary concern, previous research has assumed that (1) participants had, and reported on, only one pain site, or, in the case of multiple pain sites or systemic disease, all sites were thought to be a similar pain type, and (2) a disease state (eg, prostate cancer) is associated with only one type of pain. In addition, variability in pain classification [ie, the use of alternate classification schemes] has not been addressed in previous research.

The proposed research was designed to extend previous research examining the utility of verbal descriptors as a mechanism to distinguish between the various types of SCI pain. Participants were allowed to report multiple pain sites, and verbal descriptors were collected for each pain site. In addition, three separate classification schemes were used to categorize the type of pain for each site. Taken together, the current design was thought to allow for a more specific assessment of the pain site of interest, and account for variability in approaches to pain classification.

Methods

Participants

A total of 29 individuals with traumatic onset SCI were recruited for study (note: 28 of these individuals and their pain sites were used in a previous study[53] examining the incremental utility of the pain classification criteria on the Donovan[17] scheme). To be included for study, participants had to be 18 years or older and have reported experiencing at least one pain site. Participants were recruited from the spinal cord injury clinic at the University of Alabama at Birmingham and through local advertisement. Participants were paid $25 for their participation.

Measures

Three SCI pain classification schemes were chosen that were thought to incorporate the common core

characteristics across pain classification schemes, yet also offer unique pain types or classification criteria. The three pain classification schemes chosen for inclusion were (1) the International Association for the Study of Pain (IASP) model,[29] (2) the Donovan scheme,[17] and (3) the Tunks scheme.[30] The pain types and associated classification criteria have been discussed in detail elsewhere.[17,29,30] As seen in Table 3, the IASP model classifies pain into five types (ie, nociceptive, musculoskeletal and visceral pain, neuropathic above, at, and below lesion level pain). The Donovan scheme has five pain types (ie segmental nerve/cauda equina, spinal cord, visceral, mechanical, and psychogenic). Finally, the Tunks model identifies nine pain types (ie, above lesion level myofascial, syringomyelia, and non-SCI pain; at lesion level radicular, hyperalgesic border reactions, myofascial (incomplete lesions), and fracture site pain; below level burning, phantom, myofascial (incomplete lesions), and visceral pain; note: myofascial pains were collapsed into one category).

The short-form McGill Pain Questionnaire (SF-MPQ)[37] consists of 15 representative words from the sensory ($n=11$) and affective $n=4$) categories of the standard long-form McGill Pain Questionnaire. Pain intensity is ranked for each word (see Table 5 for list of descriptors) using a four point Likert scale (0 = no pain, 1 = mild; 2 = moderate, and 3 = severe). Two pain scores are derived from the sum of the intensity ratings for the sensory and affective scale. A total score is calculated by summing the sensory and affective scores. The SF-MPQ also includes the Present Pain Intensity (PPI) index of the long-form MPQ, a six point Likert scale ranging from 'no pain' to 'excruciating'. The correlations between the corresponding scales on the short- and long-form MPQ are generally high ($r's=0.68$ to 0.92).[37,54] In addition, the SF-MPQ has been shown to be sensitive to a variety of clinical interventions across numerous medical populations.[55] Two additional words from the long form MPQ, tingling and numbness, were added since these words were associated with different pain types on two of the three classification schemes.

Procedure

After obtaining informed consent, participants completed a questionnaire assessing demographic and injury related characteristics. Participants were administered a semi-structured interview designed to elicit information on 'all of the places you have pain.' Participants were allowed to report multiple pain sites, however, they were told 'you may have pain in several different places that to you is the same kind of pain. If this is so, we will ask you to group those pains together and answer questions about them as a group.' A separate SF-MPQ was completed for each pain site. The semi-structured interview was videotaped, and the type of pain for each site was determined using each of the three different classification schemes. A total of 64 pain sites were classified.

Statistical analysis

For each classification scheme, several statistical methods were used to determine the utility of verbal descriptors for distinguishing between pain types. First, a Chi-square analysis was performed to determine whether the proportion of individuals endorsing each verbal descriptor (four levels) differed across pain types. Next, a separate analysis of variance (ANOVA) for each classification scheme was performed with pain type as the independent grouping factor, and the McGill Pain Questionnaire – Total and subscale scores as the dependent factors. Correspondingly, an ANOVA was performed using pain type as the independent grouping factor, and the mean number of words endorsed on the McGill Pain Questionnaire total scale, and the two subscales as the dependent factors. Finally, a step-wise discriminant function analysis was used to determine if a unique set of verbal descriptors may be

Table 3

Donovan scheme	*IASP model*	*Tunks scheme*
(1) Segmental nerve/cauda equina	Nociceptive	Above level
(2) Spinal cord	(1) Musculoskeletal	(1) Myofascial
(3) Visceral	(2) Visceral	(2) Syringomyelia
(4) Mechanical		(3) Non-spinal cord injury
(5) Psychogenic	Neuropathic	
	(3) Above level	At lesion level
	(4) At level	(4) Radicular
	(5) Below level	(5) Hyperalgesic border reaction
		(6) Fracture
		(7) Myofascial (incomplete lesions)
		Below lesion / central pain
		(8) Diffuse burning
		(9) Phantom
		(10) Visceral
		(11) Myofascial (incomplete lesions)

associated with the different types of pain. The score for each verbal descriptor in the discriminant function analysis was equal to the value chosen for that word (0 = no pain to 3 = severe pain). The linear functions were calculated so that scores on all discriminant functions were orthogonal (ie, uncorrelated). Two different step-wise classification methods were used to determine variables that entered the model, (1) change in Wilks' Lambda and (2) maximization of Mahalanobis distance. Both methods generated the same set of significant verbal descriptors. Thus only the results of Wilks' Lambda method were reported. Discriminant function analysis generates G-1 or k discriminant functions, whichever is smaller, where G equals the number of groups and k equals the number of predictor variables. In order to ensure adequate sample size for between group analyses, only the three most common pain types from each classification scheme were used (this excluded 1, 1, and 24 pain sites for the IASP, Donovan, and Tunks classification method, respectively).

Results

Table 4 displays the demographic and medical characteristics of the sample. In general, participants were middle-aged, Caucasian, males with paraplegia and a greater than high school education. Motor vehicle accident was the most common cause of SCI, and time since onset ranged from 1–16 or more years.

Tables 5, 6 and 7 give the proportion of individuals who reported 'mild', 'moderate', and 'severe' for each verbal descriptor for the three most common pain

Table 4 Demographic characteristics of sample

	n
Education	
11th grade or less	5 (17)
High school or G.E.D.	8 (28)
More than high school	16 (55)
Gender	
Males	24 (83)
Females	5 (17)
Race	
Caucasian	24 (83)
African American	5 (17)
Level of impairment	
Paraplegia, incomplete	10 (35)
Paraplegia, complete	12 (41)
Tetraplegia, incomplete	5 (17)
Tetraplegia, complete	2 (17)
Etiology of SCI	
Vehicular	17 (59)
Violence	4 (14)
Sports	2 (7)
Other	6 (21)
Injury duration	
1 to 5 years	9 (31)
6 to 10 years	5 (18)
11 to 15 years	6 (20)
16 or more years	9 (31)
Reading level	
Less than 8th grade	6 (20)
8th grade	2 (7)
High shool or above	21 (73)
	M SD
Age	45.2 10.0

Note: SCI = Spinal cord injury

Table 5 Proportion (%) reporting 'mild', 'moderate' and 'severe' for each verbal descriptor (IASP model)

	Nociceptive muskoloskeletal[a]			*Neuropathic, at lesion level*[b]			*Neuropathic, below lesion level*[c]		
Verbal descriptors	*Mild*	*Moderate*	*Severe*	*Mild*	*Moderate*	*Severe*	*Mild*	*Moderate*	*Severe*
Throbbing	8	54	21	8	24	32	0	36	14
Shooting	17	21	21	16	16	28	29	29	0
Stabbing	4	25	38	8	20	32	7	21	14
Sharp	13	21	46	12	24	48	0	36	14
Cramping	21	0	25	12	12	16	0	21	7
Gnawing	29	13	13	16	12	8	0	36	0
Hot-burning	4	25	29	16	28	40	29	21	36
Aching	13	33	50	12	32	40	14	43	14
Heavy	21	29	13	16	12	20	14	29	14
Tender	8	29	17	12	24	20	7	14	0
Splitting	4	13	13	12	24	8	14	14	7
Tiring-exhausting	17	29	33	16	24	24	14	21	14
Sickening	13	4	4	12	32	8	7	0	7
Fearful	17	8	4	12	12	0	14	7	7
Punishing*	13	33	25	12	28	36	0	14	7
Tingling*	13	21	17	12	28	40	43	14	29
Numbness	21	13	13	32	28	4	14	7	0

Note: Only the three most common pain types are listed. IASP = International Association for the Study of Pain. [a]$n = 24$; [b]$n = 25$; [c]$n = 14$; *$P < 0.05$

Table 6 Proportion (%) reporting 'mild', 'moderate' and 'severe' for each verbal descriptor (Donovan scheme)

	Segmental nerve/Cauda equina[a]			*Spinal cord*[b]			*Mechanical*[c]		
Verbal descriptors	*Mild*	*Moderate*	*Severe*	*Mild*	*Moderate*	*Severe*	*Mild*	*Moderate*	*Severe*
Throbbing	10	30	30	5	32	21	8	50	21
Shooting	20	15	35	21	26	0	17	20	20
Stabbing	5	20	40	11	21	11	4	25	38
Sharp	5	25	50	11	32	21	13	21	46
Cramping	10	5	20	5	26	11	21	0	25
Gnawing	20	15	5	11	21	5	25	13	13
Hot-burning	10	40	35	21	16	42	8	25	29
Aching	5	35	45	21	37	16	13	33	50
Heavy	10	20	25	26	16	11	21	29	13
Tender	5	30	20	16	16	5	8	29	17
Splitting	5	30	10	21	11	5	4	13	13
Tiring-exhausting	15	35	25	21	11	16	17	25	33
Sickening*	15	35	10	11	5	5	13	4	4
Fearful	20	15	0	11	5	5	17	8	4
Punishing	5	30	30	5	21	21	17	29	25
Tingling	15	20	45	26	32	32	17	17	17
Numbness	30	25	5	16	16	0	21	17	13

Note: Only the three most common pain types are listed. [a]$n=20$; [b]$n=19$; [c]$n=24$; *$P<0.05$

Table 7 Proportion (%) reporting 'mild', 'moderate' and 'severe' for each verbal descriptor (Tunks scheme)

	Above lesion level, myofascial[a]			*At lesion level, radicular*[b]			*Below Lesion, burning pain*[c]		
Verbal descriptors	*Mild*	*Moderate*	*Severe*	*Mild*	*Moderate*	*Severe*	*Mild*	*Moderate*	*Severe*
Throbbing	18	55	18	13	25	31	0	39	15
Shooting	18	36	9	19	13	31	31	23	0
Stabbing	0	36	18	6	19	13	15	31	8
Sharp	18	36	36	13	19	38	8	46	8
Cramping	9	0	18	13	13	6	0	31	15
Gnawing	36	0	0	13	19	13	8	39	0
Hot-burning	0	27	18	19	25	25	15	23	46
Aching	0	55	45	13	31	44	15	54	7
Heavy	27	36	0	19	19	13	15	31	8
Tender	18	36	18	13	19	6	15	23	0
Splitting	0	18	0	13	19	6	23	15	0
Tiring-exhausting	0	46	27	19	31	13	15	23	15
Sickening	0	0	0	6	25	13	8	0	8
Fearful	0	9	0	19	13	0	8	8	0
Punishing	0	36	27	13	31	31	0	23	8
Tingling**	18	9	9	0	44	38	39	23	23
Numbness	27	9	9	38	6	6	15	15	0

Note: Only the three most common pain types are listed. [a]$n=11$; [b]$n=16$; [c]$n=13$; **$P<0.01$

types within each classification scheme. It should be noted that all of the verbal descriptors were used at least once for each pain type, thus a mutually exclusive set of descriptors did not emerge for any of the pain classification schemes. Chi-square analysis using each classification scheme to examine the proportion of endorsement (ie, none, mild, moderate, severe) for each verbal descriptor across the three most common pain types indicated relatively few significant differences. More specifically, two verbal descriptors, 'punishing' and 'tingling', were significantly different, $P<0.05$, using the IASP model, and only one word was significantly different using the Donovan scheme and Tunks model (ie, 'sickening' and 'tingling', respectively). As may be expected then, ANOVAs using pain type (three most common types for each classification scheme) as the independent grouping factor showed no significant differences, $P>0.05$, for the SF-MPQ – Total and subscale scores, as well as no significant differences for the mean number of words endorsed on the SF-MPQ total scale and subscales. There were two exceptions to this general finding in that the number of words endorsed on the SF-MPQ – affective scale was significantly different

across pain types on the IASP and Donovan classification schemes. More specifically, neuropathic at lesion level pain on the IASP, and segmental nerve pain on the Donovan scheme were associated with endorsement of a greater number of words on the affective scale ('sickening', 'fearful', 'punishing' and 'tiring-exhausting').

Discriminant function analysis was performed to determine if a linear combination of verbal descriptors would distinguish between the three most common pain types within each classification scheme. Initial analyses using each classification scheme were performed to ensure adequate compliance with the major assumptions of discriminant function analysis. The skewness statistic for each pain type was well within the normal range (-1.5 to 1.5) for all verbal descriptors. The kurtosis statistic for each verbal descriptor was in the normal range (-1.5 to 1.5) for the IASP model, however, the Donovan and Tunks models had five words that were somewhat outside of this range including 'sickening', 'fearful', 'punishing-cruel', and 'throbbing'. All of these, with the exception of 'sickening', showed a negative kurtosis within an acceptable range of -1.5 to -2.0. Bi-variate correlations between the predictor variables (ie, verbal descriptor scores) were generally in the low range ($r=0.000$ to 0.63; average $=0.24$) suggesting little redundancy across predictors. The Box's M test was nonsignificant, $P>0.05$, for each classification scheme suggesting equal variance – covariance of predictors across pain types.

Using the IASP model, only one verbal descriptor, 'punishing-cruel', entered into the step-wise discriminant function analysis. Examination of the correlations between the canonical variable of the first, and only, function, and the 'punishing-cruel' verbal descriptor indicated an increased likelihood of being classified with 'nociceptive musculoskeletal' or 'neuropathic at lesion level' pain. Correct classification using the 'Leave One Out' jackknife procedure ranged between 64% to 79% (note: only two groups are classified with only one function).

Using the Donovan scheme, four verbal descriptors, 'sickening', 'aching', 'tingling', and 'tiring', entered the step-wise discriminant function analysis. The greatest separation in group centroid means was found between mechanical pain, *vs* the other two pain types (ie, segmental/caudal equina, and spinal cord). Examination of the eigenvalues indicated that the first and second function accounted for 73% and 27% of the variance, respectively. A Chi-square transformation of Wilks Lamda was used to test whether the group means (ie, group centroids for each canonical variable) for each function were significantly different. Results showed that the group means on the first and second discriminant functions were significantly different, $P<0.01$, indicating the predictive importance of both functions. Examination of significant correlations ($r>0.4$) between the canonical variable of the first function, and scores of the verbal descriptors indicated an inverse relationship with 'aching' ($r=-0.41$), and a positive correlation ($r=0.52$) with 'tingling'. Thus, spinal cord and segmental/cauda equina pain tended to be associated with a 'tingling', but not an 'aching' sensation, and the reverse was true for mechanical pain. The second function primarily separated segmental/cauda equina pain, from mechanical and spinal cord pain. The verbal descriptors 'sickening' ($r=0.86$), 'tiring' ($r=0.50$), and 'aching' ($r=0.55$) tended to be associated with an increased likelihood of being classified with segmental/cauda equina pain. The classification rates using the 'Leave One Out' jackknife procedure were low, ranging from 50% to 63%.

Using the Tunks scheme, three verbal descriptors, 'sickening', 'aching', and 'tingling' entered the step-wise discriminant function analysis. The greatest separation in group centroid means was found between above level myofascial pain, *vs* two other pain types (ie, below lesion burning and at lesion level radicular). Examination of the eigenvalues indicated that the first and second function accounted for 80% and 20% of the variance, respectively. A Chi-square transformation of Wilks Lamda was used to test whether the group means (ie, group centroids for each canonical variable) for each function were significantly different. Results showed that the group means on the first and second discriminant functions were significantly different, $P<0.05$, indicating the predictive importance of both functions. Examination of significant correlations ($r>0.4$) between the canonical variable of the first function, and scores of the verbal descriptors indicated a positive relationship with 'tingling' and 'sickening' (r's $=0.63$ and 0.49). Thus, below lesion burning and at lesion level radicular pain tended to be associated with 'tingling' and 'sickening' sensations, and the reverse was true for myofascial pain. The second function primarily separated below level burning pain, from myofascial and at lesion level radicular pain. The verbal descriptors 'aching' ($r=0.88$) tended to be associated with an increased likelihood of being classified with myofascial or at lesion level radicular pain. The classification rates using the 'Leave One Out' jackknife procedure were low, ranging from 39% to 82%.

Discussion

The use of verbal descriptors by individuals to communicate their pain state is clearly a common phenomenon. Moreover, verbal labels show good correspondence to laboratory-induced graded physical pain stimuli,[56,57] and generally tend to reliably cluster into the three primary components (ie, sensory, affective, evaluative).[58] Indeed, verbal descriptors are common criteria used by most classification schemes to categorize pain following SCI. Unfortunately, the validity of verbal descriptors alone to distinguish between pain types following SCI has yet to be established. Therefore, the primary aim of the current

study was to evaluate the utility of verbal descriptors to distinguish between different types of pain following SCI. A secondary aim was to address two important methodological limitations of previous research examining the predictive validity of verbal descriptors. More specifically, three separate classification schemes were used to determine pain type, thus, providing for comparisons of results across classification schemes. In addition, participants were allowed to report multiple, qualitatively different, pain sites serving to ensure that the verbal descriptors reported related to the pain type of interest.

Using univariate statistical methods, a consistent pattern of results emerged that showed substantial overlap in the use of verbal descriptors across pain types. Moreover, all three pain classification schemes showed the same general pattern of results suggesting that the poor predictive validity of verbal descriptors, considered on a univariate basis, is not limited to a specific pain classification scheme. In fact, none of the verbal descriptors were found to be specific to a particular type of pain for any of the pain classification schemes. That is, every verbal descriptor was endorsed at least 8% of the time for each of the three most common pain types across classification schemes (note: one exception; none of the participants endorsed 'sickening' for Tunks' myofascial pain). Even when considering endorsement only within the 'moderate to severe' intensity range, there was considerable overlap across the three most common pain types for each verbal descriptor. Consistent with this finding, a recent meta-analysis showed that 12 of the 15 words on the SF-MPQ were selected by greater than 20% of subjects across a variety of pain populations.[33] Taken together, there does not appear to be a pathognomic verbal descriptor that can be used to identify a specific SCI pain type.

Similar results emerged when considering combinations of verbal descriptors. For instance, none of the classification schemes showed significant means differences across pain types on the various scores associated with the SF-MPQ (ie, total and subscale scores). Nor were significant differences found across pain types when considering the number of words endorsed on the various SF-MPQ scales. Given the considerable overlap in the use of verbal descriptors across pain types, the proportion of individuals that could be accurately classified using multivariate discriminant function analysis was limited. Indeed, the overwhelming majority of verbal descriptors did not enter into the discriminant function model using a step-wise procedure. In terms of consistency across the three classification schemes, a common verbal descriptor that emerged on all three step-wise discriminant functions was not found. Three verbal descriptors, 'tingling', 'aching', and 'sickening', were found to be common across two of the three discriminant function analyses. In general, 'aching' tended to be associated with mechanical pain, and 'tingling' and 'sickening' tended to be associated with neuropathic pain. This finding is consistent with the review of SCI pain classification literature which indicated 78% of the classification schemes considered the word 'aching' to be characteristic of mechanical pain, whereas 54% of the classification schemes used the word 'tingling' to describe neuropathic pain.

As may be expected given the substantial overlap in the use of verbal descriptors across pain types, a low rate of correct classification was found using the discriminant functions. That is, between 39% to 82% of the pain sites were correctly classified using verbal descriptors. On average, 60% of the pain sites were correctly classified. Thus, the discriminant function models were able to correctly classify pain types at about 30% above what would be expected based on chance alone (ie, the three most common pain types used for analysis, thus, a 33% change rate). Taken together, results suggest that the use of verbal descriptors alone to distinguish between pain types following SCI may be limited. This is particularly true since the methodology of the current study was designed to maximize the predictive validity of verbal descriptors. That is, by excluding other classification criteria (eg, pain duration, time of onset, aggravating factors) from the discriminant model, the amount of shared explanatory variance with other classification criteria was arbitrarily attributed to verbal descriptors.

Although the results of the current study showed minimal support for the use of verbal descriptors as a mechanism to classify SCI pain, there are several methodological concerns within this area of research that limit firm conclusions. Most importantly, it is difficult to determine whether the poor results of the current study should be attributed to the limited predictive validity of verbal descriptors, or to 'inaccurate' classification of pain types. Both sides of this equation will need to be clarified in future research so that the use of verbal descriptors, or any other classification criteria, as a mechanism to classify pain can be more specifically determined. On the verbal descriptor side of the equation, Bennett[47] discussed several factors that may limit the predictive validity of verbal descriptors including the (1) exclusion of important descriptors for a given pain type, (2) psychometric scaling properties of each descriptor (eg, a restricted range of scores associated with each descriptor, reading level requirements), (3) method of assessment (eg, restricting endorsement to the two or three most important verbal descriptors, *vs* allowing endorsement of all verbal descriptors associated with a pain site), and (4) the assessment time frame of reference (eg, current pain *vs* 'over the past week'). In addition to further clarification of these issues, this area of research would benefit from the establishment of a standard set of verbal descriptors with validated psychometric properties for pain site assessment. Standardization would facilitate comparisons across studies and also allow for the development of pattern analysis across pain populations.

On the pain classification side of the equation, a gold-standard has not emerged. Indeed, there are 29 published classification schemes for pain following SCI. Thus, it has yet to be determined if these results generalize across the various classification schemes. It should be noted, however, that we selected three of the most common classification schemes for study and the results were generally the same across all three classification schemes. In addition to establishing a general consensus for the classification of pain following SCI, the psychometric properties (eg, reliability) and the relative importance of the various classification criteria (eg, location, mitigating factors) have yet to be determined. Along these lines, we are currently examining the psychometric characteristics (eg, inter-rater agreement, the importance of clinician experience in pain rating) of the three classification schemes used in the current study. For instance, three independent raters classified pain sites using the Donovan scheme.[53] Inter-rater agreement for pain type was found to range from about 50% to 70%. Moreover, inter-rater agreement did not improve as additional classification criteria were provided.

Ideally, future research in pain classification would benefit from the collection of an extensive set of classification criteria (eg, location, time of onset, verbal descriptors, mitigating factors) which would be used to determine pain type based on several different classification schemes. With this information, a systematic approach, through the use of discriminant function analysis, could be used to determine the relative importance and incremental predictive validity of each criterion, and consistency of results could be compared across classification schemes. In addition, cluster analysis could be used to identify patterns in predictor variables that may be used to classify pain types independent of an underlying classification scheme. Given the inconsistency in pain classification, procedures used to classify pain should be clearly presented including measures taken to ensure participants describe the pain type of interest.

Limitations

There are some important limitations to the current study to consider. First, there may be regional, national, and/or variation in the use of verbal pain descriptors. The sample in the current study consisted of individuals in the Southeastern United States. Thus, the extent to which these findings may vary across other regions or nations is not known. Second, there is evidence to suggest that both the total number of verbal descriptors endorsed and their associated pain intensity ratings, are positively correlated with self-reported psychiatric symptoms (ie, the 'diffusion hypothesis').[46,59] Participants in the current study were not screened for psychiatric symptoms. Thus, it is unknown whether the extent of overlap in the use of verbal descriptors across pain types may have been over-estimated secondary to psychiatric symptomotology. Third, although our procedures allowed participants to report multiple pain sites so that more specific attributions could be made between verbal descriptors and pain types, it resulted in a lack independence between verbal descriptor endorsement and pain type. More specifically, the McGill Pain Questionnaire was completed for each pain site, and each pain site was subsequently categorized into the appropriate pain type group. Because an individual was allowed to report multiple pain sites, an individual may have been used in more than one pain type group. To the extent that an individual employs a common vocabulary to describe pain that is independent of pain type, the amount of overlap in the use of verbal descriptors across pain types may have been over-estimated. About 80% of the sample reported two or more pain sites. Lastly, the criteria used to classify pain types with the Donovan pain rating scheme and the verbal descriptors used for the study were confounded. More specifically, all three classification schemes employed the use of verbal descriptors that were, in turn, used to predict pain type. Therefore, the amount of explained variance attributable to the verbal descriptors was likely over-estimated. Since accurate classification of pain type based on verbal descriptors was found to be marginal even given this confound, the limited utility of current verbal descriptor scales to classify pain types following SCI can be reasonably asserted.

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