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Predicting consistency of pain over a 10-year period in persons with spinal cord injury

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Abstract—This longitudinal study was designed to test the hypothesis that persons who consistently report pain at three (women) or four (men) measurement points across 10 years (1988 to 1998) are different both physically and psychologically from those who inconsistently or never report pain. Participants were 96 persons with spinal cord injury (SCI) living in the community who participated at every measurement point. Measures included consistency of reports of pain (i.e., reported having had problems with pain in the 12 months prior to all, some, or no measurement points); demographic and injury-related data; and measures of physical and psychological health, function, and social support. Of the 96 participants, approximately half of the men and three-fourths of the women consistently reported pain at each point. Phase 1 predictors of the consistency of pain reports for men were being less impaired, being more independent, experiencing more stress, and receiving less social support. Women consistently reporting pain had more stress at Phase 1 than women inconsistently reporting pain. Persons with SCI at risk for chronic pain should be identified and referred to a multidisciplinary pain management program.

Key words: chronic pain, longitudinal studies, spinal cord injuries.

INTRODUCTION

Chronic pain can be debilitating and can diminish one's quality of life [1–4]. The majority (60% to 80%) of individuals with spinal cord injury (SCI) experience chronic pain, and a large proportion (35% to 40%) describe the intensity of their chronic pain as severe [5–12]. Furthermore, they report that their chronic pain adversely affects daily activities and sleep [11–13]. Pain, especially chronic pain, is multidimensional [14,15].

Abbreviations: ADL = activities of daily living, ANOVA = analysis of variance, ASIA = American Spinal Injury Association, CES-D Scale = Center for Epidemiologic Studies Depression Scale, FIM = Functional Independence Measure, ISEL = Interpersonal Support Evaluation List, JCAHO = Joint Commission on Accreditation of Healthcare Organizations, LSI-A = Life Satisfaction Index A, PSS = Perceived Stress Scale, SCI = spinal cord injury, SD = standard deviation.

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Persons with severe chronic pain have been found to be more likely to experience depression, anxiety, and subjective stress than those without chronic pain or with less severe pain [5–7,9–11,14,16]. Persons with SCI have been found to be at greater risk for experiencing chronic pain and more intense pain if they are older or were older at the onset of SCI; however, time since onset of SCI has not been found to predict pain [8,10,11,15,17]. Many studies regarding pain and SCI have been cross-sectional [6,9,11,12]. Even the few that have been longitudinal have mainly followed the participants for only a year or two [5,7,10,17–19]. Chronic pain among persons with SCI may have been neglected or undertreated in the past. The Joint Commission on Accreditation of Health Organizations (JCAHO) now requires pain to be considered a "5th vital sign." [20]. Information about the long-term course of pain in the SCI population is important for better planning for assessing and treating this significant problem.

Based on previous literature, we hypothesized that persons who always reported having problems with pain at several points in time would be both physically and psychologically different from those who had no pain or had inconsistent pain. Specifically, persons with consistent chronic pain would be those who were—

- Women.
- Older at study entry.
- Older at onset of SCI.
- Less impaired by the SCI (lower level of injury and/or less complete).
- Injured by a gunshot wound.

Furthermore, we hypothesized that those with consistent chronic pain would experience more depressive symptomatology and stress and would be less satisfied with their lives. Analyses were conducted on a subset of data from a larger longitudinal study to identify variables available at the beginning of the study that predict the consistency of having problems with pain in the past 12 months across three (women) or four (men) measurement phases over a 10-year period (1988–1998). Persons with consistent pain were defined as those who reported having problems with pain in the past 12 months at every data collection point, while persons with inconsistent pain were those who reported having had a problem with pain at one or more measurement points but not at all points. A third group included persons who never reported having had pain at any measurement point.

METHODS

Sample Characteristics

In preparation for this study, we established a sampling frame consisting of 661 persons with traumatic SCI living within a 13-county health services area that included Houston and Galveston, Texas. Candidates were solicited via a variety of media and by contacting them by means of lists of names obtained from area hospitals and organizations for persons with disabilities. To be included, the individual had to have sustained the SCI at least 9 months prior to enrollment, have residual motor disability at least severe enough to require use of an assistive device for walking (if the person was ambulatory), and be at least 17 years of age. The study design called for a sample of 100 men and 40 women. Women were over-sampled to assure an acceptable number for statistical analyses. Candidates for inclusion in the sample were randomly selected from the sampling frame (stratified by gender), contacted by telephone or letter, and invited to participate. That process continued until the desired number of men and women agreed to participate. They represented 61 percent (for men 63%, for women 57%) of the candidates selected from the frame. Reasons for nonparticipation included lack of interest or time (46%); unable to contact, moved away, or deceased (31%), too physically or mentally ill (16%), and no reason given (8%). Nonparticipants (n = 88), when compared to participants (n = 140), were older (41 versus 37 years), older at onset (30 versus 26 years), and more likely to live in Harris County of which Houston is a part. Participants and nonparticipants did not differ on ethnicity, gender, marital status, etiology of SCI, time since injury, having pain, or having pain that interfered with daily activities. In addition to the 140 randomly selected candidates, 15 men who had been injured over the age of 35 years (mean = 49.1 years, standard deviation (SD) = 10.0, range = 36 to 68) and 15 men who had lived with their injury for more than 20 years (mean = 28.3 years, SD = 5.4, range = 23 to 41) were recruited to enable analyses involving age at onset and time since onset. Thus, a total of 130 men and 40 women participated in the first phase of this longitudinal study.

Of this sample, 69 men (53 randomly selected, 8 older at onset, 8 long duration SCI) participated in the study for all four phases, spanning a 10-year period (Phase 1: 1988–1990, Phase 2: 1991–1993, Phase 3: 1994–1996, Phase 4: 1997–1998). Twenty-seven of the

women participated at Phases 1, 3, and 4. The 69 men who took part in all four phases and the 27 women who took part in three phases make up the sample for the results reported in this paper. Women were not included in Phase 2 because of funding and time limitations of the grant. This subsample represents 53 percent of the men and 68 percent of the women who participated in Phase 1. At the time of recruitment for Phase 4, 14 men (11% of Phase 1 men; 8 randomly selected, 3 older at onset, 3 long duration) and 3 women (8% of Phase 1 women) were deceased. The remaining Phase 1 participants either refused, were unable to be contacted, or had scheduling problems that prevented participation in one or more phases. A consent form was signed at Phase 1 for inclusion in Phases 1 and 2, and another form was signed at Phase 3 for inclusion in Phases 3 and 4. The local institutional review board for research with human subjects approved all phases of the study.

Displayed in **Table 1** are descriptive data regarding characteristics of the 69 men and 27 women who participated. There were wide ranges of age (Phase 1: men—23 to 70 years, women—21 to 61 years), time since onset (Phase 1: men—1 to 41 years, women—2 to 27 years), and age at onset (men—12 to 68 years, women—11 to 58 years). American Spinal Injury Association (ASIA) Motor Index scores (see next section) ranged from 0 to 95 for men and from 0 to 85 for women at Phase 1.

Table 1.
Characteristics of sample.

Characteristics	Men (SD)		Women (SD)	
Mean Age				
Phase 1: 1988–1990	40.5 (12.5)		37.0 (10.8)	
Phase 2: 1991–1993	43.5 (12.4)		Not Done	
Phase 3: 1994–1996	46.6 (12.3)		42.3 (10.6)	
Phase 4: 1997–1998	49.1 (12.3)		44.9 (10.6)	
Mean Time Since Onset				
Phase 1: 1988–1990	11.1 (8.8)		10.4 (7.2)	
Phase 2: 1991–1993	14.1 (8.7)		Not Done	
Phase 3: 1994–1996	17.3 (8.8)		15.6 (7.1)	
Phase 4: 1997–1998	19.9 (8.8)		18.2 (7.1)	
Mean Age at Onset	29.4 (12.3)		26.7 (12.3)	
Mean ASIA Motor Index Score at Phase 1	48.3 (24.1)		40.3 (21.8)	
Race/Ethnicity	***n***	**%**	***n***	**%**
Caucasian	49	71	18	67
African American	12	17	7	26
Hispanic	5	7	2	7
Other	3	4	0	0
Etiology of SCI				
Motor Vehicle Crash	28	41	13	48
Gunshot Wound	10	15	8	30
Fall	5	7	1	4
Sport	14	20	3	11
Other	12	17	2	7
Level of Injury at Phase 1				
Tetraplegia	33	48	15	56
Paraplegia	36	52	12	44
Completeness of Injury at Phase 1				
ASIA A	14	48	9	33
ASIA B	6	23	12	44
ASIA C	4	12	1	4
ASIA D	9	17	5	19
Level and Completeness of Injury at Phase 1				
Tetraplegia: ASIA A, B, or C	26	38	12	44
Paraplegia: ASIA A, B, or C	31	45	10	37
All ASIA D	12	17	5	19

Note: Percentages may not sum to 100% because of rounding.
ASIA = American Spinal Injury Association
SD = standard deviation

Procedure

At each phase, participants were contacted by telephone or letter. They were sent a packet of questionnaires and standardized instruments, covering a large number of topics regarding various areas of life. The completed packets were collected during an interview conducted in the participant's residence. At Phases 1 and 2, participants also underwent a medical examination at a rehabilitation hospital. They were paid $100 each time for participating in Phases 1 and 2 and transportation and meal costs on the day of the medical examination were reimbursed; they were paid $75 each time for participating in Phases 3 and 4.

Measures

Demographic Data

We assessed gender, race/ethnicity, and date of birth via questionnaires. Age was calculated at the time of participation in each phase.

Pain in Past 12 Months

At each phase, we asked participants, "In the past 12 months, have you had problems with pain of any kind?" Response options were "Yes" or "No."

Characteristics of Pain at Phase 1

At Phase 1, we asked participants who reported having problems with pain in the past 12 months to list the parts of the body where they felt pain. They were *not* given a checklist of body areas from which to choose. For each body location listed, we asked participants whether the pain seemed to be "Increasing," "Decreasing," or "Not Changing" when comparing the past year with previous years; whether they took medication of any kind for the pain (Response Options: "No," "Occasionally," or "Frequently"); and whether the pain interfered with their daily activities (Response Options: "No," "Some," or "A lot"). The number of locations with pain was calculated for each participant.

Injury-Related Information

We assessed etiology of SCI and date of onset of SCI via questionnaires. Age at onset was calculated at Phase 1, and time since onset of SCI was calculated at the time of participation in each phase. The ASIA Motor Index and Impairment Scales were completed at the time of the medical examination at Phase 1 [21]. The Motor Index is the sum of ratings for 10 key muscle segments on each side of the body. Each muscle segment is rated on a 6-point scale, ranging from 0 (total paralysis) to 5 (normal). Total scores can range from 0 to 100 (50 for each side). The participants were categorized by a combination of the level of injury and the completeness of injury. First, we categorized individuals as having tetraplegia or paraplegia. Second, we divided participants into those who had motor function preserved below the level of injury (ASIA Impairment Scale D) and those who did not (ASIA Impairment Scale A, B, or C). Finally, we formed three groups by combining level and completeness of injury—tetraplegia (ABC), paraplegia (ABC), and tetraplegia or paraplegia (D).

Functional Independence Measure (FIM) Motor Score

A self-report version of the FIM motor items was administered during the home interview at each phase to assess level of functional ability [22–24]. Each participant's degree of independence was assessed on a 7-point scale for each of 13 activities of daily living (ADL). Summing the ratings across the 13 activities derive a total score. Scores can range from 13 (totally dependent) to 91 (totally independent).

Center for Epidemiologic Studies Depression (CES-D) Scale

The CES-D scale is a 20-item self-report scale designed to measure symptoms of depression in the general population [25]. Each item is rated on a scale ranging from 0 to 3 according to how often the person experienced certain feelings (e.g., depression and hopefulness) during the previous week (0 = less than 1 day, 1 = 1 to 2 days, 2 = 3 to 4 days, and 3 = 5 to 7 days). Scores for positive feelings are reversed. A high level of internal consistency (alpha coefficient = 0.84 – 0.90) and moderately good concurrent validity (r = 0.50 – 0.70) have been reported [25].

Life Satisfaction Index A (LSI-A)

The 18-item LSI-A is designed to measure zest for life; fortitude; congruence between desired and achieved goals; physical, psychological, and social self-concept; and mood tone [26]. The respondent indicates whether he or she agrees with, disagrees with, or is uncertain about each statement. The scale has been found to have acceptable internal consistency (alpha coefficient = 0.76) and satisfactory concurrent validity with other measures of life satisfaction [27,28].

Perceived Stress Scale (PSS)

The PSS is a 10-item instrument that measures the degree to which respondents find their lives to be unpredictable, uncontrollable, and overloaded [29]. Each item is rated on a 5-point scale, ranging from 0 to 4, with regard to the frequency with which the person felt or thought a certain way (e.g., nervous, things were going your way) in the past month (0 = never, 1 = almost never, 2 = sometimes, 3 = fairly often, 4 = very often). Scores for positively worded items are reversed. The PSS has been shown to have high internal reliability (alpha coefficient = 0.78) and acceptable evidence of validity [30].

Social Support

At Phases 1 and 2, we assessed social support during the home interview using the procedures of Schulz and Decker [28]. Each participant was asked to name persons whom he or she deems to be important sources of help, support, and guidance. The participant rank-orders this

list of persons with regard to importance. The participant then indicated on a 5-point, Likert-type scale, the frequency with which each of the five top-ranked persons provided each of 11 kinds of support (1 = not at all, 2 = rarely, 3 = on some occasions, 4 = often, and 5 = very frequently). Included are items regarding affective, cognitive, and instrumental types of supports. We derived a total score by summing ratings on the 11 scales across all five supporters within a participant's network, resulting in scores that could have ranged from 0 (no support) to 275 (extensive support). The internal consistency of the total score was found to be high (alpha coefficient = 0.90) [28].

Interpersonal Support Evaluation List (ISEL)

The ISEL was administered at Phases 2, 3, and 4. It consists of a 40-item list of statements concerning the perceived availability of potential resources [31]. The respondents indicated whether each statement was true or false about themselves. Items were counterbalanced as to whether a response of "true" indicated support or lack of support. Responses indicating support were counted to yield a total score. The ISEL has been found to be reliable (alpha coefficient = 0.77) and valid [31].

Self-Assessed Health

At each phase, we measured self-assessed health with a single-item, 4-point, Likert-type scale using the descriptors of "excellent," "good," "fair," and "poor."

Amount of Personal Assistance

At each phase, we asked participants about the amount of help they needed with basic ADL. The response options were "none at all," "less than 4 days per week," "4 to 6 days per week," "every day—1 hour or less," and "every day—more than 1 hour."

Data Analysis

We obtained descriptive statistics for each study variable. A new variable, Consistency Group, assessing consistency of having pain was derived. Individuals were identified who had (1) reported having problems with pain in the past 12 months at each of the four phases for men or the three phases for women (Consistent Pain), (2) reported having had problems with pain at some phase(s) but not at others (Inconsistent Pain), and (3) never reported having problems with pain at any phase (Never Pain). Each reported location with pain was considered as an individual pain component. For simplicity, these pain components are described in the remainder of this paper as "individual pains." Descriptive statistics for characteristics of individual pains at Phase 1 were obtained. Associations between these pain characteristics and consistency of pain were assessed. We assessed other variables obtained at Phase 1 also for the ability to predict in which of the three groups (Consistent, Inconsistent, or Never Pain) the person would fall. Separate analyses were performed for women and men. For continuous variables, analyses of variance (ANOVA) and t-tests were performed; for categorical variables, chi square analyses were performed. To avoid small cell sizes, we collapsed some categorical variables into dichotomous variables. Finally, we performed repeated measures ANOVA to evaluate the relationship of the consistency of pain to subjective stress over time. Again, separate analyses were performed for men and women.

RESULTS

Descriptive Analyses

In the 12-month period prior to participation in each phase, 64 to 73 percent of the men and 85 to 96 percent of the women reported having had a problem with pain (**Tables 2** and **3**). At all phases, both men and women were most likely to rate their general health as "good." The vast majority of persons received either no help with personal assistance or received daily help, lasting 1 hour or more. Mean scores on most of the continuous outcome measures remained relatively stable across the 10-year period.

Consistency of Pain

Among the 69 men, 33 (48%) reported having had problems with pain in the past 12 months at all four phases (Consistent Pain), 28 (41%) reported problems with pain at one to three phases (Inconsistent Pain), and 8 (4%) never reported having problems with pain (Never Pain). Among the 27 women, 21 (78%) reported having had problems with pain in the past 12 months at all three phases in which the women participated (Consistent Pain) and 6 reported problems with pain at one or two phases (Inconsistent Pain). Thus, all 27 women reported problems with pain for at least one phase.

Table 2.
Outcome measures across four phases for men.

Outcome Measure	Phase 1 1988–1990		Phase 2 1991–1993		Phase 3 1994–1996		Phase 4 1997–1998	
	n	%	*n*	%	*n*	%	*n*	%
Had Pain in Past 12 Months	44	64	44	64	48	70	50	73
Self-Assessed Health								
Excellent	11	16	19	28	15	22	9	13
Good	50	73	37	54	37	54	42	61
Fair	8	12	13	19	15	22	16	23
Poor	0	0	0	0	2	3	2	3
Amount of Personal Assistance								
None	39	57	36	52	37	54	35	51
Less Than 4 Days a Week	3	4	3	4	3	4	4	6
4 to 6 Days a Week	1	1	1	1	3	4	1	1
Daily—1 Hour or Less	5	7	6	8	4	6	5	7
Daily—More Than 1 Hour	21	30	23	33	22	32	24	35
Mean FIM Motor Score (SD)	62.4 (20.1)		63.3 (19.9)		65.4 (23.2)		64.5 (22.9)	
Mean CES-D Score (SD)	10.4 (9.6)		10.0 (9.1)		10.0 (8.3)		10.3 (8.7)	
Mean LSI-A Score (SD)	9.4 (3.9)		9.4 (3.8)		9.5 (3.9)		9.2 (4.4)	
Mean PSS Score (SD)	14.1 (7.6)		13.6 (7.8)		13.4 (6.8)		13.8 (6.9)	
Mean Social Support Score (SD)	178.4 (54.7)		159.5 (61.8)		Not Done		Not Done	
Mean ISEL Score (SD)	Not Done		32.5 (6.2)		31.3 (6.9)		31.0 (7.3)	

Note: Percentages may not sum to 100% because of rounding.
FIM = Functional Independence Measure
LSI-A = Life Satisfaction Index A
SD = standard deviation
ISEL = Interpersonal Support Evaluation List
CES-D Scale = Center for Epidemiologic Studies Depression Scale
PSS = Perceived Stress Scale

Characteristics of Individual Locations with Pain at Phase 1

At Phase 1, men who had had problems with pain reported an average of 2.48 (SD = 1.84, range 1 to 9) locations with pain and women who had had problems with pain reported an average of 2.27 (SD = 1.15, range 1 to 4) locations with pain. Combining the results for men and women and excluding head and face pains, persons with ASIA D injuries reported more individual pains than did persons with ASIA A, B, or C injuries (3.31 pains per person in the ASIA D group versus 2.08 pains per person in the ASIA A, B, or C group). Separate analyses for tetraplegia and paraplegia groups resulted in similar findings. Persons with ASIA D tetraplegia reported significantly more pains per person than did persons with ASIA A, B, or C tetraplegia (3.3 versus 1.1 pains per person, $p < 0.001$). This finding was also true for persons with ASIA D paraplegia compared with ASIA A, B, or C paraplegia (2.86 versus 1.41 pains per person, $p < 0.02$).

Displayed in **Table 4** are the results of analyses of reports of individual pains, including body location of the pain, whether the pain had changed from previous years, whether medication was taken for the specified pain, and whether that pain interfered in ADL. The back and legs were the most common location for pain for both men and women. Frequency of individual pain locations was too small to conduct statistical analyses, assessing the relationship between pain at a given location and being in one of the three groups. However, it is notable that, for men, 88 percent of Phase 1 pains in the back and 96 percent of pains in the legs were found in persons who had consistent pain over the 10-year period. Similar results were noted for women (back—91%, legs—92%). After combining pains for men and women, as well as classifying

Table 3.
Outcome measures across three phases for women.

Outcome Measure	Phase 1 1988–1990		Phase 3 1994–1996		Phase 4 1997–1998	
	n	%	*n*	%	*n*	%
Had Pain in Past 12 Months	26	96	23	85	25	93
Self-Assessed Health						
Excellent	4	15	5	19	4	15
Good	17	63	17	63	15	56
Fair	5	19	5	19	7	26
Poor	1	4	0	0	1	4
Amount of Personal Assistance						
None	11	41	8	30	7	26
Less Than 4 Days a Week	0	0	2	7	3	11
4 to 6 Days a Week	0	0	1	4	2	7
Daily: 1 Hour or Less	4	15	1	4	1	4
Daily: More Than 1 Hour	12	44	15	56	14	52
Mean FIM Motor Score (SD)	53.3 (20.6)		53.4 (24.5)		53.7 (24.9)	
Mean CES-D Score (SD)	14.8 (9.7)		15.2 (8.4)		16.3 (9.7)	
Mean LSI-A Score (SD)	7.5 (5.0)		7.9 (4.2)		7.9 (5.2)	
Mean PSS Score (SD)	19.0 (5.6)		16.3 (5.5)		17.0 (5.4)	
Mean Social Support Score (SD)	184.4 (51.4)		Not Done		Not Done	
Mean ISEL Score (SD)	Not Done		30.4 (6.6)		31.1 (5.5)	

Note: Percentages may not sum to 100% because of rounding.
SD = standard deviation
FIM = Functional Independence Measure
CES-D Scale = Center for Epidemiologic Studies Depression Scale
LSI-A = Life Satisfaction Index A
PSS = Perceived Stress Scale
ISEL = Interpersonal Support Evaluation List

body locations into upper body, trunk, and lower body groups (excluding whole body, face, and head pains), we found that persons with tetraplegia had pain primarily in the upper body (33%) and lower body (44%), with few pains reported in the trunk (23%), whereas those with paraplegia had pain equally divided between trunk (44%) and lower body (44%), with a few in the upper body (12%).

Most of the pains were either increasing or not changing from previous years. Chi-square analysis indicated that a relationship existed between change status and consistency of pain. Those persons whose pain was increasing were the most likely to be in the Consistent Pain group followed by those with no change. The least likely to have consistent pain were persons whose pain was reported at Phase 1 to be decreasing. For most pains, medication was taken either not at all or only occasionally. No relationship was found between taking medication at Phase 1 and consistency of pain over time. For men, 74 percent of the pains interfered with ADL at least somewhat, and for women, 81 percent of pains interfered with ADL. No relationship was found between interference in activities at Phase 1 and consistency of pain over time.

Prediction with Phase 1 Variables

Continuous Phase 1 measures that were found to predict in which of the three consistency groups (Consistent, Inconsistent, Never Pain) male participants fell included scores on the ASIA Motor Index, FIM Motor subscale, PSS, and social support measure (**Table 5**). At Phase 1, men in the Consistent Pain group (1) were less impaired than men in either the Inconsistent Pain or Never Pain groups, (2) were more independent in motor activities than men in the Inconsistent Pain group, (3) experienced the greatest amount of stress (however, neither pairwise comparison was significant), and (4) received less social support than men in the Inconsistent Pain group. Age at

Table 4.
Characteristics of pain at Phase 1.

Pain Characteristic	Men				Women			
	No. of Pains at Location	% of All Pains	% of Men	% in Consistent Pain Group*	No. of Pains at Location	% of All Pains	% of Women	% in Consistent Pain Group*
Body Location of Pain								
Head	5	5	7	60	3	5	11	67
Teeth	2	2	3	50	2	3	7	50
Ear	1	1	1	0	1	2	4	100
Neck	1	1	1	100	2	3	7	50
Shoulder(s)	10	9	14	90	3	5	11	33
Arm(s)	8	7	12	75	3	5	11	100
Hand(s)	5	5	7	80	2	3	7	100
Chest	2	2	3	50	1	2	4	100
Back	25	23	36	88	11	19	41	91
Abdomen	4	4	6	75	7	12	26	100
Trunk	1	1	1	100	0	0	0	NA
Pelvis	6	6	9	100	1	2	4	0
Hip(s)	11	10	16	73	3	5	11	67
Leg(s)	23	21	33	96	13	22	48	92
Foot/Feet	5	5	7	80	4	7	15	75
Lower Body	0	0	0	NA	1	2	4	100
Whole Body	0	0	0	NA	1	2	4	100
Total	109	—	—	—	58	—	—	—
Change in Pain in Specified Location from Previous Years								
Increasing	47	43	—	94†‡	30	52	—	90†‡
Decreasing	12	11		58†‡	7	12	—	43†‡
No Change	50	46		80†‡	21	36	—	85†‡
Frequency of Taking Medication for Pain in Specified Location								
Do not Take Meds for Pain	47	43	—	77†	22	41	—	91†
Occasionally	46	42	—	91†	19	35	—	90†
Frequently	16	15	—	81†	13	24	—	85†
Amount of Interference with Daily Activities by Pain at Specified Location								
None	28	26	—	75†	10	19	—	100†
Some	55	50	—	87†	35	66	—	89†
A Lot	26	24	—	84†	8	15	—	75†

*Percentage of those with pain in a particular body location who reported experiencing pain at every measurement period (e.g., 3 [60%] of the 5 men with pain in their heads were in the Consistent Pain group).

†Percentage of those giving a particular response who reported experiencing pain at every measurement period (e.g., persons in the Consistent Pain group reported 44 [94%] of 47 pains that were increasing.

‡Analysis of responses by pain group—Chi-square: men = 9.45, women = 9.04, $p < 0.01$.

NA = not applicable.

onset and the CES-D score only approached significance with the Consistent Pain group, tending to be older at onset and to have more depressive symptomatology. Age, time since onset, and the LSI-A score were not significantly related to Consistency Group. Only the Phase 1 PSS score predicted whether women would have consistent pain or not (**Table 6**). Women who had consistent pain experienced more stress at Phase 1.

Table 5.
Comparisons of Phase 1 continuous measures for men who consistently reported pain, inconsistently reported pain, or never reported pain over time.

Phase 1 Variables (Potential Predictors)	Consistent Pain (n = 33)	Inconsistent Pain (n = 28)	Never Pain (n = 8)	F-Test	p-Value
Mean Age (SD)	43.0 (12.6)	39.5 (12.0)	34.1 (12.5)	1.82	0.169
Mean Age at Onset of SCI (SD)	32.9 (13.4)	26.3 (10.4)	25.9 (11.4)	2.74	0.072*
Mean Time Since Onset of SCI (SD)	10.0 (8.5)	13.2 (9.7)	8.3 (4.7)	1.49	0.233
Mean ASIA Motor Index (SD)	57.0 (22.3)	42.0 (24.8)	34.6 (17.1)	4.88†‡	0.011§
Mean FIM Motor Score (SD)	69.7 (14.8)	54.8 (21.1)	59.3 (26.2)	4.80†	0.011§
Mean CES-D Score (SD)	13.0 (11.3)	8.4 (6.9)	5.9 (6.9)	2.66	0.078*
Mean LSI-A Score (SD)	8.45 (4.0)	10.1 (3.5)	11.1 (4.2)	2.25	0.113
Mean PSS Score (SD)	16.3 (8.0)	12.8 (6.8)	9.9 (6.1)	3.29	0.043§
Mean Social Support Score (SD)	159.3 (55.6)	192.9 (51.1)	203.9 (35.5)	4.27†	0.018§

*$p < 0.10$

†Significant pairwise comparison ($p < 0.05$): Consistent Pain vs. Inconsistent Pain

‡Significant pairwise comparison ($p < 0.05$): Consistent Pain vs. Never Pain

§$p < 0.05$

Note: Administration of the ISEL was begun at Phase 2; thus, it was not included as a potential predictor in these analyses.
ASIA = American Spinal Injury Association
FIM = Functional Independence Measure
CES-D Scale = Center for Epidemiologic Studies Depression Scale
LSI-A = Life Satisfaction Index A
PSS = Perceived Stress Scale
SD = standard deviation

Table 6.
Comparisons of Phase 1 continuous measures for women who consistently or inconsistently reported pain over time.

Phase 1 Variables (Potential Predictors)	Consistent Pain (n = 21)	Inconsistent Pain (n = 6)	t-Test	p-Value
Mean Age (SD)	36.8 (11.6)	38.1 (8.1)	0.26	0.795
Mean Age at Onset of SCI (SD)	27.3 (13.2)	24.6 (9.4)	0.47	0.644
Mean Time Since Onset of SCI (SD)	9.5 (7.1)	13.5 (7.4)	1.23	0.232
Mean ASIA Motor Index (SD)	42.9 (22.3)	31.3 (19.0)	1.14	0.261
Mean FIM Motor Score (SD)	54.5 (20.2)	48.8 (23.5)	0.59	0.561
Mean CES-D Score (SD)	16.0 (10.0)	10.8 (8.1)	1.15	0.261
Mean LSI-A Score (SD)	7.0 (5.0)	9.2 (4.9)	0.94	0.357
Mean PSS Score (SD)	20.3 (5.4)	15.0 (4.4)	2.16	0.041*
Mean Social Support Score (SD)	183.3 (49.4)	188.5 (62.8)	0.22	0.831

*$p < 0.05$

Note: Administration of the ISEL was begun at Phase 2; thus, it was not included as a potential predictor in these analyses.
ASIA = American Spinal Injury Association
FIM = Functional Independence Measure
CES-D Scale = Center for Epidemiologic Studies Depression Scale
LSI-A = Life Satisfaction Index A
PSS = Perceived Stress Scale
SD = standard deviation

Displayed in **Tables 7** and **8** are comparisons among the three groups on categorical variables. For men, level of injury, the combination of level and completeness of injury, and the amount of personal assistance received were predictive of the Consistency Group. Men with paraplegia, less impairment (combined level and completeness), and less personal assistance were more likely to have consistent pain compared with either the Inconsistent Pain or Never Pain groups. Etiology approached significance with persons with gunshot wounds being more likely to consistently report pain. Race/ethnicity, completeness of injury, and self-assessed health status were not related to consistency of pain reports. None of the categorical variables predicted consistent pain for women (**Table 8**).

Repeated Measures Analyses

Presented in the **Figure** are the results of the repeated measures analyses of variance for the PSS for men and women. Men who reported problems with pain at all four phases of the study consistently had more subjective stress across time than men who never reported problems with pain. In Phases 1 and 2, the Inconsistent Pain group

Table 7.
Comparisons of Phase 1 categorical measures for men who consistently reported pain, inconsistently reported pain, or never reported pain over time.

Phase 1 Variables (Potential Predictors)	Consistent Pain (n = 33)		Inconsistent Pain (n = 28)		Never Pain (n = 8)		Chi-Square	p-Value
	n	%	*n*	%	*n*	%		
Race/Ethnicity								
Caucasian	25	51	19	39	5	10	0.78	0.678
Non-Caucasian	8	40	9	45	3	15		
Etiology								
Gunshot Wound	8	80	2	20	0	0	5.11	0.078*
All Other	25	42	26	44	8	14		
Level of Injury								
Tetraplegia	12	36	14	42	7	21	6.84	0.033†
Paraplegia	21	58	14	39	1	3		
Completeness of Injury								
ASIA A	14	42	14	42	5	15	6.07	0.415
ASIA B	6	38	8	50	2	13		
ASIA C	4	50	4	50	0	0		
ASIA D	9	75	2	17	1	8		
Level and Completeness								
Tetraplegia: ASIA A, B, or C	7	27	13	50	6	23	11.76	0.019†
Paraplegia: ASIA A, B, or C	17	55	13	42	1	3		
All ASIA D	9	75	2	17	1	8		
Self-Assessed Health								
Good or Excellent	27	44	27	44	7	12	3.16	0.206
Poor or Fair	6	75	1	13	1	13		
Amount of Personal Assistance								
No Care or 1 Hour or Less/Day	29	60	15	31	4	8	10.6	0.007‡
More Than 1 Hour/Day	4	19	13	62	4	19		

*$p < 0.10$, †$p < 0.05$, ‡$p < 0.01$
Note: Row percentage.
ASIA = American Spinal Injury Association (Impairment Scale)

Table 8.
Comparisons of Phase 1 categorical measures for women who consistently or inconsistently reported pain over time.

Phase 1 Variables (Potential Predictors)	Consistent Pain (n = 21)		Inconsistent Pain (n = 6)		Chi-Square	p-Value
	n	%	*n*	%		
Race/Ethnicity						
Caucasian	14	78	4	22	0.00	1.00
Non-Caucasian	7	78	2	22		
Etiology						
Gunshot Wound	5	63	3	37	1.54	0.319
All Other	16	84	3	16		
Level of Injury						
Tetraplegia	11	73	4	27	0.39	0.662
Paraplegia	10	83	2	17		
Completeness of Injury						
ASIA A	8	89	1	11	4.98	0.173
ASIA B	7	58	5	42		
ASIA C	1	100	0	0		
ASIA D	5	100	0	0		
Level and Completeness						
Tetraplegia: ASIA A, B, or C	8	67	4	33	2.31	0.314
Paraplegia: ASIA A, B, or C	8	80	2	20		
All ASIA D	5	100	0	0		
Self-Assessed Health						
Good or Excellent	16	76	5	24	0.14	1.000
Poor or Fair	5	83	1	17		
Amount of Personal Assistance						
No Care or 1 Hour or Less/Day	12	80	3	20	0.10	1.000
More Than 1 Hour/Day	9	75	3	25		

Note: Row percentage.
ASIA = American Spinal Injury Association (Impairment Scale)

fell between the Consistent and No Pain groups with regard to subjective stress. However, men with consistent pain and men with inconsistent pain tended to become more similar with regard to perceived stress at Phases 3 and 4. Women who reported pain at all three phases in which women took part consistently had more subjective stress across time than women who reported pain at only one or two phases.

DISCUSSION

This study resulted from a unique opportunity to follow 96 men and women with SCI over a 10-year period. We were able to identify several predictors of consistency of reporting problems with pain. To our knowledge, no other longitudinal study has investigated chronic pain over such a long time period among persons with SCI.

To summarize, we found that at each time period, approximately two-thirds to three-fourths of the men and nearly all the women reported having experienced pain in the past 12 months. Approximately half of the men and three-fourths of the women consistently reported having experienced pain at all measurement periods. Seven variables were measured at the first time point that were related to whether men would consistently report pain at all four measurement points. Five of these were measures of impairment or disability. The other two were measures of social support and perceived stress. For women, only subjective stress predicted the consistency of reports of

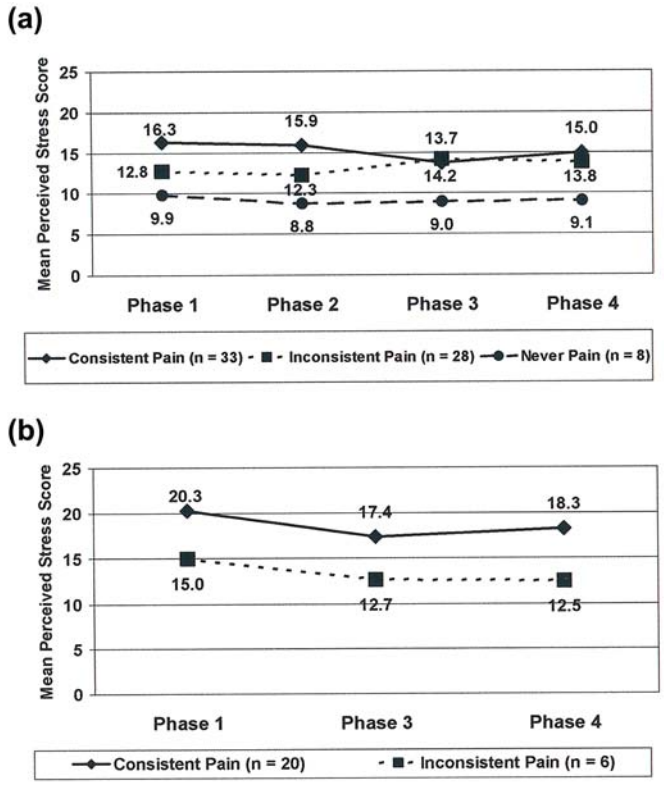

Figure.
Repeated measures analysis of variance. Relationship across time of consistency of pain with subjective stress for **(a)** men (n = 69): No main effect of phase, significant main effect of consistency of pain ($F = 3.84$, $p < 0.026$), and no interaction effect. Significant, pairwise comparison: consistent pain versus never pain, $p < 0.025$. For **(b)** women: No main effect of phase, significant main effect of consistency of pain ($F = 7.67$, $p < 0.02$), and no interaction.

pain. Women consistently reporting pain experienced greater stress. More predictors for women were not found probably because of the relatively small sample size (n = 27) and the number of women (n = 6) who inconsistently reported pain was very small. However, for all the seven variables bivariately predictive for men, the differences between the consistent and inconsistent groups were in the same direction for women but did not reach statistical significance. When analyzing the data regarding individual pains reported at Phase 1, we found that persons who reported that pain was increasing compared with past years were most likely to consistently report pain at every measurement point followed by persons who reported that their pain was not changing. Additionally, we found that persons who always reported problems with pain also were consistently disadvantaged across the 10-year period with regard to subjective stress.

Somewhat surprisingly, in this study, age was not a predictor of consistent pain, although several studies have identified older age as a risk factor for pain [10,15,32]. However, persons with consistent pain tended to be older at onset of SCI. As in other studies, time since onset of SCI was not related to consistency of pain [11,15].

Five of the six variables concerning degree of impairment and functional abilities—ASIA Motor Index, level of injury, level and completeness of injury combined, FIM Motor Score, and amount of personal assistance received—indicated that persons who reported consistent pain were less impaired and had fewer functional limitations. The relationship of impairment and disability to pain has varied from study to study. For example, some studies have found no relationship [5,10,33]. One study found pain to be more prevalent among persons with tetraplegia [34], while another found pain to be more prevalent in persons with cervical and lumbar injuries compared with persons with thoracic injuries [32]. Another study found a higher incidence of pain among persons with incomplete injuries [35]. However, a number of studies have been consistent with our finding that more chronic pain occurs among persons with less impairment or fewer functional limitations [6,11,36–40].

This study has found that the group with the greatest number of pains per person is the one with ASIA D tetraplegia. This is consistent with studies that found more pain in persons with tetraplegia and those with incomplete injuries as well as studies that found more chronic pain in persons with less impairment or fewer functional limitations cited previously [34,35]. Furthermore, the participants in our ASIA D tetraplegia group tended to be older than persons with ASIA A, B, or C tetraplegia (53 versus 35 years). Whether these findings explain the occurrence of more pain in this group is unclear. Another possible hypothesis includes the presence of injured spinal pathways that continue to transmit abnormal sensory signals to the brain in the more incomplete injuries. Alternatively, this finding may represent an expectation of "normalcy" in persons with a high degree of incompleteness. This expectation may lead to more distress and thereby more pain reported.

Our findings of poorer status on psychosocial variables (e.g., stress, social support, and depressive symptomatology) among persons with consistent pain are

similar to findings reported in the literature [5–7,9–11,14,16]. The nature of the relationship of chronic pain with these psychological variables is not completely clear—e.g., does chronic pain lead to depression and stress or do depression and stress lead to more sensitivity to pain. Cairns et al. found that reduced pain had a greater effect on depression than reduced depression had on pain from admission to discharge from initial rehabilitation after SCI [5].

This study has several limitations. They include (1) a relatively small sample, especially for women; (2) the effect of attrition from the original 130 men and 40 women to 69 (53%) men and 27 (68%) women reduces the generalizability of the findings; (3) no women were included in Phase 2; (4) the only consistent measure of pain across the four phases was the dichotomous variable regarding any problems with pain in the past 12 months; (5) the measure of social support was not consistent throughout the study—Schulz and Decker procedure was used in Phases 1 and 2 only and the ISEL was used in Phases 2, 3, and 4 only [28,31]—thus preventing complete longitudinal comparisons; and (6) many statistical analyses were performed, thus increasing the likelihood of chance findings.

CONCLUSIONS

In spite of the limitations, this study provides evidence of the continuing pain experienced by a large proportion of persons even many years following SCI; thus, pain should be assessed as the "5th vital sign" as routinely as other vital signs for the rest of their lives. This study also emphasizes the continuing relationship between chronic pain and stress. The identified predictors are risk factors that can alert healthcare professionals that a patient who is currently experiencing pain is likely to continue to have pain over long periods of time if appropriate interventions are not introduced (i.e., this is not a problem that will go away over time on its own). By identifying patients at risk, referrals can be made to pain management programs that involve a team of persons from a number of disciplines—e.g., medicine, psychiatry, psychology, nursing, social work, clergy, and physical and occupational therapy. Only by addressing the multidimensional nature of pain will the problem of chronic pain and its impact on many aspects of life be solved.

REFERENCES

1. Gamsa A. Is emotional disturbance a precipitator or a consequence of chronic pain? Pain 1990;42(2):183–95.
2. Rudy TE, Kerns RD, Turk DC. Chronic pain and depression: toward a cognitive-behavioral mediation model. Pain 1988;35(2):129–40.
3. Sternbach RA. Psychophysiology of pain. Int J Psychiatry Med 1975;6(1,2):63–73.
4. Watt-Watson JH, Graydon JE. Sickness impact profile: A measure of dysfunction with chronic pain patients. J Pain Symptom Manage 1989;4:152–56.
5. Cairns DM, Adkins RH, Scott MD. Pain and depression in acute traumatic spinal cord injury: Origins of chronic problematic pain? Arch Phys Med Rehabil 1996;77(4):329–35.
6. Demirel G, Yllmaz H, Gencosmanoglu B, Kesiktas N. Pain following spinal cord injury. Spinal Cord 1998;36(1):25–28.
7. Kennedy P, Frankel H, Gardner B, Nuseibeh I. Factors associated with acute and chronic pain following traumatic spinal cord injuries. Spinal Cord 1997;35(12):814–17.
8. Putzke JD, Richards JS, Dowler RN. The impact of pain in spinal cord injury: A case control study. Rehabil Psychol 2000;45(4):386–401.
9. Ravenscroft A, Ahmed YS, Burnside IG. Chronic pain after SCI. A patient survey. Spinal Cord 2000;38(10):611–14.
10. Richards JS, Meredith RL, Nepomuceno C, Fine PR, Bennett G. Psycho-social aspects of chronic pain in spinal cord injury. Pain 1980;8(3):355–66.
11. Rintala DH, Loubser PG, Castro J, Hart KA, Fuhrer MJ. 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):604–14.
12. Widerstrom-Noga EG, Felipe-Cuervo E, Yezierski RP. Chronic pain after spinal injury: interference with sleep and daily activities. Arch Phys Med Rehabil 2001;82(11): 1571–77.
13. Putzke JD, Richards JS, DeVivo MJ. Quality of life after spinal cord injury caused by gunshot. Arch Phys Med Rehabil 2001;82(7):949–54.
14. Wegener ST, Elliott TR. Pain assessment in spinal cord injury. Clin J Pain 1992;8(2):93–101.
15. Widerstrom-Noga EG, Duncan R, Felipe-Cuervo E, Turk DC. Assessment of the impact of pain and impairments associated with spinal cord injuries. Arch Phys Med Rehabil 2002;83(3):395–404.
16. Gerhart KA, Weitzenkamp DA, Kennedy P, Glass CA, Charlifue SW. Correlates of stress in long-term spinal cord injury. Spinal Cord 1999;37(3):183–90.
17. Putzke JD, Richards JS, DeVivo MJ. Predictors of pain 1 year post-spinal cord injury. J Spinal Cord Med 2001; 24(1):47–53.

18. Ballinger DA, Rintala DH, Hart KA. The relation of shoulder pain and range-of-motion problems to functional limitations, disability, and perceived health of men with spinal cord injury: A multifaceted longitudinal study. Arch Phys Med Rehabil 2000;81(12):1575–81.
19. Putzke JD, Richards JS. Pain after spinal cord injury: Important predictors, outcomes, and future directions in cost-effectiveness analysis. Top Spinal Cord Inj Rehabil 2001;7(2):84–92.
20. Gatchel RJ. A biopsychosocial overview of pretreatment screening of patients with pain. Clin J Pain 2001;17(3): 192–99.
21. American Spinal Injury Association. Standards for neurological classification of spinal injury patients. Atlanta, GA: American Spinal Injury Association; 1989.
22. Andres J, Robinson P, Sand M, Weyford M, Mills J. The modified FIM guide: Behavioral flow chart. Kansas City, MO: Truman Medical Center East; 1988.
23. Hamilton BB, Granger CV, Sherwin FS, Zielezny M, Tashman JS. A uniform national data system for medical rehabilitation. In: Fuhrer MJ, editor. Rehabilitation outcomes: Analysis and measurement. Baltimore, MD: Paul H. Brookes; 1987. p. 137–47.
24. Smith P, Hamilton BB, Granger CV. Functional independence measure decision tree: The FONE FIM. Buffalo, NY: Research Foundation of the State University of New York; 1989.
25. Radloff LS. The CES-D scale: A self-report depression scale for research in the general population. Appl Psychol Meas 1977;1(3):385–401.
26. Adams DL. Analysis of a life satisfaction index. J Gerontol 1969;24(4):470–74.
27. Lohmann N. Correlations of life satisfaction, morale and adjustment measures. J Gerontol 1977;32(1):73–75.
28. Schulz R, Decker S. Long-term adjustment to physical disability: The role of social support, perceived control, and self-blame. J Pers Soc Psychol 1985;48(5):1162–72.
29. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. J Health Soc Behav 1983;24(4):385–96.
30. Cohen S, Williamson GM. Perceived stress in a probability sample of the United States. In: Oskamp S, Spacapan S, editors. The social psychology of health: Claremont symposium on applied social psychology. Newbury Park, CA: Sage; 1988. p. 31–67.
31. Cohen S, Mermelstein R, Kamarck T, Hoberman HM. Measuring the functional components of social support. In: Sarason IG, Sarason BR, editors. Social support: Theory, research and application. The Hague, Holland: Martinus Nijhoff; 1985. p. 73–94.
32. Fenollosa P, Pallares J, Cervera J, Pelegrin F, Inigo V, Giner M, et al. Chronic pain in the spinal cord injured: Statistical approach and pharmacological treatment. Paraplegia 1993;31(11):722–29.
33. Summers JD, Rapoff MA, Varghese G, Porter K, Palmer RE. Psychosocial factors in chronic spinal cord injury pain. Pain 1991;47(2):183–89.
34. Holmes G. Pain of central origin. In: Hoeber PB, editor. Contributions to medical and biological research. New York: Hoeber; 1919. p. 235–46.
35. Davidoff G, Guarracini M, Roth E, Sliwa J, Yarkony G. Trazodone hydrochloride in the treatment of dysesthetic pain in traumatic myelopathy: A randomized, double-blind placebo-controlled study. Pain 1987;29(2):151–61.
36. Botterell EH, Callaghan JC, Jousse AT. Pain in paraplegia: Clinical management and surgical treatment. Proc R Soc Med 1954;47:281–88.
37. Burke DC. Pain in paraplegia. Paraplegia 1973;10(4): 297–313.
38. Davis R, Lentini R. Transcutaneous nerve stimulation for treatment of pain in patients with spinal cord injury. Surg Neurol 1975;4(1):100–101.
39. Nepomuceno C, Fine PR, Richards JS, Gowens H, Stover SL, Rantanuabol U, et al. Pain in patients with spinal cord injury. Arch Phys Med Rehabil 1979;60(12):605–9.
40. Woolsey RM. Chronic pain following spinal cord injury. J Am Paraplegia Soc 1986;9(3,4):39–41.

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