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Psychosocial Factors and Adjustment to Pain in Individuals with Postpolio Syndrome

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Abstract

Objective—The purpose of the current study was to examine the associations among measures of psychosocial factors, pain, and adjustment in persons with postpoliomyelitis syndrome.

Design—A cross-sectional survey design was used. Sixty-three community-dwelling individuals with postpoliomyelitis syndrome returned completed questionnaires (71% response rate) that included measures of pain intensity and interference, psychological functioning, pain catastrophizing, social support, and pain-related beliefs and coping.

Results—After controlling for demographic variables, the group of psychosocial variables accounted for an additional 23% of the variance in pain intensity. These variables explained an additional 35% and 50% of the variance in pain interference and psychological functioning, respectively, after accounting for demographic variables and pain intensity. Social support was associated with both psychological functioning and pain interference, whereas catastrophizing was most closely related to psychological functioning. Individual pain beliefs and coping strategies were variably related to the three criterion measures.

Conclusions—The overall results of the current study are consistent with a biopsychosocial framework for understanding pain and functioning in individuals with postpoliomyelitis syndrome. Although additional research is needed to clarify the nature of the relationships between individual psychosocial variables and functional indices, the findings suggest the need for a multidisciplinary approach to pain management in individuals with postpoliomyelitis syndrome.

Keywords

Postpolio Syndrome; Pain; Biopsychosocial; Adjustment

Postpoliomyelitis syndrome (PPS) is a disorder that is characterized by a collection of neurologic and non-neurologic symptoms that manifests many years after recovery from the initial poliovirus infection. Diagnostic criteria, as set forth by the Post-Polio Task Force, include (1) a previous episode of paralytic poliomyelitis with residual motor neuron loss, which can be confirmed through patient history, a neurologic examination, and, if needed, an electrodiagnostic examination; (2) a period of neurologic recovery followed by an interval (usually 15 yrs or more) of neurologic and functional stability; (3) a gradual or abrupt onset of new weakness or abnormal muscle fatigability (decreased endurance) or

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both, with or without generalized fatigue, muscle atrophy, or pain; and (4) exclusion of medical, orthopedic, or neurologic conditions that may be causing the symptoms noted earlier.^{1,2} Attrition of motor neurons, immunologic processes, muscle overuse and disuse, and normal aging have been implicated in the development of PPS.² Estimates of the occurrence of PPS in polio survivors range from 29% to 64%, and up to 640,000 residents of the United States may be experiencing related symptoms.³

Pain is common in individuals with PPS. Prevalence rates range from 42% to 80% for joint pain and 38%–86% for muscle pain.² The results from a recent study by our group found that 91% of participants who responded to a community-based survey reported experiencing pain currently or within the past 3 mos.⁴ Evidence indicating that individuals with PPS can have significant pain problems also comes from research showing that persons with PPS report higher levels of pain severity than comparison samples of healthy individuals⁵ as well as those diagnosed with other potentially disabling conditions such as multiple sclerosis⁶ and other forms of neuromuscular disease.⁷ The sites and causes of pain in PPS vary and can include joint pain resulting from abnormal biomechanics secondary to muscle imbalance.¹ In addition, individuals with PPS can experience significant muscle pain and cramping because of overuse as well as fasciculations presumably because of motor neuron irritability.¹

Biopsychosocial conceptualizations of chronic pain have received increasing support in the broader pain literature. Biopsychosocial models acknowledge the biological bases that underlie most pain conditions but also note that psychosocial factors may contribute to the experience and impact of pain. In support of these models in populations of individuals with disabilities, factors such as pain-related cognitions or attributions, coping, and social support have been shown to be associated with pain and functioning in individuals with multiple sclerosis,⁸ spinal cord injury,⁹ acquired limb loss,¹⁰ and muscular dystrophy.¹¹ However, as Ehde et al.¹² noted, these psychosocial factors have received little empirical attention in the context of pain in persons with PPS.

A few studies have examined the general quality of life among persons with PPS. For example, in an early study, Conrady et al.¹³ found high levels of “psychological distress” in a sample recruited from a PPS clinic and support group. More recently, Vasiliadis et al.¹⁴ found that mental health variables assessed by the MOS 36-item Short-Form Health Survey (SF-36) were associated with pain in a sample of 126 individuals with PPS. In a study with a relatively small sample ($n = 32$), Willén and Grimby¹⁵ also found pain to be significantly correlated with a broad psychological measure, the Emotional Reaction Scale of the Nottingham Health Profile.¹⁶ However, we are not aware of any research that has examined the influence of specific psychosocial variables (e.g., pain beliefs) on the severity and impact of pain in PPS. This is an important avenue of research because increased understanding of these relationships is likely to have important treatment implications that could potentially improve the quality of life of persons living with this condition.

The purpose of the current study was to examine the associations among measures of psychosocial factors, pain, and adjustment in a sample of individuals with PPS. We hypothesized that a set of psychosocial variables—specifically, pain catastrophizing, pain beliefs, pain coping strategies, and social support—would be significantly and uniquely related to pain intensity, pain interference, and general psychological functioning in a sample of individuals with PPS, even after controlling for relevant demographic and clinical variables.

METHODS

Participant Recruitment Procedures

Participants for the current study were recruited primarily from a list of patients seen by one of the authors (G.T.C.) who is a physician in the Postpolio Syndrome Clinic at the University of Washington School of Medicine. The remaining participants were self-referred after learning about the research from an advertisement. Individuals who were younger than 18 yrs of age or could not read or write English or both were excluded from the study. Inclusion criteria consisted of participant self-report of a PPS diagnosis and the ability to provide informed consent. Those who experienced additional medical (e.g., hypertension) or pain (e.g., fibromyalgia) problems were also permitted to participate.

The study survey was mailed to 102 individuals. The materials included a cover letter and consent form that described the study as a survey on quality of life in persons with disabilities. This language was adopted—as opposed to that describing a study about pain in particular—in an attempt to avoid oversampling of individuals with pain. Participants were paid \$25 for completing and returning the survey. Study personnel contacted participants by telephone to inquire about, and complete, survey items that were unclear or missing.

Twelve of the initial 102 surveys were returned because of incorrect mailing addresses. One potential participant did not have PPS and thus was not eligible for the study. Sixty-three of the remaining 89 individuals who were mailed study materials returned completed surveys (71% response rate). Fifty-five participants (87%) came from the patient list described earlier and had a confirmed diagnosis of PPS using standard, accepted clinical criteria (Postpolio Task Force diagnostic criteria^{1,2}). The remaining eight participants were self-referred and did not have their self-reported PPS diagnosis confirmed by study personnel. The study procedures were approved by human subjects review committees at the University of Washington.

Measures

Demographic and PPS-Related Characteristics—Participants provided information about their sex, age, race and ethnicity, education level, marital status, and employment status. Clinical information was elicited about the approximate date of onset of both poliomyelitis symptoms and PPS symptoms. Information about medications and co-morbid conditions was also collected.

Pain Intensity—Participants were asked to indicate the presence or absence of pain problems by responding to the following question: “Are you currently experiencing, or have you in the past 3 mos experienced any pain (other than occasional headaches or menstrual cramps)?” Participants who responded affirmatively to this question were then asked to rate their average pain in the past week on an 11-point numerical rating scale anchored at 0 (no pain) and 10 (pain as bad as could be). This scale was adapted from the Graded Chronic Pain Scale.¹⁷ Numerical rating scales for pain intensity are widely used in pain research and demonstrate excellent psychometric characteristics.¹⁸

Pain Interference—Pain interference was assessed using a modified version of the Brief Pain Inventory (BPI) Pain Interference Scale.¹⁹ The original BPI assesses the degree to which pain interferes with seven functional domains: general activity, mood, normal work, walking, relations with other people, sleep, and enjoyment of life. Many individuals with PPS are unable to ambulate; therefore, the walking item was modified to assess interference with mobility (ability to get around). Five additional items assessing pain interference with self-care, recreational activities, social activities, communication with others, and learning

new information and skills were also added to increase the breadth of the assessment of pain-related interference in important activities. These items extend the functional domains assessed by the measure to those defined as relevant and unique by the International Classification of Functioning, Disability, and Health of World Health Organization.²⁰ Participants provided ratings of pain interference in these 12 domains on an 11-point numerical rating scale anchored at 0 (does not interfere) and 10 (completely interferes). A total score is calculated by averaging the item ratings. This modified BPI has been used in previous studies on pain in persons with disabilities and has demonstrated good psychometric properties.^{8,10,21} The internal consistency of the modified BPI pain interference scale in the current sample was excellent (Cronbach's $\alpha = 0.94$).

Psychological Functioning—Psychological functioning was assessed with the five-item Mental Health Scale of the SF-36.²² Items on this measure are scored with a possible range of 0–100, with higher scores indicating better psychological functioning. This scale is used widely and has demonstrated good reliability and validity.²² The Mental Health Scale demonstrated good internal consistency in the current sample (Cronbach's $\alpha = 0.87$).

Pain Beliefs—Pain-related cognitions were measured using the 57-item survey of pain attitudes (SOPA).²³ The SOPA includes seven subscales that assess the extent to which an individual holds certain beliefs about pain: control (belief in one's own control over pain), disability (belief that one is unable to function because of pain), harm (belief that pain indicates damage and that activities should be avoided), emotion (belief that emotions influence pain), medication (belief that medications are suitable for treating chronic pain), solicitude (belief that others should offer assistance in response to pain behaviors), and medical cure (belief that there exists a medical cure for one's pain). Individual items are rated on a scale from 0 (this is very untrue for us) to 4 (this is very true for us). The subscale score is the mean of the corresponding items. The SOPA has demonstrated good reliability and validity.^{24,25} In the current sample, internal consistency coefficients were adequate for six of the seven subscales (Cronbach's $\alpha = 0.72$ – 0.83), with the solicitude subscale demonstrating marginal reliability (Cronbach's $\alpha = 0.67$).

Catastrophizing—Pain catastrophizing was assessed with the catastrophizing subscale of the Coping Strategies Questionnaire.²⁶ This six-item scale assesses the frequency of helpless and pessimistic cognitions about pain. Items are rated from 0 (never) to 6 (always), and higher scores indicate more frequent catastrophizing in response to pain. The subscale score is the mean of the six items. The catastrophizing subscale of the Coping Strategies Questionnaire has been shown to possess good psychometric properties and is used widely in pain research.^{26,27} The internal consistency of this scale in the current sample was excellent (Cronbach's $\alpha = 0.91$).

Coping—Pain-related coping was assessed with the Chronic Pain Coping Inventory (CPCI).²⁸ The original CPCI contains 65 items and assesses the following eight domains of coping: guarding, resting, asking for assistance, relaxation, task persistence, exercise or stretching, coping self-statements, and seeking social support. In addition, items from the pacing domain were included in the current study.²⁹ The CPCI used in this study contained 70 items in total. Respondents indicate the number of days in the past week (0–7) that they used these strategies at least once to cope with pain. Subscale scores represent the average of the item ratings for each domain. The CPCI has demonstrated good psychometric properties in previous research.^{28,30} The internal consistencies of the CPCI scales in the current sample ranged from adequate to excellent (Cronbach's $\alpha = 0.72$ – 0.93).

Social Support—Perceived social support was assessed with the Multidimensional Scale of Perceived Social Support (MSPSS).³¹ The MSPSS contains 12 items that are rated on a scale from 1 to 7 anchored at “very strongly disagree” and “very strongly agree.” This instrument can be scored to measure perceived support from family, friends, and a significant other as well as a total score representing global perceived support. Only the total score was used in the current study and is calculated by averaging the ratings for all 12 items. The range for the total score is 1–7, with higher scores indicating greater perceived support. The psychometric properties of the MSPSS and subscales have been shown to be strong in previous research.³¹ In the current sample, the internal consistency of the MSPSS total score was excellent (Cronbach’s $\alpha = 0.92$).

Data Analyses

The analytic plan used to address the study hypotheses is consistent with previous research examining the influence of psychosocial factors in persons with disabilities.^{8,9} After computing statistics related to subject recruitment, we compiled descriptive statistics related to the demographic, pain, and psychosocial variables as noted earlier. The study hypotheses were tested using a series of three hierarchical multiple-regression equations. The three criterion variables for these analyses were pain intensity, pain-related interference, and psychological functioning. Before these analyses, the demographic and clinical variables were analyzed (*t* tests and correlations) to determine whether any had significant associations with the three criterion variables, with a plan to enter any significant variables first in the subsequent regressions to control for their influence. Non-white participants reported greater pain intensity than white participants ($t[55] = 1.94, P = 0.06$), and participants with posthigh school education reported poorer psychological functioning than those with high school education or less ($t[8.84] = 2.49, P < 0.05$). No other significant or marginally significant results emerged for the demographic variables, and no significant results emerged for any of the clinical variables (e.g., medication status and comorbidities). Thus, race and education were entered first in the regressions predicting pain intensity and psychological functioning, respectively.

Because of the sample size and the large number of subscales for the SOPA and CPCI, it was not statistically appropriate to include each of these variables in the regression analyses.³² Therefore, the attribution (SOPA) and coping (CPCI) subscales were subjected to principal-components analyses to reduce the number of variables representing these constructs. Principal-components analysis provides a unique solution that extracts maximum variance from the data. The orthogonal Varimax rotation was selected to maximize the variance of the loadings within the components and across variables, which simplifies the interpretability of the results.³² The scree test³³ and Kaiser criterion³⁴ were used to determine the number of extracted components.

In the first regression predicting pain intensity, after controlling for race, the psychosocial predictor variables were entered simultaneously in step 2. In the second regression predicting pain-related interference, pain intensity was entered in step 1, followed by the psychosocial variables in step 2. The third regression predicting psychological functioning consisted of education in step 1, pain intensity in step 2, and the psychosocial variables in step 3. The analytic approach for the second and third regression models (pain-related interference and psychological functioning, respectively) was adopted to determine whether the psychosocial variables accounted for unique variance in the two criterion variables after controlling for pain intensity.

In the event that the results of the regression analyses were consistent with the hypotheses, follow-up univariate correlation analyses were planned to examine the relationships between the psychosocial and criterion variables further. In addition to the Coping Strategies

Questionnaire and MSPSS, each subscale of the SOPA and CPCI were included in these analyses. Partial correlation coefficients were computed in which participant race was controlled for analyses involving pain intensity, pain intensity was controlled for analyses involving pain interference, and participant education and pain intensity were controlled for analyses involving psychological functioning. Because of the large number of analyses (18 psychosocial predictor variables per criterion measure) and consequent increase in type I error, a Bonferroni correction was used for each criterion ($0.05/18 = 0.0028$) to determine whether the associations were significantly different from 0.

RESULTS

Sample Characteristics

The final sample ($n = 63$) was mostly women (62%) and self-reported white (95%). The average age of participants was 64 yrs ($SD = 8.9$ yrs) with a range of 45–85 yrs. More than half of the sample (62%) were currently married or living with a partner in a committed relationship. The majority of respondents reported some level of education beyond high school (85%). Only 17% of participants were working (full time or part time) at the time of survey completion. With regard to clinical characteristics, respondents reported an average of 28.8 yrs ($SD = 16.9$ yrs, range = 2.8–61 yrs) since the onset of PPS symptoms. The average interval between acute poliomyelitis infection and onset of PPS was 34.5 yrs ($SD = 9$ yrs); consistent with normative data, there was sizeable variability in this time interval (range: 10–63 yrs).

Pain and Psychosocial Variables

Fifty-seven participants (91% of total sample) reported current pain or pain within 3 mos of completing the survey. These individuals reported an average pain intensity during the past week of 5.3 ($SD = 2.2$) on the 11-point numerical rating scale. Thirty-one participants reported that they had seen a healthcare provider for pain in the past 6 mos. With regard to pain interference, respondents with current or recent pain had an average score of 3.5 ($SD = 2.2$) on the BPI Pain Interference Scale, which has a possible range of 0–10. The mean score on the 0–100 SF-36 Mental Health Scale was 71.8 ($SD = 18.4$). Descriptive data for the pain and psychosocial variables of interest are presented in Table 1.

Principal-Components Analyses

The principal-components analysis of the SOPA subscales yielded three components with eigenvalues >1 and accounted for 68% of the variance in pain beliefs. The first component had significant loadings from the medication, medical cure, and harm subscales (loadings = 0.79, 0.70, and 0.69, respectively). The solicitude and disability subscales loaded on the second component (loadings = 0.86 and 0.69, respectively). The third component consisted of the emotion and control subscales (loadings = 0.90 and 0.71, respectively). The three components were labeled medically focused beliefs, illness role beliefs, and emotion or control beliefs, respectively. These component scores were saved and included in the regression analyses.

The principal-components analysis of the CPCI subscales also resulted in a three-component solution. The three components with eigenvalues >1 accounted for 65% of the variance in pain coping. Three subscales had significant loadings on the first component (pacing = 0.78, relaxation = 0.75, and exercise or stretching = 0.74). The second component consisted of the following four subscales: asking for assistance (loading = 0.79), seeking social support (loading = 0.77), resting (loading = 0.66), and guarding (loading = 0.54). The third component comprised subscales reflecting task persistence and coping self-statements (loadings = 0.84 and 0.60, respectively). The first component was labeled activity-related

coping, the second component social and protective coping, and the third component motivation-related coping. These three component scores were saved and entered in the regression models.

Predicting Pain Intensity, Pain Interference, and Psychological Functioning

Table 2 contains detailed results of the hierarchical multiple-regression analyses predicting pain intensity, pain interference, and psychological functioning. In the first regression, after controlling for participant race in step 1, the psychosocial variables (entered simultaneously) accounted for an additional 23% of the variance in pain intensity in step 2; this step showed a nonsignificant trend ($P = 0.08$). Examination of the regression coefficients indicated that only activity-related coping ($\beta = 0.30$, $P < 0.05$) was a significant, independent contributor in this step of the model. In addition, pain catastrophizing approached significance ($\beta = 0.32$, $P = 0.06$) in this analysis.

Pain interference served as the criterion variable in the second regression model. In this analysis, pain intensity was entered first and accounted for 25% of the variance in pain interference ($P < 0.001$). The block of psychosocial variables in step 2 predicted an additional 35% of variance ($P < 0.001$); however, illness role beliefs ($\beta = 0.49$, $P < 0.001$) and social support ($\beta = 0.29$, $P < 0.05$) were the only unique predictors among these variables.

The final regression consisted of participant education in step 1, pain intensity in step 2, and the group of psychosocial variables in step 3. The results indicated that after controlling for education, pain intensity did not account for significant variance in psychological functioning ($[\Delta R^2 = 0.01, P > 0.05]$). The psychosocial variables were a significant addition in the final step and accounted for 50% of the variance in the criterion after controlling for education and pain intensity. Of the psychosocial variables, pain catastrophizing ($\beta = -0.53$, $P < 0.001$), social support ($\beta = 0.34$, $P < 0.01$), and emotion or control beliefs ($\beta = -0.18$, $P < 0.05$) were the only variables that were uniquely associated with psychological functioning.

Collinearity statistics were generated for each of the regression models above. These data indicated that multicollinearity among the predictor variables did not exceed commonly accepted limits (i.e., for each variable, variance inflation factor was < 4 and tolerance was > 0.20).

Univariate Associations

The partial correlation coefficients with Bonferroni correction ($0.05/18 = 0.0028$) between predictors and the criterion measures are reported in Table 1. Respondent race was controlled for in analyses involving pain intensity, pain intensity was controlled for in analyses involving pain interference, and participant education and pain intensity were controlled for in analyses involving psychological functioning. Given the conservative nature of these analyses, significant results ($P < 0.0028$) and nonsignificant trends ($P < 0.05$) are reported to avoid prematurely dismissing relationships that may be clinically meaningful and potential targets of additional research.

The SOPA subscales of disability ($r = 0.53$) and solicitude ($r = 0.41$) were significantly related to pain interference, and the solicitude subscale was also significantly associated with psychological functioning ($r = -0.43$). Nonsignificant trends were observed for the relationships between pain interference and SOPA medical cure ($r = 0.35$, $P < 0.01$) and control ($r = -0.33$, $P < 0.05$) subscales and for the relationships between psychological functioning and SOPA emotion ($r = -0.34$, $P < 0.05$) and disability ($r = -0.30$, $P < 0.05$) subscales. The direction of these coefficients indicated that greater endorsement of beliefs

that one is disabled by pain (SOPA-disability) and that others should respond solicitously in response to expressions of pain (SOPA-solicitude) is associated with poorer outcome (greater pain interference and poorer psychological functioning). These results also suggest that greater beliefs about one's personal control over pain (SOPA-control) are associated with lower levels of pain interference, whereas greater beliefs that a medical cure exists for one's pain (SOPA-medical cure) are associated with higher pain interference. Finally, greater endorsement of beliefs that emotions influence pain (SOPA-emotion) was associated with poorer psychological functioning.

Pain catastrophizing was significantly related to psychological functioning ($r = -0.68$), and its relationship to pain interference approached significance ($r = 0.31$, $P < 0.05$). Examination of these coefficients indicated that greater pain catastrophizing was associated with poorer outcome (poorer psychological functioning and greater pain interference). No other significant relationships emerged for pain catastrophizing and the three criterion variables.

Among the CPCI variables, the only subscale that was significantly related to any of the criterion measures was task persistence, which was negatively related to pain interference ($r = -0.45$). Thus, greater endorsement of this coping strategy was associated with lower levels of pain interference among survey respondents in the current sample. Several nonsignificant trends also emerged. The relationships between pain intensity and the following CPCI subscales approached significance: relaxation ($r = 0.33$, $P < 0.05$), coping self-statements ($r = 0.31$, $P < 0.05$), and guarding ($r = 0.26$, $P = 0.05$). In addition, pain interference was marginally related to the resting subscale ($r = 0.29$, $P < 0.05$). Greater use of these coping strategies was associated with lower levels of pain intensity and pain interference, respectively.

Finally, perceived social support was significantly related to psychological functioning ($r = 0.58$), such that greater levels of perceived support were associated with better functioning. No other significant relationships or nonsignificant trends were observed for social support and the pain and psychological criterion variables.

DISCUSSION

The results of the current study are generally consistent with a biopsychosocial model of pain and adjustment in individuals with PPS. Although psychosocial factors have been recognized as important considerations in the experience of pain across a range of diagnostic groups, this is one of the first studies to specifically investigate these issues in a sample of individuals with PPS. The findings also suggest that certain psychosocial variables may be more important than others in this context. The results of this study have important implications for future research and clinical work in persons with PPS.

As a group, the psychosocial variables were strong predictors of the three criterion measures, accounting for 23%, 35%, and 50% of the variance in pain intensity, pain interference, and psychological functioning, respectively. These are substantial amounts of variance in their own right but are even more noteworthy when considered in light of the fact that the latter two values were calculated after controlling for the effects of pain intensity. Although the role of psychosocial factors in the experience of PPS-related pain has received relatively little empirical attention to date, these results strongly suggest that such factors warrant consideration in both the research and clinical settings.

Several specific psychosocial variables emerged as particularly important in this context. With regard to pain catastrophizing, when the results of univariate and multivariate analyses are considered collectively, this variable was most closely related to one criterion measure—

psychological functioning—with a higher frequency of catastrophizing cognitions associated with poorer functioning. The observed relationships between pain catastrophizing and both pain intensity ($r = 0.20$) and pain interference ($r = 0.31$) were medium in magnitude; however, these results did not meet the conservative α level adopted for this study. Overall, the results involving pain catastrophizing are consistent with the voluminous literature wherein this variable is associated with poorer outcomes across a range of chronic pain conditions,³⁵ including those in which pain is secondary to a disability.^{8,9,36,37} To our knowledge, this is the first study to demonstrate that the deleterious effects of pain catastrophizing observed in other diagnostic groups may also hold true for individuals who have pain associated with PPS. It is also interesting to note that the mean level of pain catastrophizing in the current sample was generally similar to that found in other disability samples, such as multiple sclerosis,⁸ spinal cord injury,⁹ cerebral palsy,³⁶ limb loss,³⁷ and muscular dystrophy.¹¹ This is an important contribution to the literature and suggests that cognitions of patients with PPS should be monitored by healthcare providers and treatment initiated where appropriate. Changes in the frequency of catastrophizing cognitions have been found to be associated with improved outcomes after multidisciplinary pain treatment,^{38–40} and intervention efforts that target these cognitions have been developed.^{41,42} Research is needed to determine whether such clinical efforts may also benefit individuals with PPS who catastrophize.

Social support was associated with psychological functioning and pain interference at both the univariate and multivariate levels. As predicted, greater perceived support was associated with better psychological functioning. This finding is consistent with previous research indicating that increased social support is related to more favorable mental health status among individuals with diverse chronic pain conditions.^{8,10,43,44} Given the cross-sectional nature of these data, it is not possible to determine the direction of this effect; i.e., whether perceived social support influences psychological functioning or whether psychological functioning influences one's perceptions of the availability of support. This is an important area of future study, with significant clinical implications. For example, if longitudinal research indicates that perceived support directly impacts psychological functioning, then clinicians may want to consider incorporating interventions aimed at enhancing the social effectiveness of persons with PPS.

The finding that greater perceived social support was also related to higher pain interference was not expected. Increased social support is often found to be related to lower levels of pain interference among individuals with chronic pain^{9,44}; however, such relationships are not always observed.⁴⁵ It is difficult to contextualize the current results, given the lack of attention this topic has received in the PPS literature. One explanation for these findings is that individuals with PPS who are most disabled by pain may, as a consequence, recruit a greater support system on whom to rely. It is also possible that a greater social support system, while conferring positive benefits in some respects, possesses some negative attributes as well. For example, overly solicitous responding on the part of significant others has been consistently found to be associated with greater disability in the chronic pain literature.^{10,44,46} Irrespective, the results of this study clearly indicate that additional work is needed to understand better the role of social support in the context of pain and functioning in persons with PPS.

The pain coping and beliefs measures were subjected to data reduction analyses, which make interpretation of the associated results more difficult. Therefore, the general pattern of results across the univariate and multivariate analyses will be considered, with the strong caveat that these findings are tentative and in need of replication. Coping strategies that we termed “activity-related” were a significant predictor of pain intensity in the regression analyses. Of the three CPCI subscales that comprised this coping factor, only the relaxation

subscale was significantly associated with pain intensity at the univariate level; greater use of relaxation to cope with pain was associated with higher pain intensity. Because it is doubtful that relaxation causes increased pain, a reasonable interpretation of this relationship is that individuals who have greater pain were more likely to use relaxation strategies to manage this pain. The results of post hoc analyses indicated that individuals who previously had participated in treatments pertaining to relaxation, hypnosis, or counseling ($n = 19$) did report higher pain intensity and greater use of relaxation strategies than those who denied having participated in such treatments ($n = 38$); however, these differences were not statistically significant. These 19 participants also demonstrated a stronger relationship between pain intensity and relaxation use ($r = 0.49$) compared with those who denied such past treatment participation ($r = 0.24$), but this difference also failed to reach statistical significance. Previous research supports the use of relaxation techniques (e.g., progressive muscle relaxation and autogenic relaxation) as part of a multidisciplinary pain management program.⁴⁷ We are not aware of any research that has specifically examined this in persons with PPS; therefore, future work is needed to determine the appropriateness of relaxation for pain management in this diagnostic group.

Other coping strategies also demonstrated significant univariate associations with the three criterion measures and, thus, may warrant future investigation. Increased use of strategies involving task persistence was strongly related to less pain interference, a relationship that has consistently been found in other chronic pain samples.^{9,28,40} Higher scores on the CPCI subscales of coping self-statements and guarding were moderately associated with increased pain intensity, and higher scores on the resting subscale were moderately related to increased pain interference. Although these relationships did not meet the conservative α level adopted for this study ($P < 0.0028$), they were of sufficient magnitude to be considered for future investigation.

Pain-related beliefs demonstrated a much closer relationship to both pain interference and psychological functioning than to pain intensity. At the multivariate level, “illness role beliefs” was an independent predictor of pain interference. Univariate analyses indicated that both subscales that comprised this factor score were significant, such that increased beliefs that one is disabled by pain (SOPA-disability) and that others should be solicitous in their responses to pain behaviors (SOPA-solicitude) were related to increased pain interference. Increased beliefs that a medical cure exists for pain (SOPA-medical cure) and that one has little control over pain (SOPA-control) were also related to increased pain interference. Finally, the same beliefs regarding disability and solicitude as well as beliefs that emotions influence pain (SOPA-emotion) were also associated with poorer psychological functioning. This overall pattern of results—that pain beliefs were closely related to pain interference and psychological functioning but not pain intensity—was also found by Osborne et al.⁸ in a sample of individuals with multiple sclerosis. The current results are also consistent with other investigations indicating that beliefs about disability, control, and solicitude are associated with poorer functioning and adjustment to chronic pain in various diagnostic groups.^{8,9,23,38,40} Again, given the lack of published reports on this topic in the PPS literature, interpretations of the current data are necessarily tentative. These results do suggest, however, that individuals with PPS and pain may be similar in many ways to other chronic pain groups, both where pain is the primary problem and where pain is secondary to a disability. These data also suggest a need for further research into the relationships between pain beliefs and outcomes in persons with PPS to determine whether these beliefs should be a focus of intervention efforts.

In the broadest sense, the study results are consistent with a biopsychosocial framework for understanding pain and functioning among individuals with PPS. Clinical interventions should reflect this complexity by focusing on more than just pain intensity and providing

more than just biomedical interventions (e.g., medications). Given their relationship to negative outcomes, providers should be particularly alert to evidence of maladaptive thinking patterns and coping responses among their patients and refer for targeted psychological treatment as appropriate. For example, cognitive-behavioral interventions could be initiated with a focus on labeling and replacing unhelpful cognitions with more helpful ones. Acceptance-based interventions could also be used, with a focus on minimizing the deleterious functional consequences of certain thoughts and beliefs rather than altering their content. Both of these approaches have received empirical support for the management of chronic pain.^{48,49}

Several limitations of the current study should also be considered. First, the relatively small sample size and lack of diversity limit the generalizability of these findings. Much additional work is needed in larger and more diverse samples before drawing any strong conclusions about the relationships examined in this study. Second, individuals who participated in this study may differ in important ways from those who did not respond to the survey. Similarly, because the majority of participants were recruited from the same facility, there is an increased likelihood that the findings may not generalize beyond this sample. Third, eight participants were self-referred and did not have their self-reported PPS diagnosis confirmed by study personnel. It is possible, although we believe unlikely, that these participants did not have PPS or that they were unique in other important ways. However, when these eight participants were excluded from the analyses, the results were not appreciably different from those presented earlier. Fourth, the cross-sectional nature of these data does not permit causal inferences about the observed relationships. Fifth, this study relied exclusively on self-report measures of pain and psychosocial variables, which may be subject to reporting bias. Finally, because we did not include biological variables, such as musculoskeletal abnormalities, which are likely to be important in this context, our findings cannot confirm the applicability of a biopsychosocial model of pain and adjustment in individuals with PPS. Future studies could collect imaging or electrophysiological data or both to test a biopsychosocial model more comprehensively.

Despite these limitations, the current study makes an important contribution to the understanding of pain and adjustment in persons with PPS. These data are consistent with a biopsychosocial conceptualization and suggest that psychosocial variables are particularly important when considering the severity and impact of pain in this population. Additional research is needed to elucidate further the nature of the relationships observed herein, with particular emphasis on experimental and longitudinal designs that test for and identify causal associations among pain, psychosocial variables, and functioning in PPS.

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TABLE 1

Descriptive data for psychosocial variables and partial correlations between these variables and pain intensity, pain interference, and psychological functioning

Variable	Mean (SD)	Range	Correlation with Pain Intensity	Pain Interference	Psychological Functioning
Pain intensity	5.3 (2.2)	1–10	—	—	—
Pain interference	3.5 (2.2)	0–8	—	—	—
Psychological functioning	71.8 (18.4)	12–100	—	—	—
SOPA					
Control	2.1 (0.8)	0.6–3.9	–0.21	–0.33 ^a	0.17
Disability	2.3 (0.8)	0.7–3.9	0.20	0.53 [*]	–0.30 ^a
Harm	2.3 (0.8)	0.5–3.9	0.14	0.15	0.09
Emotion	1.8 (0.8)	0–3.4	–0.17	0.18	–0.34 ^b
Medication	2.7 (0.9)	0.3–4	0.12	0.16	–0.08
Solicitude	1.3 (0.8)	0–3.5	0.01	0.41 ^c	–0.43 ^c
Medical cure	1.3 (0.7)	0–3.6	0.03	0.35 ^b	–0.09
Catastrophizing (CSQ-CAT)	1.2 (1.3)	0–5.7	0.20	0.31 ^a	–0.68 ^c
CPCI					
Pacing	4.2 (1.8)	0.7–7	0.22	–0.06	0.15
Guarding	3.5 (1.5)	0.4–6.2	0.26 ^a	0.20	–0.14
Resting	4.0 (1.6)	0.3–6.7	0.19	0.29 ^a	–0.08
Asking for assistance	3.3 (2.3)	0–7	0.03	–0.03	0.13
Relaxation	1.6 (1.4)	0–6	0.33 ^a	0.08	0.25
Task persistence	4.5 (1.9)	0–7	–0.09	–0.45 ^c	0.17
Exercise/stretching	2.1 (2.0)	0–6.7	0.11	–0.01	–0.08
Seeking social support	2.0 (1.5)	0–5.8	0.22	0.05	0.20
Coping self-statements	2.9 (1.9)	0–7	0.31 ^a	–0.07	0.10
Social support (MSPSS)	5.4 (1.2)	1.4–7	0.10	–0.03	0.58 ^c

n = 57 except for Psychological Functioning and MSPSS variables where *n* = 63.

^a *P* < 0.05.

^b $p < 0.01$.

^c $p < 0.0028$ (Bonferroni correction).

Pain intensity, average pain intensity the past week (0–10); Pain interference, modified Brief Pain Inventory Interference scale; Psychological functioning, SF-36 Mental Health Scale; SOPA, survey of pain attitudes; CSQ-CAT, Coping Strategies Questionnaire catastrophizing scale; CPCI, chronic coping pain inventory; MSPSS, multidimensional scale of perceived social support.

TABLE 2
Regression analyses predicting pain intensity, pain interference, and psychological functioning

	R^2	ΔR^2	ΔF	β	b	95% CI for b
Pain intensity						
Race	0.06	0.06	3.78 ^a	0.25 ^a	2.48	-0.08 to 5.04
Psychosocial variables						
Medically focused beliefs (SOPA)	0.29	0.23	1.91 ^a	0.16	0.35	-0.27 to 0.96
Illness role beliefs (SOPA)				0.07	0.16	-0.55 to 0.86
Emotion/control beliefs (SOPA)				-0.19	-0.42	-0.98 to 0.14
Catastrophizing (CSQ-CAT)				0.32 ^a	0.55	-0.03 to 1.14
Activity-related coping (CPCI)				0.30 ^b	0.67	0.12 to 1.22
Social and protective coping (CPCI)				-0.06	-0.12	-0.87 to 0.62
Motivation-related coping (CPCI)				0.11	0.24	-0.40 to 0.88
Social support (MSPSS)				0.25	0.44	-0.20 to 1.08
Pain interference						
Pain intensity	0.25	0.25	17.97 ^c	0.50 ^c	0.49	0.26 to 0.72
Psychosocial variables						
Medically focused beliefs (SOPA)	0.59	0.35	5.04 ^c	0.16	0.35	-0.12 to 0.81
Illness role beliefs (SOPA)				0.49 ^c	1.06	0.54 to 1.58
Emotion/control beliefs (SOPA)				-0.01	-0.03	-0.45 to 0.40
Catastrophizing (CSQ-CAT)				0.16	0.27	-0.18 to 0.71
Activity-related coping (CPCI)				0.09	0.19	-0.25 to 0.62
Social and protective coping (CPCI)				-0.14	-0.31	-0.86 to 0.24
Motivation-related coping (CPCI)				-0.16	-0.34	-0.82 to 0.13
Social support (MSPSS)				0.29 ^b	0.49	0.01 to 0.98
Psychological functioning						
Education	0.22	0.22	15.61 ^c	0.47 ^c	25.04	12.34 to 37.74
Pain intensity	0.23	0.01	0.94	0.12	0.98	-1.05 to 3.00
Psychosocial variables						
Medically focused beliefs (SOPA)	0.73	0.50	10.65 ^c	0.02	0.40	-2.88 to 3.68

	<i>R</i> ²	ΔR^2	ΔF	β	<i>b</i>	95% CI for <i>b</i>
Illness role beliefs (SOPA)				−0.11	−1.97	−5.77 to 1.83
Emotion/control beliefs (SOPA)				−0.18 ^b	−3.42	−6.43 to −0.41
Catastrophizing (CSQ-CAT)				−0.53 ^c	−7.84	−11.43 to −4.26
Activity-related coping (CPCI)				−0.02	−0.43	−3.52 to 2.66
Social and protective coping (CPCI)				0.05	0.92	−2.97 to 4.82
Motivation-related coping (CPCI)				−0.02	−0.42	−3.84 to 2.99
Social support (MSPSS)				0.34 ^d	5.08	1.59 to 8.57

n = 57.

^a *p* < 0.10.

^b *p* < 0.05.

^c *p* < 0.001.

^d *p* < 0.01.

Pain intensity, average pain intensity the past week (0–10); Pain interference, modified Brief Pain Inventory Interference scale; Psychological functioning, SF-36 Mental Health Scale; SOPA, Survey of pain attitudes; CSQ-CAT, Coping Strategies Questionnaire Catastrophizing Scale; CPCI, chronic coping pain inventory; MSPSS, multidimensional scale of perceived social support.