



HHS Public Access

Author manuscript

Rehabil Psychol. Author manuscript; available in PMC 2017 February 01.

Published in final edited form as:

Rehabil Psychol. 2016 February ; 61(1): 7–18. doi:10.1037/rep0000055.

Resilience and vulnerability in individuals with chronic pain and physical disability

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Abstract

Objective—To examine the independent contributions of vulnerability and resilience factors to pain interference, self-efficacy for managing pain, global mental health, and global physical health.

Research Method/Design—Secondary analysis of baseline data from individuals with a spinal cord injury (N=73), amputation (N=33), or multiple sclerosis (N=82) and chronic pain who participated in a randomized controlled trial comparing two chronic pain interventions. Participants completed a comprehensive battery of pain-related outcomes that assessed for both psychosocial assets and maladaptive cognitions and behaviors.

Results—Results suggested that vulnerability and resilience factors together account for a considerable amount of variance in the physical outcomes, but that neither set of factors was able to make a substantial contribution above and beyond the other. In contrast, for mental health related outcomes, results indicated that resilience factors did make a meaningful contribution above and beyond vulnerability factors, suggesting the important contribution of resilience factors to the psychological experience of chronic pain.

Conclusions—The present study suggested a valuable contribution of both resilience and vulnerability factors to pain outcomes, with the additional caveat that resilience factors uniquely impact specific outcomes – particularly those that are more psychosocially focused – above and beyond vulnerability factors. Taken together, this highlights the importance of considering resilience factors in addition to vulnerability factors for individuals with chronic pain. Additional research is needed to explore other factors that could be considered representative of the resilience construct and more attention should be focused on evaluating the effects of interventions that seek to build an individual's assets.

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Keywords

Resilience; vulnerability; pain; physical disability

Chronic pain is a common, distressing, and disabling symptom for many people living with acquired disabilities, including spinal cord injury (SCI), amputation (AMP), or multiple sclerosis (MS). More than three quarters of adults with SCI (Finnerup, Yeziarski, Sang, Burchiel, & Jensen, 2001; M. P. Jensen, Hoffman, & Cardenas, 2005; Turner, Cardenas, Warms, & McClellan, 2001) or AMP (Ehde et al., 2000; Ephraim, Wegener, MacKenzie, Dillingham, & Pezzin, 2005), and more than half of adults with MS (O'Connor, Schwid, Herrmann, Markman, & Dworkin, 2008) report persistent, bothersome pain years after the onset of their disability. When present, chronic pain negatively interferes with physical functioning, participation in life roles and activities, mental health, and self-reported quality of life (Ehde & Hanley, 2006). These findings underscore the serious nature of pain in these rehabilitation populations.

Important research conducted by some of Rehabilitation Psychology's most respected researchers over the past 50 years has demonstrated that the experience of chronic pain extends beyond the sensory domain. A large body of research conducted since the late 1960's has shown that psychosocial variables are highly influential in both the perception of pain as well as in pain-related outcomes, including pain-related interference and quality of life (M. P. Jensen & Turk, 2014). This work largely emerged from Wilbert Fordyce's seminal work on the intersection of pain behaviors and their consequences, including environmental responses, to those behaviors (Fordyce, 1976). Fordyce's operant model of chronic pain (Fordyce, Fowler, Lehmann, & DeLateur, 1968), according to which pain behaviors can be either increased by means of reinforcing consequences or eliminated by means of negative consequences, set the stage for future theory and research on the psychosocial contributors to both the experience and impact of pain on individuals.

Broadly, subsequent research has explored two dimensions to the psychological response to chronic pain. One dimension has focused on how vulnerability factors, such as depressed mood, catastrophic thinking, and maladaptive pain beliefs, contribute to suffering in individuals with chronic pain (Gatchel, Peng, Peters, Fuchs, & Turk, 2007; M. P. Jensen & Turk, 2014). A second dimension has focused on how resilience factors – such as pain acceptance, positive affect, and adaptive pain beliefs – relieve or buffer against pain-related distress and improve functioning and social integration (Bruce et al., 2014; M. P. Jensen, Moore, Bockow, Ehde, & Engel, 2011; McCracken & Vowles, 2014).

The research on vulnerability factors has built upon the work of Fordyce and others to identify maladaptive cognitions (e.g., pain catastrophizing (M. J. Sullivan et al., 2001), beliefs (e.g., that pain signals harm (M. P. Jensen, Romano, Turner, Good, & Wald, 1999)), behaviors (e.g., avoidance (Vlaeyen, Kole-Snijders, Boeren, & van Eek, 1995; Vlaeyen & Linton, 2000), and social interactions (e.g., solicitous and punishing (Kerns, Turk, & Rudy, 1985)) that increase pain-related interference and decrease quality of life. This research has led to the development of clinical interventions that focus primarily on modifying maladaptive thoughts and behaviors, such as in cognitive-behavioral therapy (Turk,

Meichenbaum, & Genest, 1983) or exposure therapy (Vlaeyen, de Jong, Geilen, Heuts, & van Breukelen, 2002), with the intention of increasing adaptive behavior as a byproduct.

While much has been made of Fordyce's work on maladaptive behavioral responses to pain, his work also focused on adaptive behavioral responses to pain, including developing operant therapy to increase adaptive behavior, such as maintaining physical activity despite pain, in chronic pain treatment (Fordyce, 1976, 1984). However, it is only in recent years that pain researchers have focused in earnest on resilience factors that buffer against the negative effects of living with chronic pain. Consistent with Beatrice Wright's foundational work on psychosocial assets (Wright, 1983), emerging research suggests that resilience factors represent personal assets which might be developed and supported in order to relieve pain-related distress and improve functioning and integration. Commonly-studied constructs include pain acceptance, positive affect, and adaptive pain beliefs.

Pain acceptance, which has been most widely studied in back pain and primary care samples with pain, has been associated with lower pain intensity, anxiety and depressive symptoms, physical disability, and greater psychosocial functioning, positive affect, daily uptime, and employment (Kratz, Davis, & Zautra, 2007; McCracken, 1998; McCracken & Eccleston, 2003; McCracken, Spertus, Janeck, Sinclair, & Wetzel, 1999; Viane, Crombez, Eccleston, Devulder, & De Corte, 2004; Viane et al., 2003). In the only known study of pain acceptance in a sample with physical disability, acceptance was shown to buffer against negative pain-related outcomes (e.g. depressive symptoms and pain interference) among persons with disabilities and to enhance quality of life and satisfaction with social functioning (Kratz, Hirsh, Ehde, & Jensen, 2013).

According to Fredrickson's Broaden and Build model (Fredrickson, 2001), positive affect works to expand a person's response to stressors such as pain, thereby building stable personal physical, social, intellectual, and psychological resources. Consistent with this model, positive affect has been found to be a source of resilience in terms of lessening the association between pain and negative affect (A. Zautra, Smith, Affleck, & Tennen, 2001; A. J. Zautra, Johnson, & Davis, 2005) and deficits in positive affect have been implicated in difficulties with emotion regulation in fibromyalgia, a chronic pain condition (A. J. Zautra, Fasman, et al., 2005).

The presence of adaptive pain beliefs and the lack of maladaptive pain beliefs are foundational to a resilient adjustment to chronic pain. For example, increases in the adaptive pain belief that one has control over pain and decreases in the maladaptive pain belief that one is disabled by pain were found to be important mediators of a multidisciplinary pain treatment program in fibromyalgia on positive treatment outcomes (Nielson & Jensen, 2004). It has been suggested that maladaptive beliefs are most consequential to chronic pain adjustment and directly influence adaptive beliefs and coping efforts (Geisser, Robinson, & Riley, 1999). However, evidence suggests that the relative importance of maladaptive versus adaptive beliefs depends on the outcome under consideration, with one study showing that adaptive responses are more strongly related to pain intensity and maladaptive responses are more strongly related to depressive symptoms and pain interference in a mixed chronic pain sample (Tan, Teo, Anderson, & Jensen, 2011) .

While the aforementioned studies have identified important contributions of vulnerability *or* resilience factors to pain outcomes, even fewer studies have simultaneously explored the *unique* contribution of vulnerability and resilience factors for individuals experiencing chronic pain. In perhaps one of the most sophisticated analyses of this relationship, Sturgeon et al. (2014) identified that the relationship between pain and affect is mediated by a vulnerability factor (pain catastrophizing) and a resilience factor (day to day positive experiences) in women with fibromyalgia or osteoarthritis. Intriguingly, this study also emphasizes that resilience factors are not always the inverse of vulnerabilities: while day-to-day *positive* experiences influenced affect, day-to-day *negative* experiences did not, suggesting that the contribution of positive experiences is unique from the contribution of negative experiences. Therefore, it is important to consider whether vulnerability and resilience factors contribute independently and uniquely to various outcomes.

The purpose of the present study was to examine the *independent* contributions of vulnerability and resilience factors to pain-related outcomes - specifically pain interference, self-efficacy for managing pain, and global mental health, and global physical health - with the goal of improving our understanding of how resilience factors relate to adaptive coping and function to buffer against negative consequences for those living with chronic pain. Using cross-sectional data, we examined four vulnerability factors: pain catastrophizing, depressive symptoms, and two maladaptive pain beliefs, that one is disabled by their pain (i.e. Survey of Pain Attitudes (SOPA) disability scale) and that solicitous responses from others are acceptable when in pain (i.e., SOPA solicitousness scale); and four resilience factors: pain acceptance, positive affect, and two adaptive pain beliefs, that one has some control over pain (SOPA control scale) and that emotions can influence pain (i.e., SOPA emotion scale). Given the literature available to date, we hypothesized that compared to vulnerability factors, resilience factors will have as strong or stronger associations with pain interference, self-efficacy, and global physical and mental well-being in a sample of individuals with chronic pain and SCI, AMP, or MS.

Methods

Participants and Procedures

Participants consisted of adults with AMP, MS, or SCI who participated in a randomized controlled trial comparing two different telephone-delivered self-management interventions for chronic pain (see (Ehde, Jensen, Turner, Dillworth, & Ciol, 2015, under review) for details regarding the trial procedures and interventions). Individuals from across the United States were recruited from several sources, including the University of Washington's (UW) Rehabilitation Medicine Research Registry, print and web-based advertisements through national consumer organizations (including the Amputee Coalition, the National MS Society, the MS Foundation, and the Paralyzed Veterans of America), ClinicalTrials.gov, and referrals from local rehabilitation medicine providers and other studies in the UW Department of Rehabilitation Medicine.

Research staff screened potential participants by telephone, and for those otherwise eligible, obtained by mail informed written consent and authorization for staff to contact the individuals' physicians to confirm the disability diagnosis (AMP, MS, or SCI) and the

presence of chronic pain. Eligibility inclusion criteria were: (1) definitive diagnosis of AMP, MS, or SCI confirmed independently by participants' physicians; (2) average pain intensity in the past month > 3 on 0–10 numeric rating scale; (3) pain that either started or worsened since the onset of the disability; (4) pain of at least six months duration, with pain reportedly present greater than or equal to half of the days in the past six months; (5) able to read, write and understand English; (6) able to communicate over the telephone (i.e., must be verbal); and (6) age 18 or above. Exclusion criteria were: (1) cognitive impairment defined as one or more errors on the Six-Item screener (Callahan, 2002); (2) current or previous participation in a psychological intervention for pain; and (3) current participation (1 or more sessions with a therapist/month, not including support groups) in a psychological intervention for any reason.

After determination of eligibility and consent but before randomization, participants completed a baseline (pre-treatment) assessment, which consisted of four telephone interviews conducted by a research assistant on different days over seven days. Three brief (3–5 minutes) interviews assessed pain intensity for the past 24-hours. The remaining measures were administered during one longer (45–60 minutes) interview. Study staff mailed a paper response key to assist participants during the outcome assessments. All study procedures were approved by the UW Human Subjects Division.

Data for the analyses reported in this manuscript were obtained in the baseline data collected prior to treatment allocation. Participants in the analyses were those who provided complete baseline data for the variables of interest in the planned analyses. To reach the final sample, research staff screened 640 individuals, of whom 207 consented to participate, and 188 provided complete data for the present manuscript. The CONSORT diagram for the entire trial is available in the article reporting the results of the trial (Ehde et al., 2015, under review).

Measures

Cognitive Screening—All potential participants were screened for cognitive impairment over the telephone using the Six-Item Screener (Callahan, 2002), a brief measure developed for use in studies that rely on participants' cognitive ability to participate in a complex intervention protocol and/or provide self-report data. To optimize sensitivity we excluded individuals who made one or more errors, a cut-off shown to have a sensitivity of 97.7 in detecting impairment in a community based sample (Callahan, 2002).

Demographic Variables—Demographic variables used in the present study include sex, age, and education level. The degree of motor impairment was assessed using the Gross Motor Functional Classification System (Palisano et al., 1997), which types motor impairment into specific categories (e.g., from Level I, able to walk without restrictions, to V, self-mobility is severely limited even with the use of assistive technology) based on self-report. We added an additional item to the GMFCS (Level 0, no motor limitations) for potential participants who had no gross motor impairment.

Average pain intensity—Average pain intensity was assessed using an 11-point numerical rating scale (NRS), where 0 indicated “no pain” and 10 indicated “pain as bad as

you can imagine”, accompanied by the following instructions: “Please rate your pain by indicating the number that best describes your pain on average in the last 24 hours” (C.S. Cleeland & K.M. Ryan, 1994).. This NRS was administered at the three brief and one long assessments within the pre-treatment week. The arithmetic mean of the four ratings was computed and used as the measure of average pain intensity for the week. Composite pain intensity measures are more reliable, valid, and sensitive to treatment effects than single ratings (M. P. Jensen, Turner, & Romano, 1994). The 0 –10 NRS has consistently shown its validity as a measure of pain intensity through its strong association with other measures of pain intensity as well as its sensitivity to detect changes in pain associated with pain treatments (M. P. Jensen & Karoly, 2011).

Pain Interference—To assess pain interference with functioning, we used the Pain Interference Scale of the Brief Pain Inventory (C. S. Cleeland & K. M. Ryan, 1994; Daut, Cleeland, & Flanery, 1983), modified to change the walking ability items to “mobility, that is your ability to get around”. The other 6 items of the scale assess interference of pain in general activity, mood, normal work (inside and outside of the home), relations with other people, sleep, and enjoyment of life. This scale has shown excellent psychometric properties among persons with chronic pain (C. S. Cleeland & K. M. Ryan, 1994), cancer pain (Cleeland et al., 1996), and among individuals with physical disabilities, including SCI (Raichle, Osborne, Jensen, & Cardenas, 2006). Cronbach’s alpha = 0.90 in this sample.

Pain Catastrophizing—The Pain Catastrophizing Scale (PCS; M. J. L. Sullivan, Bishop, & Pivik, 1995) has 13 items that reflects anxious thoughts or feelings about pain. The measure context is “When I’m in pain...” and respondents are asked to rate each item on a 0 (not at all) to 4 (all the time scale) to indicate the degree to which they have the thoughts or feeling when experiencing pain. Sample items are: “I worry all the time about whether the pain will end,” “I keep thinking about how much it hurts,” and “It’s awful and I feel it overwhelms me.” The PCS yields three subscale – rumination (4 items), magnification (3 items), and helplessness (6 items) – as well as a total score that reflects the sum of responses to all 13 items. PCS total scale scores range from 0–52, with higher scores indicating higher levels of catastrophizing. The PCS has demonstrated excellent psychometric properties (D’eon, Harris, & Ellis, 2004; Osman et al., 2000; Osman et al., 1997). Cronbach’s alpha for the total scale = 0.93 in this sample.

Pain beliefs—We administered two full subscales from the Survey of Pain Attitudes (SOPA; M. P. Jensen, Karoly, & Huger, 1987; Mark P. Jensen, Turner, Romano, & Lawler, 1994) and two 2-item shortened SOPA subscales (M. P. Jensen, Keefe, Lefebvre, Romano, & Turner, 2003). The *Control* scale assesses the degree to which participants believed that they have personal control over pain and its effects with 10 items including “there are times I can influence the amount of pain I feel” (Cronbach’s alpha = 0.82 in this sample). The *Disability* scale assesses the belief that one’s pain is disabling with 10 items including “I do not consider my pain to be a disability” (Cronbach’s alpha = 0.77). The brief *Emotion* subscale assesses the belief that emotions can impact pain with two items, “there is a connection between my emotions and my pain level” and “stress in my life increases the pain I feel” (Cronbach’s alpha = 0.70). The brief *Solicitude* subscale assesses the attitude

that others should respond solicitously when in pain with 2 items, “When I am hurting I deserve to be treated with care and concern” and “When I hurt I want my family to treat me better” (Cronbach’s alpha = 0.66). The *Control* and *Emotion* subscales are thought to reflect adaptive pain beliefs whereas the *Disability* and *Solicitude* subscales are thought to reflect maladaptive pain beliefs. All items were rated on a 0 (“This is very untrue for me”) to 4 (“This is very true for me”) scale, reflecting the extent to which respondents agree with each of the items. Subscales scores are calculated as the average of all items and range from 0 to 4, with higher scores indicating a greater degree of endorsement of the pain beliefs. These scales from the SOPA have demonstrated good internal consistency, test-retest reliability, and criterion-oriented validity (Mark P. Jensen et al., 1994). Studies have also provided support for the subscales’ validity (M. P. Jensen et al., 1987; Mark P. Jensen et al., 1994; Strong, Ashton, & Chant, 1992) and internal consistency reliability in this sample was acceptable for all subscales.

Pain acceptance—The Chronic Pain Acceptance Questionnaire-8 (CPAQ-8) is an abbreviated version of the 20-item CPAQ (Fish, Hogan, Morrison, Stewart, & McGuire, 2013; Fish, McGuire, Hogan, Morrison, & Stewart, 2010). The CPAQ-8 assesses the two main facets of pain acceptance, pain willingness and activities engagements with 4 items each. Respondents were asked to rate the truth of 8 statements on a scale of 0 (never true) to 6 (always true). Examples items include “I lead a full life even though I have chronic pain” (activities engagement) and “I avoid putting myself in situations where pain might increase” (pain willingness). After reverse scoring pain willingness items, all items are summed to derive a total score. Possible scores range from 0–48 where higher scores indicate greater levels of acceptance. Cronbach’s alpha = 0.79 in this sample.

Global mental health—The PROMIS® global mental health scale consists of four items that assess quality of life, mental health, satisfaction with social roles and activities, and emotional distress rated on a 1 (Poor) to 5 (Excellent) response scale (Hays, Bjorner, Revicki, Spritzer, & Cella, 2009). Scores were summed for the total raw score with a possible range of 0–20 with higher scores indicating greater mental health. PROMIS® provides a conversion table on assessmentcenter.net where raw scores can be converted to a T-score metric with a Mean=50 and standard deviation=10. Cronbach’s alpha = 0.78 in this sample.

Global physical health—The PROMIS® global physical health scale consists of four items that assess fatigue, pain, general physical health, and physical functioning rated on a 1 – 5 scale (Hays et al., 2009). Response sets were different such that for pain 1 = no pain, 5 = worst pain imaginable, for fatigue, 1 = very severe, 5 = none, etc. Scores were summed to derive a total score with a possible range of 0–20 with higher scores indicating greater physical health. These scores can be converted into a T-score metric with a Mean=50 and standard deviation=10 (assessmentcenter.net). Cronbach’s alpha = 0.84 in this sample.

Depressive symptoms—The Patient Health Questionnaire-8 (Kroenke et al., 2009) was used to assess depressive symptoms. It includes all items of the PHQ-9 (Spitzer, Kroenke, & Williams, 1999), a commonly used depression scale, but omits the self-harm question. The

8-item version is commonly used in studies that are not specifically focused on depression but want to include depressive symptoms. Participants rated the degree to which they have experienced eight depressive symptoms within the previous two weeks on a 4-point scale ranging from 0 (“not at all”) to 3 (“nearly every day”). Item scores are summed to produce a symptom-severity score with a theoretical range of 0–24, where higher values reflected greater depressive symptomology (Kroenke, Spitzer, & Williams, 2001). Internal consistency of the PHQ-8 in this sample was excellent (Cronbach’s alpha = 0.86)

Positive Affect—The Positive Affect scale of the Positive and Negative Affect Schedule (PANAS) (Watson, Clark, & Tellegen, 1988) was used to assess positive affect. The 10-item subscale lists 10 positive affect descriptors such as excited, determined, and strong, and asks respondents to rate the extent to which that each descriptor was experienced in the past week on a 5-point Likert scale from 1 (very slightly or not at all) to 5 (extremely). The items were summed for a positive affect score (possible range = 10–50, where higher scores indicate more positive affect). The Cronbach’s alpha = 0.90 in this sample, indicating excellent internal consistency reliability.

Pain self-efficacy—Self-efficacy for managing pain was assessed using the Self-efficacy for Pain Management subscale of the Arthritis Self-Efficacy Scale (SES; Lorig, Chastain, Ung, Shoor, & Holman, 1989). For this study the scale was modified by replacing the word “arthritis” with “pain”. Respondents rate on a scale from 0 (“very uncertain”) to 10 (“very certain”) their certainty that they can manage their pain (e.g., decrease their pain quite a bit, deal with the frustration of pain, keep pain from interfering with the things they want to do). The score is calculated as the mean of the eight items; higher scores indicate greater self-efficacy. The SES Pain management scale is distinguished from the Control scale of the SOPA in that it assesses not only the confidence to decrease pain but also to manage specific pain related problems (e.g., interference with sleep, activities, frustration). The psychometric properties of the SES have are well-established (Gonzalez, Stewart, Ritter, & Lorig, 1995; Lorig et al., 1989). Cronbach’s alpha = 0.88 in this sample.

Data Analyses

Prior to testing the primary study hypotheses, preliminary data analyses were conducted, including descriptive statistics, zero-order (for continuous variables) or Spearman’s rho correlations (for ordinal variables) for demographic and criterion variables. Univariate general linear models with simple contrasts were used to examine mean differences in demographic and key study variables by diagnostic group. Data distribution characteristics indicated that parametric statistical procedures were appropriate to use (Cohen, Cohen, West, & Aiken, 2003). The diagnostic group variable was dummy-coded (i.e., two dummy variables with MS as the reference group) for use as an independent variable (IV) in linear regression (Cohen et al., 2003). Separate hierarchical linear regressions were used to test four criterion variables: BPI pain interference, PROMIS® global mental health, PROMIS® global physical health, and self-efficacy. Diagnosis and pain intensity variables were entered in Step 1. In order to obtain proportion of variance (i.e., R^2) parameters that estimate the amount of variance in the outcome resilience or vulnerability factors account for over and above the opposing set of IVs, models were run first with vulnerability factors

(catastrophizing, depressive symptoms, SOPA disability, SOPA solicitousness) entered in Step 2 and resilience factors (pain acceptance, positive affect, SOPA control, SOPA emotion) entered in Step 3. This provides an estimate of how much variance resilience factors account for in the outcome above and beyond vulnerability factors. Then, the order of entry for vulnerability and resilience factors was reverse to give an estimate of how much variance vulnerability factors account for above and beyond resilience factors. These two models provide identical parameters for individual IVs and only the R^2 and model change statistics differed based on order of set entry. To examine the main study aims of evaluating the role of vulnerability factors in contrast to resilience factors in relation to the outcome variables, beta weights and significance for individual variables, as well as the proportion of variance accounted for by each set of variables, were examined. All analyses were completed using IBM SPSS Statistics for Windows, Version 22.0 (Armonk, NY: IBM Corp).

Results

Descriptives of the sample

Frequencies or means and standard deviations for independent and dependent variables by diagnosis are reported in Table 1. Most participants with MS were female, but most participants with SCI or AMP were male, which is consistent with the demographics of individuals with these conditions at large. Across all conditions, most participants had completed at least some college. There was a wide range of ages in the sample, from 23–85 years, with a mean age of 53.31 ($SD=11.13$). Average age did not differ between the conditions. Compared to the other subgroups, the MS subgroup showed the highest levels of pain intensity, pain interference, SOPA disability, SOPA solicitousness, and SOPA emotion, and lowest levels of global physical health, global mental health, pain acceptance, and positive affect. The SCI subgroup showed the lowest levels of depressive symptoms and the highest levels of self-efficacy, pain acceptance, and positive affect. These between-diagnosis differences were statistically significant ($p < 0.05$; see Table 1). Very few participants reported no mobility restrictions on the GMFCS and, as would be predicted, high levels of mobility difficulty were most common in the SCI group.

Correlation of study variables

Correlation results are presented in Table 2. Most correlations between demographic and criterion variables were very small (all $r_s < .17$), which support our decision to include diagnosis as the only demographic covariate in the regression models. Correlations among the four criterion variables were moderate to large in size, significant, and in expected direction.

Association of resilience and vulnerability factors with pain outcomes

Hierarchical linear regression results with pain interference, global physical health, global mental health, and self-efficacy as the outcomes are presented in Table 3. It is important to note that R^2 and model change statistics for the sets of vulnerability and resilience variables are provided from a regression model where the vulnerability set (Step 2) was entered before the resilience set (Step 3) and also from a second regression model where the order of entry

was reversed (i.e. resilience at Step 2 and vulnerability in Step 3). This provides an estimate of independent variance accounted for above and beyond the other main set of IVs. In terms of the results for the sets of IVs, resilience and vulnerability factors accounted for a relatively small amount of variance above and beyond the other set, particularly for the pain interference and global physical health outcomes. For these outcomes, the first set of predictors, pain intensity in particular, accounted for a large proportion of the variance (29% and 38%, respectively). The first set of IVs accounted for less variance in global mental health (15%) and self-efficacy (5%). Vulnerability and resilience factors were very similar to each other in terms of how much variance they accounted for above and beyond the other outcomes, with the exception of self-efficacy where resilience factors (10%) accounted for more than twice the amount of variance compared to vulnerability factors (4%).

In terms of unique contribution of independent variables, higher depressive symptoms were significantly associated with greater pain interference, lower global physical health, and lower global mental health. Higher chronic pain acceptance was significantly associated with lower pain interference and higher global physical health; acceptance was not significantly associated with global mental health or self-efficacy. Greater positive affect was associated with higher levels of global mental health and self-efficacy. Different pain attitudes/beliefs were important for different outcomes: disability beliefs were positively related to pain interference; emotion beliefs were negatively related to global mental health; and, control beliefs were positively related to self-efficacy.

Discussion

Building on and integrating the foundational work of Fordyce, Wright, and other rehabilitation scholars, the purpose of the present study was to identify the independent contribution of “vulnerability factors” (i.e., variables that are associated with worse outcomes) and “resilience factors” (i.e., variables that are associated with better outcomes and/or variables that buffer against worse outcomes) to pain-related outcomes among individuals with chronic pain and MS, SCI, or AMP. Our results suggested a valuable contribution of both resilience and vulnerability factors to pain outcomes, with the additional caveat that resilience factors uniquely impact specific outcomes – particularly those that are more psychosocially focused – above and beyond vulnerability factors.

Consistent with the prior literature on the association of psychosocial variables with pain outcomes, both vulnerability and resilience factors were found to be strongly associated with pain outcomes. In fact, across the four outcomes, the variance accounted for by the full regression models ranged from 40% to 62%. Notably, with the exception of the global health outcome, vulnerability and resilience variable sets accounted for more variance in outcomes than medical diagnosis and pain intensity combined. However, results also revealed that in terms of pain interference and PROMIS® global physical health outcomes, resilience factors only accounted for a minimal amount of variance above and beyond vulnerability factors and, when entered in reverse order, vulnerability factors only accounted for a minimal amount of variance above and beyond resilience factors. In contrast, in terms of the PROMIS® global mental health and self-efficacy outcomes, resilience factors accounted for 10% of the variance above and beyond the vulnerability factors. These

findings are somewhat inconsistent with findings in a sample of veterans with mixed chronic pain, where adaptive responses, which reflected a composite measure of adaptive beliefs and coping, were significantly related only to pain intensity, but not to pain interference or depressive symptoms; maladaptive responses, on the other hand, were strongly related to pain interference and depressive symptoms (Tan et al., 2011). Taken together, the results suggest that resilience factors contribute above and beyond vulnerability factors for outcomes that are focused on the psychological experience in the context of chronic pain. This highlights the unique value of an individual's assets, particularly in the context of optimizing mental health-oriented outcomes, and is consistent with Wright's (1983) foundational writings on the value of psychosocial assets in living with a chronic condition such as chronic pain.

Within the sets of vulnerability and resilience variables, individual independent variables emerged as associated with specific outcomes. For example, chronic pain acceptance was significantly associated with pain interference and global physical health – outcomes that are primarily related to physical health and functioning. Pain acceptance was not independently related to the global mental health and self-efficacy outcomes – the more psychosocially oriented outcomes. While this may initially be surprising, the concept of pain acceptance is related to an individual's willingness to experience pain, while choosing to engage in valued behaviors despite the presence of pain (McCracken & Vowles, 2014); thus the primary outcome of pain acceptance is the extent to which an individual is able to continue to engage with the world around them, which may speak more to active outcomes, such as physical functioning, than to intrapsychic outcomes, such as mental well-being. In contrast, pain beliefs and positive affect were independently associated only with global mental health and self-efficacy and not with the physical health and functioning outcomes, again suggesting that these resilience factors are most instrumental in supporting psychosocial outcomes.

Not surprisingly, depressive symptoms were independently related to three of the outcomes – pain interference, global physical health, and global mental health – suggesting depressed mood is a vulnerability across both physical and mental health domains. Depression has long been recognized as a particularly important comorbid condition among those with chronic pain; for example, Fordyce wrote about the pervasiveness of depression among those with chronic pain, describing depression as “a state of deprivation of reinforcement” (p. 72; (Fordyce, 1976)). Given that research on other medical populations has identified that depression and chronic pain have a reciprocal and additive adverse impact on quality of life (Kroenke et al., 2011), treatment of both is essential. Interventions that promote behavioral activation despite pain are consistent with both Fordyce's operant treatment of pain and more recent applications of behavior therapy in depression care that emphasize behavioral activation and engagement in valued activities (Sturmey, 2009).

While the present study identifies resilience as an asset for individuals experiencing chronic pain, the findings are presented in a context where there is a lack of consensus about how to best conceptualize and assess resilience (Davydov, Stewart, Ritchie, & Chaudieu, 2010). One approach is to assess resilience directly, by using measures that are intended to measure resilience as a construct. For example, a recent study used the Brief Resilience Scale (Newton-John, Mason, & Hunter, 2014; Smith et al., 2008) and found that resilience

accounted for an inconsequential amount of variance in depression and disability scores above and beyond the contribution of pain intensity, pain duration, self-efficacy, pain catastrophizing, and pain-related fear of movement in a chronic pain sample. The authors interpreted these findings to suggest that resilience is, in part, an indicator of coping (measures of which were covariates in their models) and suggested that the concept and measurement of resilience needs further development. In contrast, there is the opportunity to identify factors that are theoretically indicative of resilience, rather than use a single measure that is believed to directly assess resilience. We took this approach in the current study, by identifying factors that are theoretically indicative of vulnerability or resilience, and supported as such by previous empirical findings. Our more robust findings for the importance of resilience features may be a product of having measured coping (e.g. acceptance) and belief variables that are more “proximal” to the outcomes than the meta-concept of resilience, which is an overarching concept that reflects various beliefs and behaviors. A limitation of this approach is that the broader resilience literature suggests that we could have considered a plethora of other factors in our assessment of resilience, including cultural factors, financial resources, and social and community resources and connections (Gallo, Penedo, Espinosa de los Monteros, & Arguelles, 2009; Keyes, 2009; Rios & Zautra, 2011; West, Buettner, Stewart, Foster, & Usher, 2012; West, Stewart, Foster, & Usher, 2012). In our case, we were limited to the variables that were collected in the primary study. Future research is needed to expand resilience to include these other factors, as well as to refine the definition of resilience itself in the context of chronic pain. In addition, issues of assessment of positive psychological constructs in rehabilitation populations must be attended to. Measures related to resilience are not usually developed in rehabilitation samples. Consequently, steps must be taken to evaluate, validate, refine and/or develop new measures of these key constructs for use in rehabilitation populations and research.

The impact of resilience factors on pain-related outcomes suggests that attention should be given to interventions that enhance these factors. Increasing focus has been placed on acceptance-based self-management interventions for chronic pain, such as Acceptance and Commitment Therapy (Hayes, Levin, Plumb-Villardaga, Villatte, & Pistorello, 2013; Hayes, Luoma, Bond, Masuda, & Lillis, 2006), which have been shown to increase pain acceptance and improve emotional and physical well-being and functional status (McCracken, Vowles, & Eccleston, 2005; Vowles & McCracken, 2008). Resilience interventions have been developed for other health conditions, such as cancer (Loprinzi, Prasad, Schroeder, & Sood, 2011) and cardiac disease (Burton, Pakenham, & Brown, 2009); whether they may benefit individuals with chronic pain is unknown. A recent feasibility study suggests that other interventions focused on building assets may also be of benefit to people with chronic pain. Muller et al. (2015) evaluated the effects of a web-based positive psychology intervention for chronic pain, which was designed in part to increase positive affect, and found that it not only improved positive affect but also pain-specific outcomes, including pain intensity, pain interference, and mood post-treatment, with the effects on pain intensity, mood, and pain control maintained at a 2.5 month follow-up. Even though they are not typically conceptualized as building assets as much as they are thought to address maladaptive

behaviors and thoughts, traditional behavioral therapies for chronic pain, including CBT, may also increase resilience factors and should be studied for such benefits.

Future research on resilience in rehabilitation would be strengthened by the development of rehabilitation-relevant theories and testable models (Dunn & Dougherty, 2005). Without unifying theories and models that help to categorize, clarify, and understand scientific results on resilience, rehabilitation psychology runs the risk of generating a collection of findings that are interesting but fail to transform rehabilitation research or practice. An example of a theoretically-driven, testable model relevant to resilience research is the Limit, Activate, and Enhance model of pain treatment moderation (Day, Ehde, & Jensen, In press). This model proposes a theoretical framework for answering the question “for whom” psychosocial pain treatments work, an important direction for improving existing treatments and treatment matching (Thorn & Burns, 2011). According to this model, psychosocial pain treatments are hypothesized to work differentially based not only on individuals’ “weaknesses” (vulnerability factors such as maladaptive coping or pain catastrophizing) but also on their “strengths” (resilience factors such as self-efficacy, pain acceptance, or social resources). Based on an assessment of an individual’s vulnerabilities and assets, psychosocial pain treatments may then be selected to limit vulnerabilities, activate adaptive utilization of strengths, and enhance treatment outcomes based on strengths and resources. For example, an individual with pain who is significantly isolated and inactive (vulnerabilities) but shows strengths in trait mindfulness (strengths) may be suited to a treatment package that focuses on both behavioral activation (limiting inactivity and activating social engagement) and mindfulness-based skills (building upon and enhancing existing mindfulness). The degree to which treatments should focus on limiting, activating, or enhancing are not known but also provide testable hypotheses for research. Although untested due to its novelty, the Limit, Activate, and Enhance model takes an important step towards expanding the focus of pain treatment research to resilience factors and exemplifies the value of theoretically-driven rehabilitation research.

While the present study provided a unique opportunity to simultaneously assess the impact of vulnerability and resilience factors on pain-related outcomes, it does come with limitations. First, this is a secondary analysis of baseline data from a pain management trial and thus represents individuals who are willing to participate in a behavioral treatment trial. The use of this sample also limited our options for vulnerability and resilience factors; there are likely other vulnerability and resilience factors that play a role in pain outcomes that were not measured in this study. Second, the data are cross-sectional in nature, which allowed us to report on the associations of the variables of interest, but not causal effects. Third, there is a need in the literature to compare and contrast different ways of measuring resilience. Unfortunately, given the limited dataset, we were unable to make such a contribution by comprehensively assessing resilience factors.

In summary, the present results indicate that it is well time for the field to move beyond a singular focus on risk factors when conducting research and providing care to people with chronic pain. As long noted by rehabilitation psychology scholars, psychosocial assets are also important to recognize and build upon. This is not a call for chronic pain researchers and clinicians to disregard vulnerability factors; rather, the science and care of people with

pain will make greater strides if a broader view that capitalizes on the unique contribution of psychosocial assets and addresses factors that impede participation in valued roles and activities is adopted. Further, this study highlights that the field may also benefit from moving beyond the constraints of the term “resilience” by looking more carefully at identifying and studying *specific* assets that people with chronic pain bring to bear on their condition. These may include the factors studied here but also others, such as cultural factors, financial resources, and, more broadly, the social and community resources and connections. Despite the need for further research, these findings, and the foundational principles upon which they are built, provide a framework for both clinicians and researchers to broaden their approaches to chronic pain.

Acknowledgments

Sources of support: This research was supported by grants awarded to Dawn Ehde from the National Center for Medical Rehabilitation Research, National Institute of Child Health and Human Development, (R01 HD057916 and HD057916-03 S1). Anna Kratz was supported during manuscript preparation by a grant from the National Institute of Arthritis and Musculoskeletal and Skin Diseases (1K01AR064275).

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Impact

- This is the first study to simultaneously examine the independent contributions of vulnerability and resilience factors to pain-related outcomes, including how resilience factors relate to adaptive coping and buffer against negative consequences for those living with chronic pain and physical disability.
- Results suggested that both vulnerability and resilience factors account for a substantial amount of variance in the physical outcomes, but that neither set of factors was able to make a meaningful contribution above and beyond the other. In contrast, for mental health oriented outcomes, results indicated that resilience factors did make a meaningful contribution above and beyond vulnerability factors, suggesting the important contribution of resilience factors to the psychological experience of chronic pain.
- Given that resilience factors make a unique contribution to pain-related outcomes, it is important for future research to examine how best to address these psychosocial assets in addition to maladaptive cognitions and behaviors.

Table 1

Descriptive statistics for demographic, clinical, and key study variables by diagnosis.

Variable (possible range)	MS n = 82	SCI n = 73	AMP n = 33
Age	53.84 (9.18)	51.48 (11.56)	56.70 (13.67)
Pain Intensity	5.53 (1.63) ^A	4.90 (1.52)	4.54 (1.53)
BPI Pain Interference	5.47 (2.04) ^A	3.64 (2.12)	4.44 (2.83)
PROMIS® Global Physical Health	40.38 (7.59) ^A	47.13 (7.90)	46.03 (11.04)
PROMIS® Global Mental Health	42.23 (8.15) ^A	48.86 (7.67)	48.27 (10.61)
Self-Efficacy Scale	5.31 (1.68)	6.12 (1.79) ^A	5.29 (2.50)
PCS Pain Catastrophizing	22.96 (12.97)	18.25 (12.51)	22.96 (13.42)
PHQ-8 Depressive Symptoms	9.96 (5.60)	5.89 (4.11) ^A	8.16 (7.31)
CPAQ-8 Pain Acceptance	25.32 (7.34) ^A	30.90 (8.70) ^B	28.36 (9.77) ^{AB}
PANAS Positive Affect	28.84 (7.24) ^A	33.92 (7.30) ^B	31.30 (8.51) ^{AB}
SOPA disability	2.26 (.80) ^A	1.73 (.79)	1.78 (.83)
SOPA Solicitousness	2.67 (1.16) ^A	1.90 (1.25)	1.91 (1.06)
SOPA control	1.94 (.74)	2.06 (.82)	1.73 (.90)
SOPA emotion	3.03 (.92) ^A	2.32 (1.20)	2.43 (1.30)
Frequencies N (%)			
Female Sex	67 (81.7)	33 (45.2)	8 (24.2)
Education			
< 12 th grade	1 (1.2)	1 (1.4)	1 (3.0)
High school or GED	8 (9.8)	11 (15.1)	2 (6.1)
Vocational/Tech School	6 (7.3)	10 (13.7)	2 (6.1)
Some College	24 (29.3)	18 (24.7)	13 (39.4)
College Graduate	25 (30.5)	16 (21.9)	4 (12.1)
Graduate or Prof School	18 (22.0)	17 (23.3)	11 (33.3)
Mobility Limitations (GMFCS)			
0. walk without restrictions	13 (15.9)	4 (5.5)	5 (15.2)
1. walk w/o restrictions, but have limitations in more advanced gross motor skills	11 (13.4)	2 (2.7)	5 (15.2)
2. walk w/o an assistive device and have limits walking outdoors & in the community	9 (11.0)	3 (4.1)	9 (27.3)
3. walk with assistive mobility device & have limits walking outdoors & in the community	29 (35.4)	4 (5.5)	7 (21.2)
4. limited self-mobility with assistance or device & use power mobility outdoors & in community	12 (14.6)	25 (34.2)	4 (12.1)
5. severely limited self-mobility even with use of assistive technology	8 (9.8)	35 (47.9)	3 (9.1)

Note. GED = General Education Development (high school equivalency test); GMFCS = Gross Motor Functioning Scale; MS = multiple sclerosis, AMP = amputation, SCI = spinal cord injury;

A,B,C means with different superscripts are significantly different in general linear models with simple group contrasts.

Table 2
 Bivariate correlations of participant demographic and study outcome variables

Variable	1	2	3	4	5	6	7	8
1. Age	-							
2. Sex	.06	-						
3. GMFCS score	-.09	.10	-					
4. Education	.05	-.10	-.12	-				
5. Pain Intensity	-.07	-.06	-.03	-.10	-			
6. BPI Pain Interference	-.13	-.04	-.16*	-.08	.46**	-		
7. PROMIS® Global Physical Health	.09	.07	.07	.07	-.55**	-.66**	-	
8. PROMIS® Global Mental Health	.08	.15*	.15*	.09	-.23**	-.60**	.48**	-
9. Self-Efficacy	.00	-.10	.14	.10	-.08	-.44**	.36**	.37**

Note.

* p<0.05;

** p<0.01;

Correlations between two continuous variables (variables 1,5–9) are zero-order correlations.

Correlations that include variables 2–4 are Spearman correlations. Sex, 0 = female, 1 = male.

Hierarchical linear regression results examining the association of four indicators of pain adjustment with diagnosis, pain intensity, vulnerability factors and resilience factors.

Table 3

Criterion	Step [†]	Predictor	Adjusted R ²	R ² [†]	Final β	p value
BPI Pain Interference	1	MS vs. SCI	.27	.29**	-.08	.15
		MS vs. AMP			.01	.87
	2/3	Pain intensity			.31	<.001
		Catastrophizing	.60	.29**/.05	.11	.13
		Depressive Symptoms			.24	.001
		SOPA Disability			.14	.04
3/2	SOPA Solicitous			-.05	.59	
	Pain Acceptance	.60	.03**/.29	-.24	.004	
	Positive Affect			-.08	.21	
	SOPA Control			.07	.24	
PROMIS® Global Physical Health	1	MS vs. SCI	.37	.38**	.01	.81
		MS vs. AMP			.08	.18
	2/3	Pain intensity			.05	.38
		Catastrophizing	.56	.18**/.04	-.49	<.001
		Depressive Symptoms			.13	.09
		SOPA Disability			-.29	<.001
3/2	SOPA Solicitous			-.11	.15	
	Pain Acceptance	.56	.03**/.17	-.02	.78	
	Positive Affect			.24	.006	
	SOPA Control			.10	.13	
PROMIS® Global Mental Health	1	MS vs. SCI	.14	.15**	-.01	.81
		MS vs. AMP			.09	.14
	2/3	Pain intensity			.06	.29
		Catastrophizing	.62	.39**/.07	.13	.01
		Positive Affect			.03	.51
		SOPA Control			-.15	.03

Criterion	Step [†]	Predictor	Adjusted R ²	R ² [†]	Final β	p value
		Depressive Symptoms			-.28	<.001
		SOPA Disability			-.12	.08
		SOPA Solicitous			.06	.26
	3/2	Pain Acceptance	.62	.10**/.42**	.02	.85
		Positive Affect			.31	<.001
		SOPA Control			-.04	.48
		SOPA Emotion			-.23	<.001
Self-efficacy	1	MS vs. SCI	.03	.05*	.02	.82
		MS vs. AMP			-.06	.34
		Pain intensity			-.02	.79
	2/3	Catastrophizing	.40	.29**/.04*	-.08	.38
		Depressive Symptoms			.06	.45
		SOPA Disability			-.26	.002
		SOPA Solicitous			.08	.23
	3/2	Pain Acceptance	.40	.10**/.34**	.14	.15
		Positive Affect			.22	.003
		SOPA Control			.24	<.001
		SOPA Emotion			.01	.90

Note.

* $p < .05$,

** $p < .01$;

β = Standardized Coefficient; AMP = amputation, MS = multiple sclerosis, SCI = spinal cord injury; Adjusted R² = a modification of R² that adjusts for the number of explanatory terms in the model.

[†] R² change values provided for sets of vulnerability and resilience and resilience variables when entered in Step 2 or Step 3.