Personal Resource Profiles of Individuals With Chronic Pain: Sociodemographic and Pain Interference Differences

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Purpose/Objective: Previous studies have demonstrated important associations between personal resources and pain interference. Using latent profile analysis, the present study (a) identified subgroups of individuals with chronic pain who have different personal resource profiles; (b) explored sociodemographic differences among subgroups; and (c) examined how these subgroups differ in pain interference. *Research Method/Design:* Study 1 is based on daily diary and survey data from 220 individuals with fibromyalgia (FM). Study 2 is based on 4 annual surveys of 483 individuals with long-term neurological/neuromuscular disease or injury, and chronic pain. Modifiable personal resource variables including sense of resilience, social support, pain acceptance, and sleep quality were included in latent profile analyses. *Results:* Three subgroups were identified in both studies: High, Moderate, and Low Personal Resource groups. In both studies, annual income level was significantly different among subgroups. Study 1 results showed a significant between-groups difference in pain interference across 21-days only between High and Moderate Personal Resource groups controlling for the level of pain intensity and depressive symptoms. In Study 2, however, all subgroups were significantly different with respect to their levels of pain interference at baseline over and above various covariates, with the Low Personal Resource group reporting the highest level of pain interference at baseline. These baseline differences remained stable over 4 years. *Conclusions/Implications:* The findings suggest a robust association between economic disparity and personal resource profiles among individuals with chronic pain. The role of different personal resource profiles in pain interference appears to differ by chronic pain condition.

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Impact and Implications
Growing evidence suggests that various personal resources can influence pain interference. The present study employed an integrative person-centered approach with 2 separate samples to better examine how the heterogeneity of personal resource profiles among individuals with chronic pain is associated with pain interference over time. This is the first study that has reliably identified 3 distinct subgroups of individuals with chronic pain based on their personal resource profiles. The present study also confirmed that individuals with low personal resources who have not received an intervention are more likely to experience significantly higher pain interference. Individuals with fibromyalgia may need a more thorough assessment of depression compared with individuals with other chronic pain conditions. In the case of individuals with neurological/neuromuscular disability conditions who also have chronic pain, strategies for effectively implementing accessible, evidence-based chronic pain interventions, especially for those individuals who are classified within the Low Personal Resource group, are needed.

Keywords: chronic pain, personal resource, pain interference, health disparity, latent profile analysis

Introduction

A substantial number of adults (approximately 10 to 30%) in the United States have chronic pain (Dahlhamer et al., 2018; Johannes, Le, Zhou, Johnston, & Dworkin, 2010). The annual cost of noncancer chronic pain treatment in the U.S. has been reported to be over $635 billion, which surpasses the annual cost of treating any other chronic illness (Gaskin & Richard, 2012). Hence, helping individuals to cope more successfully with chronic pain remains an important objective for researchers and health care providers.

For individuals with chronic pain, a particularly salient threat to their psychosocial well-being is *pain interference,* defined as one's perception of how pain interferes with performance of daily activities (e.g., Kerns, Turk, & Rudy, 1985; Rudy, Kerns, & Turk, 1988). From a cognitive-motivational perspective, repeated pain-related interruptions of important daily activities and goals can underscore the development of self-defeating negative schemas, which can significantly limit one's successful adjustment to pain (Jensen & Karoly, 1991; Jensen, Turner, & Romano, 1991; Karoly & Jensen, 1987). In addition, Fordyce (1976), based upon an operant behavioral perspective, noted that repeated activity interference because of pain can substantially reduce the availability of rewards that derive from engaging in meaningful social and physical activities. Thus, attenuating pain interference is central to successful chronic pain management. An important step toward reaching this goal is to examine *modifiable personal resources* that are associated with and, therefore, might influence pain interference. The current study seeks to address this goal using longitudinal data and person-centered analysis.

Personal Resources Associated With Pain Interference

Although pain intensity is a strong predictor of pain interference (Krebs, Carey, & Weinberger, 2007; Rudy et al., 1988), growing evidence suggests that a broad range of personal resources can be influential. *Personal resources* are operationalized as individual difference characteristics that buffer against the negative effects of life events and preserve meaningful goal pursuit (Hobfoll, Johnson, Ennis, & Jackson, 2003; Van den Heuvel, Demerouti, Bakker, & Schaufeli, 2010). There is no uniform consensus as to which attributes constitute personal resources, but researchers often include constructs tapped by self-reports of social support, locus of control, resilience to stress, self-esteem, self-acceptance, and self-efficacy (Kamen, Jabson, Mustian, & Boehmer, 2017; Turner & Lloyd, 1999; Turner, Taylor, & Van Gundy, 2004). In the present study, we not only include some variables that are often conceptualized as personal resources, but also some other potential personal resource variables that are modifiable through psychosocial intervention and have particularly important implications for individuals with chronic pain (i.e., pain acceptance and sleep quality). Below, we discuss personal resources that have garnered some theoretical and empirical support suggesting that they may act to buffer pain interference.

Resilience

Resilience has been defined as having personal qualities that can help an individual minimize the negative consequences and maintain positive functioning in the face of adversity, and subsequently bounce back (Bonanno, Brewin, Kaniasty, & La Greca, 2010; Rutter, 1987). It can also play an important role in chronic pain adjustment (Sturgeon & Zautra, 2010). Resilience is often measured by self-report questionnaires that assess individuals' perceived sense of resilience (Friborg, Hjemdal, Rosenvinge, & Martinussen, 2003; Smith et al., 2008), as well as other attributes that buffer against the negative consequences of stress. Included among the attributes is having a purpose in life, which has been suggested as one of the core elements of resilience that can help individuals handle adversities and retain personal strength (Frankl, 1963; Friborg et al., 2003; Nygren et al., 2005; Smith et al., 2008). Consistent with this, a previous study demonstrated that higher perceived resilience and having a greater purpose in life are both associated with increased habituation to experimentally induced pain from heat and cold (Smith et al., 2008).

Positive Self-Concept

Positive self-concept refers to individuals making favorable inferences about themselves and self-acceptance (Judge, Erez, & Bono, 1998). Hence, *self-efficacy* (that represents peoples' beliefs in their ability to accomplish goals; Bandura, 1986) and *self-acceptance* (that indicates individuals' ability to hold positive regard toward oneself and one's present and past experiences;

Carson & Langer, 2006) are often conceptualized together as positive self-concept domains (Arli & Sutanto, 2018; de Souza & Hutz, 2016; Judge et al., 1998). In terms of their relationship with pain experiences, previous studies have found that higher self-efficacy is associated with higher pain tolerance and less pain severity (Bandura, O'Leary, Taylor, Gauthier, & Gossard, 1987), and is also associated with higher performance of valued life activities (Ahlstrand, Vaz, Falkmer, Thyberg, & Björk, 2017). Similarly, self-acceptance is also a potent predictor of pain severity and disability (Schleicher et al., 2005).

Social Support and Social Role Satisfaction

Previous research suggests that individuals with chronic pain who have a higher level of perceived social support tend to report less pain and distress (Jensen et al., 2002; Waltz, Kriegel, & Van'T Pad Bosch, 1988). Another potentially important factor predicting pain interference is individuals' satisfaction with their ability to fulfill their social roles (i.e., social role function), a tendency that has been negatively associated with disability (Chwastiak & Von Korff, 2003). Hence, those who receive adequate amounts of social support and are satisfied with their ability to function in social roles might be able to more successfully cope with pain.

Pain Acceptance

Pain acceptance, defined as experiencing pain without a desire to control it or to avoid pain-related activities (McCracken, Vowles, & Eccleston, 2004), is associated with higher psychosocial functioning (McCracken & Eccleston, 2005), and lower pain intensity and interference (McCracken, Spertus, Janeck, Sinclair, & Wetzel, 1999; McCracken et al., 2004). A recent daily diary study of individuals with chronic pain in the community found that those with relatively high pain acceptance levels showed reduced associations between morning pain and afternoon pain interference with goal pursuit (Mun, Karoly, & Okun, 2015). Moreover, Acceptance and Commitment Therapy (ACT), which targets acceptance of one's experience (Hayes, Strosahl, & Wilson, 1999), has been shown to significantly decrease pain and improve physical function among individuals with chronic pain (Thorsell et al., 2011).

Sleep Quality

Sleep quality has not been generally included as a personal resource. However, it is a variable that can be reasonably considered to be personal resource factor as it is largely influenced by individuals' behavior, affect, and cognition, and it can be effectively improved by evidence-based cognitive–behavioral sleep interventions (e.g., Trauer, Qian, Doyle, Rajaratnam, & Cunnington, 2015). Poor sleep quality also serves an important role in the maintenance and exacerbation of chronic pain (Finan, Goodin, & Smith, 2013). In fact, numerous previous research has found a robust positive association between poor sleep quality and high levels of pain (Finan et al., 2013; Haythornthwaite, Hegel, & Kerns, 1991; Smith, Perlis, Smith, Giles, & Carmody, 2000). Some findings suggest that low sleep quality decreases pain threshold (Onen, Alloui,

Gross, Eschallier, & Dubray, 2001) and increases attention to pain stimuli (Affleck, Urrows, Tennen, Higgins, & Abeles, 1996). Sleep quality has also been found to be a significant predictor of pain interference (Kothari, Davis, Yeung, & Tennen, 2015), even when controlling for the influence of depressive symptoms and pain severity (McCracken & Iverson, 2002).

To better understand the mechanisms by which potentially modifiable personal resources might influence pain interference, an integrative approach that takes into consideration multiple variables is necessary. Person-centered analyses in general and latent profile analysis (LPA) in particular allow for an examination of unobserved subgroups of individuals who share similar response patterns on multiple variables (Collins & Lanza, 2010). This approach offers unique insight into how a person's individual difference factors interact to predict study outcomes (Cicchetti & Rogosch, 1996; Lanza, Rhoades, Nix, & Greenberg, 2010). Thus, LPA can be a useful tool for examining the potential heterogeneity of personal resource profiles among individuals with chronic pain in a holistic and parsimonious manner to understand the role of subgroups in pain interference.

The Present Study

The present study reports findings from two separate studies conducted with different chronic pain samples. Study 1 consists of a community sample of individuals with fibromyalgia (FM), which is an idiopathic centralized chronic pain condition. Study 2, on the other hand, consists of a community sample of individuals with chronic pain and with one of the four neurological/neuromuscular disability conditions (i.e., Multiple Sclerosis [MS], Muscular Dystrophy [MD], Post-Polio Syndrome [PPS], or Spinal Cord Injury [SCI]) who mostly experience neuropathic and nociceptive pain issues. Despite some limitations (e.g., inconsistencies in some measurements, different sample characteristics), we thought that it would be important to report findings from two different studies because: (a) profile or clustering analyses are highly exploratory; (b) there has been significant concern regarding nonreproducibility of findings in the fields of psychology and medicine (Shrout & Rodgers, 2018); and (c) this approach may also improve generalizability of personal resource profiles in individuals with chronic pain.

First, although none of the previous studies have attempted to identify subgroups of individuals with chronic pain that have distinct personal resource profiles, we hypothesized that approximately three different subgroups would be identified. This was based on previous studies that investigated subgroups of individuals with chronic pain using psychological and pain functioning variables and robustly found three subgroups (e.g., Bergström, Hagberg, Bodin, Jensen, & Bergström, 2011; Rabey, Smith, Beales, Slater, & O'Sullivan, 2016; Turk & Rudy, 1988).

Second, we expected to find significant sociodemographic differences among subgroups, as past studies have found that sociodemographic variables such as socioeconomic status (SES), race, and age are significantly associated with some personal resources (e.g., Beatty, Kamarck, Matthews, & Shiffman, 2011; Edwards, Fillingim, & Keefe, 2001; Janevic, McLaughlin, Heapy, Thacker, & Piette, 2017; Myers, 2009). We believe that investigating sociodemographic differences among personal resource

profile subgroups is important, as the findings may provide some potential implications for policy change, as well as development of culturally sensitive chronic pain interventions.

Third, we anticipated that there would be significant between-groups differences in pain interference assessed daily (Study 1) and over 4 years (Study 2), controlling for possible confounding variables including pain intensity, age, and depressive symptoms (Krebs et al., 2007; Scott, Kroenke, Wu, & Yu, 2016).

Study 1

Method

Participants. Participants were 220 individuals with FM who completed the preintervention daily diary assessment and self-report questionnaires before they were randomized into a trial of psychological treatments for chronic pain. Participants were recruited between 2008 and 2013 by physician referrals, newspaper advertisements, online postings, and fliers posted in local doctors' offices. To be eligible for the trial, individuals had to (a) be between the ages of 18 and 72; (b) have had pain for three months or more in at least three quadrants of the body, or in two quadrants while endorsing substantial sleep disturbance and fatigue; (c) report pain in at least 11 of 18 tender points during a home visit consistent with diagnostic criteria for FM established by the American College of Rheumatology (Wolfe et al., 2010); (d) not have any autoimmune or neuropathic pain disorders; (e) not be currently participating in other clinical trials or receiving psychotherapy for pain or depression; and (f) not be pursuing litigation related to their pain condition.

Procedures. All procedures were approved by the Institutional Review Board in a university that is located in the south western part of the United States; all participants provided written informed consent. As part of the initial assessment, participants completed a nurse visit and questionnaires regarding current FM symptoms, and physical and emotional functioning. They also completed a 21-day electronic daily diary that assessed day-to-day pain, physical, psychological, and social experiences. For the diary assessment, a mobile phone was provided to each participant. Before the diary assessment, research staff met individually with each participant and provided them with detailed training in how to complete the daily diaries via a mobile phone. An automated phone system called each participant four times per day and delivered audio recorded questions, and participants pressed phone keypad to respond these questions. The first morning assessment time was determined by participants to occur approximately 30 min after their usual waking time, and the remaining calls were at 11:00 a.m. (morning), 4:00 p.m. (afternoon), and 7:00 p.m. (evening). If participants missed any calls, they were allowed to log into the system through their mobile phone within 3 h to complete the assessments. If participants missed diary assessments for 2 days in a row, research staff contacted them to problem solve any barriers relating to diary completion. Participants were paid $2 for each day they completed diaries, with a bonus of $1/day for rates of diary completion that were more than or equal to 50%. Participants completed 3,796 of 4,620 (82%) observations possible across 21 days. After completion of the daily diary, participants completed additional self-report questionnaires of preintervention outcome measures before starting an intervention.

Measures.

Sense of resilience. The 6-item Brief Resilience Scale assesses an individual's perceived ability to bounce back from stress was used to assess sense of resilience (Smith et al., 2008). Examples of items includes "I tend to bounce back quickly after hard times" and "It does not take me long to recover from a stressful event." Participants are asked to rate the extent to which they agree with each item using a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The mean item score was used and Cronbach's α was .90. This measure was assessed after participants completed the 21-day daily diary and before starting an intervention.

Purpose in life. The 9-item Purpose in Life subscale from Scales of Psychological Well-Being assess goal directedness, sense of meaning, and purpose (Ryff & Keyes, 1995). This measure was used as an additional variable to measure resilience. Respondents indicate the extent to which they agree with each item on a 6-point Likert scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*). The mean item score was used and Cronbach's α was .82. This measure was assessed during the initial assessment period before participants started the 21-day daily diary.

Self-Acceptance. Ability to acknowledge and accept various aspects of self, including negative qualities, was measured by the 9-item Self-Acceptance subscale from Scales of Psychological Well-Being (Ryff & Keyes, 1995). Respondents indicate agreement with each item on a 6-point Likert scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*). Mean item score were used and Cronbach's α was .88. This measure was assessed during the initial assessment period before participants started the 21-day daily diary.

Satisfaction with social support (from the daily diary). Participants were asked to rate their satisfaction with how their (a) spouses or partner and (b) people other than spouse or partner (i.e., family members, friends, and coworkers) responded to their pain and stress coping on a 5-point Likert scale ranging from 1 (*not at all satisfied*) to 5 (*completely satisfied*) every day for 21 days. Responses to these four items were averaged across 21 days, with a Cronbach's α of .81 in the current study. This measure was assessed every evening for 21 days.

Pain acceptance. The 20-item Chronic Pain Acceptance Questionnaire (CPAQ; McCracken et al., 2004) was used. Respondents are asked to indicate how frequently they respond to pain in ways that reflect acceptance of pain using a 7-point Likert scale ranging from 0 (*never*) to 6 (*always*). A mean item score was used and Cronbach's α was .78. This measure was assessed after participants completed the 21-day daily diary and before starting an intervention.

Sleep quality (from daily diary). Every morning for 21-days, 30 min after participants' usual wake up time, they were asked to report the quality of their sleep using a numerical rating scale (0 = *extremely poor sleep* to 100 = *extremely good sleep*), how refreshed they felt upon awakening (0 = *not at all refreshed* to 100 = *extremely refreshed*), and the extent to which they had trouble staying asleep (1 = *not at all* to 4 = *quite a bit*). These first two items were rescaled from a 0 to 100 scale to a 0 to 5 scale by dividing each score by 20 to reduce the computational burden in conducting LPA. Note that this rescaling method does not influ-

ence correlation or the significance of results (see Cohen, Cohen, West, & Aiken, 2003). The trouble staying asleep item was reverse scored. A mean items score was computed and Cronbach's α was .78 in the current study. This measure was assessed every morning for 21 days.

Morning pain intensity (from the daily diary). Morning pain intensity in the past 2–3 h was measured using a 0 (*no pain*) to 100 (*pain as bad as it can be*) numerical rating scale (Jensen, Karoly, & Braver, 1986). This measure was assessed every morning for 21 days.

Depressive symptoms. The Hamilton Depression Inventory Short Form (HDI SF; Reynolds & Kobak, 1995a) was used to evaluate depressive symptoms. HDI consists of a total 15 questions. Item scores are summed to yield an overall score with higher scores indicating higher levels of depressive symptoms. Scores more than 13 are thought as having clinical level of depression. The HDI SF has strong evidence supporting its internal and test–retest reliability and validity and has been shown to be highly correlated with clinical interview results (Reynolds & Kobak, 1995a, 1995b). Cronbach's α for the HDI in the current study was .88. This measure was assessed after participants completed the 21-day daily diary and before starting an intervention.

Afternoon pain interference (from the daily diary). The following diary item was asked to assess pain interference: "During the past 2–3 hours, how much did your pain interfere with your ability to carry on with your activities?" The scale ranged from 1 (*not at all*) to 5 (*completely*). This measure was assessed every afternoon for 21 days.

Data analysis plan. As a preliminary analysis, descriptive statistics and intercorrelations were computed for the study variables. As all clustering analysis approaches are sensitive to outliers, multivariate outlier analyses were conducted by using Cook's distance (Cook, 1977) as criteria (cutoff value = 1). We used LPA to identify subgroups. LPA is a special case of finite mixture modeling that identifies unobserved subgroups within a population (Nylund, Asparouhov, & Muthén, 2007). A total of eight indicators were included in the LPA. In determining the optimal number of classes for LPA, several model fit criteria were used, as there is no consensus as to which fit index is the best. These criteria included: (a) the Bayesian information criteria (BIC; Schwarz, 1978) and a sample-size adjusted BIC (Adj BIC; Sclove, 1987), with smaller values representing a better model fit; (b) the Vuong-Lo-Mendell-Rubin Likelihood Ratio Test (VLMR; Lo, Mendell, & Rubin, 2001) and the Bootstrap Likelihood Ratio Test (BLRT; McLachlan & Peel, 2000), which compares whether *k* number of class model is better-fitting than that of *k*-1 class model. A *p* value less than .05 indicates that the *k* class model is significantly better-fitting than that of *k*-1 class model; (c) entropy (Ramaswamy, DeSarbo, Reibstein, & Robinson, 1993), an index of classification certainty that ranges from 0 to 1. A value that is close to 1.0 implies that clusters are more clearly separated from each other; and (d) theoretical justification, interpretability of the latent classes, and model parsimony (Grimm & Ram, 2009; Jung & Wickrama, 2008; Muthén, 2004). Different sets of starting values were used and the model was run multiple times to prevent it from converging into a local maximum solution (Asparouhov & Muthén, 2013). Once the best fitting model was identified, and when entropy was high enough (i.e., close to 0.8), the most likely class membership was exported from LPA. Previous simulation

studies suggest that use of the most likely classification membership is less likely to introduce bias when the entropy is high (Asparouhov & Muthén, 2013; Clark & Muthen, 2009). Missing data for these indicator variables were examined with Little's MCAR test. Full information maximum likelihood estimation was used to handle the missing data.

Using the exported most likely class membership, we then performed a series of analyses to compare demographic and covariate differences between the groups that emerged. We used analysis of variance (ANOVA) for continuous variables and χ^2 analyses for categorical variables. A Bonferroni correction was used to control for the inflation of Type I error. For main outcome analysis, a multilevel model was used to adequately account for the nested data structure of the daily diary data. The afternoon pain interference variable was used as an outcome variable. Dummy variables with the High Resource group set as a reference group were entered as person-level (Level 2) predictor variables. Morning pain intensity (a Level 1 covariate), depressive symptoms (a Level 2 covariate), and age (a Level 2 covariate) were included as control variables in the model. Mplus software Version 7 (Muthén & Muthén, 2012) was used for running LPA, and SPSS Version 23 (IBM Corp., 2013) was used for conducting demographic and covariate comparisons among groups, as well as multilevel modeling.

Results

Preliminary findings. Table 1 summarizes the descriptive statistics of the indicator variables for LPA and covariates. Skewness and kurtosis of all variables were within the acceptable range (Skewness cutoff = 2; Kurtosis cutoff = 7; West, Finch, & Curran, 1995). No influential outliers were identified. Many of the indicator variables were moderately correlated. Note that correlation values below .4 represent "weak" correlation, while values between .4 to .59 indicate "moderate" correlation, and values over .6 demonstrate "strong" correlation (Evans, 1996). Self-Acceptance and Purpose in Life variables had quite a large correlation (*r* = .61). Both pain intensity and depressive symptoms variables were significantly correlated with LPA indicator variables. The result of Little's MCAR test was nonsignificant ($\chi(88) = 106.801$, $p = .08$), indicating no systematic missing data pattern.

Overall sociodemographics. Among the 220 participants, 195 (89%) were female. The mean age of the sample was 51.25 years ($SD = 11.02$) and the majority of participants were White (78% White, 3% African American, 14% Hispanic, 4% Native American, 1% Asian, and 5% other). Their education level varied across participants (15% had a high school diploma or less education, 17% had post graduate education, 47% attended some college or had earned an Associate's degree, and the remaining 18% had a bachelor's degree). Regarding relationship status, 55% of participants indicated that they were either married or living with a romantic partner, 8% reported never married, 27% were divorced, and 6% were widowed. Twenty-three percent of the participants were working full-time, and 27% were working part-time. Participants' median annual household income was in the range of $40,000 to $59,999. We conducted an additional analysis to determine if the range of SES within our sample is associated with daily diary completion. There were no significant associations

Table 1

Descriptive Statistics and Bivariate Correlations of LPA Indicator Variables and Covariates for Study 1 (N = 220)

Variables	1	2	3	4	5	6	7	8	9
1. Pain acceptance	—	.46**	.47**	.45**	.25**	.22**	−.28**	−.68**	.26**
2. Self-acceptance		—	.43**	.61**	.39**	.15*	−.22**	−.49**	.13
3. Sense of resilience			—	.38**	.26**	.12	−.16*	−.50**	.12
4. Purpose in life				—	.31**	.14*	−.22**	−.49**	.00
5. Social support satisfaction					—	.24**	−.28**	−.30**	.03
6. Sleep quality						—	−.21**	−.24**	.10
7. Morning pain intensity							—	.38**	−.15*
8. Depressive symptoms								—	−.17*
9. Age									—
Mean	3.41	3.04	2.92	3.42	2.87	2.50	48.99	11.52	51.25
SD	1.01	.86	.90	.71	.98	.57	17.68	5.75	11.02
Skewness	.19	.01	.13	−.11	.17	−.05	−.13	.46	−.51
Kurtosis	−.56	−.68	−.60	−.20	−.66	.42	−.36	−.33	.23
Observed range	1–6	1–4.9	1–5	1.6–5	1–5	1–4.2	6.6–92.5	1–27.3	19–72
Missing %	14.5%	0%	14.5%	0%	.9%	2.3%	0%	14.1%	0%

Note. LPA = latent profile analysis.
* $p < .05$. ** $p < .01$.

between SES (i.e., income and education level) and the number of daily diaries completed. To be specific, the bivariate correlation (Pearson *r*) between education level and diary completion was .03 ($p = .64$), and the correlation between income level and diary completion was .03 ($p = .71$).

Findings of LPA. The results of the systematic LPA model fitting process are presented in Table 2. Based on various fit indices and theoretical justifications, the 3-class model was chosen as the best fitting model. Neither the 4- or 5-class model was chosen because each demonstrated a greater BIC and nonsignificant VLMR and BLRT results.

Figure 1 shows the estimated pattern of these three classes. The first class ($n = 84$; 38%), labeled as "Low Personal Resource group," was characterized by low levels of pain acceptance, resilience, and social support. The second class, labeled as "Moderate Personal Resource group," was the largest ($n = 94$; 43%), with average levels on all indicators. The third class ($n = 42$; 19%), labeled as "High Personal Resource group," displayed

high level of pain acceptance, resilience, social support, and sleep quality.

Sociodemographic and covariate difference among subgroups. Table 3 shows the results of the analyses used to examine differences in demographic characteristics across the three groups (High, Moderate, and Low Personal Resource group) emerged in LPA. Marital status, annual household income, morning pain severity, and depressive symptoms significantly differed by group after applying the Bonferroni correction (i.e., nine analyses; adjusted *p* value is .005). The High Personal Resource group had the highest proportion of participants with a romantic partner, the highest annual household income, and the lowest levels of morning pain severity and depressive symptoms. On the other hand, the Low Personal Resource group showed the lowest proportion of participants with a romantic partner, the lowest annual household income, and the highest levels of morning pain severity and depressive symptoms.

Table 2

Model Fit Information for Class Determination of Latent Profile Analysis Models (Study 1 and Study 2)

Number of classes	BIC	Adjusted BIC	VLMR	BLRT	Entropy
		Study 1 (*N* = 220)			
1 Class	3598.831	3560.803	N/A	N/A	N/A
2 Class	3414.284	3354.073	$p < .001$	$p < .001$	.77
3 Class	3397.801	3315.407	$p < .05$	$p < .001$	.75
4 Class	3414.033	3309.456	$p = .12$	$p = .06$	.79
5 Class	3430.768	3304.008	$p = .53$	$p = .09$	.75
		Study 2 (*N* = 483)			
1 Class	8283.808	8245.721	N/A	N/A	N/A
2 Class	7629.880	7569.575	$p < .001$	$p < .001$	.78
3 Class	7326.853	7244.331	$p < .001$	$p < .001$	.85
4 Class	7303.494	7198.755	$p = .28$	$p < .001$	.77
5 Class	7298.784	7171.827	$p = .02$	$p < .001$	.79

Note. BIC = Bayesian information criteria; Adj BIC = adjusted Bayesian information criteria; VLMA = Vuong-Lo-Mendell-Rubin Likelihood Ratio Test; BLRT = Bootstrap Likelihood Ratio Test.
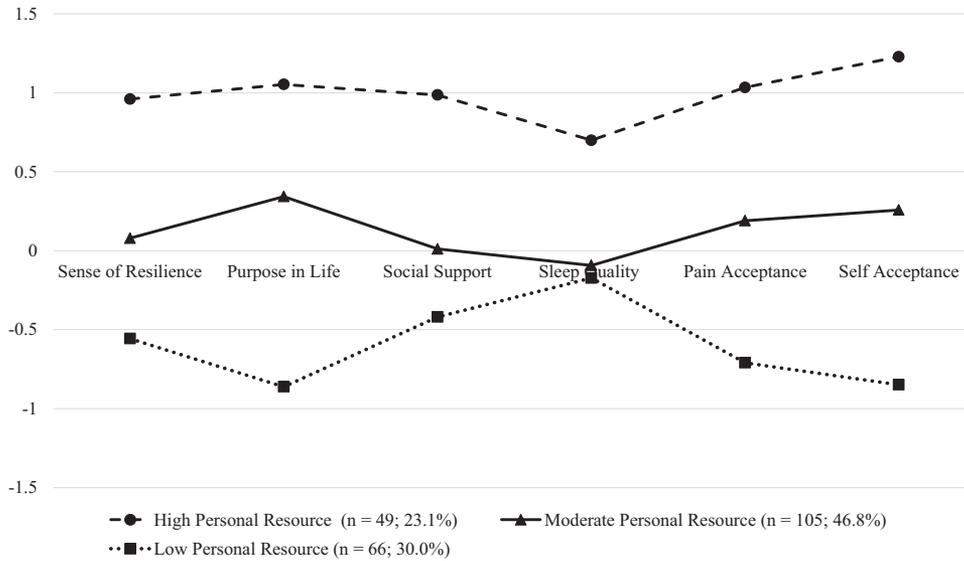
Figure 1. Results of the latent profile analysis of individuals with chronic pain in Study 1.

Subgroup differences in afternoon pain interference. Results of the multilevel model revealed a significant group difference between Moderate and High Personal Resource groups ($B = 0.40$, $SE = 0.12$, $p < .01$) in average level of afternoon pain interference over 21 days, controlling for morning pain severity ($B = 0.02$, $SE = 0.001$, $p < .001$) and depressive symptoms ($B = 0.05$, $SE = 0.01$, $p < .001$), and age ($B = 0.003$, $SE = 0.004$, $p = .37$). In other words, the Moderate Personal Resource group reported 0.4 points (10% difference on a 1- to 5-point scale) higher afternoon pain interference across 21 days on average compared with the High Personal Resource group over and above confounders (i.e., pain severity, depressive symptoms, and age). However, there was no significant group difference in afternoon pain interference between Low and High Personal Resource groups ($B = 0.18$, $SE = 0.15$, $p = .24$). When the reference of dummy variables

were set on the Moderate Personal Resource group, we found that the Moderate Personal Resource group reported significantly lower afternoon pain interference compared with the Low Personal Resource group ($B = -0.22$, $SE = 0.11$, $p < .05$), when controlling for confounding variables.

Findings of post hoc analyses. We further investigated if any of the control variables could account for these counterintuitive findings (i.e., no significant differences in pain interference between High vs. Low Personal Resource groups). We reran a series of models by including each control variable one at a time and found that the results changed depending on whether the depressive symptoms variable is controlled or not. Without controlling for this variable, the three subgroups all significantly differed in terms of the level of 21-day afternoon pain interference. The Low Personal Resource group differed from the other two groups in

Table 3
Baseline Sociodemographic and Covariate Characteristics of Subgroups of Individuals With Chronic Pain in Study 1 (N = 220)

Variables	Class 1: Low Personal Resource group		Class 2: Moderate Personal Resource group		Class 3: High Personal Resource group		Test statistic	p-value
	n	% (within-the class)	*n*	% (within-the class)	*n*	% (within-the class)		
Sex (female)	64	86.5%	79	89.8%	34	94.4%	$\chi^2 (2) = 1.64$	.44
Ethnicity (European American)	64	76.2%	62	66.0%	31	73.8%	$\chi^2 (2) = 2.43$	.30
Education (4-year college or above)	30	41.7%	36	41.9%	19	52.8%	$\chi^2 (2) = 1.44$	.49
Marital status (partnered)	39	46.4%	55	58.5%	33	78.6%	$\chi^2 (2) = 11.90$	.003
Work status (employed)	34	46.6%	46	52.9%	24	64.9%	$\chi^2 (2) = 3.30$	.19
	Mean	*SD*	Mean	*SD*	Mean	*SD*		
Annual household income	10.26	5.58	12.75	4.15	14.60	3.32	$F(2, 185) = 11.38$	<.001
Age (years)	49.20	10.92	51.47	10.28	53.51	12.36	$F(2, 217) = 2.22$	.11
Morning pain severity	56.30	16.06	48.66	16.20	39.64	18.61	$F(2, 217) = 13.84$	<.001
Depressive symptoms	15.62	5.03	10.42	4.55	5.96	3.24	$F(2, 186) = 58.69$	<.001

Note. Bonferroni adjusted *p*-value = .005.

terms of depressive symptom level as well as Personal Resources. In fact, Table 3 shows that this group reported a clinical level of depression whereas other groups did not. It seems that the group difference of afternoon pain interference between the Low and High Personal Resource groups is mainly because of the difference in the level of depressive symptoms. Hence, when the Low Personal Resource group is compared with the High Personal Resource group, the group difference of afternoon pain interference becomes nonsignificant after accounting for the difference in depression level. On the other hand, the High and Moderate Personal Resource groups and the Moderate and Low Personal Resource groups are less different in terms of depressive symptom level. Therefore, when these groups are compared, the differences in afternoon pain interference are still statistically significant.

Study 2

Method

Participants. Study 2 utilized a subsample from a larger longitudinal study of secondary health conditions in people with medical conditions that are often associated with physical disability. Originally, the total sample size was 1,862, including individuals who completed a baseline (Time 1) survey and met the following eligibility criteria: (a) 18 years of age or older; (b) able to read and understand English; (c) and have a physician's diagnosis of MS, MD, PPS, or SCI. However, some baseline variables in the present study were only measured from the half of the sample that was randomly chosen (to minimize assessment burden for the participants as whole). Furthermore, as the present study focuses on individuals who have chronic pain, we only included participants who reported having persistent bothersome pain at baseline. Hence, the final sample size used in the present study was 483 individuals.

Procedures. All study procedures were reviewed and approved by the Institutional Review Board in a university that is located in the northwestern part of the United States. In 2009, participants were recruited into the study by a number of sources: (a) disability-specific research registries, (b) former research project participants, and (c) Web and print advertisements. Participants who were interested in the present study completed an over-the-phone eligibility screen and information statement. Then, these screened participants were mailed an initial (Time 1) survey along with a postage-paid return envelope and informed consent form. Approximately every year, participants were asked to complete a survey using the same method (via mail). When participants successfully returned their surveys to the research office, they were paid $25. The present study uses a total of four waves (Time 1 to Time 4) of longitudinal data.

Measures.

Indicators of LPA.

Sense of resilience. The 10-item Connor-Davidson Resilience Scale (Campbell-Sills & Stein, 2007) was used to assess individuals' sense of resilience. Participants rated each item on a 5-point Likert scale ranging from 0 (*not true at all*) to 4 (*true nearly all the time*). The mean item score was used and the Cronbach's α of this measure was .92.

Self-efficacy. The 17-item University of Washington Self-Efficacy Scale (Amtmann et al., 2012) was used to assess self-efficacy for people with disabilities. This measure was used as an additional variable to measure resilience. Participants are asked to rate the extent to which they agree with each item using a 5-point Likert scale ranging from 1 (*not at All*) to 5 (*completely*). The mean item score was used and the Cronbach's α of this measure was .94.

Perceived social support. The Multidimensional Scale of Perceived Social Support (MSPSS; Zimet, Powell, Farley, Werkman, & Berkoff, 1990) was used to measure perceived social support from three sources (i.e., significant other, family, or friends). Participants are asked to rate the extent to which they agree with each item using a 7-point Likert scale ranging from 1 (*very strongly disagree*) to 7 (*very strongly agree*). The mean item score was used and the Cronbach's α was .94.

Satisfaction with social roles. The 7-item Patient-Reported Outcomes Measurement Information System (PROMIS) Satisfaction with Participation in Social Roles (Cella et al., 2010) was used to assess individuals' contentment with social roles (e.g., work, chores, and ability to help others). Respondents indicate the extent to which they agree with each item on a 5-point Likert scale ranging from 1 (*not at all*) to 5 (*very much*). The scores are on a *T* score metric, score of 50 indicating the mean of the general U.S. population. Higher scores indicate greater satisfaction with social roles. The Cronbach's α of this measure was .93.

Pain acceptance. The same pain acceptance measure (i.e., CPAQ) that was used in Study 1 was used. The Cronbach's α of this measure was .92.

Sleep quality. The 8-item PROMIS sleep disturbance short-form was used to assess sleep quality (Buysse et al., 2010; Cella et al., 2010). Respondents indicate the extent to which they agree with each item on a 5-point Likert scale ranging from 1 (*not at all*) to 5 (*very much*). Items that represent lower sleep quality were reverse coded. Higher *T* scores indicate better sleep quality. The mean score was used and the Cronbach's α was .92.

Control variables.

Pain intensity. Average pain intensity in the past week was assessed using a 0 to 10 numerical rating scale ranging from 0 (*none*) to 10 (*very severe*; Jensen et al., 1986).

Depressive symptoms. Depressive symptoms were measured using the Patient Health Questionnaire–9 (PHQ-9; Kroenke, Spitzer, & Williams, 2001). With the PHQ-9, respondents are asked to indicate how frequently they experienced each of the nine symptoms of depression in the past two weeks on a 4-point Likert scale ranging from 0 (*not at all*) to 3 (*nearly every day*). The mean item score was used and the Cronbach's α was .83. Interpretation of total scores are as follows: (a) scores 1–4 (minimal depression); (b) scores 5–9 (mild depression); (c) scores 10–14 (moderate depression); (d) scores 15–19 (moderately severe depression); and (e) scores 20–27 (severe depression).

Medical symptom severity. Average symptoms that the participants experienced because of their medical condition were measured using a Likert scale that ranges from 0 (*none*) to 10 (*very severe*). Symptoms assessed included: weakness, fatigue, imbalance, numbness anywhere in the body, numbness in hands or feet, memory loss, vision loss, shortness of breath, and spasticity. Mean item score was calculated and the Cronbach's α was .75.

Gross motor function. The 1-item self-report of the Gross Motor Function Classification System (Palisano et al., 1997) was used to measure individuals' ability to sit, walk, and use wheeled

mobility. Higher score indicates greater impairment of a participant's gross motor function.

Duration of since medical diagnosis. Participants were asked to report the number of years since their diagnosis of MS, MD, PPS, or SCI.

Age. As we are using longitudinal growth modeling in Study 2 and participants' age was not the same at baseline, grand-mean centered participants' age was included as an additional covariate. Centering was used to make a meaningful zero because none of the participants were 0 years old.

Pain interference. We used short-form 6-item PROMIS pain interference measure to assess pain interference from Time 1 to 4 (Cella et al., 2010). Participants indicate the extent to which they agree with each item on a 5-point Likert scale ranging from 1 (*not at all*) to 5 (*very much*). The scores are on a *T* score metric, score of 50 indicating the mean of the general U.S. population. Higher scores indicate greater pain interference. Cronbach's αs ranged from .92 to .95.

Data analysis plan. All the analytic procedures up to and including exporting the most likely class membership from LPA are identical to those described for Study 1. After exporting the most likely class membership, dummy variables were created to compare trajectories of pain interference among subgroups. Latent growth curve modeling (LGCM; Singer & Willett, 2003) was used to test change in pain interference over time. LGCM specifies intercept and slope growth parameters. The intercept represents the initial status (Time 1) of the outcome variable and the slope represents rate of change from Time 1 to Time 4. We constrained the slope factor loadings to 0, 1, 2, and 3. Both intercept and slope growth factors were regressed on dummy variables and control variables. Acceptable model fit was evaluated by comparative fit index (CFI) greater than .90, standardized root mean square residual (SRMR) less than .10, and root mean square error of approximation (RMSEA) less than .08 (Byrne, 2001; Kline, 1998). In terms of missing data, pain interference measure at Time 1 had 1% missing, Time 2 had 45% missing, Time 3 had 48% missing, and

Time 4 had 16% missing. The large portion of missing data for Time 2 and 3 outcome variables was due mostly to the fact that only participants who were middle-aged were asked to complete the questionnaires at these time points, in line with one of the main goals of the parent study. Specifically, because the parent study sought to evaluate factors related to employment status during middle age, these participants were assessed most often. As participants' age was directly associated with missingness, we assumed these data were missing at random; that is, missingness was not related to the missing data but with some observed variables. We conducted additional attrition analyses and found that education and marital status were also significantly associated with missingness. Hence, age, education, and marital status were included as auxiliary variables in the model so as to increase precision of full information maximum likelihood estimation in handling missing data (Widaman, 2006). Mplus software Version 7 (Muthén & Muthén, 2012) was used to run both LPA and LGCM.

Results

Preliminary findings. Table 4 summarizes the descriptive statistics of study variables for the second sample. Skewness and kurtosis of all study variables were within an acceptable range. No influential cases were identified. Most of the indicator variables were moderately correlated. Correlations between self-efficacy and sense of resilience ($r = .69$), and social role satisfaction ($r = .69$) were quite large. However, potential issues of collinearity between indicators are not a concern in LPA because indicators in LPA are used as outcome variables (as in a confirmatory factor analysis) rather than as predictor variables.

Overall sociodemographics. Among the 483 participants, 298 (62%) were women. The mean age of the sample was 55.88 years ($SD = 12.61$) and participants were predominantly European White (92% White, 3% African American, 1% Asian, 1% Native American, and 3% other). In terms of their diagnoses, 15% had MD, 26% had MS, 27% had PPS, and 32% had SCI. Their

Table 4
Descriptive Statistics and Bivariate Correlations of LPA Indicator Variables and Covariates for Study 2 (N = 483)

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1. Pain acceptance	—	.37**	.30**	.20**	.29**	.10*	.01	−.03	−.03	−.07	.05	.10*
2. Sense of resilience		—	.69**	.40**	.57**	.28**	−.23**	−.39**	−.32**	−.08	.09	.05
3. Self-efficacy			—	.40**	.69**	.30**	−.32**	−.43**	−.40**	−.14**	.07	.03
4. Social support satisfaction				—	.34**	.15**	−.15**	−.22**	−.19**	.00	−.02	.05
5. Social role satisfaction					—	.23**	−.28**	−.41**	−.40**	−.31**	.00	−.09
6. Sleep quality						—	−.18**	−.39**	−.19**	.10*	.02	.14**
7. Average pain							—	.31**	.40**	.19**	.10*	−.04
8. Depressive symptoms								—	.35**	−.02	−.03	−.04
9. Medical symptom severity									—	.21**	.05	.06
10. Mobility										—	.24**	.14**
11. Years since diagnosis											—	.29**
12. Age												—
Mean	3.57	2.75	2.18	5.32	44.01	2.94	5.29	.83	3.55	2.99	15.93	55.88
SD	1.03	.74	.76	1.40	7.57	.98	1.94	.58	1.83	1.42	10.24	12.61
Skewness	−.12	−.54	−.02	−.93	.17	−.02	−.04	.97	.40	−.53	.77	.28
Kurtosis	−.27	.48	−.48	.33	.28	−.70	−.57	.65	−.30	−.61	.23	.05
Observed range	.6–6	0–4	0–3.9	1–7	27–66	1–5	1–10	0–3	0–9	0–5	0–60	20–91
Missing %	.0%	.4%	.0%	.4%	1.2%	.0%	.0%	.0%	.2%	.6%	3.5%	.0%

Note. LPA = latent profile analysis.
* $p < .05$. ** $p < .01$.

education level was varied across participants (14% had a high school diploma or less education, 17% had post graduate education or attended some college, 29% had earned a bachelor's degree, and the remaining 22% had earned degrees in either graduate or professional school). In terms of their relationship status, 60% of the participants indicated that they were either married or living with a significant other, 13% reported that they had never married, 21% were either separated or divorced, and 7% were widowed. Their median annual household income was in the range of $41,000 to $55,000.

Findings of LPA. The results of the systematic LPA model fitting process are presented in Table 2. Based on various fit indices and our theoretical justification, the 3-class model was chosen as the best fitting model. Neither the 4- or 5-class model was chosen because they showed nonsignificant VLMR results and significant decrease in entropy value compared with the 3-class model. Furthermore, the 3-class model shows the "elbow criterion" for both BIC and Adj BIC values where these values start decreasing minimally from the 4-class model.

Figure 2 shows the estimated pattern of these three classes. The first class ($n = 83$; 17%), labeled as Low Personal Resource group, was characterized by low level of pain acceptance, resilience, satisfaction with social role, social support, and sleep quality. The second class ($n = 269$; 56%), labeled as Moderate Personal Resource group, was the largest group and was characterized by average levels on all indicators. The third class ($n = 131$; 27%), labeled as High Personal Resource group, displayed high level of pain acceptance, resilience, satisfaction with social role, social support, and sleep quality.

Sociodemographic and covariate difference among subgroups. Table 5 shows the results of the analyses to examine differences in demographic characteristics and covariates across the three groups (i.e., High, Moderate, and Low Personal Resource groups) emerged in LPA. Similar to the result of Study 1, annual household income, pain severity, depressive symptoms, diagnosis-related medical symptom severity, and mobility significantly differed by groups after the Bonferroni correction (i.e., 12 analyses; adjusted p value = .004). The High Personal Resource group had the highest annual household income on average, and the Low Personal Resource group showed the lowest income.

Group mean differences in trajectories of pain interference. To test between-groups differences in pain interference trajectory across the three subgroups, we created two sets of dummy variables. First, we set the High Personal Resource group as the reference group and created two dummy variables to compare the High Personal Resource group with the two other groups. Second, we set the Moderate Personal Resource group as the reference group to compare the difference between the Moderate Personal Resource group and Low Personal Resource group.

Figure 3 shows each group's trajectories of pain interference over time based upon the unconditional LGCM, which does not include any covariates. The graph indicates a slight decreasing trend (more so in High and Low Personal Resource groups) in pain interference over time for all three groups. A summary of the final LGCM that includes dummy variables and covariates is presented in Figure 4. Note that we initially included medical symptom severity, time since diagnosis of medical condition, and mobility covariates in addition to age and depression covariates in the model. However, they were not significant predictors of pain interference outcomes nor did they change the main results (i.e., group mean differences in trajectories of pain interference). Hence, because of model parsimony we excluded these covariates in the final model. The model fit was good overall, $\chi^2(15) = 23.25$, $p = .08$, RMSEA <0.03, CFI = 0.99, and SRMR = 0.04. Even when controlling for baseline pain severity, depressive symptoms, and age, significant group mean differences emerged in pain interference at the baseline (i.e., intercept growth factor). Specifically, the T scores of pain interference at Time 1 among Low Personal Resource group and Moderate Personal Resource group were 5.33 and 2.98 points higher than that of the High Personal Resource
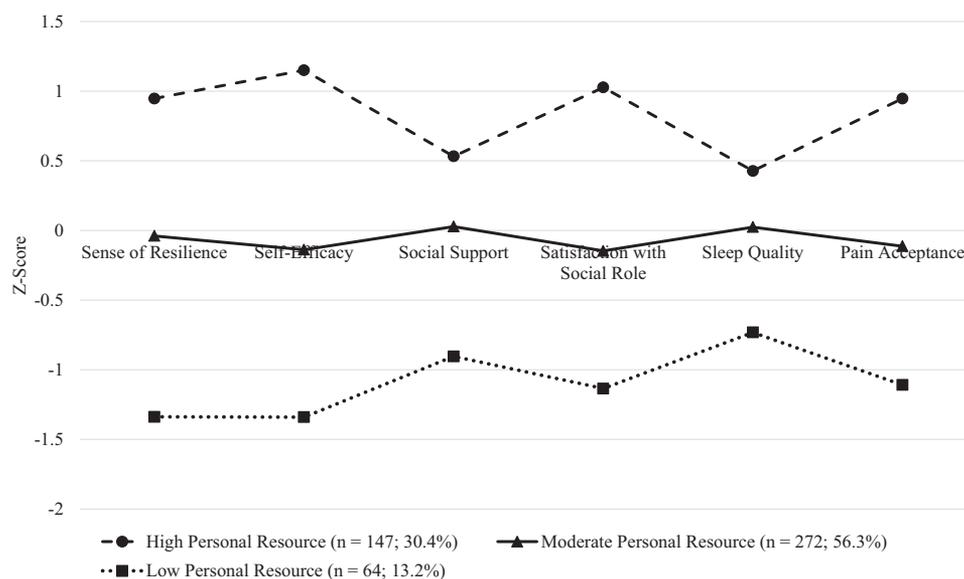

Figure 2. Results of the latent profile analysis of individuals with chronic pain in Study 2.

Table 5

Baseline Sociodemographic and Covariate Characteristics of Subgroups of Individuals With Chronic Pain in Study 2 (N = 483)

Variables	Class 1: Low Personal Resource group		Class 2: Moderate Personal Resource group		Class 3: High Personal Resource group		Test statistic	p
	n	% (within-the class)	n	% (within-the class)	n	% (within-the class)		
Sex (female)	53	63.9%	178	66.2%	67	51.1%	$\chi^2 (2) = 8.61$	.01
Ethnicity (European American)	71	85.5%	253	94.1%	121	92.4%	$\chi^2 (2) = 6.35$	.04
Education (4-year college or above)	35	42.2%	138	51.3%	72	55.0%	$\chi^2 (2) = 3.41$	.18
Marital status (partnered)	43	51.8%	160	59.5%	85	64.9%	$\chi^2 (2) = 3.62$	.16
Diagnostic group (multiple sclerosis)	26	31.3%	66	24.5%	32	24.4%	$\chi^2 (6) = 6.25$	.40
	Mean	SD	Mean	SD	Mean	SD		
Annual household income	2.60	1.89	3.39	2.10	3.95	2.17	$F(2, 460) = 10.32$	<.001
Age (years)	54.52	11.08	56.86	12.50	54.71	13.63	$F(2, 480) = 1.87$	.16
Pain severity	6.28	1.91	5.36	1.86	4.50	1.81	$F(2, 480) = 23.74$	<.001
Depressive symptoms	13.73	5.77	7.33	3.92	3.81	2.99	$F(2, 475) = 148.38$	.04
Medical symptom severity	5.00	2.02	3.53	1.60	2.66	1.56	$F(2, 479) = 49.54$	<.001
Mobility	3.16	1.29	3.12	1.29	2.60	1.66	$F(2, 477) = 6.79$	.001
Duration since medical diagnosis	14.11	9.32	16.91	10.39	15.12	10.32	$F(2, 463) = 2.88$	.06

Note. Bonferroni adjusted *p*-value = .004.

group, respectively. Using the second set of dummy variables, we found that the Low Personal Resource group' pain interference *T* score was 2.35 points higher than that of the Moderate Personal Resource group ($B = 2.35$, $SE = 0.67$, $p < .001$). However, there was no significant difference in slope growth factors (i.e., the rate of change in pain interference from Time 1 to Time 4) among the subgroups.

Discussion

The aims of the present study were to (a) identify subgroups of individuals with chronic pain across two separate community samples using a number of important modifiable personal resources; (b) explore sociodemographic differences among subgroups; and (c) examine subgroup differences in terms of pain interference while controlling for important confounding variables. As hypothesized, we were able to identify three subgroups that are quite comparable with previous studies (e.g., Bergström et al., 2011; Rabey et al., 2016; Turk & Rudy, 1988) across two unique chronic pain samples. Among the many different sociodemographic variables, participants' annual income level was robustly different across subgroups in both Study 1 and 2. Findings of subgroup differences in pain interference, however, were quite different between Study 1 (of individuals with FM) and Study 2 (of individuals with chronic pain in the context of a chronic neurological/neuromuscular disease or injury). In Study 1, after controlling for pain intensity and depressive symptoms, the High and Low Personal Resource groups did not significantly differ in average level of afternoon pain interference across 21 days. On the other hand, in Study 2, there were significant differences in pain inter-
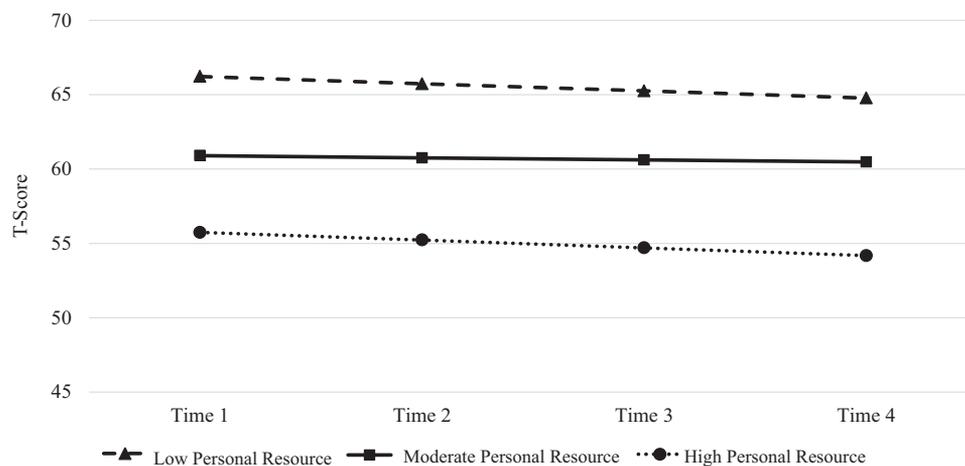

Figure 3. Different trajectories of pain interference over 4 years among subgroups of individuals with chronic pain in Study 2.
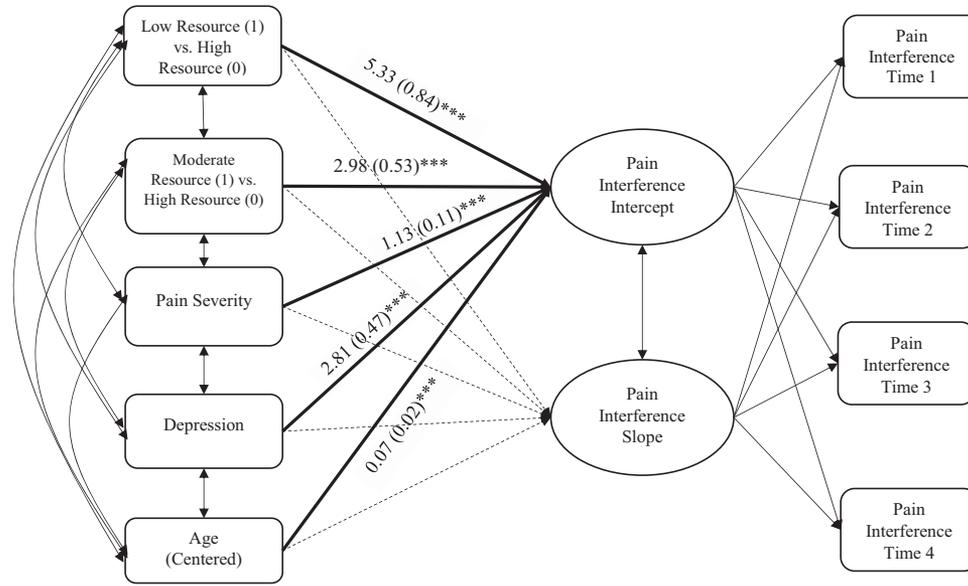
Figure 4. Summary of latent growth curve modeling in Study 2. *** *p* < .001. Results did not differ when other covariates (i.e., medical symptoms severity, mobility, and duration of diagnosis) were included in the model. Hence, they were excluded in the final model because of model parsimony.

ference across all subgroups at baseline while controlling for various covariates. It was also notable that we did not find significant subgroup differences in the rate of change of pain interference over time in Study 2. The significant baseline subgroup differences in pain interference remained stable over 4 years. These findings have important clinical and research implications, which are discussed in more detail below.

Personal Resource Profile Differences Between Individuals With FM and Individuals With Chronic Pain Because of Neurological/Neuromuscular Disability Conditions

Although the overall personal resource profiles among subgroups were quite similar in Study 1 and Study 2 (see Figures 1 and 2), there were some noticeable differences between the two studies. First, the proportion of Low Personal Resource group was much larger in the Study 1 sample (30%) than the Study 2 sample (13%). This difference may be because of the source of participants for each sample. Individuals in first study were presenting with a primary pain problem, met the diagnostic criteria of FM, and were seeking treatment, whereas the participants in the second sample were nontreatment seeking and had one of the conditions associated with physical disability. Between-groups differences in function across the study variables may also be related to the nature of FM versus other pain conditions. That is, individuals with FM tend to endorse higher levels of emotional distress, HPA-axis disturbances, and lower social support than individuals with other chronic pain disorders (McInnis, Matheson, & Anisman, 2014; Schoofs, Bambini, Ronning, Bielak, & Woehl, 2004).

Another noticeable personal resource profile difference between studies is that in Study 1 the Low Personal Resource group did not show much difference in their level of social support and sleep

quality compared with the Moderate Personal Resource group. In Study 2, the Low Personal Resource group evidenced more pronounced differences in their levels of social support and sleep quality compared with the Moderate Personal Resource group. Again, it is possible that this may be because of the nature of FM versus those of other chronic pain conditions. For instance, individuals with FM are known to endorse low level of sleep quality and high social isolation (Åsbring & Närvänen, 2002; Bigatti, Hernandez, Cronan, & Rand, 2008). Hence, except for a relatively small proportion of FM patients, such as those who were classified as part of the High Personal Resource group, the majority of individuals with FM appear to report similar levels of (low) sleep quality and (low) perceived social support. It is also possible that these taxonomic differences between the two samples might be because of the use of different measures of social support and sleep quality in the two studies. In addition, sleep quality and social support measures were assessed with different methods (i.e., Study 1 using daily diary and Study 2 with a one-time full battery assessment). Differences in measures and measurement methods may have been responsible for the discrepancies in the findings between the two studies.

Sociodemographic Differences Among Subgroups With Distinct Personal Resource Profiles

There was a significant difference between these subgroups with respect to annual household income. On average, the High Personal Resource group reported the highest and the Low Personal Resource group reported the lowest level of annual household income in both Study 1 and Study 2. This finding is in line with previous studies showing that financial strain and economic pressure are significantly associated with individuals' increased emotional distress, higher reactivity to social interactions, lower social

support, reduced perceived control, lowered resilience, and attenuated experience of positive affect (Beatty et al., 2011; Benzies & Mychasiuk, 2009; Gallo, Bogart, Vranceanu, & Matthews, 2005; Gallo, de Los Monteros, & Shivpuri, 2009; Kahn & Pearlin, 2006). It is also possible that limited personal resources and repeated exposure to high pain interference could have resulted in lower income and financial insecurity. In fact, a recent study based upon a nationally representative group of 1,925 community individuals in the U.S. found that low wealth is one of the key variables associated with "high-impact chronic pain," which refers to a persistent pain that significantly limits individuals' engagement in various daily activities (Janevic et al., 2017). A recent epidemiological study further corroborates the finding that SES, such as poverty and health insurance coverage, was associated with higher prevalence of both chronic pain and high-impact chronic pain (Dahlhamer et al., 2018). Thus, it is important to facilitate a national transformation in pain care that particularly focuses on addressing socioeconomic disparities (Kerns, 2018). Health care organizations and clinicians are encouraged to take into account patients' income and wealth disparities in their evaluations of personal resources, and consider some creative ways (e.g., telemedicine, group intervention with rolling admission) to lower the economic burden that prevents those with disadvantages from accessing evidence-based nonpharmacological pain treatments.

For individuals with FM, romantic partner status also significantly varied across subgroups. Specifically, individuals in the Low Personal Resource group reported lowest romantic partner status, whereas the High Personal Resource group reported highest romantic status. Although it is not possible to disentangle whether romantic partner status caused the formulation of different personal resource groups, or whether different levels of personal resources contributed to disparities in romantic partner status, our finding is consistent with those of previous studies that reported that relationship status is associated with various domains of psychosocial well-being (Dush & Amato, 2005; Kraaimaat, van Dam-Baggen, & Bijlsma, 1995). As a romantic partner can provide a critical resource of social and emotional support (Gottlieb & Bergen, 2010), clinicians' assessments of a patient's relationship status and offering extra assistance in minimizing the negative impact of not being in a relationship (e.g., loneliness) and improving existing personal resources seem to be important, especially for individuals with FM.

Subgroup Differences in Pain Interference

The overall subgroup differences in pain interference were quite different between the Study 1 and Study 2 samples. Whereas differences among subgroups in pain interference were quite small and significant in only two group comparisons (High vs. Moderate and Moderate vs. Low groups) in Study 1, findings in Study 2 exhibited clinically meaningful differences in pain interference among all subgroups. Post hoc analyses revealed that depressive symptoms appear to serve an important role in subgroup differences in pain interference for individuals with FM (Study 1). When depressive symptoms were not controlled for in the analyses, all subgroups differed significantly. However, when depressive symptoms were controlled, there was no significant difference in pain interference between the Low Personal Resource group (with a clinical level of depression) and High Personal Resource group.

The different proportions of male and female participants between the two study samples may have contributed to these differences. Study 1 participants were predominantly women and it is well-known that the association between chronic pain and depression is more pronounced in women than men (Campbell, Clauw, & Keefe, 2003). Hence, it is possible that depressive symptoms accounted for more variance in pain interference in Study 1 compared with Study 2.

We also believe that these findings have potentially important clinical implications. Consistent with previous research, it appears that managing depression is particularly important for successful FM treatment (Bernik, Sampaio, & Gandarela, 2013; Gracely, Ceko, & Bushnell, 2012). In fact, both depressive symptoms and major depressive disorders are highly prevalent in individuals with FM compared with other chronic pain conditions, which have led some to argue that FM is a type of affective spectrum disorder (Bradley, 2009; Hudson, Arnold, Keck, Auchenbach, & Pope, 2004). Furthermore, meta-analyses have shown strong evidence for the efficacy of antidepressants in relieving pain, depressive symptoms, and sleep disturbances, and increasing the quality of life of individuals with FM (Häuser, Bernardy, Üçeyler, & Sommer, 2009; Häuser, Wolfe, Tölle, Üçeyler, & Sommer, 2012; Üçeyler, Häuser, & Sommer, 2008). Perhaps, when clinicians encounter patients with FM, they should prioritize assessing depression and incorporate this information in their treatment conceptualization and plans.

In the case of those who have chronic pain and disability-associated neurologic conditions (Study 2); however, all three of the subgroups were significantly different in their level of pain interference above and beyond their baseline depressive symptoms and pain intensity, as well as medical symptom severity, duration of diagnoses, and mobility. Furthermore, the findings from the Study 2 sample show that without psychosocial treatment, these individuals who have low personal resources are more likely to experience high levels of pain interference that extend for many years. In fact, the Low Personal Resource group's pain interference scores across 4 years were consistently above a T score of 65, indicating a clinically significant—and stable—level of pain interference over many years.

Findings of Study 2 indicate that more emphasis should be put on increasing personal resources for effectively decreasing pain interference, particularly for those who are classified in the Low Personal Resource group. An important pathway for this subgroup could be to more systematically implement those chronic pain interventions that have accrued strong scientific evidence, such as cognitive–behavioral therapy (Ehde, Dillworth, & Turner, 2014) and acceptance- and mindfulness-based interventions (Veehof, Trompetter, Bohlmeijer, & Schreurs, 2016). Recent studies suggest some feasibility and effectiveness of broad dissemination of chronic pain interventions in nonpain specialty settings (Stewart et al., 2015). Technology-assisted interventions for chronic pain are also a promising and low-burden method that may increase the early access to evidence-based treatment of chronic pain for these individuals who are in need. Recent nation-wide statistics report that 89% of individuals in the United States have access to either the Internet or a smartphone (Poushter, Bishop, & Chwe, 2018; Pew Research Center, 2018). Even among those with an annual income below $30,000, more than 80% had access to the Internet or a smartphone (Pew Research Center, 2018; Poushter et al.,

2018). In fact, a number of recent studies demonstrated their comparable efficacy in improving various pain-related outcomes compared with face-to-face individual or group intervention format (de Boer, Versteegen, Vermeulen, Sanderman, & Struys, 2014; Heapy et al., 2015, 2017). Hence, providing evidence-based interventions for chronic pain through the Internet or smartphones could at least partially address the difficulty in patients gaining access to evidence-based psychosocial chronic pain interventions and the expensive cost of in-person delivery of these interventions.

Future Directions

A number of future research directions are suggested based on the present set of findings. First, in the present study, replication and extension of current findings to other distinct chronic pain conditions with more consistent and parsimonious personal resource measures is needed. In fact, a number of studies suggest that a more nuanced understanding of the potential influence of heterogeneity of chronic pain conditions will further inform the development of more effective and personalized interventions for chronic pain (e.g., Maixner, Fillingim, Williams, Smith, & Slade, 2016; Sluka & Clauw, 2016). Second, studies that longitudinally examine how socioeconomic disparity influences various personal resources, and pain interference are warranted. This would further inform understanding of the mechanisms between socioeconomic disparity and high-impact chronic pain. Third, future chronic pain intervention studies should consider identifying subgroups of individuals with chronic pain and determine the extent to which group membership moderates treatment outcome (e.g., Rhoades Cooper & Lanza, 2014). This type of analyses could address two important research questions that are relevant to intervention tailoring: (a) Which group of people benefit most from interventions for chronic pain?, and (b) Do different groups respond differently to different chronic pain interventions? (e.g., Day, Ehde, & Jensen, 2015). Fourth, as pointed out in the present study, addressing the economic disparity in chronic pain is important especially because individuals with economic disadvantages have substantial difficulty in accessing existing psychosocial interventions for chronic pain. As Thorn and her colleagues (Thorn et al., 2018) recently demonstrated, literacy-adapted CBT does not lose its therapeutic efficacy; thus, more effort is needed to simplify psychosocial interventions for chronic pain so that they become more accessible to these underserved populations.

Limitations

Several limitations should be considered when interpreting our results. First, all of the measures were based on self-report, which may increase the possibility of common method variance. Second, the social support diary measure that was used in Study 1 was not previously validated. However, similar to other well-validated measures of social support, the diary measure that we used in Study 1 captures participants' family, friends, or spouses' availability and support of participants. Third, the indicators that were used to classify individuals were not identical across the two studies. Study 1 included purpose in life and self-acceptance variables that were not available in Study 2. Study 2 included satisfaction with social role that was not available in Study 1. Furthermore, sleep quality and social support measures were as-

sessed with different methods (Study 1 with daily diary reporting and Study 2 with a one-time full battery assessment). Items that were used to measure sleep quality and social support were also not identical across studies. These differences could potentially have contributed to the differences found between the two studies in terms of subgroup proportions and outcome prediction. Fourth, our studies are missing some important additional personal resource indicators that could be useful for classifying individuals with chronic pain. For example, measures of pain catastrophizing (Quartana, Campbell, & Edwards, 2009) and perceived disability (Feuerstein & Thebarge, 1991)—that are both important modifiable resources for coping with pain—were not included. Future studies should examine whether inclusion of these variables would influence subgroup identification. Fifth, discrepancies in findings could also have emerged because of the different characteristics of Study 1 and Study 2 samples. While the Study 1 sample was comprised of individuals with a single diagnosis who were recruited for an intervention study, the Study 2 sample was comprised of individuals with various diagnostic conditions who were recruited for an observational study. Future studies should replicate our findings in other single-diagnosis chronic pain samples with identical measures. Sixth, in Study 1 both preintervention questionnaires and 21-day averages of some diary measures were used to classify individuals, which had some slight time differences between the two assessment time points. However, it was expected that both preintervention questionnaire data and averages of dairy diary data would capture individuals' overall stable tendencies. Consistent with this idea, a number of daily diary studies have used aggregated diary measures to assess trait-like variables (e.g., Karoly, Okun, Enders, & Tennen, 2014; O'Hara, Armeli, & Tennen, 2015; Zautra, Johnson, & Davis, 2005). Seventh, sleep quality was included as an indicator for personal resource profiling but may also be conceptualized as an outcome or comorbid condition. Lastly, although the sample of Study 1 was representative of the SES of a specific geographic region (i.e., Maricopa County) in Arizona (United States Census Bureau, 2017), it did not include a large proportion of individuals with low SES. Future studies should try to recruit a more representative sample to more precisely examine how socioeconomic disparities are associated with personal resources and pain interference. It would also be important to investigate how socioeconomic disadvantages might influence the use of technology (e.g., IVR system that was used in our study or ecological momentary assessment through smartphones) that assesses participants' cognition and behavior.

Summary and Conclusion

In two separate samples of persons with chronic pain we were able to identify three distinct subgroups. There was a substantial difference in annual income level among groups. More empirical studies and active discussions that tap into how we can reduce socioeconomic barriers that prevent individuals with chronic pain from developing personal resources and decreasing pain interference are needed. We found that the role of different personal resource profiles in pain interference also differed between the study samples. For individuals with FM, our findings suggest that a more thorough assessment (and treatment, when indicated) of depression may be particularly helpful when conceptualizing and planning treatment that is focused on reducing pain interference. In

the case of individuals with disabling conditions who also have chronic pain, the findings suggest evidence that pain interference does not appear to change significantly over time in subgroups of untreated individuals. The Low Personal Resource group, in particular, reported a clinical level of pain interference across 4 years, even when controlling for important confounders. Thus, strategies for effectively implementing accessible, evidence-based chronic pain interventions, especially for those individuals who are classified within the Low Personal Resource group, need to be actively pursued.

References

Affleck, G., Urrows, S., Tennen, H., Higgins, P., & Abeles, M. (1996). Sequential daily relations of sleep, pain intensity, and attention to pain among women with fibromyalgia. *Pain, 68,* 363–368. http://dx.doi.org/10.1016/S0304-3959(96)03226-5

Ahlstrand, I., Vaz, S., Falkmer, T., Thyberg, I., & Björk, M. (2017). Self-efficacy and pain acceptance as mediators of the relationship between pain and performance of valued life activities in women and men with rheumatoid arthritis. *Clinical Rehabilitation, 31,* 824–834. http://dx.doi.org/10.1177/0269215516646166

Amtmann, D., Bamer, A. M., Cook, K. F., Askew, R. L., Noonan, V. K., & Brockway, J. A. (2012). University of Washington self-efficacy scale: A new self-efficacy scale for people with disabilities. *Archives of Physical Medicine and Rehabilitation, 93,* 1757–1765. http://dx.doi.org/10.1016/j.apmr.2012.05.001

Arli, D., & Sutanto, N. (2018). Investigating the importance of self-acceptance and self-efficacy on weight management in a developing country. *International Journal of Nonprofit and Voluntary Sector Marketing, 23,* e1583. http://dx.doi.org/10.1002/nvsm.1583

Åsbring, P., & Närvänen, A. L. (2002). Women's experiences of stigma in relation to chronic fatigue syndrome and fibromyalgia. *Qualitative Health Research, 12,* 148–160.

Asparouhov, T., & Muthén, B. (2013). *Auxiliary variables in mixture modeling: A 3-step approach using Mplus.* Retrieved from http://statmodel.com/examples/webnotes/Aux-Mixture_submitted_corrected_webnote.pdf

Bandura, A. (1986). The explanatory and predictive scope of self-efficacy theory. *Journal of Social and Clinical Psychology, 4,* 359–373.

Bandura, A., O'Leary, A., Taylor, C. B., Gauthier, J., & Gossard, D. (1987). Perceived self-efficacy and pain control: Opioid and nonopioid mechanisms. *Journal of Personality and Social Psychology, 53,* 563–571. http://dx.doi.org/10.1037/0022-3514.53.3.563

Beatty, D. L., Kamarck, T. W., Matthews, K. A., & Shiffman, S. (2011). Childhood socioeconomic status is associated with psychosocial resources in African Americans: The Pittsburgh Healthy Heart Project. *Health Psychology, 30,* 472–480. http://dx.doi.org/10.1037/a0024304

Benzies, K., & Mychasiuk, R. (2009). Fostering family resiliency: A review of the key protective factors. *Child & Family Social Work, 14,* 103–114. http://dx.doi.org/10.1111/j.1365-2206.2008.00586.x

Bergström, C., Hagberg, J., Bodin, L., Jensen, I., & Bergström, G. (2011). Using a psychosocial subgroup assignment to predict sickness absence in a working population with neck and back pain. *BMC Musculoskeletal Disorders, 12,* 81. http://dx.doi.org/10.1186/1471-2474-12-81

Bernik, M., Sampaio, T. P., & Gandarela, L. (2013). Fibromyalgia comorbid with anxiety disorders and depression: Combined medical and psychological treatment. *Current Pain and Headache Reports, 17,* 358. http://dx.doi.org/10.1007/s11916-013-0358-3

Bigatti, S. M., Hernandez, A. M., Cronan, T. A., & Rand, K. L. (2008). Sleep disturbances in fibromyalgia syndrome: Relationship to pain and depression. *Arthritis Care and Research, 59,* 961–967. http://dx.doi.org/10.1002/art.23828

Bonanno, G. A., Brewin, C. R., Kaniasty, K., & Greca, A. M. L. (2010). Weighing the costs of disaster: Consequences, risks, and resilience in individuals, families, and communities. *Psychological Science in the Public Interest, 11,* 1–49.

Bradley, L. A. (2009). Pathophysiology of fibromyalgia. *The American Journal of Medicine, 122,* S22–S30. http://dx.doi.org/10.1016/j.amjmed.2009.09.008

Buysse, D. J., Yu, L., Moul, D. E., Germain, A., Stover, A., Dodds, N. E., . . . Pilkonis, P. A. (2010). Development and validation of patient-reported outcome measures for sleep disturbance and sleep-related impairments. *Sleep, 33,* 781–792. http://dx.doi.org/10.1093/sleep/33.6.781

Byrne, B. M. (2001). *Structural equation modeling with AMOS: Basic concepts, applications and programming.* Mahwah, NJ: Erlbaum.

Campbell, L. C., Clauw, D. J., & Keefe, F. J. (2003). Persistent pain and depression: A biopsychosocial perspective. *Biological Psychiatry, 54,* 399–409.

Campbell-Sills, L., & Stein, M. B. (2007). Psychometric analysis and refinement of the Connor-Davidson Resilience Scale (CD-RISC): Validation of a 10-item measure of resilience. *Journal of Traumatic Stress, 20,* 1019–1028. http://dx.doi.org/10.1002/jts.20271

Carson, S. H., & Langer, E. J. (2006). Mindfulness and self-acceptance. *Journal of Rational-Emotive & Cognitive-Behavior Therapy, 24,* 29–43. http://dx.doi.org/10.1007/s10942-006-0022-5

Cella, D., Riley, W., Stone, A., Rothrock, N., Reeve, B., Yount, S., . . . the PROMIS Cooperative Group. (2010). The Patient-Reported Outcomes Measurement Information System (PROMIS) developed and tested its first wave of adult self-reported health outcome item banks: 2005–2008. *Journal of Clinical Epidemiology, 63,* 1179–1194. http://dx.doi.org/10.1016/j.jclinepi.2010.04.011

Chwastiak, L. A., & Von Korff, M. (2003). Disability in depression and back pain: Evaluation of the World Health Organization Disability Assessment Schedule (WHO DAS II) in a primary care setting. *Journal of Clinical Epidemiology, 56,* 507–514. http://dx.doi.org/10.1016/S0895-4356(03)00051-9

Cicchetti, D., & Rogosch, F. A. (1996). Equifinality and multifinality in developmental psychopathology. *Development and Psychopathology, 8,* 597–600. http://dx.doi.org/10.1017/S0954579400007318

Clark, S., & Muthen, B. (2009). *Relating latent class analysis results to variables not included in the analysis.* Retrieved from https://www.statmodel.com/download/relatinglca.pdf

Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2003). *Applied multiple regression/correlation analysis for the behavioral sciences* (3rd ed.). Mahwah, NJ: Erlbaum Publishers.

Collins, L. M., & Lanza, S. T. (2010). *Latent class and latent transition analysis: With applications in the social, behavioral, and health sciences.* New York, NY: Wiley.

Cook, R. D. (1977). Detection of influential observation in linear regression. *Technometrics, 19,* 15–18.

Dahlhamer, J., Lucas, J., Zelaya, C., Nahin, R., Mackey, S., DeBar, L., . . . Helmick, C. (2018). Prevalence of chronic pain and high-impact chronic pain among adults—United States, 2016. *Morbidity and Mortality Weekly Report, 67,* 1001–1006.

Day, M. A., Ehde, D. M., & Jensen, M. P. (2015). Psychosocial pain management moderation: The limit, activate, and enhance model. *The Journal of Pain, 16,* 947–960. http://dx.doi.org/10.1016/j.jpain.2015.07.003

de Boer, M. J., Versteegen, G. J., Vermeulen, K. M., Sanderman, R., & Struys, M. M. R. F. (2014). A randomized controlled trial of an Internet-based cognitive-behavioural intervention for non-specific chronic pain: An effectiveness and cost-effectiveness study. *European Journal of Pain, 18,* 1440–1451. http://dx.doi.org/10.1002/ejp.509

Edwards, C. L., Fillingim, R. B., & Keefe, F. (2001). Race, ethnicity and pain. *Pain, 94,* 133–137. http://dx.doi.org/10.1016/S0304-3959(01)00408-0

Ehde, D. M., Dillworth, T. M., & Turner, J. A. (2014). Cognitive-behavioral therapy for individuals with chronic pain: Efficacy, innovations, and directions for research. *American Psychologist, 69,* 153–166. http://dx.doi.org/10.1037/a0035747

Evans, J. D. (1996). *Straightforward statistics for the behavioral sciences.* Pacific Grove, CA: Brooks/Cole Publishing.

Feuerstein, M., & Thebarge, R. W. (1991). Perceptions of disability and occupational stress as discriminators of work disability in patients with chronic pain. *Journal of Occupational Rehabilitation, 1,* 185–195. http://dx.doi.org/10.1007/BF01073455

Finan, P. H., Goodin, B. R., & Smith, M. T. (2013). The association of sleep and pain: An update and a path forward. *The Journal of Pain, 14,* 1539–1552. http://dx.doi.org/10.1016/j.jpain.2013.08.007

Fordyce, W. E. (1976). *Behavioral methods for chronic pain and illness.* St. Louis, MO: C. V Mosby.

Frankl, V. E. (1963). *Man's search for meaning: An introduction to logotherapy, part one.* New York, NY: Washington Square Press.

Friborg, O., Hjemdal, O., Rosenvinge, J. H., & Martinussen, M. (2003). A new rating scale for adult resilience: What are the central protective resources behind healthy adjustment? *International Journal of Methods in Psychiatric Research, 12,* 65–76. http://dx.doi.org/10.1002/mpr.143

Gallo, L. C., Bogart, L. M., Vranceanu, A. M., & Matthews, K. A. (2005). Socioeconomic status, resources, psychological experiences, and emotional responses: A test of the reserve capacity model. *Journal of Personality and Social Psychology, 88,* 386–399. http://dx.doi.org/10.1037/0022-3514.88.2.386

Gallo, L. C., de Los Monteros, K. E., & Shivpuri, S. (2009). Socioeconomic status and health: What is the role of reserve capacity? *Current Directions in Psychological Science, 18,* 269–274. http://dx.doi.org/10.1111/j.1467-8721.2009.01650.x

Gaskin, D. J., & Richard, P. (2012). The economic costs of pain in the United States. *The Journal of Pain, 13,* 715–724. http://dx.doi.org/10.1016/j.jpain.2012.03.009

Gottlieb, B. H., & Bergen, A. E. (2010). Social support concepts and measures. *Journal of Psychosomatic Research, 69,* 511–520. http://dx.doi.org/10.1016/j.jpsychores.2009.10.001

Gracely, R. H., Ceko, M., & Bushnell, M. C. (2012). Fibromyalgia and depression. *Pain Research and Treatment, 2012,* Article ID 486590. http://dx.doi.org/10.1155/2012/486590

Grimm, K. J., & Ram, N. (2009). Non-linear growth models in M*plus* and SAS. *Structural Equation Modeling, 16,* 676–701. http://dx.doi.org/10.1080/10705510903206055

Häuser, W., Bernardy, K., Üçeyler, N., & Sommer, C. (2009). Treatment of fibromyalgia syndrome with antidepressants: A meta-analysis. *Journal of the American Medical Association, 301,* 198–209. http://dx.doi.org/10.1001/jama.2008.944

Häuser, W., Wolfe, F., Tölle, T., Üçeyler, N., & Sommer, C. (2012). The role of antidepressants in the management of fibromyalgia syndrome: A systematic review and meta-analysis. *CNS Drugs, 26,* 297–307. http://dx.doi.org/10.2165/11598970-000000000-00000

Hayes, S. C., Strosahl, K. D., & Wilson, K. G. (1999). *Acceptance and commitment therapy: An experiential approach to behavior change.* New York, NY: Guilford Press.

Haythornthwaite, J. A., Hegel, M. T., & Kerns, R. D. (1991). Development of a sleep diary for chronic pain patients. *Journal of Pain and Symptom Management, 6,* 65–72. http://dx.doi.org/10.1016/0885-3924(91)90520-E

Heapy, A. A., Higgins, D. M., Cervone, D., Wandner, L., Fenton, B. T., & Kerns, R. D. (2015). A systematic review of technology-assisted self-management interventions for chronic pain: Looking across treatment modalities. *The Clinical Journal of Pain, 31,* 470–492. http://dx.doi.org/10.1097/AJP.0000000000000185

Heapy, A. A., Higgins, D. M., Goulet, J. L., LaChappelle, K. M., Driscoll, M. A., Czlapinski, R. A., . . . Kerns, R. D. (2017). Interactive voice response–based self-management for chronic back pain: The COPES noninferiority randomized trial. *Journal of the American Medical Association Internal Medicine, 177,* 765–773. http://dx.doi.org/10.1001/jamainternmed.2017.0223

Hobfoll, S. E., Johnson, R. J., Ennis, N., & Jackson, A. P. (2003). Resource loss, resource gain, and emotional outcomes among inner city women. *Journal of Personality and Social Psychology, 84,* 632–643. http://dx.doi.org/10.1037/0022-3514.84.3.632

Hudson, J. I., Arnold, L. M., Keck, P. E., Jr., Auchenbach, M. B., & Pope, H. G., Jr. (2004). Family study of fibromyalgia and affective spectrum disorder. *Biological Psychiatry, 56,* 884–891. http://dx.doi.org/10.1016/j.biopsych.2004.08.009

IBM Corp. (2013). IBM SPSS statistics for windows (Version 22.0) [Computer software]. Armonk, NY: Author.

Janevic, M. R., McLaughlin, S. J., Heapy, A. A., Thacker, C., & Piette, J. D. (2017). Racial and socioeconomic disparities in disabling chronic pain: Findings from the health and retirement study. *The Journal of Pain, 18,* 1459–1467. http://dx.doi.org/10.1016/j.jpain.2017.07.005

Jensen, M. P., Ehde, D. M., Hoffman, A. J., Patterson, D. R., Czerniecki, J. M., & Robinson, L. R. (2002). Cognitions, coping and social environment predict adjustment to phantom limb pain. *Pain, 95,* 133–142. http://dx.doi.org/10.1016/S0304-3959(01)00390-6

Jensen, M. P., & Karoly, P. (1991). Control beliefs, coping efforts, and adjustment to chronic pain. *Journal of Consulting and Clinical Psychology, 59,* 431–438. http://dx.doi.org/10.1037/0022-006X.59.3.431

Jensen, M. P., Karoly, P., & Braver, S. (1986). The measurement of clinical pain intensity: A comparison of six methods. *Pain, 27,* 117–126. http://dx.doi.org/10.1016/0304-3959(86)90228-9

Jensen, M. P., Turner, J. A., & Romano, J. M. (1991). Self-efficacy and outcome expectancies: Relationship to chronic pain coping strategies and adjustment. *Pain, 44,* 263–269. http://dx.doi.org/10.1016/0304-3959(91)90095-F

Johannes, C. B., Le, T. K., Zhou, X., Johnston, J. A., & Dworkin, R. H. (2010). The prevalence of chronic pain in United States adults: Results of an Internet-based survey. *The Journal of Pain, 11,* 1230–1239. http://dx.doi.org/10.1016/j.jpain.2010.07.002

Judge, T. A., Erez, A., & Bono, J. E. (1998). The power of being positive: The relation between positive self-concept and job performance. *Human Performance, 11*(2–3), 167–187.

Jung, T., & Wickrama, K. S. (2008). An introduction to latent class growth analysis and growth mixture modeling. *Social and Personality Psychology Compass, 2,* 302–317. http://dx.doi.org/10.1111/j.1751-9004.2007.00054.x

Kahn, J. R., & Pearlin, L. I. (2006). Financial strain over the life course and health among older adults. *Journal of Health and Social Behavior, 47,* 17–31. http://dx.doi.org/10.1177/002214650604700102

Kamen, C., Jabson, J. M., Mustian, K. M., & Boehmer, U. (2017). Minority stress, psychosocial resources, and psychological distress among sexual minority breast cancer survivors. *Health Psychology, 36,* 529–537. http://dx.doi.org/10.1037/hea0000465

Kamp Dush, C. M., & Amato, P. R. (2005). Consequences of relationship status and quality for subjective well-being. *Journal of Social and Personal Relationships, 22,* 607–627. http://dx.doi.org/10.1177/0265407505056438

Karoly, P., & Jensen, M. P. (1987). *Multimethod assessment of chronic pain.* New York, NY: Pergamon Press.

Karoly, P., Okun, M. A., Enders, C., & Tennen, H. (2014). Effects of pain intensity on goal schemas and goal pursuit: A daily diary study. *Health Psychology, 33,* 968–976. http://dx.doi.org/10.1037/hea0000093

Kerns, R. D. (2018). Shining the LAMP on efforts to transform pain care in America. *Annals of Internal Medicine, 168,* 517–518. http://dx.doi.org/10.7326/M18-0061

Kerns, R. D., Turk, D. C., & Rudy, T. E. (1985). The West Haven-Yale Multidimensional Pain Inventory (WHYMPI). *Pain, 23,* 345–356. http://dx.doi.org/10.1016/0304-3959(85)90004-1

Kline, R. B. (1998). *Principals and practice of structural equation modeling.* New York, NY: Guilford Press.

Kothari, D. J., Davis, M. C., Yeung, E. W., & Tennen, H. A. (2015). Positive affect and pain: Mediators of the within-day relation linking sleep quality to activity interference in fibromyalgia. *Pain, 156,* 540–546. http://dx.doi.org/10.1097/01.j.pain.0000460324.18138.0a

Kraaimaat, F. W., van Dam-Baggen, C. M. J., & Bijlsma, J. W. J. (1995). Depression, anxiety and social support in rheumatoid arthritic women without and with a spouse. *Psychology & Health, 10,* 387–396. http://dx.doi.org/10.1080/08870449508401958

Krebs, E. E., Carey, T. S., & Weinberger, M. (2007). Accuracy of the pain numeric rating scale as a screening test in primary care. *Journal of General Internal Medicine, 22,* 1453–1458. http://dx.doi.org/10.1007/s11606-007-0321-2

Kroenke, K., Spitzer, R. L., & Williams, J. B. (2001). The PHQ-9: Validity of a brief depression severity measure. *Journal of General Internal Medicine, 16,* 606–613. http://dx.doi.org/10.1046/j.1525-1497.2001.016009606.x

Lanza, S. T., Rhoades, B. L., Nix, R. L., & Greenberg, M. T., & the Conduct Problems Prevention Research Group. (2010). Modeling the interplay of multilevel risk factors for future academic and behavior problems: A person-centered approach. *Development and Psychopathology, 22,* 313–335. http://dx.doi.org/10.1017/S0954579410000088

Lo, Y., Mendell, N. R., & Rubin, D. B. (2001). Testing the number of components in a normal mixture. *Biometrika, 88,* 767–778. http://dx.doi.org/10.1093/biomet/88.3.767

Maixner, W., Fillingim, R. B., Williams, D. A., Smith, S. B., & Slade, G. D. (2016). Overlapping chronic pain conditions: Implications for diagnosis and classification. *The Journal of Pain, 17,* T93–T107. http://dx.doi.org/10.1016/j.jpain.2016.06.002

McCracken, L. M., & Eccleston, C. (2005). A prospective study of acceptance of pain and patient functioning with chronic pain. *Pain, 118,* 164–169. http://dx.doi.org/10.1016/j.pain.2005.08.015

McCracken, L. M., & Iverson, G. L. (2002). Disrupted sleep patterns and daily functioning in patients with chronic pain. *Pain Research & Management, 7,* 75–79. http://dx.doi.org/10.1155/2002/579425

McCracken, L. M., Spertus, I. L., Janeck, A. S., Sinclair, D., & Wetzel, F. T. (1999). Behavioral dimensions of adjustment in persons with chronic pain: Pain-related anxiety and acceptance. *Pain, 80,* 283–289. http://dx.doi.org/10.1016/S0304-3959(98)00219-X

McCracken, L. M., Vowles, K. E., & Eccleston, C. (2004). Acceptance of chronic pain: Component analysis and a revised assessment method. *Pain, 107,* 159–166. http://dx.doi.org/10.1016/j.pain.2003.10.012

McInnis, O. A., Matheson, K., & Anisman, H. (2014). Living with the unexplained: Coping, distress, and depression among women with chronic fatigue syndrome and/or fibromyalgia compared to an autoimmune disorder. *Anxiety, Stress, & Coping, 27,* 601–618. http://dx.doi.org/10.1080/10615806.2014.888060

McLachlan, G., & Peel, D. (2000). *Finite mixture models.* New York, NY: John Wiley & Sons.

Mun, C. J., Karoly, P., & Okun, M. A. (2015). Effects of daily pain intensity, positive affect, and individual differences in pain acceptance on work goal interference and progress. *Pain, 156,* 2276–2285. http://dx.doi.org/10.1097/j.pain.0000000000000278

Muthén, B. (2004). Latent variable analysis. In D. Kaplan (Ed.), *The Sage handbook of quantitative methodology for the social sciences* (pp. 346–368). Thousand Oaks, CA: Sage. http://dx.doi.org/10.4135/9781412986311.n19

Muthén, L. K., & Muthén, B. O. (2012). *Mplus* (Version 7.1). Los Angeles, CA: Author.

Myers, H. F. (2009). Ethnicity- and socio-economic status-related stresses in context: An integrative review and conceptual model. *Journal of Behavioral Medicine, 32,* 9–19. http://dx.doi.org/10.1007/s10865-008-9181-4

Nygren, B., Aléx, L., Jonsén, E., Gustafson, Y., Norberg, A., & Lundman, B. (2005). Resilience, sense of coherence, purpose in life and self-transcendence in relation to perceived physical and mental health among the oldest old. *Aging & Mental Health, 9,* 354–362. http://dx.doi.org/10.1080/1360500114415

Nylund, K. L., Asparouhov, T., & Muthén, B. O. (2007). Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte Carlo simulation study. *Structural Equation Modeling, 14,* 535–569. http://dx.doi.org/10.1080/10705510701575396

O'Hara, R. E., Armeli, S., & Tennen, H. (2015). College students' drinking motives and social-contextual factors: Comparing associations across levels of analysis. *Psychology of Addictive Behaviors, 29,* 420–429. http://dx.doi.org/10.1037/adb0000046

Onen, S. H., Alloui, A., Gross, A., Eschallier, A., & Dubray, C. (2001). The effects of total sleep deprivation, selective sleep interruption and sleep recovery on pain tolerance thresholds in healthy subjects. *Journal of Sleep Research, 10,* 35–42. http://dx.doi.org/10.1046/j.1365-2869.2001.00240.x

Palisano, R., Rosenbaum, P., Walter, S., Russell, D., Wood, E., & Galuppi, B. (1997). Development and reliability of a system to classify gross motor function in children with cerebral palsy. *Developmental Medicine & Child Neurology, 39,* 214–223. http://dx.doi.org/10.1111/j.1469-8749.1997.tb07414.x

Pew Research Center. (2018, February 05). *Mobile fact sheet.* Retrieved from http://www.pewinternet.org/fact-sheet/mobile/

Poushter, J., Bishop, C., & Chwe, H. (2018). *Social media use continues to rise in developing countries, but plateaus across developed ones.* Washington, DC: Pew Internet and American Life Project.

Quartana, P. J., Campbell, C. M., & Edwards, R. R. (2009). Pain catastrophizing: a critical review. *Expert Rreview of Neurotheutics, 9,* 745–758.

Rabey, M., Smith, A., Beales, D., Slater, H., & O'Sullivan, P. (2016). Differing psychologically derived clusters in people with chronic low back pain are associated with different multidimensional profiles. *The Clinical Journal of Pain, 32,* 1015–1027. http://dx.doi.org/10.1097/AJP.0000000000000363

Ramaswamy, V., Desarbo, W. S., Reibstein, D. J., & Robinson, W. T. (1993). An empirical pooling approach for estimating marketing mix elasticities with PIMS data. *Marketing Science, 12,* 103–124. http://dx.doi.org/10.1287/mksc.12.1.103

Reynolds, W. M., & Kobak, K. A. (1995a). *Hamilton Depression Inventory: A self-report version of the Hamilton Depression Rating Scale (HDRS).* Odessa, FL: Psychological Assessment Resources, Inc.

Reynolds, W. M., & Kobak, K. A. (1995b). Reliability and validity of the Hamilton Depression Inventory: A paper-and-pencil version of the Hamilton Depression Rating Scale Clinical Interview. *Psychological Assessment, 7,* 472–483. http://dx.doi.org/10.1037/1040-3590.7.4.472

Rhoades Cooper, B., & Lanza, S. T. (2014). Who benefits most from Head Start? Using latent class moderation to examine differential treatment effects. *Child Development, 85,* 2317–2338.

Rudy, T. E., Kerns, R. D., & Turk, D. C. (1988). Chronic pain and depression: Toward a cognitive-behavioral mediation model. *Pain, 35,* 129–140. http://dx.doi.org/10.1016/0304-3959(88)90220-5

Rutter, M. (1987). Psychosocial resilience and protective mechanisms. *American Journal of Orthopsychiatry, 57,* 316–331. http://dx.doi.org/10.1111/j.1939-0025.1987.tb03541.x

Ryff, C. D., & Keyes, C. L. M. (1995). The structure of psychological well-being revisited. *Journal of Personality and Social Psychology, 69,* 719–727. http://dx.doi.org/10.1037/0022-3514.69.4.719

Schleicher, H., Alonso, C., Shirtcliff, E. A., Muller, D., Loevinger, B. L., & Coe, C. L. (2005). In the face of pain: The relationship between psychological well-being and disability in women with fibromyalgia. *Psychotherapy and Psychosomatics, 74,* 231–239.

Schoofs, N., Bambini, D., Ronning, P., Bielak, E., & Woehl, J. (2004). Death of a lifestyle: The effects of social support and healthcare support on the quality of life of persons with fibromyalgia and/or chronic fatigue syndrome. *Orthopedic Nursing, 23,* 364–374. http://dx.doi.org/10.1097/00006416-200411000-00005

Schwarz, G. (1978). Estimating the dimension of a model. *Annals of Statistics, 6,* 461–464. http://dx.doi.org/10.1214/aos/1176344136

Sclove, S. L. (1987). Application of model-selection criteria to some problems in multivariate analysis. *Psychometrika, 52,* 333–343. http://dx.doi.org/10.1007/BF02294360

Scott, E. L., Kroenke, K., Wu, J., & Yu, Z. (2016). Beneficial effects of improvement in depression, pain catastrophizing, and anxiety on pain outcomes: A 12-month longitudinal analysis. *The Journal of Pain, 17,* 215–222. http://dx.doi.org/10.1016/j.jpain.2015.10.011

Shrout, P. E., & Rodgers, J. L. (2018). Psychology, science, and knowledge construction: Broadening perspectives from the replication crisis. *Annual Review of Psychology, 69,* 487–510. http://dx.doi.org/10.1146/annurev-psych-122216-011845

Singer, J. D., & Willett, J. B. (2003). *Applied longitudinal data analysis: Modeling change and event occurrence.* Cambridge: Oxford University Press. http://dx.doi.org/10.1093/acprof:oso/9780195152968.001.0001

Sluka, K. A., & Clauw, D. J. (2016). Neurobiology of fibromyalgia and chronic widespread pain. *Neuroscience, 338,* 114–129. http://dx.doi.org/10.1016/j.neuroscience.2016.06.006

Smith, B. W., Dalen, J., Wiggins, K., Tooley, E., Christopher, P., & Bernard, J. (2008). The brief resilience scale: Assessing the ability to bounce back. *International Journal of Behavioral Medicine, 15,* 194–200. http://dx.doi.org/10.1080/10705500802222972

Smith, M. T., Perlis, M. L., Smith, M. S., Giles, D. E., & Carmody, T. P. (2000). Sleep quality and presleep arousal in chronic pain. *Journal of Behavioral Medicine, 23,* 1–13. http://dx.doi.org/10.1023/A:1005444719169

de Souza, L. K. D., & Hutz, C. S. (2016). Self-compassion in relation to self-esteem, self-efficacy and demographical aspects. *Paidéia, 26,* 181–188. http://dx.doi.org/10.1590/1982-43272664201604

Stewart, W. F., Yan, X., Boscarino, J. A., Maeng, D. D., Mardekian, J., Sanchez, R. J., & Von Korff, M. R. (2015). Patterns of health care utilization for low back pain. *Journal of Pain Research, 8,* 523–535.

Sturgeon, J. A., & Zautra, A. J. (2010). Resilience: A new paradigm for adaptation to chronic pain. *Current Pain and Headache Reports, 14,* 105–112. http://dx.doi.org/10.1007/s11916-010-0095-9

Thorn, B. E., Eyer, J. C., Van Dyke, B. P., Torres, C. A., Burns, J. W., Smith, L. J., & Tucker, D. H. (2018). Literacy-Adapted Cognitive Behavioral Therapy Versus Education for Chronic Pain at Low-Income Clinics. *Annals of Internal Medicine, 168,* 471–480.

Thorsell, J., Finnes, A., Dahl, J., Lundgren, T., Gybrant, M., Gordh, T., & Buhrman, M. (2011). A comparative study of 2 manual-based self-help interventions, acceptance and commitment therapy and applied relaxation, for persons with chronic pain. *The Clinical Journal of Pain, 27,* 716–723. http://dx.doi.org/10.1097/AJP.0b013e318219a933

Trauer, J. M., Qian, M. Y., Doyle, J. S., Rajaratnam, S. M., & Cunnington, D. (2015). Cognitive behavioral therapy for chronic insomnia: A systematic review and meta-analysis. *Annals of Internal Medicine, 163,* 191–204. http://dx.doi.org/10.7326/M14-2841

Turk, D. C., & Rudy, T. E. (1988). Toward an empirically derived taxonomy of chronic pain patients: Integration of psychological assessment data. *Journal of Consulting and Clinical Psychology, 56,* 233–238. http://dx.doi.org/10.1037/0022-006X.56.2.233

Turner, R. J., & Lloyd, D. A. (1999). The stress process and the social distribution of depression. *Journal of Health and Social Behavior, 40,* 374–404. http://dx.doi.org/10.2307/2676332

Turner, R. J., Taylor, J., & Van Gundy, K. (2004). Personal resources and depression in the transition to adulthood: Ethnic comparisons. *Journal of Health and Social Behavior, 45,* 34–52. http://dx.doi.org/10.1177/002214650404500103

Üçeyler, N., Häuser, W., & Sommer, C. (2008). A systematic review on the effectiveness of treatment with antidepressants in fibromyalgia syndrome. *Arthritis Care and Research, 59,* 1279–1298. http://dx.doi.org/10.1002/art.24000

United States Census Bureau. (2017). *Quick facts Maricopa County, AZ.* Retrieved from https://www.census.gov/quickfacts/fact/table/maricopacountyarizona/EDU635217#EDU635217

van den Heuvel, M., Demerouti, E., Bakker, A. B., & Schaufeli, W. B. (2010). Personal resources and work engagement in the face of change. *Contemporary Occupational Health Psychology: Global Perspectives on Research and Practice, 1,* 124–150. http://dx.doi.org/10.1002/9780470661550.ch7

Veehof, M. M., Trompetter, H. R., Bohlmeijer, E. T., & Schreurs, K. M. G. (2016). Acceptance- and mindfulness-based interventions for the treatment of chronic pain: A meta-analytic review. *Cognitive Behaviour Therapy, 45,* 5–31. http://dx.doi.org/10.1080/16506073.2015.1098724

Waltz, M., Kriegel, W., & Van'T Pad Bosch, P. (1998). The social environment and health in rheumatoid arthritis: Marital quality predicts individual variability in pain severity. *Arthritis Care & Research, 11,* 356–374. http://dx.doi.org/10.1002/art.1790110507

West, S. G., Finch, J. F., & Curran, P. J. (1995). Structural equation models with nonnormal variables: Problems and remedies. In R. H. Hoyle (Ed.), *Structural equation modeling: Concepts, issues, and applications* (pp. 56–75). Thousand Oaks, CA: Sage.

Widaman, K. F. (2006). Missing data: What to do with or without them. *Monographs of the Society for Research in Child Development, 71,* 42–64.

Wolfe, F., Clauw, D. J., Fitzcharles, M. A., Goldenberg, D. L., Katz, R. S., Mease, P., . . . Yunus, M. B. (2010). The American College of Rheumatology preliminary diagnostic criteria for fibromyalgia and measurement of symptom severity. *Arthritis Care & Research, 62,* 600–610.

Zautra, A. J., Johnson, L. M., & Davis, M. C. (2005). Positive affect as a source of resilience for women in chronic pain. *Journal of Consulting and Clinical Psychology, 73,* 212–220. http://dx.doi.org/10.1037/0022-006X.73.2.212

Zimet, G. D., Powell, S. S., Farley, G. K., Werkman, S., & Berkoff, K. A. (1990). Psychometric characteristics of the multidimensional scale of perceived social support. *Journal of Personality Assessment, 55,* 610–617. http://dx.doi.org/10.1080/00223891.1990.9674095