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Pain catastrophizing, perceived injustice, and pain intensity impair life satisfaction through differential patterns of physical and psychological disruption

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Abstract

Background and purpose—Previous research has highlighted the importance of cognitive appraisal processes in determining the nature and effectiveness of coping with chronic pain. Two of the key variables implicated in appraisal of pain are catastrophizing and perceived injustice, which exacerbate the severity of pain-related distress and increase the risk of long-term disability through maladaptive behavioral responses. However, to date, the influences of these phenomena have not been examined concurrently, nor have they been related specifically to quality of life measures, such as life satisfaction.

Methods—Using data from an online survey of 330 individuals with chronic pain, structural path modeling techniques were used to examine the independent effects of pain catastrophizing, perceived injustice, and average pain intensity on life satisfaction. Two potential mediators of these relationships were examined: depressive symptoms and pain-related interference.

Results—Results indicated that depressive symptoms fully mediated the relationship between pain catastrophizing and life satisfaction, and pain interference fully mediated the relationship between pain intensity and life satisfaction. Both depressive symptoms and pain interference were found to significantly mediate the relationship between perceived injustice and life satisfaction, but

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The authors have no conflicts of interest to disclose.

Ethical Issues

The current study was conducted under an IRB-approved protocol for an observational study (a questionnaire validation study; study results not presented here). Participant consent was obtained using the online REDCap system by clicking a link after being provided an information sheet on the online study; participants could not advance to completing study questionnaires without completing the online informed consent. The study protocol was not registered with any organization outside of the institution where the study was conducted.

perceived injustice continued to demonstrate a significant and negative relationship with life satisfaction, above and beyond the other study variables.

Conclusions—The current findings highlight the distinct affective and behavioral mediators of pain and maladaptive cognitive appraisal processes in chronic pain, and highlight their importance in both perceptions of pain-related interference and longer-term quality of life.

Keywords

Pain catastrophizing; perceived injustice; life satisfaction; pain interference; depression

Introduction

The role of cognitive appraisals in coping and overall adjustment to chronic pain has been well-documented (1, 2). Appraisals typically develop in a milieu of cultural orientations and justice principles (3), rendering socially-constructed justice principles of the pain experience (e.g. fairness of the experience), an emerging area of study. Perception of injustice, defined as an appraisal reflecting the severity and irreparability of injury- or disability-related loss, blame, and unfairness, has been identified as a significant barrier to effective recovery after acute injury (4–7), and predicts poorer outcomes in both acute pain and chronic pain populations (4, 6). For example, individuals who view their pain as unjust tend to report greater pain (8, 9) and depressive symptoms (10–12) and show greater susceptibility to maladaptive pain behaviors (13, 14). Perceived injustice may bias an individual's appraisal process to loss and blame-related cues, thus limiting their coping repertoire.

In addition to injustice appraisals, other cognitive processes can complicate effective adaptation to chronic pain, most notably viewing pain as a catastrophic personal experience. Pain catastrophizing is a pattern of negative key appraisal process, defined as “exaggerated cognitive and affective reaction to an expected or actual pain experience” (15). It plays an important role in chronic pain and appears to be directly related to pain intensity, disability, emotional distress, and physical dysfunction (16–19). Pain catastrophizing narrows an individual's cognitive focus to threat-related cues, which subsequently contributes to rigid and less effective coping styles (20, 21).

Variability in appraisal processes has been shown to be related to adjustment and recovery outcomes (22); however, the degree of overlap between these processes, as well as the mechanisms of effect, remain unclear. Of interest are mechanisms related to emotional distress and perceptions of daily life function, as they can facilitate targeted interventions and influence broader life outcomes. For example, depression in chronic pain may occur because pain impedes an individual's motivation to achieve goals and engage in valued pursuits (23, 24) thereby reducing quality of life. Similarly, pain-related interference shows a longitudinal relationship with emotional distress (25) and low life satisfaction in some pain populations (26), highlighting the possibility that broader perceptions of pain as a barrier to function might mediate the relationship between appraisals of pain and quality of life outcomes.

It is notable that beyond the initial validation study that demonstrated some incremental predictive validity of a measure of perceived injustice above and beyond the effects of pain catastrophizing (6), perceived injustice and pain catastrophizing are rarely examined together in predictive models. The current study examined the direct effects of pain intensity, perceived injustice, and pain catastrophizing on life satisfaction in an Internet-based sample of 330 individuals with chronic pain. Based on the expectation that the effects of chronic pain-specific factors may influence life satisfaction through indicators of broader physical and psychosocial function, we expected that a significant degree of the effects of pain intensity, pain catastrophizing and perceived injustice on life satisfaction would be explained by the presence of depressive symptoms and pain-related interference.

Methods

Procedure

The current study constitutes a secondary data analysis of a questionnaire validation study (manuscript in preparation; results not reported here). Participants were asked to complete a set of Internet-based questionnaires. Participants were recruited via e-mails sent to prior participants from the Stanford Neuroscience and Pain Laboratory, and via an open recruitment link posted by the National Pain Report (www.nationalpainreport.com). Study measures were administered using the REDCap online survey system (27). All responses were anonymous, and participants were not compensated for their participation. As a result, the study was approved by the Stanford University Institutional Review Board as an exempt protocol. Participant consent was obtained through the REDCap system by clicking a link after being provided an information sheet on the online study; participants could not advance to completing study questionnaires without completing the online informed consent. Eligibility criteria were minimal: being 18 years of age or older, being able to read and write in English, and the presence of a chronic pain condition. As the initial target of the study was validation of a self-report measure containing an item pool of 35 items, a sample of at least 350 was considered optimal.

Participants

The initial online data collection included 497 people who completed the online consent; of these, 330 participants provided sufficient data to be included in the current analysis, which constituted the sample for analysis. The sample was 90% female and predominantly Caucasian (92.7% of the overall sample). Median age, which was assessed using a categorical variable reflecting 10-year increments, was between 40 and 49 years. Regarding marital status, 54.8% of the sample reported being married at the time of data collection. Median education level was a completed Associate's Degree. Mean average pain intensity over the previous 30 days was 6.42 (SD = 1.53) out of 10, and mean pain duration was 15 years (SD = 6.42, range: 1 year to 60 years). Regarding psychological history, 43.6% of the sample reported a previous mental health diagnosis, 50.3% of the sample reported no prior mental health diagnosis, and 6.1% declined to answer this question. Pain diagnosis information was obtained via self-report, and was broadly categorized according to common causes of pain (e.g., nerve pain) or common pain diagnoses (e.g., fibromyalgia). Participants reported their prior pain diagnoses using a free-text entry, which was then coded by the lead

author into 12 pain categories. Pain diagnosis categories were not mutually exclusive: 138 participants endorsed a single pain category, 103 participants endorsed 2 pain categories, 30 participants endorsed 3 or more pain categories, and 8 participants endorsed 4 or more pain categories. Full diagnosis information can be found in Table 1. The most commonly endorsed pain categories were fibromyalgia, musculoskeletal pain, nerve pain, pain associated with a rheumatic or autoimmune disease, and headaches or orofacial pain.

Measures

PROMIS Depression and Pain Interference—Depression and pain interference were assessed using 6-item short-form versions of the Patient-Reported Outcome Measurement Information System (PROMIS) Depression and Pain Interference instruments (28). PROMIS Depression items assess negative mood, negative views of the self, negative cognitions, and decreased positive emotion and engagement. PROMIS pain interference items assess the severity of pain-related interference in multiple domains of life, including social, recreational, cognitive, emotional, and overall physical functioning domains. All PROMIS assessments were converted from raw scores to t-scores, consistent with their initial publications. Higher scores on depression signified greater severity of these symptoms. Similarly, higher scores on PROMIS Pain Interference reflect greater pain-related interference. Questions were framed according to the experience of symptoms or functioning over the past 7 days using a 5-point Likert scale from 1 (“Never”) to 5 (“Always”). In this sample, both measures demonstrated high internal consistency (depression $\alpha = .929$; pain interference $\alpha = .934$).

Pain intensity—Average pain intensity over the previous 30 days was rated on an 11-point numerical rating scale (NRS) with 0 representing “no pain” and 10 representing “worst pain imaginable.” Use of numerical rating scale has been identified as a suitable assessment of pain intensity in acute and chronic pain populations in previous studies (29).

Life satisfaction—Life satisfaction was assessed using the 5-item Satisfaction with Life Questionnaire (SWLS). The 5-item measure assesses satisfaction with life as a whole. For each item, participants rate their satisfaction on a scale from 1 (*strongly disagree*) to 7 (*strongly agree*); scores are summed to calculate a total score that ranges from 5 to 35 (with higher scores reflecting greater life satisfaction). This scale shows discriminant validity from emotional well-being measures, good test-retest stability and sufficient sensitivity to detect changes (30). In this sample, this measure demonstrated adequate internal consistency (Cronbach’s $\alpha = .881$).

Pain catastrophizing—Pain catastrophizing was assessed using the Pain Catastrophizing Scale (31), a 13-item self-report questionnaire widely used to assess catastrophizing tendencies in chronic pain research and clinical settings. The PCS directs respondents to consider how they tend to think and feel in the broad context of pain stimuli. A sample item from the PCS: “I become afraid that the pain will get worse”. Respondents rate their endorsement of frequency for each item using a 0–4 Likert scale 0 (*not at all*) to 4 (*all the time*). The PCS is comprised of three subscales: magnification, rumination, and feelings of helplessness. All items are summed to create a total score. The psychometric validity of the

PCS has been demonstrated.(32, 33) In the current sample, the internal consistency of the PCS was high (Cronbach's $\alpha = .943$).

Perceived injustice—Perceived injustice was assessed using the Injustice Experience Questionnaire (IEQ)(6). The construct of perceived injustice encompasses two related domains: irreparability of loss and self-blame (6). The IEQ consists of 12 items, scored from 0 (*never*) to 4 (*all the time*); IEQ scores are computed as a sum score with a range from 0 to 48, with higher scores representing greater perceived injustice. The IEQ has demonstrated adequate psychometric properties (6), and been validated for use in both acute injury samples (6, 11) and chronic pain samples (34, 35). In the current sample, the internal consistency of the IEQ was high (Cronbach's $\alpha = .904$).

Analyses

Path models were estimated using Mplus software, Version 6.12 (36) to test the direct and indirect effects of average pain intensity, pain catastrophizing, and perceived injustice on life satisfaction through ratings of depression and pain interference. Missing data were handled using Full Information Maximum Likelihood (FIML) estimation, which is designed to include all available information. Indirect effects were estimated using a 1000-draw bootstrap-estimated product of coefficients (*ab*) approach, which is preferable to normal theory mediation analytic approaches due to greater statistical power and a lower risk of Type-I error (37). It should be noted that our use of the term “mediation” refers to the analytic approach of establishing a direct effect of an exogenous predictor (e.g., perceived injustice, pain intensity) on a mediator (the *a* path) and the effect of the mediator (e.g., pain interference, depressive symptoms) on an endogenous outcome (life satisfaction), above and beyond the effects of the predictor (the *b* path). This type of mediation analysis is concluded by testing the statistical significance of the product of the *a* and *b* path coefficients (38). However, there are other assumptions inherent within statistical mediation (i.e., assumptions of temporal precedence and strong causal inference regarding effects from each predictor to each mediator to each outcome) that cannot be satisfied with cross-sectional data analysis. It is therefore optimal to refer to “mediators” in cross-sectional models as “intervening variables” (38). With this caveat in mind, however, we continue to refer to mediation analysis for the sake of consistency throughout the manuscript. All model parameters are presented as standardized path coefficients to allow comparison across paths; as Mplus does not output significance values for standardized path coefficients in conjunction with bootstrapping procedures, these significance values are drawn from equivalent unstandardized path models. In addition to relative size of standardized beta coefficients, r^2 variance statistics were used to determine the amount of variance accounted for in each endogenous variable (i.e., a variable that is modeled as an outcome in our model, including both mediators and outcomes) by each predictor when modeled separately, as well as the total amount of variance accounted for in the fully-specified model. Adequacy of model fit is represented by chi-square (χ^2), the comparative fit index (CFI), the Tucker-Lewis Index (TLI), the root mean square of approximation (RMSEA), and the standardized root mean square residual (SRMR). Model fit was deemed to be adequate if CFI and TLI were greater than .90 and RMSEA and SRMR values were less than .05 (39).

Results

Descriptive statistics can be found in Table 2, correlations between study variables can be found in Table 3, and the total proportion of variance of the outcome variable (R^2) accounted for in each model can be found in Table 4.

When the total effects of each study predictor were examined in a univariate model (i.e., without any other predictors in the model), higher levels of pain intensity ($\beta = -.247, p < .001$), pain catastrophizing ($\beta = -.494, p < .001$), and perceived injustice ($\beta = -.558, p < .001$) significantly predicted lower levels of life satisfaction. According to the r^2 variance statistic, the main effect of perceived injustice accounted for the largest proportion of variance in life satisfaction, followed by pain catastrophizing, and pain intensity. In the initial specification of the path model, no relationship was specified between pain interference and depressive symptoms; however, the resulting fit indices indicated significant model misfit ($\chi^2(3) = 35.08, p < .001$; RMSEA = .181; CFI = .939; TLI = .755; SRMR = .048). These model fit indices suggest that a significant degree of covariance was not accounted for in this model specification. Consequently, it was assumed that this model misfit resulted from the lack of a modeled relationship between pain interference and depressive symptoms, which has been noted in prior studies (25, 40). As a result, exploratory models were estimated specifying either an effect of pain interference on depressive symptoms, or an effect of depressive symptoms on pain interference. The specified model appeared to better account for the covariance between variables when the model included an effect of depressive symptoms on pain interference, so this path was included in the final model.

The final specified model, which includes standardized beta coefficients for each path, is represented in Figure 1. In the final specified model, depressive symptoms, pain interference, and perceived injustice continued to show a significant relationship with life satisfaction. No significant effects of pain intensity and pain catastrophizing were noted on life satisfaction after inclusion of pain interference and depressive symptoms. Similarly, pain intensity was not found to predict depressive symptoms, nor did pain catastrophizing predict pain interference in the final model. As a result, these effects were not specified in the final estimated model. The fully-specified model yielded model fit indices that were suggestive of good model fit ($\chi^2(4) = 5.45, p = .24$; RMSEA = .033; CFI = .997; TLI = .992; SRMR = .017). Subsequent mediation analyses suggested that depressive symptoms accounted for a significant degree of the relationship between pain catastrophizing and life satisfaction ($ab = -.131, p < .001$) and accounted for a significant degree of the relationship between perceived injustice and life satisfaction ($ab = -.052, p = .006$). Similarly, pain interference was found to account for a significant degree of the variance in the relationship between perceived injustice and life satisfaction ($ab = -.034, p = .018$) and the relationship between pain intensity and life satisfaction ($ab = .034, p = .019$). Inclusion of all predictors and intervening variables in the model accounted for 37.7% of the variance in life satisfaction.

Discussion

The relationship between cognitive appraisals of pain and general life satisfaction is influenced by a complex interplay of emotional and physical factors. In a sample of 330 individuals with chronic pain, our analyses suggested significant bivariate relationships of both pain intensity and cognitive appraisals with life satisfaction, by which higher scores for pain catastrophizing, perceived injustice and pain intensity correlated with lower life satisfaction. Notably, our findings revealed more robust associations of perceived injustice and pain catastrophizing with life satisfaction, compared to effects of pain intensity. Our results support and extend previous findings demonstrating the role of psychological factors in coping and adjustment among individuals with chronic pain (1, 2). Specifically, injustice perceptions and catastrophic appraisal about pain appear to have stronger associations with life satisfaction than pain intensity.

Given the complex and multifactorial nature of psychological responses to chronic pain, we opted to estimate our hypothesized study model using a structural path modeling approach. These models, which allow for the simultaneous estimation of multivariate mediation models, also allow for more effective modeling of complex psychological phenomena. In this respect, our analyses revealed several indirect effects in the relationship between life satisfaction and both pain intensity and appraisals (catastrophizing and perceived injustice). Our results suggest that pain-related interference in daily life and depressive symptoms are related to broad pain-relevant variables (e.g., pain intensity, maladaptive appraisal patterns related to pain), but also appear to map more closely onto patterns of life satisfaction than these other pain-relevant variables.

Unsurprisingly, the indirect effects of the cognitive appraisal variables overlapped to some degree with the effects of pain, as perceived injustice in particular appeared to show an effect on life satisfaction through both pain interference and depressive symptoms. Further, these intervening variables were themselves linked; only by specifying a relationship between them was an adequate degree of model fit achieved. Despite the overlapping nature of these effects, a few distinctions are noteworthy: with both depressive symptoms and pain interference in the model, we found no remaining relationship between either pain catastrophizing or pain intensity with life satisfaction, suggesting that depressive symptoms and pain interference may act as more proximal factors (i.e., factors that track more closely with life satisfaction). The relative contributions of pain interference and depressive symptoms, compared to pain interference or catastrophizing, is a key finding, given prior research that both intensity and catastrophizing about pain are related to quality of life metrics in chronic pain (41). Although we cannot state that these effects follow any particular causal sequence, and despite the relatively high degree of overlap between these constructs, our analyses help to identify a few factors that most closely relate to concurrent ratings of life satisfaction (namely, pain interference and depressive symptoms).

Interestingly, perceived injustice continued to show an effect, above and beyond these other effects, suggesting that there may be other potential mediators that were not assessed in the current study that may connect these variables. For instance, feelings of social isolation and anger, which have shown significant conceptual and statistical relationships with perceived

injustice in prior studies (9, 42) may be candidates for future mediation research. Perceived injustice has been conceptualized as a cognitive antecedent for anger (3), as both share in the common the experience of “being wronged” (43). Hence, anger could serve as a mechanism for the impact of perceived injustice on health outcomes; a finding supported by rehabilitation studies (35, 44). Further, strong beliefs of injustice or inequity related to pain appears to yield significant feelings of disconnection or social isolation from others, which correlates strongly with anger (42). As social relationships are considered to be a key determinant in quality of life (45–47), feelings of isolation or disconnection may be key factors that yield incremental gains in predicting quality of life in individuals with chronic pain.

The current findings highlight the distinct affective and behavioral mediators of pain and maladaptive cognitive appraisal processes in chronic pain, and highlight their importance in both perceptions of pain as a barrier to meaningful function and in longer-term quality of life. More importantly, we included perceived injustice in our models, a relatively new but important construct to consider when studying coping and function in the context of pain, which accounted for the largest proportion with life satisfaction when modeled as a main effect. We thus urge study of the consequences of both perceived injustice and pain catastrophizing, as both of these patterns of maladaptive cognitive appraisal may have interrelated and distinct consequences for quality of life for people living with chronic pain.

Limitations

Data used in the current analysis were collected from a single time point, which results in significant limitations in interpretability. The cross-sectional nature of our data precludes interpretations regarding temporal precedence or causality. Also, data were not collected on anger or social isolation, both of which show robust relationships with perceived injustice and has significant implications for pain and health-related outcomes (42, 48–51). It is also possible that other factors (e.g., behavioral avoidance, social conflict) may mediate this effect, though additional study is warranted. Additionally, the current study sample was overwhelmingly female and Caucasian; we underscore the need to replicate this work in samples with greater diversity.

It is also notable that the model we tested was nearly saturated, suggesting that there was significant covariance between each examined exogenous and endogenous variable (as indicated, for example, by the poor model fit when we did not free depression and pain interference to co-vary in our earlier model). In this respect, it should be noted that these variables are significantly related to one another and our examined mediation analyses allowed us only to examine the topology of effects; by including pain interference and depression as mediators, the residual direct effects of pain intensity and pain catastrophizing on life satisfaction were no longer significant. We do not claim that this proposed model reflects strictly unidimensional effects. Indeed, it stands to reason that for individuals who are more depressed or perceive greater pain-related interference in daily life, they may be more prone to catastrophizing or to report greater pain intensity, as there is some evidence that improvements in depressive symptoms may presage improvements in pain intensity and

function (52). It is likely that these constructs are strongly mutually influential, and our results should be interpreted with this caveat in mind.

Additionally, chronic pain was loosely defined as an inclusion criterion, and showed considerable heterogeneity in sample. Despite strengths in generalizability, this heterogeneity precludes clear comparisons of these effects across different pain conditions. For instance, research shows that headaches have a neurological basis, and they are likely initiated by one of numerous pathways including nerve stimulation, irritation or disinhibition (53). This factor may influence patients' attributions regarding the etiology of their conditions, which may impact their coping style and subsequent adjustment. Further, our use of broad self-reported pain categories, which was necessary due to the open-ended nature of our pain diagnosis question, may include some degree of error in terms of participants' beliefs regarding the etiology of their pain. As a result, our pain diagnosis categories should be interpreted only as a broad-level description of the pain locations and characteristics of our mixed chronic pain sample. Identifying moderator variables including the etiology and physiological mechanisms of pain transmission may further clarify how these appraisal processes differ across pain conditions and, potentially, inform more targeted interventions.

Future Directions

As noted previously, our findings warrant replication and extension in longitudinal studies. As appraisal processes may vary across time due to general adaptation, changes in pain intensity or quality, or psychological intervention, examination of how these factors interrelate across time may yield additional information regarding causality and the temporal ordering of effects. Similarly, replication of these findings in clinical studies targeting pain intensity, pain catastrophizing, or perceived injustice may help to elucidate differential patterns of treatment response due to different participant characteristics. To date, there have been no published studies examining perceived injustice as a key mediator of treatment; indeed, the degree to which perceived injustice beliefs vary across time or may be changed via clinical intervention is unclear. However, our findings highlight that this variable may be a key target for intervention in terms of promoting better emotional well-being and overall quality of life.

Conclusions

The current study presents a cross-sectional path model representing distinct and overlapping effects of pain intensity, pain catastrophizing, and perceived injustice on life satisfaction, mediated by perceptions of pain-related interference and depressive symptomatology. The relative salience of perceived injustice as a potential determinant of quality of life in individuals with chronic pain suggests that this factor may be underappreciated, understudied and undertreated. Our results require replication and extension in specific pain populations across clinical and longitudinal studies, but continue to expand upon evidence of the highly complex and multifactorial nature of pain coping.

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Highlights

- Pain intensity and cognitive factors contribute to reduced life satisfaction
- These effects were fully mediated by pain interference and depressive symptoms
- Perceived injustice predicted life satisfaction, above and beyond other variables

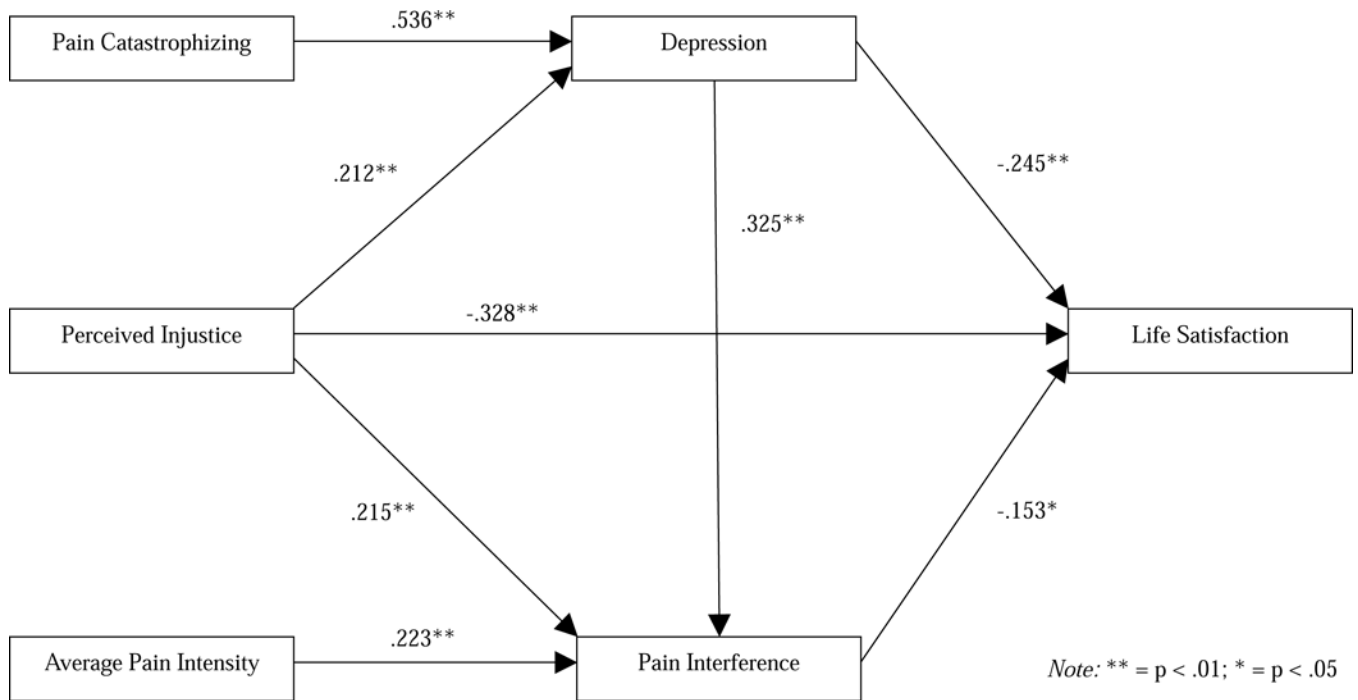


Figure 1.

Depressive symptoms and pain interference as intervening variables of the effects of pain intensity, pain catastrophizing, and perceived injustice on life satisfaction.

Note: All path coefficients reflect standardized beta coefficients from the fully-specified model.

Table 1

Pain diagnosis information

Pain Group	N (% of Sample)
Central	6 (1.8%)
Complex Regional Pain Syndrome	17 (5.2%)
Ehlers-Danlos/Mixed Connective Tissue Disorder	11 (3.3%)
Fibromyalgia	155 (47.0%)
Gastrointestinal/Pelvic Pain	20 (6.1%)
Headaches/Orofacial Pain	35 (10.6%)
Musculoskeletal Pain	76 (23.0%)
Myofascial Pain	12 (3.6%)
Nerve Pain	80 (24.2%)
Neurological Condition	6 (1.2%)
Rheumatic/Autoimmune Condition	39 (11.8%)
Vascular Condition	3 (0.9%)
Unsure about diagnosis	7 (2.1%)

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Table 2

Descriptive Statistics

Study variable	Mean (SD)
Pain Intensity	6.42 (1.53)
Pain Catastrophizing	23.3 (12.7)
Perceived Injustice	30.0 (10.3)
Depression	61.8 (8.19)
Pain Interference	67.8 (6.20)
Life Satisfaction	15.3 (7.65)

Note: Depression and Pain Interference are t-scores (mean = 50, standard deviation = 10)

Table 3

Correlations between study variables.

	Pain intensity	Pain catastrophizing	Perceived injustice	Depression	Pain interference	Life satisfaction
Pain Intensity	1	.373	.293	.319	.388	-.242
Pain Catastrophizing		1	.753	.688	.513	-.491
Perceived Injustice			1	.608	.493	-.557
PROMIS Depression				1	.532	-.525
PROMIS Pain Interference					1	-.438
Life Satisfaction						1

PROMIS assessments are based on a mean of 50 with an SD of 10.

PROMIS, Patient-Reported Outcomes Measurement Information Systems

Note: All *p*-values significant at $p < .01$.

Table 4Variance Accounted for in the Fully Specified Model (R^2)

	Pain intensity Main Effect	Pain Catastrophizing Main Effect	Perceived Injustice Main Effect	Fully Specified Model
Life satisfaction	.061	.241	.310	.377
Depressive symptoms	.102	.473	.369	.503
Pain interference	.150	.263	.243	.353

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