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The impact of perceived injustice on pain-related outcomes: A combined model examining the mediating roles of pain acceptance and anger in a chronic pain sample

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Abstract

Objective: Perceived injustice has been identified as an important risk factor for pain-related outcomes. To date, research has shown that pain acceptance and anger are mediators of the association between perceived injustice and pain-related outcomes. However, a combined conceptual model that addresses the interrelationships between these variables is currently lacking. Therefore, the current study aimed to examine the potential mediating roles of pain acceptance and anger on the association between perceived injustice and adverse pain-related outcomes (physical function, pain intensity, opioid use status).

Method: This cross-sectional study used a sample of 354 patients with chronic pain being treated at a tertiary pain treatment center. Participants completed measures of perceived injustice, pain acceptance, anger, physical function, pain intensity and opioid use status. Mediation analyses were used to examine the impact of pain acceptance and anger on the association between perceived injustice and pain-related outcomes.

Results: Examination of the specific indirect effects revealed that pain acceptance fully mediated the relationship between perceived injustice and physical function, as well as the relationship between perceived injustice and opioid use status. Pain acceptance emerged as a partial mediator of the relationship between perceived injustice and pain intensity.

Discussion: This is the first study to provide a combined conceptual model investigating the mediating roles of pain acceptance and anger on the relationship between perceived injustice and pain outcomes. Based on our findings, low levels of pain acceptance associated with perceived injustice may help explain the association between perceived injustice and pain outcomes. Clinical and theoretical implications are discussed.

Keywords

Chronic pain; Perceived injustice; Pain acceptance; Physical function; Opioid use

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Introduction

In the past decade, accumulating research has examined the role of perceived injustice in the context of chronic pain. Perceived injustice has been operationalized as an appraisal of the severity and irreparability of pain-related losses, a sense of unfairness, and blame attributions.^{1,2} Perceived injustice has been identified as a significant barrier to effective recovery and has been shown to predict numerous adverse pain-related outcomes in patients with chronic pain.^{3,4} Notably, high levels of perceived injustice have been associated with more intense pain, heightened pain behavior, greater self-reported disability, greater medication use and longer duration of work disability.^{1,3,5-8} To date, the relationship between perceived injustice and adverse pain outcomes has been demonstrated in individuals suffering from a wide range of debilitating pain conditions such as work-related low back pain,¹ whiplash injury,⁹ fibromyalgia,¹⁰ osteoarthritis,^{7,11} rheumatoid arthritis,¹² and children and adolescents with chronic pain.¹³

Research suggests that perceived injustice may influence pain-related outcomes at least in part through its impact on pain acceptance.¹⁴ Pain acceptance involves the cessation of ineffective pain control strategies and continuing meaningful life activities even with pain.¹⁵ Pain acceptance has been consistently associated with better functioning and less medication use in individuals with chronic pain.¹⁶⁻¹⁹ Pain acceptance has been conceptualized within the psychological flexibility model, which offers a conceptual framework to better understand the association between perceived injustice, pain acceptance and chronic pain outcomes.¹⁴ In the context of chronic pain, this model suggests that attempts to control or avoid pain and pain-related thoughts often fail, and in turn reinforce psychological distress and maladaptive behavior.²⁰ Individuals with high perceptions of injustice who ruminate excessively on past losses and suffering may attempt to avoid such thoughts or any other experience that may create suffering. These attempts can become particularly problematic when they interfere with engagement in life activities that are valued by the individual. Failure to disengage and avoidance behavior are, in fact, processes that characterize low pain acceptance.²¹ In a study of patients with fibromyalgia, high perceived injustice was significantly associated with low levels of pain acceptance.¹⁰ Moreover, in a community sample of chronic pain patients, researchers have recently shown that pain acceptance mediated the relationship between perceived injustice and pain disability, as well as between perceived injustice and psychological distress.²¹ Despite the growing interest in research on perceived injustice and pain acceptance, very few studies have examined the nature of the relationship between these constructs.

It has also been suggested that anger might explain the impact of perceived injustice on adverse pain-related outcomes.²² Researchers have identified perceived injustice as a cognitive antecedent to anger in chronic pain patients and have discussed anger reactions as a central component to the experience of injustice.²³⁻²⁵ It is likely that focusing on blame and unfairness associated with the experience of injustice might give rise to anger reactions that, in turn, trigger a cascade of psychological and physiological responses that ultimately result in adverse pain outcomes.²² It has been suggested that anger reactions may take the form of nonadherence to treatment recommendations and may give rise to revenge motives to “right the wrongs” of the unjust situation.^{26,27} Studies have demonstrated that high levels

of perceived injustice are associated with high levels of anger^{22,23,28} and a recent study suggests that anger might partially explain the association between perceived injustice and problematic recovery in patients with chronic pain.²²

To date, research has focused on the independent contributions of pain acceptance and anger on the association between perceived injustice and pain outcomes. However, a combined conceptual model that addresses the interrelationships between these variables is currently lacking. Researchers have highlighted the importance of a multiple mediation model that includes both pain acceptance and anger as mediators to provide a more comprehensive account for the associations between perceived injustice and chronic pain outcomes.²¹ Identification of the specific processes that link perceived injustice and adverse outcomes stands to inform the implementation of more targeted intervention approaches for patients with high levels of perceived injustice, and may provide evidence for current interventions for patients with chronic pain.

The current study examined the potential mediating roles of pain acceptance and anger on the association between perceived injustice and adverse pain outcomes in a sample of chronic pain patients seeking specialized care. In accordance with previous literature, it was hypothesized that perceived injustice would be negatively associated with pain acceptance and positively associated with anger. It was also hypothesized that perceived injustice would be positively associated with adverse outcomes, such as physical function, pain intensity, and opioid use status. Finally, we predicted that both pain acceptance and anger would mediate the relationship between perceived injustice and pain-related outcomes.

Materials and Method

Participants and procedures

Data were collected from the initial visits of 354 patients at the Stanford Pain Management Center, a large, urban, tertiary academic interdisciplinary pain treatment center located in the San Francisco Bay Area in the United States. Data were extracted for patients with initial evaluations at the pain clinic between April and July 2015. Study procedures, which involved exclusively retrospective review of clinical data, were approved by the Institutional Review Board (IRB) at the Stanford University School of Medicine.

Data were collected using the Pain Collaborative Health Outcomes Information Registry (CHOIR)²⁹ (<http://choir.stanford.edu>). CHOIR is an open source platform for a health registry and learning health system. The patient reported outcomes component of CHOIR is an electronic patient survey characterizing multiple domains of physical, psychological and social functioning. CHOIR is administered to all patients in the Stanford Pain Management Center. Prior to their scheduled initial medical evaluation, all patients receive an email with instructions to follow a link to register with the CHOIR system and complete their new patient survey. Patients who are unable to complete the survey prior to their appointment complete it at clinic check-in using a tablet computer. CHOIR has been used as a platform for prior pain research.^{5,30,31} Data for the following measures were extracted from the initial CHOIR survey: demographic variables (gender, education, marital status, injury type), the Injustice Experience Questionnaire,¹ the Chronic Pain Acceptance Questionnaire,³² and

average pain intensity. Physical functioning and anger were measured using the physical function and anger item banks of the National Institutes of Health Patient Reported Outcomes Measurement Information System (PROMIS).³³ Within CHOIR, PROMIS items are delivered as a computer-based survey that uses a Computerized Adaptive Test (CAT) approach. The CAT approach is based on Item Response Theory (IRT) to allow for item-level responses, greater precision achieved through lowered standard error and a smaller set of questions with reduced susceptibility to population variability.^{34,35} With a CAT approach, participant responses guide the system's choice of subsequent items from the full item bank. A minimum of 4 items must be answered in order to receive a score for the PROMIS anger and physical function item banks. The response to the first item will guide the system's choice of the next. The CAT will continue until either the standard error drops below a specified level, or the participant has answered the maximum number of questions (12), whichever occurs first. Although items differ across respondents taking a CAT, scores are comparable across participants. PROMIS instruments are normed on the US population and are reported using t-scores with a mean of 50 and a standard deviation of 10.³⁶

Measures

Perceived Injustice.—Perceived injustice was measured with the Injustice Experience Questionnaire (IEQ).¹ The IEQ contains two correlated factors labeled “severity of loss/irreparability of loss” and “blame/unfairness”. This measure asks participants to reflect on how their injury has globally affected their life. Participants were asked to rate the frequency with which they experience 12 thoughts related to their injury on a 5-point scale, ranging from 0 (never) to 4 (all the time). Examples of some of the items include, “my life will never be the same” and “this seems so unfair”. A total IEQ score is computed by summing the 12 items, with higher scores reflecting higher levels of perceived injustice. The IEQ has shown to have good internal consistency and test-retest reliability.¹ The reported coefficient alpha for the total IEQ is 0.92,¹ and is also .92 using this data.

Pain Acceptance.—Pain acceptance was measured with the short-form of the Chronic Pain Acceptance Questionnaire (CPAQ-8).³² The CPAQ-8 has two subscales: activity engagement, which reflects the degree to which they continue to engage in personally meaningful activities despite pain; and, pain willingness which reflects efforts directed at controlling pain. Participants rate each item using a 6-point scale, ranging from 0 (never true) to 5 (always true). Examples of some of the items include, “I am getting on with the business of living no matter what my level of pain is” and “Keeping my pain level under control takes first priority whenever I am doing something”. Scores for the pain willingness subscale are reversed before calculating a total score so that higher total scores reflect greater levels of pain acceptance. The reported coefficient alpha for the CPAQ-8 is 0.77-.89,³² and is .79 using this data.

Physical Function.—The PROMIS physical functioning item bank examines a person's ability to perform a variety of physical activities. Each item asks respondents to rate the difficulty they have completing a wide range of activities. Examples of some of the items include putting on and taking off a coat or jacket, walking more than a mile, and doing chores such as vacuuming or yard work. Participants were asked to consider the previous 7

days when rating their physical functioning. Items are rated on a 5-point scale from “without any difficulty” to “unable to do”, where higher scores indicating better physical functioning. The PROMIS Physical Function item bank has demonstrated validity and consistency.³⁷⁻⁴⁰

Anger.—The PROMIS Anger items assess the occurrence of angry moods, negative beliefs about others, verbal aggression and attempts to control anger. Participants were asked to consider the previous 7 days when rating their anger. Examples of some of the items include, “I felt like I was ready to explode” and “I made myself angry about something just by thinking of it”. Items are rated on a 5-point scale from “not at all” to “very much”, where higher scores indicate higher anger. The PROMIS Anger item bank has demonstrated validity and consistency.⁴¹

Average Pain Intensity.—Average pain intensity was measured using the Numeric Rating Scale (NRS) which operates on a 0 to 10 scale with “0” being no pain and “10” being the worst pain imaginable⁴². Respondents were asked to consider the previous 7 days for rating their average pain intensity. The NRS has been validated for specificity and use in chronic pain research.^{42,43} As part of CHOIR, participants were asked to self-report what type of pain they had. Participants could choose from 7 categories, which were not mutually exclusive: nerve, muscle, disk, infection, bone, cancer, or unknown.

Opioid Use Status.—Patients were asked to report whether they held an active opioid prescription to control their pain (yes/no). All current opioid prescriptions were reported either electronically via CHOIR or verbally to medical staff.

Data Analysis

Relationships among patient characteristics data and questionnaire data were analyzed using Pearson correlations, chi-square analyses and independent samples t-tests, depending whether the variables were categorical or continuous. Means and SDs were computed on all sample characteristics and questionnaire scores. T-tests for independent samples were used to compare women and men on all study measures. These analyses were conducted using IBM SPSS Statistics version 21.0 (IBM Corp., 2012).

A multiple mediation analysis was conducted to assess whether pain acceptance and anger mediated the relationship between perceived injustice and pain outcomes. By conducting a multiple mediation analysis we were able to test the overall mediation effect for all mediators included in the model (i.e. total indirect effect), and to test the effects of each mediator separately (i.e. specific indirect effects). These specific indirect effects are used to determine whether the independent variable (IV) exerts its effect on the dependent variable (DV) through the mediator, while controlling for all other mediators in the model.⁴⁴ Given the cross-sectional nature of this study, all causal paths remain speculative.

The multiple mediation analysis was conducted using the SPSS macro (PROCESS) developed by Preacher and Hayes.^{44,45} Bootstrapping is a nonparametric procedure that is increasingly being used to test mediation (i.e. indirect) effects. It provides a way of circumventing power deficiencies of normal theory tests (i.e. Sobel) typically introduced by the non-normality in the sampling distribution.⁴⁶⁻⁴⁸ Bias-corrected 95% confidence intervals

(CIs) were produced for each potential mediator and were used to test the significance of the total and specific indirect (i.e. mediation) effects. Estimates of indirect effects were considered significant in the case that zero was not included within the CIs.^{44,45} The PROCESS macro is recommended by Hayes (<http://afhayes.com/macrofaq.html>) for testing mediation with both continuous and dichotomous outcomes. However, we conducted an additional analysis using Tingley and colleagues' R Package for Causal Mediation for binary outcomes⁴⁹ to provide greater confidence in our results. Tingley and colleagues' causal mediation analysis allows for decomposition of the total effect into indirect and direct effects for binary outcomes and nonlinear relationships. Study variables were standardized before performing the mediation analyses.

Results

Descriptive statistics

Descriptive statistics for all study measures are presented in Table 1. The mean score for perceived injustice ($M = 16.8$, $SD = 11.41$) was below the previously established cut-off point, suggesting that participants experienced lower levels of perceived injustice than most samples of individuals with chronic pain. The mean score for pain acceptance ($M = 22.93$, $SD = 9.35$) was comparable to previous samples.^{21,32} The mean score for anger ($M = 50.48$, $SD = 10.62$) was also comparable to previous samples.³⁰ Finally, participants' total score for physical function ($M = 39.4$, $SD = 9.71$) was also comparable to previous samples.⁴¹

Results of independent samples t-tests and chi-square analyses revealed no significant sex differences on measures of perceived injustice, pain acceptance, anger, physical function, pain intensity and opioid use status (all $ps > .05$). Analyses revealed that 24.7% of the sample reported having an active opioid prescription.

Associations between study variables

Results of correlational analyses can be seen in Table 2. Analyses revealed that perceived injustice was negatively associated with pain acceptance and physical function, and positively associated with anger and pain intensity. Results also showed that pain acceptance was negatively associated with anger, physical function, and pain intensity. Similarly, anger negatively associated with physical function and positively associated with pain intensity.

Results of independent samples t-tests indicated that opioid use status was positively associated with perceived injustice ($t(1,352) = 3.21$, $p < .001$), anger ($t(1,352) = 2.54$, $p < .001$) and pain intensity ($t(1,352) = 3.81$, $p < .001$). Opioid use was negatively associated with pain acceptance ($t(1,352) = -4.92$, $p < .001$) and physical function ($t(1,352) = -5.33$, $p < .001$). Given that significant intercorrelations were found between the independent variable (e.g. perceived injustice), the potential mediators (e.g., pain acceptance and anger), and the outcome variables (e.g., physical function, pain intensity and opioid use status), preconditions for mediation testing were met.

Mediation analyses

Physical function—Results from the mediation analysis revealed that perceived injustice indirectly influenced physical function through its effect on pain acceptance and anger. As can be seen in Table 3 and Figure 1, patients with higher perceptions of injustice reported significantly lower levels of pain acceptance ($a1 = -0.57$) and significantly higher levels of anger ($a2 = 0.56$), and patients with lower pain acceptance reported lower levels of physical function ($b1 = 0.42$). A bias-corrected bootstrap 95% confidence interval (BC 95% CI) for the indirect effect ($a1b1xa2b2$) based on 1000 bootstrap samples was entirely below zero (-0.3131 to -0.3124). There was no evidence that perceived injustice influenced physical function independent of its effect on pain acceptance and anger ($c1 = -0.02$, $p = .80$). Examination of the specific indirect effects revealed that only pain acceptance was a mediator, since its 95% BC CI did not contain zero. Analyses controlled for age, sex and pain intensity.

Pain intensity—Results from the mediation analysis revealed that perceived injustice did not indirectly influence pain intensity through its effect on pain acceptance and anger. As can be seen in Table 3 and Figure 2, patients with higher perceptions of injustice reported significantly lower levels of pain acceptance ($a1 = -0.62$) and higher levels of anger ($a2 = 0.57$), and participants with lower pain acceptance reported higher pain intensity ($b1 = -0.19$). A bias-corrected bootstrap 95% confidence interval (BC 95% CI) for the indirect effect ($a1b1xa2b2$) based on 1000 bootstrap samples was entirely above zero (0.0431 to 0.2464). However, there was evidence that perceived injustice influenced pain intensity independent of its effect on pain acceptance and anger ($c1 = -0.20$, $p = .004$), suggesting partial mediation. Examination of the specific indirect effects revealed that only pain acceptance was a partial mediator, since its 95% BC CI did not contain zero. Analyses controlled for age and sex.

Opioid use status—Results from the mediation analysis revealed that perceived injustice did not indirectly influence opioid use status through its effect on pain acceptance and anger. As can be seen in Table 3 and Figure 3, patients with higher perceptions of injustice reported significantly lower levels of pain acceptance ($a1 = -0.57$) and higher levels of anger ($a2 = 0.56$), and patients with lower pain acceptance were more likely to have an active opioid use status ($b1 = -.51$). A bias-corrected bootstrap 95% confidence interval (BC 95% CI) for the indirect effect ($a1b1xa2b2$) based on 1000 bootstrap samples was entirely above zero (0.0772 to 0.5745). There was no evidence that perceived injustice influenced opioid use status independent of its effect on pain acceptance and anger ($c1 = -0.06$, $p = .75$). Examination of the specific indirect effects revealed that only pain acceptance was a mediator, since its 95% BC CI did not contain zero. Additional analyses using causal mediation for binary outcome variables confirmed these results (See supplementary Table 1). Analyses controlled for age, sex and pain intensity.

Discussion

The purpose of this study was to provide a combined conceptual model that examines the potential mediating roles of pain acceptance and anger on the relationship between perceived

injustice and adverse pain-related outcomes among patients with chronic pain. The findings are consistent with previous research showing that perceived injustice is negatively associated with pain acceptance^{10,21,50} and positively associated with anger.^{22,28} Results also showed that high perceived injustice was associated with low physical function, high pain intensity and active opioid use status. On the basis of previous research and theory, it was hypothesized that pain acceptance and anger would mediate the association between perceived and pain-related outcomes. However, examination of the specific indirect effects revealed that only pain acceptance emerged as a mediator of the relationship between perceived injustice and physical function, as well as the relationship between perceived injustice and opioid use status. Pain acceptance also emerged as a partial mediator of the relationship between perceived injustice and pain intensity. Thus, low levels of pain acceptance associated with perceived injustice may help explain the association between perceived injustice and pain outcomes.

Our findings contribute to the literature in several ways. Previous studies have identified pain acceptance and anger as potential mediators of the association between perceived injustice and chronic pain-related outcomes.^{21,22} Moreover, researchers have called for a multiple mediator model that includes both variables in order to provide a more comprehensive account of the association between perceived injustice and chronic pain outcomes.²¹ To our knowledge, the present study is the first to compare current mechanisms and theories within a single, integrated model. By using multiple mediation, we were able to examine the overall effects and to break down these relationships to determine the specific pathways by which these effects occur.

The results of the present study revealed that only pain acceptance fully mediated the relationship between perceived injustice and physical function in patients with chronic pain. Our findings lend further support to previous work demonstrating that pain acceptance mediated the relationship between perceived injustice and perceived disability,²² which may be considered a proxy for physical function. The psychological flexibility model suggests that perceived injustice leads individuals to become 'stuck' in a struggle to control pain, which in turn may lead to disruptions in physical, mental and social activities.¹⁴ It is notable that examination of the specific indirect effects revealed that when both mediators were included in the model, anger did not mediate the relationship between perceived injustice and physical function. These findings are in accordance with previous research where anger failed to mediate the relationship between perceived injustice and disability in a sample of patients with musculoskeletal pain.²² As the broad construct of pain acceptance entails continuing to pursue life goals and valued activities even when in pain, as well as the cessation of efforts to control or avoid pain,⁵¹ our findings may suggest that the extent to which perceived injustice is related to physical function may be due to ineffective control-based strategies and disengagement, rather than frustration and anger reactions to pain and disability.

The findings of the present study also showed that pain acceptance fully mediated the relationship between perceived injustice and opioid use status. Recent research has pointed to an association between perceptions of injustice and medication use. For example, in one study, perceived injustice was significantly associated with opioid prescription in a sample

of chronic pain patients.⁵ In another study, perceptions of injustice prospectively predicted opioid use at 1-year follow-up in patients with musculoskeletal pain.² Results of our mediation analyses suggest that patients who experience high levels of perceived injustice may be less willing to experience pain and to engage in meaningful activities despite pain, and in turn may be more likely to hold an active opioid prescription. Examination of the specific indirect effects revealed that when both mediators were included in the model, anger did not account for the relationship between perceived injustice and opioid prescription.

There are a number of possible explanations for the mediating role of pain acceptance in the association between perceived injustice and opioid use status. It is possible that individuals with high perceived injustice and low pain acceptance may resort to passive treatment options, such as opioid therapy, which do not require them to actively cope with their pain and pain-related thoughts. In fact, research suggests that individuals with low pain acceptance are more likely to use opioids, not only to treat subjective levels of pain, but also to treat distress related to feeling unable to function due to pain.⁵² It is also possible that individuals with high perceived injustice may intentionally maintain disability behavior to seek adequate retribution for losses. In fact, in certain circumstances, disability might represent the only ‘power’ that an individual possesses in efforts to communicate the extent of losses sustained.³ In this sense, disengagement of meaningful activities and constant attempts to reduce or avoid pain, which characterize low pain acceptance, may lead prescribing physicians to infer higher levels of disability and in turn increase the likelihood that patients are prescribed and consequently use opioids for chronic pain.

According to the results of this study, the association between perceived injustice and pain intensity was not entirely accounted for by pain acceptance nor anger. Examination of the specific indirect effects revealed that pain acceptance partially mediated the relationship between perceived injustice and pain intensity. However, our findings suggest that other variables may be influencing the effect of perceived injustice on pain intensity, independent of pain acceptance and anger. Research has demonstrated that perceived injustice and pain acceptance are only weakly correlated with pain intensity, and may be more related to patient functioning.^{1,10,16,17,21,22,52,53} It has been suggested that within the psychological flexibility model, willingness to experience pain and engagement in activities does not show a strong relationship with the experience of pain itself,⁵⁴ which might explain the weak associations with perceived injustice, pain acceptance and pain intensity. According to our findings, high perceived injustice was strongly associated with high anger, however, the relationship between anger and pain intensity was particularly weak, which resulted in a failed mediation model.

The findings from this study differ from previous research examining the mediating role of anger on the relationship between perceived injustice and pain intensity.²² It is possible that the use of different measures to assess anger may have contributed in the difference in study results. Previous work by Scott and colleagues employed the State-Trait Anger Expression Inventory (STAXI)⁵⁵ and reported that only *state* anger subscale mediated the relationship between perceived injustice and pain intensity. Moreover, only the *state* anger and anger *inhibition* subscales showed significant associations with pain intensity. Given that the

measure used in this study (PROMIS anger) provides an overall assessment of negative mood, negative beliefs and attempts to control anger,⁴¹ direct comparisons of study results require caution. Future research is needed to replicate our findings and to further examine the mediating role of anger in the relationship between perceived injustice and pain intensity.

The findings of the present study have implications for the treatment of patients with chronic pain. Our results provide further support to the growing literature detailing the benefits of pain acceptance on pain-related outcomes. Acceptance and Commitment Therapy (ACT) is the current treatment approach that is most used to increase pain acceptance. A predominant focus of the ACT approach is improving patient's quality of life by enhancing psychological flexibility and encouraging the pursuit of valued goals.^{54,56} This is promoted by fostering acceptance of thoughts, emotions, or sensations as they are in the moment, to offset the influence of negative thoughts on adaptive functioning.⁵⁷ Significant improvements in outcomes have been reported following the application of acceptance-based programs in various pain management settings.⁵⁸⁻⁶³ Several other processes discussed in the psychological flexibility model may also be useful for neutralizing the functional impacts of perceptions of injustice and related experiences of loss, irreparability, blame and unfairness. For example, researchers have discussed the roles of cognitive defusion, present-focused awareness, perspective-taking, and values-based action in pain treatments.^{20,64} Although there is strong support for significant positive effects on outcomes for acceptance, values-based-action, cognitive defusion, present-focused awareness, and committed action,⁶⁵ it is not clear whether these processes may reduce perceptions of injustice.

Some degree of caution is warranted in the interpretation of the current findings. Primarily, the cross-sectional nature of this study precludes any firm conclusions regarding the directionality of associations between study variables. It cannot be determined whether perceived injustice is a precursor of pain acceptance based on our data. The cross-sectional study design also prevents from establishing causality based on the findings of the mediation analyses. Longitudinal studies are required in order to confirm our findings. Moreover, the study sample had relatively low perceived injustice scores (below clinical cut-off), which could have influenced our results. Indeed, the participants in this study were seeking specialized treatment in a tertiary care setting, which could in itself potentially contribute to reducing injustice perceptions and may limit our ability to generalize our findings. In addition, all study measures were self-report which raises the possibility of social desirability biases. Finally, this study employed the PROMIS anger, which may be distinct from other traditional measures of anger and limits cross study comparisons. There are many advantages to using the PROMIS anger in this area of research. Most importantly, scores across the PROMIS item banks can be derived with just a few items (in most cases, four to six items using CAT), making them practical and cost-effective to implement in both clinical and epidemiological contexts. Future research will be needed to examine the roles of anger and pain acceptance in relation to perceived injustice and chronic pain outcomes.

In summary, this is the first study to examine a combined conceptual model investigating the mediating roles of pain acceptance and anger on the relationship between perceived injustice and pain outcomes. Using multiple mediation, we were able to determine to what extent specific variables mediate the effect of perceived injustice on pain outcomes, conditional on

the presence of the other mediator in the model. Although anger has been consistently linked with both perceived injustice and pain outcomes, it appears that it does not account for the association between these variables, once pain acceptance is accounted for. The findings highlight the importance of integrating interventions aimed at increasing pain acceptance in the treatment of chronic pain.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.

Mediation models illustrating the impact of perceived injustice on physical function through pain acceptance and anger. Analyses controlled for age, sex and pain intensity. Path coefficients are presented.

** $p < .001$

* $p < .05$.

Figure 2.

Mediation model illustrating the impact of perceived injustice on pain intensity through pain acceptance and anger. Analyses controlled for age and sex. Path coefficients are presented.

** $p < .001$

* $p < .05$.

Figure 3. Mediation model illustrating the impact of perceived injustice on opioid use status through pain acceptance and anger. Analyses controlled for age, sex and pain intensity. Path coefficients are presented.

** $p < .001$

* $p < .05$.

Table 1.

Characteristics of the study population.

Variable	N (%) or M (SD)
Gender	
Women	236 (67)
Men	118 (33)
Age	47.5 (15.3)
Marital Status	
Separated / divorced	21 (6)
Cohabiting	42 (11.9)
Widowed	80 (24.3)
Married	188 (53)
Never married	16 (4.5)
Education	
No high school diploma	28 (8)
High school diploma or equivalent	31 (9)
Some university/Associate's degree	122 (34)
Bachelor's degree	91 (26)
Graduate degree	82 (23)
Pain type	
Nerve	116 (32.8)
Unknown	25 (7.1)
Muscle	56 (17.8)
Disk	68 (19.2)
Infection	13 (3.7)
Cancer	5 (2)
Perceived injustice	16.8 (11.41)
Pain acceptance	22.93 (9.35)
Anger	50.48 (10.62)
Physical function	39.4 (9.71)
Pain intensity	4.72 (2.74)
Opioid prescription	85 (24.9%)

Note. N = 354. Pain type = categories are not mutually exclusive. Perceived injustice = Injustice Experience Questionnaire (score range 0-47); Pain acceptance = Chronic Pain Acceptance Questionnaire – short form (score range 0-48); Anger = PROMIS anger (score range 28-80); Physical function = PROMIS physical function (score range 17-70); Average pain intensity = Numerical rating scale (score range 1-10).

Table 2.

Correlations among study variables.

	1.	2.	3.	4.
1. Perceived injustice				
2. Acceptance	-.595			
3. Anger	.550	-.443		
4. Physical function	-.314	.504	-.216	
5. Pain intensity	.326	-.323	.244	-.442

N = 354; all $ps < .001$

Table 3.

Bootstrapped multiple mediation analysis testing the indirect effect of perceived injustice on physical function, pain intensity and opioid use status through pain acceptance and anger.

	Path coefficient	Bootstrap SE	T	BC 95% CI
Outcome: Physical function				
Path c	-.2039	.0510	-3.9987**	
Path c ¹	-.0157	.0616	.2549	
Path a1	-.5668	.0465	-12.1799**	
Path a2	.5552	.0488	11.3749**	
Path b1	.4177	.0555	7.5246**	
Path b2	-.0308	.0529	.5815	
Specific indirect effects				
a1 × b1	-.2367	.0374		LL=-.3059 UL=-.1698
a2 × b2	.0171	.0349		LL = -.0476 UL=.0898
Total/overall indirect effect				
a1b1 × a2b2	-.2197	.0459		LL=-.3131 UL=-.3124
Outcome: Pain intensity				
Path c	.3376	.0513	6.5820**	
Path c ¹	.1977	.0691	2.8608*	
Path a1	-.6168	.0445	-13.8708**	
Path a2	.5743	.0460	12.4750**	
Path b1	-.1902	.0621	-3.0611*	
Path b2	.0393	.0600	.6555	
Specific indirect effects				
a1 × b1	.1173	.0425		LL= .0344 UL=.2029
a2 × b2	.0226	.0362		LL = -.0517 UL=.0898
Total/overall indirect effect				
a1b1 × a2b2	.1399	.0517		LL=.0431 UL=.2464
Outcome: Opioid use status				
Path c	.2430	.1307	1.8602*	
Path c ¹	.0559	.1740	-.1267	
Path a1	-.5668	.0465	-12.1779**	
Path a2	.5552	.0488	11.3749**	
Path b1	-.5062	.1681	-3.0121*	
Path b2	.0568	.1557	.3647	
Specific indirect effects				
a1 × b1	.2869	.0968		LL= .0994 UL=.4842
a2 × b2	.0315	.0903		LL = -.1370 UL=.2123

	Path coefficient	Bootstrap SE	T	BC 95% CI
Total/overall indirect effect				
a1b1 × a2b2	.3184	.1286		LL=.0772 UL=.5745

Abbreviations: SE, standard error; CI: Confidence intervals; LL, lower limit; LU, upper limit.

Note. Table shows standardized path coefficients for the total and specific indirect effects. Path c, total effect of perceived injustice on the outcome variable; path c¹, direct effect of perceived injustice on outcome variable; path a1, effect of perceived injustice on pain acceptance; path a2, effect of perceived injustice on anger; path b1, effect of pain acceptance on the outcome variable; path b2, effect of anger on outcome variable; path a1xb1, indirect effect of perceived injustice on the outcome variable through pain acceptance; path a2xb2, indirect effect of perceived injustice on the outcome variable through anger; path a1b1xa2b2, total indirect effect of perceived injustice on the outcome variable through pain acceptance and anger. Path coefficients are based on 5,000 bootstraps for the indirect effect. LL and UL CIs were used to determine statistical significance of indirect effects.

**
p < .001.

*
p < .05.