

## Original Reports

# Battle of the Appraisals: Pain-Related Injustice Versus Catastrophizing as Mediators in the Relationship Between Pain Intensity and 3-Month Outcomes in Adolescents with Chronic Pain

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**Abstract:** Pain appraisals are closely tied to pain and functional outcomes. Pain-related injustice and pain catastrophizing appraisals have both been identified as important cognitive-emotional factors in the pain experience of youth. Although pain-related injustice and catastrophizing have been linked to worse pain outcomes – as primary predictors and intermediary variables – little is known about whether they operate as independent or parallel mediators of the relationship between pain and functioning in youth. We tested pain-related injustice and catastrophizing appraisals as candidate mediators of the relationship between baseline pain intensity and 3-month functional outcomes in adolescents. Youth with chronic pain (N = 89, 76% female, 89% White, average age = 15 years) completed measures assessing pain intensity, pain-related injustice, and catastrophizing at baseline, as well as measures assessing functional disability and overall quality of life 3 months later. Multiple mediation analyses indicated that injustice mediated the relationship between pain intensity and 3 month quality of life. Exploratory analyses of specific quality of life domains indicated that injustice mediated the relationship between pain intensity and 3 month emotional functioning, whereas catastrophizing mediated the relationship between pain intensity and 3 month social functioning. The findings suggest these pain-related appraisals play different intermediary roles in the relationships among pain and future psychosocial outcomes.

**Perspective:** *Pain-related injustice and catastrophizing appraisals play different intermediary roles in the relationships among pain and future psychosocial outcomes in youth with chronic pain. Treatments targeting pain-related injustice appraisals in pediatric populations are needed to complement existing treatments for catastrophizing.*

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**Key words:** *Injustice, catastrophizing, chronic pain, quality of life, functioning, youth, adolescents.*

Pain appraisals, defined as assessments or evaluations of one's pain experience, are closely tied to pain intensity and functional outcomes.<sup>20,22,79</sup> Appraisal theories hold that emotional episodes –

which include feeling, cognitive, somatic, motor, and motivational components stem from evaluations of a stimulus (eg, pain) as relevant to and/or (in)congruent with a goal or concern (eg, daily functioning, valued

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activities), thereby engendering behavioral efforts to facilitate goals and adjust to environmental demands.<sup>42</sup> This process highlights how pain appraisals influence functioning via emotional and behavioral reactions to pain and represent possible targets for clinical treatment.

Pain-related injustice is a pain appraisal concerning: 1) pain severity and irreparable loss, and 2) blame and unfairness surrounding pain-related suffering.<sup>60</sup> Appraising pain as unjust is an important cognitive-emotional factor for youth<sup>2,39,41</sup> and adults with chronic pain.<sup>36,50,53,63,65,67,71,84,83</sup> At the intra-individual level, in pediatric chronic pain samples, pain-related injustice predicted unique variability in baseline physical disability and emotional, social, and school functioning above that of catastrophizing.<sup>39</sup> At the inter-individual level, youth reported worse physical functioning and quality of life (QOL) when they held high pain-related injustice appraisals but their caregiver did not.<sup>41</sup> Additionally, preliminary longitudinal findings suggest a more nuanced relationship, such that baseline injustice appraisals predicted future emotional (3 and 12 month), social (12 month), and school (3 month) functioning – but not future pain intensity or functional disability above that of baseline pain intensity and catastrophizing.<sup>37,40</sup>

Pain catastrophizing, [The authors would like to acknowledge the growing dissatisfaction with the term “catastrophizing” and the current ongoing efforts to find a new patient-centered term. However, given an alternative term has not yet been established in the literature we use the term “catastrophizing” for this paper.] a well-established appraisal characterized by rumination, magnification, and helplessness cognitions about pain, has also been linked with negative outcomes in youth.<sup>38</sup> Children and adolescents who catastrophize more tend to experience greater pain intensity<sup>7,70</sup> and disability,<sup>7,59,76</sup> report worse QOL,<sup>38</sup> engage in more pain behaviors,<sup>34,75</sup> and use more analgesic medications.<sup>3</sup> They also experience more emotional distress.<sup>28,38</sup> Less is known about catastrophizing vis-à-vis social and school functioning. Initial support for catastrophizing as a mediator between pain and physical functioning has been established cross-sectionally such that greater pain intensity was related to greater disability through greater catastrophizing.<sup>16</sup> The mediating role of pain catastrophizing between pain intensity and future QOL and functioning in youth remains to be explored.

Pain-related injustice and catastrophizing are positively correlated,<sup>39,60,61</sup> but their conceptualizations differ in important ways. Catastrophizing appraisals are limited to the self (eg, “I feel I can’t go on”), whereas injustice appraisals are both self- (eg, “My life will never be the same”) and other-oriented (eg, “Most people don’t understand how severe my condition is”). Additionally, while their primary measures (ie, Pain Catastrophizing Scale and Injustice Experiences Questionnaire, respectively) include items assessing the severity and/or irreparable loss of pain, pain-related injustice includes appraisals of pain regarding blame or unfairness. Both pain related injustice and

catastrophizing have been linked to worse pain, QOL, and functional outcomes as either primary predictors and/or intermediary variables. The incremental utility of measuring pain-related injustice in addition to catastrophizing has been established in youth with chronic pain.<sup>37,39,40</sup> However, no published study has examined their independent and comparative effects as mediators between pain and *future* QOL in youth with pain. Such information would advance knowledge of the cognitive-emotional symptoms that should be prioritized in clinical practice for youth with pain.

This clinic-based study of youth with chronic pain aimed to: 1) examine and contrast injustice and catastrophizing as mediators of the relationship between pain intensity and functional disability and between pain intensity and overall QOL and 2) explore injustice and catastrophizing as mediators in the relationship between pain intensity and specific QOL domains (ie, physical, emotional, social, and school functioning). Prior studies found pain-related injustice consistently explained additional variance, above and beyond catastrophizing, in functional outcomes.<sup>37,39,40</sup> Therefore, we hypothesized that injustice would be a consistently stronger mediator in the relationships examined herein. However, given the lack of prior evidence suggesting pain related-injustice and catastrophizing would differentially mediate domain-specific outcomes, we did not have hypotheses for these analyses. The comparative strength of both mediators was explored in models where both pain-related injustice and catastrophizing were significant mediators.

## Methods

### Sample

Participants for this study were patients attending a midwestern tertiary care interdisciplinary pediatric pain management clinic between January 2014 and January 2019. Patients seen at the clinic have persistent pain related to chronic disease, injury, sports activity, or surgery. Patients are referred to the clinic by a primary care provider or specialist for evaluation and comprehensive chronic pain management services, including anesthesiology, physical therapy, and psychology. Following initial evaluation at the clinic, patients are scheduled for follow-up visits on a variable timescale depending on the severity of their condition and the clinic services being utilized. Retrospective clinical data for 447 patients with varying pain conditions was available in the database for a baseline time point. Patient data that met the following criteria were included in the current analyses: patient was 1) between the ages of 11 and 18 years, 2) attended the pain clinic for at least two clinic visits approximately 3 months apart, 3) able to speak and read English, and 4) without significant developmental delays. Only data for patients who fell within the 3 month clinical capture window were extracted for this study. Of the 447 patients who provided clinical data for a baseline time point, eighty-nine adolescents completed measures again 3 months later

(3 month time point). We compared patients who completed both baseline and 3 month time points to those who completed only a baseline time point (ie, did not complete a 3 month time point). Patients who completed both time points were more likely to be diagnosed with migraine or chronic headache ( $\chi^2(1, N = 447) = 6.13, P < .05$ ) or a psychological condition ( $\chi^2(1, N = 447) = 5.65, P < .05$ ) than were patients who completed a baseline time point only. There were no other differences in demographic or clinical characteristics between the 2 groups. The baseline time point for this study included patients ( $n = 62$ ) who were being seen for the first time in the clinic and patients ( $n = 27$ ) who were being seen for a routine follow-up appointment in the clinic. All patients included in this study received follow-up care for medication management and/or interventional procedures with the anesthesiology team 3 months after their baseline time point. A subset of patients also received physical therapy and/or pain psychology services including cognitive behavioral therapy, biofeedback, and/or hypnosis for pain. Data regarding the specific services received by each patient were not available in the clinical research database. Partial data from this sample were analyzed in 2 previous studies<sup>39,41</sup>; however, those studies included only cross-sectional data from the baseline time point and had different aims than the current study.

## Procedure

This study is an analysis of data collected from patients during clinical appointments as part of the clinic's pain assessment procedures. Patients completed forms electronically at the beginning, and if necessary, end of their clinic appointments. Demographic variables, as well as pain and psychological diagnoses, were extracted during chart review. Pain and psychiatric diagnoses were noted in the chart following a standardized clinical interview with patient and family during their initial pain clinic appointment. All data were de-identified to ensure compliance with HIPAA and PHI standards. All study procedures were approved by the Indiana University Institutional Review Board.

## Measures

### Pain-related Injustice (Baseline Time Point)

Injustice appraisals were assessed using the Injustice Experiences Questionnaire (IEQ) at the baseline time point.<sup>60</sup> The IEQ is a 12 item measure assessing injustice appraisals related to one's own pain. Using a 5 point Likert scale from 0 ("never") to 4 ("all the time"), respondents rate how frequently they identify with statements such as "It all seems so unfair." The IEQ is written at a 2nd grade reading level, which was determined by the Flesch Kincaid Grade Level Formula.<sup>11</sup> The instructions for the original IEQ have patients answer questions in regards to their "injury." For this study, patients were

asked to focus on their "pain" when responding to each item. All item responses are summed to calculate the total score for pain-related injustice. Although the IEQ can also be scored along two subscales, due to the large overlap in item loadings on the two scales in the adult validation study, the instrument developers support treating it as a unitary measure.<sup>60</sup> Thus, for the current study, we analyzed only the total score, which has shown good reliability and validity across several adult chronic pain samples and more recently in youth with chronic pain.<sup>39,41</sup> The IEQ has been found to have a similar factor structure and good reliability in samples of youth<sup>39</sup> and adults<sup>60,64,71</sup> with chronic pain. In the current sample, the IEQ demonstrated good internal consistency ( $\alpha = 0.93$ ).

### Pain Catastrophizing (Baseline Time Point)

Pain catastrophizing was assessed using the Pain Catastrophizing Scale for Children (PCS-C) at patients' baseline time point.<sup>7</sup> The PCS-C is a 13 item questionnaire adapted from the Pain Catastrophizing Scale (PCS), which measures the degree to which individuals engage in rumination, magnification, and feelings of helplessness when in pain.<sup>68</sup> Questions are rated on a 5 point Likert scale ranging from 0 ("not at all") to 4 ("extremely"). The total score is calculated by summing all items, with higher scores indicating greater catastrophizing. Previous studies found the child form to be reliable and valid.<sup>7,15</sup> The PCS-C total score was used for this study and had good internal consistency ( $\alpha = 0.94$ ).

### Numeric Pain Rating Scale (Baseline and 3-month Time Points)

Patients rated their average pain over the past week using a numerical rating scale ranging from 0 ("no pain at all") to 10 ("most pain ever"). Patients completed pain ratings during their baseline and 3 month time points. Patients' pain rating at the baseline time point was used in the main analyses.

### Functional Disability (Baseline and 3-month Time Points)

Functional disability was measured using the Functional Disability Inventory (FDI) at the baseline and 3 month clinic time points.<sup>78</sup> The FDI is a 15 item self-report questionnaire that asks respondents to rate their difficulty performing daily tasks, such as walking up stairs and walking to the bathroom, on a scale of 0 ("no trouble") to 4 ("impossible"). The items are summed to create a total score, with higher scores reflecting greater functional disability. The FDI was found to be reliable and valid in several different pediatric pain populations,<sup>5,24,77</sup> and showed excellent internal consistency ( $\alpha = 0.90$ ) in the current sample. Patients' 3 month FDI was used in the main analyses.

## Quality of Life – Overall and Specific Domains (Baseline and 3-month Time Points)

QOL was assessed at baseline and 3 month time points using the Pediatric Quality of Life Inventory (PedsQL) – Generic Core Scales.<sup>74</sup> The measure includes 23 self-report items assessing physical (eg, “It is hard for me to run”), emotional (eg, “I feel angry”), social (eg, “Other kids tease me”), and school (eg, “It is hard to pay attention in class”) functioning over the past month. All items are rated on a 5 point Likert scale of 0 (“never”) to 4 (“almost always”) and then reverse scored and transformed into a 0 to 100 scale, with higher scores reflecting better QOL. The PedsQL is frequently used in studies of pediatric chronic health conditions, which have shown the measure to be reliable and valid.<sup>48</sup> The total score, representing overall QOL, and the physical, emotional, social, and school functioning subscale scores of the PedsQL were examined for the current study. Total and subscale scores had good internal consistency in the current sample (Total  $\alpha = 0.92$ , Physical  $\alpha = 0.89$ , Emotional  $\alpha = 0.86$ , Social  $\alpha = 0.82$ , School  $\alpha = 0.87$ ). Patients’ 3 month QOL was used in the main analyses.

## Statistical Analyses

Assumptions of normality were assessed prior to conducting the analyses, and no violations were indicated. Zero-order correlations were calculated to assess the bivariate relationships among all study variables. First, changes in clinical outcomes between baseline and 3 month time points were examined to provide context for the mediation analyses. Changes in pain, functional disability, and QOL (overall and specific domains) between baseline and 3 month time points were summarized with descriptive statistics and evaluated with paired samples t-tests. Gender and race differences in pain-related injustice and catastrophizing were evaluated using independent samples t-tests. At the 3 month time point, 20 participants (22%) were missing data for the FDI, and 3 participants (3%) were missing data for the PedsQL. As is the case with most clinical datasets, data can be missing for a variety of reasons. The most common reason for missingness in the current study was that patients did not complete all measures prior to being seen by the clinic providers and subsequently left the clinic after their appointment without finishing the remaining measures. Systematic differences in demographic (eg, gender, race, ethnicity) and clinical (eg, pain diagnosis, presence of psychological diagnosis) characteristics based on FDI completion status were examined with chi-square tests. No significant differences were found (all  $ps > .05$ ). Thus, to address missing data, hotdeck imputation<sup>17,43</sup> was performed using the HOTDECK SPSS macro.<sup>43</sup> For each participant who was missing data on a specific variable (eg, functional disability) hotdeck imputation finds all participants that match the participant with missing data on one or more specified categories (eg, participant gender). These matching participants constitute the “deck” from which missing values are imputed. A value from the “deck” is

chosen at random to serve as the imputed value for participants that are missing data. Hotdeck imputation has been proven superior to, and has several advantages over commonly used missing data methods (ie, listwise deletion and mean imputation) including increased accuracy in data variance estimation and preservation of power to detect significant effects.<sup>17,43,51</sup> For the current study, patient age and gender were used to match patients (ie, create the “deck”) for data imputation.

A series of multiple mediation models (one model per outcome) were used to evaluate the mediating role of baseline pain catastrophizing and pain-related injustice appraisals in relationships between baseline pain intensity and 3 month functional disability and QOL (overall and specific domains) using Hayes’ PROCESS macro.<sup>18</sup> In the multiple mediation model used in the current study, the effects of each mediator within a given model are estimated in parallel and are considered the indirect effect of the independent variable (baseline pain intensity) on the dependent variable (3 month functional outcome) through the mediator (baseline pain catastrophizing and/or injustice). This approach accounts for the shared variance between the mediators, and in the event of significant mediating pathways for both mediators, indirect effects of each mediator can be contrasted as well. The effect of baseline pain intensity on baseline catastrophizing or injustice defines paths  $a_1$  and  $a_2$ , respectively. The effect of baseline catastrophizing or injustice on the specific 3 month functional outcome defines path  $b_1$  and  $b_2$ , respectively. The bootstrapping method was used to create a 95% bootstrap confidence interval to assess for statistical inference of the total (path  $a + b + c$ ), direct (path  $c'$ ), and indirect (path  $a_1 + b_1$  or path  $a_2 + b_2$ ) effects using 10,000 resamples (with replacement). Mediation is supported if zero is not included in the 95% bias-corrected bootstrap confidence interval, as this denotes that the indirect (mediation) effect is statistically different than zero. In the event that both baseline pain-related injustice and catastrophizing are significant mediators within a given model, the indirect effects will be directly compared using the bootstrapping method to determine if there is a statistical difference.

## Results

Sample descriptives are summarized in Table 1. The sample included 89 pediatric patients with chronic pain. Patients were predominately female (75%) and White (89%), with an average age of 15 years ( $SD = 1.64$ ). The most common pain conditions were musculoskeletal pain (55.1%) and migraine and/or headache (31.5%). Approximately two-thirds of the sample had one or more psychiatric diagnoses noted in their charts. Descriptive information and bivariate correlations among variables are detailed in Table 2. The overall sample mean for pain-related injustice appraisals exceeded the clinically meaningful threshold of 19 suggested for adults with chronic pain.<sup>55</sup> The sample also endorsed high levels of pain catastrophizing according



**Table 1. Demographic and Clinical Characteristics**

<i>N</i> = 89	<i>N</i> (%)
Sex	
Male	22 (24.7)
Female	67 (75.3)
Race	
White	79 (88.8)
Black/African-American	10 (11.2)
Ethnicity	
Hispanic/Latinx	3 (3.4)
Non-Hispanic/Latinx	85 (95.5)
Unknown	1 (1.1)
Age	
11-13 years	18 (20.2)
14-16 years	54 (60.7)
17-18 years	17 (19.1)
Pain Condition	
Complex regional pain syndrome	10 (11.2)
Migraine/headache	28 (31.5)
Neuropathic	7 (7.9)
Musculoskeletal	49 (55.1)
Visceral	18 (20.2)
Sickle Cell Disease	3 (3.4)
Ehlos-Danlos Syndrome	6 (6.7)
Other (chronic pancreatitis, jaw pain, lupus)	4 (4.5)
Psychiatric Diagnoses	
Depressive disorder	26 (29.2)
Bipolar disorder	1 (1.1)
Anxiety disorder	43 (48.3)
Trauma- and Stressor-related disorder	6 (6.7)
Somatic disorder	36 (40.4)
Neurodevelopmental disorder	4 (4.5)
Obsessive-Compulsive disorder	1 (1.1)
Conduct disorder	1 (1.1)
Other disorder (substance, feeding & eating)	2 (2.2)
No psychiatric diagnosis	26 (29.2)

Note: Due to some patients having multiple pain and psychiatric diagnoses, sum of percentages does not equal 100% for those categories.

to established cutoff scores.<sup>46</sup> On average, patients endorsed moderate pain intensity, moderate functional disability,<sup>24</sup> and at-risk levels of overall QOL and physical, social, and school functioning.<sup>74</sup> The average self-

reported emotional functioning was on the cusp of being considered at-risk per established cutoff scores.<sup>74</sup>

### **Changes in Pain, Disability, and Quality of Life**

A summary of the clinical changes in pain, disability, and QOL between baseline and 3 month time points are provided in Table 3. Significant improvements in overall QOL (mean difference [MD] = 3.80,  $t(84) = 2.48$ ,  $P < .05$ ,  $d_z = .27$ ) and in the specific domain of physical functioning (MD = 4.78,  $t(84) = 2.27$ ,  $P < .05$ ,  $d_z = .25$ ) occurred from baseline to 3-month time points. No significant changes were found for pain intensity, functional disability, or emotional, social, and school functioning ( $ps > .05$ ).

### **Appraisals as Mediators for Functional Disability and Overall Quality of Life Outcomes**

Baseline IEQ and PCS-C scores did not significantly differ between patients who were attending their first clinic visit ( $n = 62$ ) and those who were attending a

**Table 3. Change in Pain, Overall Quality of Life, and Functioning Between Baseline and 3 Month Follow-Up**

	MEAN $\Delta$	STANDARD DEVIATION	<i>N</i>
Pain intensity (NRS)	-0.30	2.11	89
Functional Disability (FDI)	-0.39	11.65	69
Quality of Life (PedsQL Total Score)	3.80*	14.10	86
Physical Functioning (PedsQL Subscale)	4.78*	19.41	86
Emotional Functioning (PedsQL Subscale)	2.65	15.84	86
Social Functioning (PedsQL Subscale)	3.35	20.74	86
School Functioning (PedsQL Subscale)	3.82	20.60	86

Abbreviations: NRS, Numeric Rating Scale, FDI, Functional Disability Inventory, PedsQL, Pediatric Quality of Life Inventory

\* $P < .05$ . Note: Baseline values were subtracted from 3-month values so that mean change reflects improvements (ie, decreased pain, increased quality of life) in variables

**Table 2. Study Variable Descriptives**

	MEAN	STANDARD DEVIATION	<i>N</i>	1	2	3	4	5	6	7	8
1. Baseline IEQ Total	19.52	12.45	89	-							
2. Baseline PCS Total	26.91	12.78	89	.73**	-						
3. Baseline Pain intensity (NRS)	5.20	2.11	89	.24*	.32**	-					
4. 3-month FDI	22.63	12.59	69	.22	.17	.42**	-				
5. 3-month PedsQL Quality of Life Total Score	53.75	18.75	86	-.52**	-.47**	-.38**	-.83**	-			
6. 3-month PedsQL Physical Functioning Scale	46.08	23.45	86	-.32**	-.34**	-.44**	-.86**	.87**	-		
7. 3-month PedsQL Emot. Functioning Scale	68.66	24.03	86	-.51**	-.34**	-.22*	-.50**	.78**	.54**	-	
8. 3-month PedsQL Social Functioning Scale	58.43	24.45	86	-.53**	-.55**	-.20	-.48**	.73**	.47**	.50**	-
9. 3-month PedsQL School Functioning Scale	46.45	22.13	86	-.33**	-.28**	-.28*	-.67**	.77**	.60**	.50**	.38**

Abbreviations: IEQ, Injustice Experiences Questionnaire, PCS, Pain Catastrophizing Scale, NRS, Numeric Rating Scale, FDI, Functional Disability Inventory, PedsQL, Pediatric Quality of Life Inventory.

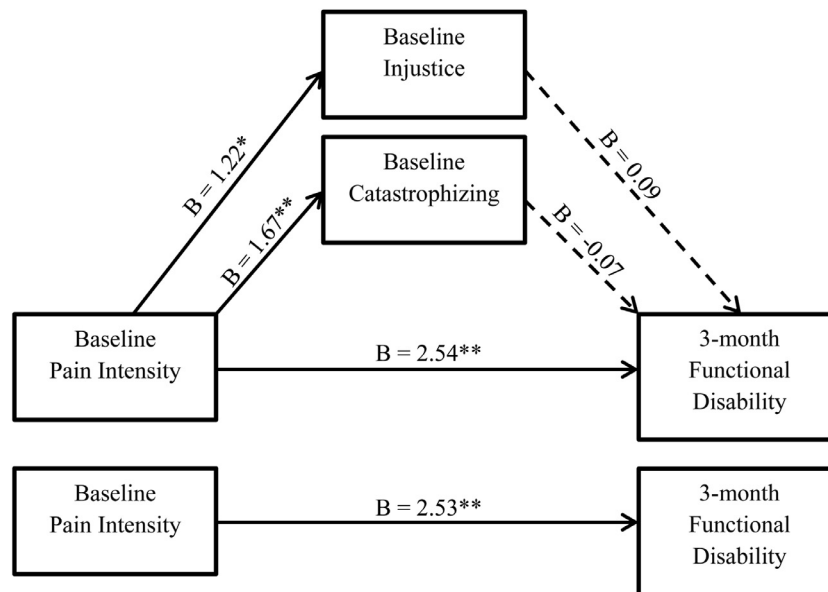
\* $P < .05$ .

\*\* $P < .01$ .

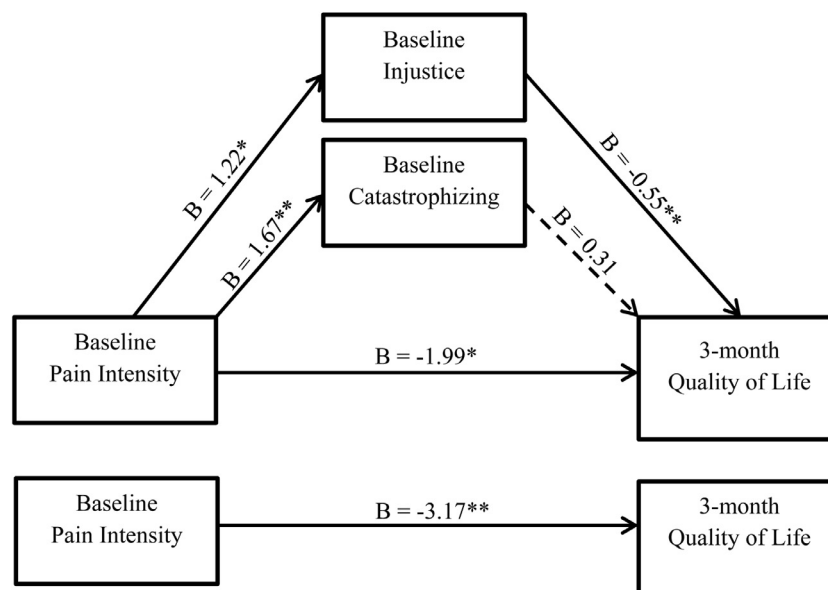
follow-up appointment ( $n = 27$ ,  $ps > .05$ ). Baseline IEQ scores significantly differed by patient gender ( $t(87) = 2.25$ ,  $P < .05$ ,  $d = 0.55$ ), with female patients reporting higher pain-related injustice appraisals compared to male patients ( $MD = 6.72$ ,  $SE = 2.99$ , 95% CI [-12.67, -0.78]). IEQ scores did not differ by patient race ( $P > .05$ ). Baseline PCS-C scores significantly differed by patient gender ( $t(87) = 2.16$ ,  $P < .05$ ,  $d = 0.53$ ) and race ( $t(87) = 2.16$ ,  $P < .05$ ,  $d = 0.76$ ), with female ( $MD = 6.64$ ,  $SE = 3.08$ , 95% CI [-12.76, -0.53]) and Black and/or African American ( $MD = 9.45$ ,  $SE = 4.19$ , 95% CI [-17.79, -1.11]) patients reporting higher pain catastrophizing than their counterparts. Therefore, both patient gender

and race were included as covariates in the mediation models. Patient age was not significantly correlated with baseline IEQ or PCS-C scores ( $ps > .05$ ) and, therefore, was not included as a covariate in the mediation models.

The mediating role of baseline pain-related injustice and catastrophizing appraisals on the relationships between baseline pain intensity and 3 month functional disability and overall QOL was examined using multiple mediation models (Fig. 1 and 2). Model 1 (Fig. 1) accounted for 23% of the variance in 3 month functional disability (FDI). The direct effect of baseline pain intensity on 3 month functional disability was



**Figure 1.** Model 1: The mediating effect of baseline pain-related injustice and catastrophizing in the association between baseline pain intensity and 3 month functional disability. \* $P < .05$ , \*\* $P < .01$ .



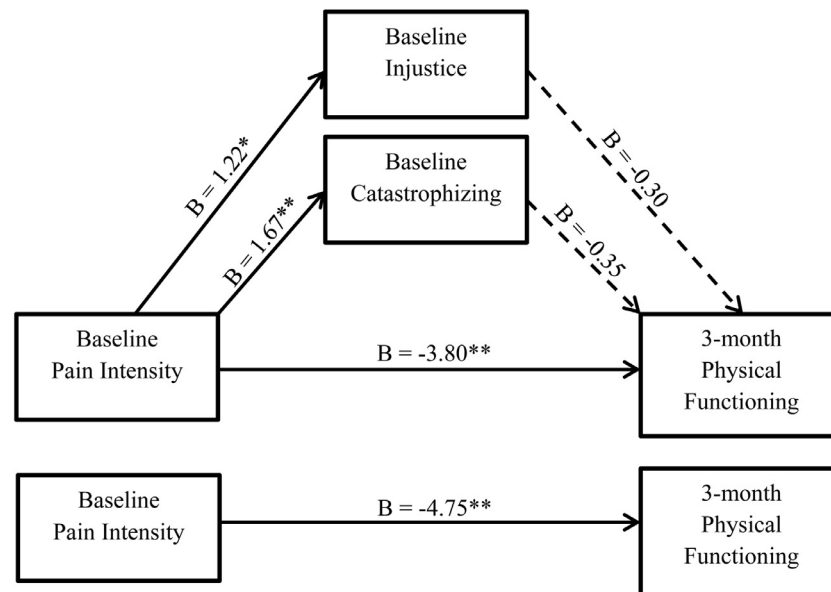
**Figure 2.** Model 2: The mediating effect of baseline pain-related injustice and catastrophizing in the association between baseline pain intensity and 3 month overall quality of life. \* $P < .05$ , \*\* $P < .01$ .

significant (direct effect = 2.54; 95% CI [1.25, 3.83],  $P < .01$ ). Neither baseline pain-related injustice nor catastrophizing were significant mediators of this relationship (Table 4).

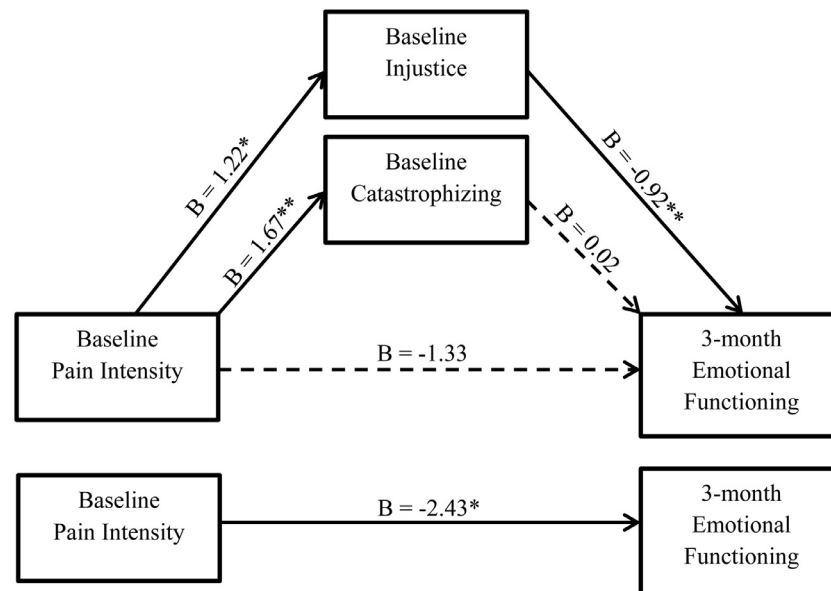
Model 2 (Fig 2) accounted for 34% of the variance in 3-month overall QOL. The direct effect of baseline pain intensity on 3 month QOL was significant (direct effect = -1.99; 95% CI [-3.74, -.23],  $P < .01$ ). Of the 2 proposed mediators, only baseline pain-related injustice mediated the effect of pain intensity on 3-month QOL (Table 4). Greater baseline pain intensity was related to poorer 3 month overall QOL through higher levels of pain-related injustice appraisals.

### Exploratory Mediation Analyses of Specific Quality of Life Domains

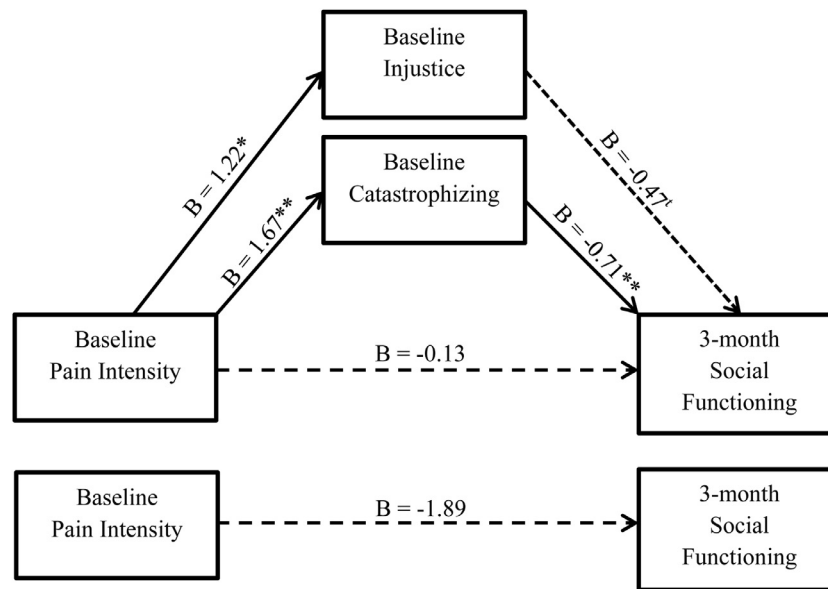
To facilitate a more nuanced understanding of the mediating role of baseline pain-related injustice and catastrophizing appraisals in the relationships between baseline pain intensity and the 3 month outcomes for specific QOL domains, we conducted exploratory multiple mediation analyses of the physical, emotional, social, and school functioning subscales of the PedsQL (Fig. 3-6). Model 3 (Fig 3) accounted for 26% of the variance in 3-month physical functioning. The direct effect of baseline pain intensity on 3-month physical



**Figure 3.** Model 3: The mediating effect of baseline pain-related injustice and catastrophizing in the association between baseline pain intensity and 3 month physical functioning.  $*P < .05$ ,  $**P < .01$ .



**Figure 4.** Model 4: The mediating effect of baseline pain-related injustice and catastrophizing in the association between baseline pain intensity and 3 month emotional functioning.  $*P < .05$ ,  $**P < .01$ .



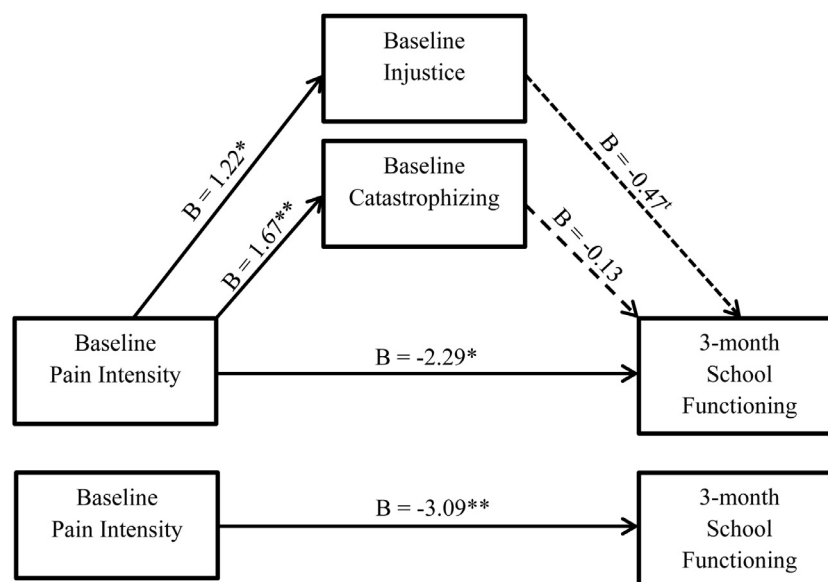
**Figure 5.** Model 5: The mediating effect of baseline pain-related injustice and catastrophizing in the association between baseline pain intensity and 3 month social functioning.  $^†P < .10$ ,  $*P < .05$ ,  $**P < .01$ .

functioning was significant (direct effect = -3.80; 95% CI [-6.07, -1.53],  $P < .01$ ). Similar to the functional disability (FDI) results presented above, neither baseline pain-related injustice nor catastrophizing were significant mediators of the relationship between pain intensity and 3-month physical functioning (Table 4).

Model 4 (Fig 4) accounted for 25% of the variance in 3-month emotional functioning. The direct effect of baseline pain intensity on 3 month emotional functioning was not significant ( $P > .05$ ). Of the 2 proposed mediators, only baseline pain-related injustice mediated the effect of pain intensity on 3 month emotional functioning (Table 4). Greater baseline pain intensity was related to poorer 3 month emotional functioning through higher levels of baseline pain-related injustice appraisals.

Model 5 (Fig 5) accounted for 33% of the variance in 3 month social functioning. The direct effect of baseline pain intensity on 3 month social functioning was not significant ( $P > .05$ ). Catastrophizing mediated the relationship between baseline pain intensity and 3 month social functioning (Table 4), with greater baseline pain intensity related to poorer 3 month social functioning through higher levels of baseline pain catastrophizing. Though pain-related injustice did not meet traditional significance cutoffs (the 95% confidence interval included 0), it demonstrated a trend towards significance in the model ( $P = .08$ ).

Model 6 (Fig 6) accounted for 19% of the variance in 3 month school functioning. The direct effect of baseline pain intensity on 3 month school functioning was significant (direct effect = -2.29; 95% CI [-4.44, -.13],  $P < .01$ ).



**Figure 6.** Model 6: The mediating effect of baseline pain-related injustice and catastrophizing in the association between baseline pain intensity and 3-month school functioning.  $^†P < .10$ ,  $*P < .05$ ,  $**P < .01$ .



**Table 4. Bootstrapped Parallel Mediation Analysis Testing Indirect Effects of Pain Intensity on 3 Month Functional Outcomes Using Injustice and Catastrophizing**

INDIRECT EFFECTS	POINT	BOOTSTRAPPING BC 95% CI	
	ESTIMATE	LOWER	UPPER
Model 1: 3-month Functional Disability			
Total	-0.01	-0.44	0.46
Injustice	0.11	-0.17	0.81
Catastrophizing	-0.12	-0.79	0.43
Model 2: 3-month Quality of Life			
Total	-1.19	-2.77	-0.07
Injustice	-0.68	-1.97	-0.01
Catastrophizing	-0.51	-1.84	0.11
Model 3: 3-month Physical Functioning			
Total	-0.95	-2.51	-0.01
Injustice	-0.37	-1.77	0.22
Catastrophizing	-0.59	-2.47	0.25
Model 4: 3-month Emotional Functioning			
Total	-1.09	-2.79	0.16
Injustice	-1.13	-3.17	-0.04
Catastrophizing	0.04	-0.89	1.01
Model 5: 3-month Social Functioning			
Total	-1.75	-3.81	-0.28
Injustice	-0.57	-2.12	0.05
Catastrophizing	-1.18	-2.91	-0.18
Model 6: 3-month School Functioning			
Total	-0.80	-2.34	0.14
Injustice	-0.58	-1.99	0.01
Catastrophizing	-0.22	-1.64	0.68

Abbreviation: BC, bias-corrected

Neither baseline pain-related injustice nor pain catastrophizing met traditional significance cutoffs (the 95% confidence interval included 0, Table 4). However, pain-related injustice demonstrated a trend towards significance in the model ( $P = .07$ ).

## Discussion

We evaluated the 3 month change in pain, functional disability, overall QOL, and specific QOL domains among youth with chronic pain seeking care at a university-affiliated pain clinic. Overall QOL and physical functioning significantly improved over the course of the 3 months. We then examined the mediating role of pain appraisals in the relationship between patients' baseline pain and future functioning. Higher initial pain intensity was related to increased functional disability and decreased overall QOL, as well as decreased physical, emotional, and school functioning, 3 months later. Parallel multiple mediation analyses indicated that baseline pain-related injustice played a stronger mediating role than catastrophizing in the relationships between baseline pain and both 3 month overall QOL and emotional functioning. In contrast, baseline catastrophizing played a stronger mediating role between baseline pain

and 3 month social functioning. Neither pain-related injustice nor catastrophizing mediated the relationships between baseline pain and 3 month functional disability, physical functioning, and school functioning.

Pain-related injustice mediated the relationship between pain intensity and poorer overall QOL, whereas pain catastrophizing did not. Both pain-related injustice and pain catastrophizing have been strongly associated with poorer QOL in previous cross-sectional investigations.<sup>38,41</sup> The current longitudinal analyses further suggest that only pain-related injustice is a mechanism through which pain intensity impacts future QOL for youth with mixed chronic pain conditions. An even more nuanced picture is suggested by our exploratory mediation analyses of the specific QOL domains (emotional, social, and school) that comprise QOL; however, given their exploratory nature, these findings require replication before drawing definitive conclusions.

Pain-related injustice mediated the relationship between pain intensity and poorer future emotional functioning. Within the context of the appraisal theories of emotion, injustice appraisals provoke strong negative emotional reactions.<sup>10,54,73</sup> Pain-related injustice is comprised of two overarching appraisals: severity and/or irreparable loss and blame/unfairness. Appraisals of irreparable loss due to pain may engender feelings of hopelessness and perceived loss of control. This is important because negative attributional style, appraisals of lost control, and feelings of hopelessness are tied to depression in youth.<sup>1,14,80</sup> Moreover, other-oriented appraisals that people do not understand the severity of their pain may generate feelings of being misunderstood. Indeed, Forgeron and colleagues<sup>13</sup> found that adolescents with chronic pain considered non-supportive social situations with friends to be more distressing than did their healthy counterparts. Adolescents who think that others do not understand the severity of their condition may have experienced rejection or pain-related discounting in the past. Such thoughts may also increase the likelihood of future rejection, as suggested by the rejection sensitivity literature.<sup>9,33,47,49</sup> Kool and colleagues<sup>28</sup> characterize this interpersonal experience as a type of invalidation, and research suggests that it is common and emotionally detrimental among both youth and adults with chronic pain.<sup>27–29,81</sup>

Catastrophizing mediated the relationship between pain intensity and poorer future social functioning. Youth with chronic pain have poorer peer relationships than their pain-free counterparts.<sup>12</sup> Interpreted through the lens of appraisals theories, and consistent with the Communal Coping Model, pain-related magnification, rumination, and helplessness may lead to expressive behaviors to marshal support from others.<sup>4,69,62,66</sup> These pain behaviors may elicit negative responses,<sup>30,35,57</sup> particularly when others (eg, peers) do not understand the chronicity or severity of the pain.<sup>13</sup> Additionally, consistent with appraisals theories as well as the fear-avoidance model, high catastrophizing youth may limit their social activities because they believe they are physically incapable (helplessness component of catastrophizing)

and/or that such activities may exacerbate their pain (magnification component of catastrophizing).<sup>58</sup>

Pain intensity was a direct predictor of future functional disability; neither pain-related injustice nor catastrophizing were mediators. Contextualizing this finding within the existing literature is difficult as previous findings are mixed, which may be due to use of cross-sectional versus longitudinal designs, as well as differences conceptualizing the variables of interest (eg, as independent, mediating, or moderating variables). Previous cross-sectional studies in youth found that both injustice and catastrophizing were associated with worse disability,<sup>39,41,59,63,67</sup> and another cross-sectional study found catastrophizing mediated the relationship between pain and functional disability.<sup>19</sup> By contrast, two longitudinal studies found injustice did not predict future functional disability.<sup>37,40</sup> Two other longitudinal studies are also relevant. Junghans-Ruteloni and colleagues<sup>23</sup> found that improvements in catastrophizing mediated functional improvements for youth with chronic pain and youth with postural orthostatic tachycardia syndrome following a pain rehabilitation program. Vervoort et al. [88] found that baseline catastrophizing predicted 6 month disability in schoolchildren, and pain intensity moderated this effect. Given these mixed findings, future research is needed to clarify the longitudinal relationships among pain, pain-related appraisals (injustice and catastrophizing), and functional disability in youth.

Pain intensity also directly predicted 3-month school functioning. Neither pain-related injustice nor catastrophizing mediated this relationship, suggesting that pain appraisals do not play a mechanistic role. Previous research indicates that chronic pain is a risk factor for poorer academic functioning and increased absenteeism among youth.<sup>32,25</sup> Taken together with the current mediation results, it appears that pain itself which did not improve over our 3 month clinical capture window is the driving factor in poorer school functioning among youth with chronic pain. Nevertheless, it is possible that other unmeasured variables also play an important role in this context.

Catastrophizing has been a psychosocial darling of the pain literature, with consistent calls for assessment and intervention. While we agree, our findings suggest that injustice appraisals may be equally important in this context. Psychological interventions targeting pain catastrophizing are effective in adults.<sup>82</sup> Although a few studies support their effectiveness in pediatrics,<sup>19,26,45</sup> this literature is less established, and a similar systematic review has yet to summarize the effect of psychological interventions on pain catastrophizing in children and/or adolescents. In contrast to catastrophizing, pain-related injustice is less responsive to typical multidisciplinary pain interventions, at least among adults.<sup>56,67</sup> Collectively, this argues for the development of interventions that specifically target pain-related injustice appraisals. Scott and colleagues<sup>52</sup> suggested Acceptance and Commitment Therapy for this purpose, particularly through its emphasis on psychological flexibility. At minimum, continually

measuring injustice appraisals over the course of therapy may provide important material for exploration. For example, under the framework of Cognitive Behavioral Therapy (CBT) an evidence-based approach for pediatric chronic pain<sup>44</sup> pain-related injustice appraisals would be considered negative cognitions that might be amenable to evaluation or restructuring techniques. One hypothetical example of how this might play out: If a child's injustice appraisals (eg, "no one understands my pain") are driving behaviors (eg, avoidance) surrounding social situations, helping that child develop more accurate and adaptive thoughts ("some kids do understand...") may lead to improved social functioning ("...and these are new friends I could play with"). Additionally, for some, the experience of chronic pain in childhood or adolescence may be especially aversive, even traumatic. In these cases, trauma-focused CBT<sup>6</sup> may prove useful. From this framework, clinicians can validate youths' experience of the unfairness, severity, and irreparability of chronic pain while maintaining a focus on developing positive coping skills and improving function. Moreover, ACT or CBT in a group format may serve to normalize pain experiences and provide peer support.

These findings should be interpreted in light of limitations. The PedsQL subscales are brief (5 to 8 items per domain) and limited (eg, the Social Functioning subscale only contains items about peer relationships; it does not assess other aspects such as relationships with family and non-peer others). Therefore, the results should be interpreted cautiously, pending replication with more comprehensive measures. Relatedly, including measures of specific psychological domains, such as depression and anxiety, would strengthen our understanding of the relationships examined herein. Another limitation is that information on treatments received by patients over the course of the 3 month follow-up period was not available; therefore, the impact of treatment on these relationships cannot be accounted for. In terms of demographics, patients were predominately White and female, and all were from a single midwestern pain clinic. These sample characteristics may limit generalizability; for example, race differences in injustice and catastrophizing have been found in adults with chronic pain.<sup>72</sup> Additionally, patients with a variety of pain diagnoses were included; therefore, it is unclear if the observed relationships replicate across specific diagnostic subgroups. Finally, we did not have access to other potentially relevant information, such as maternal education and household income level, nor did we include data from patients who were not seen during the 3 month follow-up window.

Future research is needed to identify factors that precipitate and interact with pain-related injustice appraisals in youth with chronic pain. How parental factors influence the development and maintenance of injustice appraisals remains under-investigated. We recently found that both the degree and congruence between child and parent injustice appraisals were associated with child-reported outcomes.<sup>41</sup> The relationship between injustice appraisals and other important parental factors, such as parental responding and distress levels,<sup>44</sup> remains to be explored. Several studies

have examined the relationship between catastrophizing and pain behaviors.<sup>31,34,57</sup> In contrast, little is known about the relationship between pain-related injustice, pain behaviors, and functional outcomes this represents an important area for future study. Pain-related invalidation is another potentially important factor. Invalidation was associated with poorer physical and mental health in adults with rheumatic diseases.<sup>28</sup> Pain dismissal is also noted as a frequent occurrence in youth with chronic pain, occasioning negative emotions such as anger, self-directed negativity, and isolation.<sup>8,21</sup>

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