Pain catastrophizing mediates the negative influence of pain and trait-anxiety on health-related quality of life in fibromyalgia

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Abstract

Background Patients with fibromyalgia syndrome (FMS) usually display a decrease in health-related quality of life (HRQoL). This decrease in HRQoL is related to clinical pain, anxiety, and depression. This cross-sectional study analyzes the mediating role of pain-coping strategies (especially catastrophizing) in the negative relationships of pain, anxiety, depression, and HRQoL in FMS.

Methods One hundred and thirteen women with FMS and 63 healthy women were assessed using the Short-Form Health Survey (SF-36). Participants completed self-report questionnaires to evaluate clinical pain, anxiety, depression, and pain-coping strategies.

Results Pain catastrophizing was inversely associated with the physical function, general health perception, vitality, emotional role, mental health, the physical and mental general components, and the global index of HRQoL, with percentages of variance explained ranging between 9 and 18%. Cognitive distraction showed a positive association with the physical function, general health perception, vitality, emotional role, mental health, physical component, and global index of HRQoL, with percentages of variance explained ranging between 4 and 7%. Mediation analysis showed that catastrophizing mediates the negative influence of clinical pain and trait-anxiety on the physical function, general health perception, vitality, mental health, and global index of HRQoL. No mediating effect of pain catastrophizing on the relation between depression and HRQoL was observed.

Conclusions Patients with FMS exhibited markedly lower HRQoL than healthy individuals. While pain catastrophizing was inversely related to several domains of HRQL, associations were positive for cognitive distraction. Catastrophizing mediates the negative influence of clinical pain and trait-anxiety on HRQoL. Therefore, cognitive behavioral treatments focused on adaptive management and control of catastrophizing and negative emotional states may be helpful.

Keywords Health-related quality of life · Clinical pain · Anxiety · Depression · Catastrophizing · Coping strategies

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Introduction

Fibromyalgia syndrome (FMS) is a chronic disorder that predominately affects women. It is characterized by widespread and persistent musculoskeletal pain. Other related symptoms included fatigue, insomnia, morning stiffness, anxiety, depression, and cognitive impairment [1].

FMS has a negative impact on activities of daily life, work, career, parenting, interpersonal relationships, and mental health. The observed alterations remain relatively stable, excluding physical disability, which tend to increase over time [2–4].

The concept of health-related quality of life (HRQoL) refers to the interfering effect of an illness (and its treatment) on adaptive functioning [5]. Measurement of HRQoL

includes evaluation of individual health and functioning in terms of daily activities, including physical, psychological, and social function, and the patient's general perception of their own health, mobility, and emotional well-being [5]. It is thus a multidimensional construct that subsumes several factors (i.e., functionality, general satisfaction, perceptions about health status, etc.), together with assessment of the interaction between an individual and their social environment. The concept of HRQoL proposed by Guyatt and Patrick [5] refers to the perception of patients about the interfering effect of their illness on adaptive functioning. This conceptualization is in accordance with our primary goal of studying how FMS affects functioning at everyday activities.

For the assessment of HRQoL, we used the 36-Item Short-Form Survey Instrument (SF-36) [6], a comprehensive self-report instrument of functional health status and well-being. This questionnaire measures the patients' perception about health status and the interference of an illness with their functioning at physical, psychological, and social levels as well as their general health perception. The SF-36 is widely used in health studies and specifically in FMS research [2, 3, 7]. Furthermore, its holistic approach seems to be more adequate to assess HRQoL in FMS than that provided by specific instruments such as the Fibromyalgia Impact Questionnaire [8, 9].

Previous studies have shown that patients with FMS usually have poorer HRQoL [2, 7, 10, 11] than healthy individuals, also showing lower HRQoL values than patients with other musculoskeletal disorders and rheumatic diseases, such as rheumatoid or psoriatic arthritis [2, 12, 13]. The main factors cited to explain the decrease in HRQoL seen in FMS are the intensity of clinical pain and levels of depression and anxiety, which are inversely associated with HRQoL [2, 4, 14].

The concept of catastrophizing was first introduced by the American psychologist Ellis in 1962 [15] and later elaborated on by Beck in 1987 [16]. Catastrophizing is a negative emotion-focused coping strategy that, in the context of pain, can be conceptualized as an exaggeratedly negative orientation to pain that provokes fear, discomfort, worrying and helplessness, and comprises three major dimensions: magnification, helplessness, and rumination [17]. People with high levels of catastrophizing usually magnify any currently experienced pain, anticipate painful stimuli, and assess their capacity to deal with pain negatively [18, 19]. Catastrophizing is usually positively related to physical disability, pain [20–23], and difficulties in self-care routines [24] in chronic pain disorders, including FMS. Thus, catastrophizing could be considered as a relevant factor in the development and maintenance of chronic pain [25, 26]. As such, greater pain catastrophizing is related to increased brain activation in response to evoked pain in areas associated with attention, anticipation, and emotional aspects of pain in FMS [27–29].

Catastrophizing also seems to be a significant variable which seems to influence illness exacerbation, poor treatment outcomes, loss of function, and chronicity in FMS [23, 30–32], and exacerbates the use of analgesics and healthcare services, increasing public health costs of FMS [28, 30]. In addition, catastrophizing has been related to greater levels of psychological distress (i.e., anxiety and depression) [22, 33], negative perception of one's own illness [32], and pain-related fear [34]. It has been proposed that there is a vicious circle in pain chronicity, which starts with pain catastrophizing that leads to fear of pain, which in turn produces avoidance behaviors that finally increase pain and lead to depression [26]. Additionally, catastrophizing may act as a cognitive appraisal process before the initiation of other coping strategies [6, 35].

The few studies which have analyzed the association between catastrophizing and HRQoL in FMS and other chronic pain disorders have observed negative correlations [20, 36]. Further coping strategies of possible relevance to FMS are cognitive distraction and the ignoring of pain sensations. Cognitive distraction (i.e., diverting attention away from pain or other negative perceptions) is considered as a positive strategy in chronic pain and depression [37]. Some studies suggest that this strategy may contribute to improvement of HRQoL FMS [38]. The strategy of ignoring pain sensations is infrequently in FMS, supporting the idea of suboptimal coping mechanisms in this illness [39–41].

We hypothesize that catastrophizing mediates the negative impacts of pain, anxiety, and depression on the different dimensions of HRQoL. The rationale for this hypothesis is based on evidence showing that (1) FMS patients have poorer HRQoL than healthy individuals [2, 7, 11]; (2) FMS patients experience greater levels of depression, anxiety, and catastrophizing than healthy individuals [2, 41, 42]; (3) depression, anxiety, and clinical pain are associated with lower HRQoL [2, 41]; (4) catastrophizing is positively associated with clinical pain, depression, and anxiety [22, 33]; and (5) catastrophizing is related to greater disease severity, loss of functionality, and pain chronicity in FMS [23, 30–32] and has been proposed as a mediator of treatment efficacy [23, 30]. Therefore, we hypothesize that chronic pain, depression, and anxiety may increase catastrophizing, which in turn, decreases HRQoL in FMS. Catastrophizing may exert its negative influence through several mechanisms, like aggravation of symptoms [30], hypervigilance and somatosensory amplification [8, 30, 43], rumination of negative events and thoughts [17], interference with positive health behaviors [44], etc. Considering this, the aim of the study was to examine through mediation models the role of catastrophizing as a possible indirect mechanism in the associations between chronic pain, anxiety, and depression and HRQoL.

Methods

Participants

In total, 113 women with FMS (Mean age ± SD: 52.08 ± 8.30 years) were recruited through the Fibromyalgia Association of Jaén. All patients met the 1990 and 2010 American College of Rheumatology criteria for FMS [1, 45]. A high proportion of patients took antidepressants (66.37%), anxiolytics (69.03%), non-opioid analgesics (84.07%), or opiates (44.25%). Moreover, a substantial part of them had comorbid depression (65.49%) or anxiety disorders (72.57%). Sixty-three healthy women (Mean age ± SD: 49.40 ± 8.23) were recruited via women's associations and through friends of patients. Exclusion criteria for both groups included the presence of metabolic abnormalities, neurological disorders, drug abuse, and severe somatic (i.e., cancer) or psychiatric (i.e., psychotic) diseases. In the healthy group, the presence of any kind of pain disorder was an exclusion criterion. Table 1 displays the demographic and questionnaire data of both groups.

Instruments and measures

The patients' clinical history and demographic data were obtained via a semi-structured interview. The Structured Clinical Interview for Axis I Disorders of the Diagnostic and Statistical Manual for Mental Disorders (SCID, [46]) was applied to diagnose possible mental disorders. In addition, the following self-report questionnaires were administered:

– Short-Form Health Survey (SF-36) [47, 48]. The SF-36 is one of the instruments most frequently used to assess HRQoL, and has the advantage of evaluating several dimensions and components. It consists of 36 items pertaining to eight domains of functioning: (1) physical function (limitations in physical activities due to health problems), (2) physical role (limitations in usual role activities because of physical health problems), (3) body pain (frequency of pain and its interference on general work activities, both outside and within the home; scored via an inverse scale; greater values indicate lower pain), (4) general health perception, (5) vitality (energy and fatigue), (6) social function (limitations in social activities because of health or emotional problems), (7) emotional role (limitations in usual role activities owing to

Table 1 Sociodemographic data, clinical variables, and questionnaire scores in patients with FMS and healthy individuals (M ± SD)

N	Patients 113	Healthy participants 63	t	p	η_p^2
Age	52.08 ± 8.30	49.40 ± 8.23	2.06	.041	.02
Body mass index	27.98 ± 4.68	25.98 ± 4.28	2.80	.006	.04
Years of education	10.16 ± 4.20	12.54 ± 4.04	− 3.65	< .0001	.07
State-anxiety (STAI-E)	27.96 ± 11.72	17.92 ± 10.55	5.64	< .0001	.16
Trait-anxiety (STAI-T)	44.57 ± 13.60	20.62 ± 10.62	12.07	< .0001	.46
Depression (BDI)	32.30 ± 16.82	7.96 ± 8.24	10.78	< .0001	.40
Total Pain (MPQ)	66.42 ± 35.34	15.54 ± 12.96	10.88	< .0001	.41
Pain intensity (VAS)	5.35 ± 2.44	1.87 ± 1.89	9.63	< .0001	.35
Catastrophizing (CAT)	21.67 ± 9.60	4.31 ± 5.90	12.59	< .0001	.49
Cognitive distraction (CD)	14.91 ± 8.11	13.50 ± 10.47	.91	.172	.01
Ignoring pain sensations (IPS)	10.79 ± 5.99	8.97 ± 6.82	1.81	.025	.03
Physical function (SF-36)	25.07 ± 10.35	53.66 ± 7.41	− 19.32	< .0001	.68
Physical role (SF-36)	30.41 ± 6.57	52.36 ± 6.62	− 21.19	< .0001	.72
Body Pain (SF-36)	27.59 ± 14.99	50.35 ± 8.82	− 11.03	< .0001	.41
General health perception (SF-36)	30.96 ± 8.58	53.58 ± 7.68	− 17.39	< .0001	.64
Vitality (SF-36)	27.00 ± 8.59	48.85 ± 8.05	− 16.54	< .0001	.61
Social function (SF-36)	25.29 ± 13.95	48.50 ± 11.05	− 11.36	< .0001	.43
Emotional role (SF-36)	26.64 ± 11.84	50.18 ± 9.39	− 13.58	< .0001	.51
Mental Health (SF-36)	29.22 ± 10.30	45.62 ± 8.90	− 10.61	< .0001	.39
Physical component (SF-36)	28.56 ± 11.53	45.64 ± 9.12	− 10.12	< .0001	.69
Mental component (SF-36)	28.79 ± 8.64	54.43 ± 7.83	− 19.50	< .0001	.37
Global Index of HRQoL (SF-36)	28.68 ± 6.80	50.03 ± 6.25	− 20.55	< .0001	.71

Statistics of the group comparisons were also included (Student's *t* test)

HRQoL health-related quality of life, η_p^2 effect size. $p < .0001$ in all dimensions and components

emotional problems), and (8) mental health (psychological distress and well-being). Three general indices can be derived from these subscales: physical component, mental component, and global index. Cronbach's α values for the SF-36 range from 0.70 to 0.94 [48].

– State-Trait Anxiety Inventory (STAI) [49, 50]. This instrument assesses current and habitual anxiety levels (20-item scale) using a 4-point Likert scale (score range 0–60). The Cronbach´s α values are 0.93 for the State Anxiety scale and 0.87 for the Trait Anxiety scale [50].
– Beck Depression Inventory (BDI) [51, 52]. This 21-item scale was applied to assess the severity of symptoms of depression (4 point Likert scales; score range: 0–63). The Cronbach´s α for the BDI is 0.95 [52].
– McGill Pain Questionnaire (MPQ) [53, 54]. This 73-item instrument allows for quantification of the sensorial, emotional, and cognitive-evaluative components of pain experience. The global MPQ score (Total Pain, score range 0–146) was used in the analyses in this study. In addition, current pain intensity was assessed via a 10 cm visual analogue scale (VAS). A Cronbach´s α value of 0.74 was reported for total pain [54].
– Coping Strategies Questionnaire (CSQ) [55, 56]. This instrument was used to evaluate pain-related coping strategies. Only the catastrophizing (6 point Likert scales; score range 0–36), cognitive distraction (6 point Likert scales; score range 0–36), and ignoring pain sensations (7 point Likert scales; score range 0–42) subscales of this instrument were applied herein. The Cronbach's a values range between 0.68 (ignoring pain sensations) to 0.89 (catastrophizing) [56].

Procedure

The Fibromyalgia Association of Jaén provided the authors with a list of possible patients, who had previously been asked for their consent with participation in the study. The authors made contact with them by phone. The study was conducted over two sessions performed on the same day. During the first session, a clinical psychologist took the patients' clinical history, recorded sociodemographic data and medication use, evaluated possible violations of the exclusion criteria, and presented the SCID interview. During the second session, the standardized questionnaires were completed. The study protocol was approved by the Ethics Committee for Human Research of the University of Jaén and all participants provided written informed consent.

Statistical analysis

Raw scores on the SF-36 were transformed into standardized scores using the available norms for the Spanish general population [48] and then normalized (mean = 50, standard deviation = 10). The general physical and mental components of the SF-36 were computed using weightings for the Spanish population [48]. The Global SF-36 index was calculated as the average of the general physical and mental components. Group differences in SF-36 variables were analyzed using multivariate analysis of variance (MANCOVA). Age, years of education, and BMI were included as covariates in this analysis.

Associations between SF-36 variables and the other questionnaire scales were analyzed in two steps, both restricted to the FMS group ($N = 113$). Firstly, at an exploratory level, Pearson correlations were computed. Secondly, multiple regression analyses were computed. Two blocks were entered in the analyses: (1) age, BMI, and years of education (simultaneously; enter method) and (2) variables that showed significant correlations in the previous exploratory analysis (stepwise method). Dependent variables were the SF-36 domains. Adjusted Change R^2 is presented as an index of the change in predictive power associated with each new block. A maximum of six predictor variables was used (at least 10 cases per predictor is considered appropriate, [57]).

Mediation analyses were then performed with the PROCESS macro for SPSS. To assess the significance of partial mediation effects, the Sobel test, based on K.J. Preacher´s algorithms, was used [58, 59]. This test compares the difference in statistical significance between the direct effects of a predictor variable and the indirect effects occurring through a mediating variable (i.e., when a mediating variable is included in the model, a significant decrease in the effects of the predictor variable on the dependent variable should be observed). Furthermore, to increase the robustness of the results, confidence intervals (CIs) generated from bootstrapping effect estimation techniques were used. For a significant mediating effect, the limits of the CI should not include the 0 value [58, 59]. A total of 5000 bootstrap resamples were used to generate bias-corrected 95% CIs for the indirect effect.

Results concerning group differences in HRQoL, as well as associations between HRQoL and anxiety, depression, and pain scores replicated those observed in a previous study [2], and are reported in the online Supplementary material associated with this article.

Results

A multivariate group effect was obtained on SF-36 variables ($F(8, 167) = 74.39$, $p < 0.0001$, $\eta_p^2 = 0.78$). Patients with FMS displayed lower values in all SF-36 variables. Age, BMI, and Years of education did not show a multivariate significant effect. Only BMI showed a univariate significant effects on General Health Perception ($F(1, 171) = 3.14$, $p = 0.030$, $\eta_p^2 = 0.03$). Both Catastrophizing and Ignoring

Pain Sensations scores were higher in patients than healthy participants; the group difference was far greater for Catastrophizing. No group difference was observed for Cognitive Distraction (Table 1).

Catastrophizing scores were inversely associated with the Physical Function, General Health Perception, Vitality, Emotional Role, Mental Health, Physical Component, Mental Component, and Global Index domains of HRQoL (Table 2). Cognitive Distraction was positively associated with the Physical Function, General Health Perception, Vitality, Emotional Role, Mental Health, Physical Component, and Global Index domains of HRQoL. No significant correlations were found for Ignoring Pain Sensations.

Significant results of the second block of multiple regression analyses for the prediction of SF-36 variables according to the three coping strategies are presented in Table 3. After controlling for the effects of age, years of education and BMI, Catastrophizing, with an inverse influence, was the main predictor of the Physical Function, General Health Perception, Vitality, Emotional Role, Mental Health, Mental and Physical Components, and Global Index domains of HRQoL. Regarding thirds regression models, cognitive distraction was significantly positively related to the Physical Function, Vitality, Emotional Role, Mental Health, Physical Component, and Global Index domains of HRQoL.

Table 4 displays the significant results of the mediation analysis and Fig. 1 shows statistical diagrams of the partial mediation effect of Catastrophizing on SF-36 variables. All analyses presented in Table 4 fulfill the assumptions of significant correlations (1) between predictor and dependent variables, (2) between predictor and mediation variables and (3) between mediation and dependent variables (54, 55) (see the supplementary material associated with this submission). Catastrophizing was a significant mediator of the

Table 2 Correlations between SF-36 variables and pain-coping strategies in patients with FMS ($N = 113$)

Dimensions of HRQoL	CAT	CD	IPS
Physical function	− .432*	.285*	.083
Physical role	− .084	.133	.151
Body pain	− .141	.136	.017
General health perception	− .308*	.208[+]	.154
Vitality	− .343*	.325*	.099
Social function	− .065	.109	.030
Emotional role	− .288*	.281*	.045
Mental health	− .420*	.303*	.072
Physical component	− .298*	.278*	.043
Mental component	− .205[+]	.152	.106
Global Index of HRQoL	− .383*	.332*	.103

HRQoL health-related quality of life, *CSQ* Coping Strategies Questionnaire, *CAT* catastrophizing, *CD* cognitive distraction, *IPS* ignoring pain sensations

[+]$p < 0.05$, *$p < 0.01$, two-tailed testing

Table 3 Significant results of the stepwise multiple regression analysis for prediction of SF-36 variables in patients with FMS from pain-coping strategies ($N = 113$)

Dependent variable	Models	Predictors	β	Δr2	t	p
Physical Function	1st model	Catastrophizing (CAT)	− .43	.18	− 4.95	< .001
	2nd model	Catastrophizing (CAT)	− .38	.05	− 4.41	< .001
		Cognitive distraction (CD)	.23		2.66	.009
General health perception	1st model	Catastrophizing (CAT)	− .30	.09	− 3.33	.001
Vitality	1st model	Catastrophizing (CAT)	− .35	.12	− 3.85	< .001
	2nd model	Catastrophizing (CAT)	− .29	.07	− 3.27	.001
		Cognitive distraction (CD)	.28		3.07	.003
Emotional role	1st model	Catastrophizing (CAT)	− .29	.09	− 3.18	.002
	2nd model	Catastrophizing (CAT)	− .25	.05	− 2.67	.009
		Cognitive distraction (CD)	.23		2.42	.017
Mental health	1st model	Catastrophizing (CAT)	− .43	.18	− 5.00	< .001
	2nd model	Catastrophizing (CAT)	− .38	.05	− 4.46	< .001
		Cognitive distraction (CD)	.23		2.69	.008
Physical Component	1st model	Catastrophizing (CAT)	− .31	.09	− 3.35	.001
	2nd model	Catastrophizing (CAT)	− .26	.04	− 2.85	.005
		Cognitive distraction (CD)	.22		2.35	.021
Mental Component	1st model	Catastrophizing (CAT)	− .19	.04	− 2.09	.039
Global Index of HRQoL	1st model	Catastrophizing (CAT)	− .38	.15	− 4.32	< .001
	2nd model	Catastrophizing (CAT)	− .33	.07	− 3.75	< .001
		Cognitive distraction (CD)	.27		3.03	.003

Standardized β, change in r2 (Δr2), t, and p are indicated. Results of the first block, which served to control for the effects of age, educational level and body mass index, are not reported

Table 4 Results of significant mediation analysis for the prediction of SF-36 outcome variables ($N=113$)

Independent variables	Mediator variables	Direct effects				Indirect effects					
		Effect	SE	t	p	Effect	SE	Z	p	Boot LLCI	Boot ULCI
		Dependent variable: Sf-36 outcome variables									
Physical function											
Trait-anxiety (STAI-T)	Catastrophizing (CAT)	− .35	.07	− 4.98	< .001	− .08	.04	− 2.01	.044	− .17	− .01
Pain intensity (VAS)	Catastrophizing (CAT)	− 2.15	.35	− 6.11	< .001	− .39	.18	− 2.23	.026	− .85	− .11
General health perception											
Trait-anxiety (STAI-T)	Catastrophizing (CAT)	− .09	.07	− 1.16	.249	− .08	.04	− 2.15	.031	− .17	− .01
Total pain (MPQ)	Catastrophizing (CAT)	.06	.02	− 2.50	.014	− .02	.01	− 2.00	.046	− .05	− .01
Pain intensity (VAS)	Catastrophizing (CAT)	− .44	.35	− 1.23	.220	− .39	.18	− 2.24	.025	− .84	− .10
Vitality											
Total pain (MPQ)	Catastrophizing (CAT)	− .07	.02	− 3.17	.002	− .02	.01	− 2.14	.032	− .05	− .01
Mental health											
Pain intensity (VAS)	Catastrophizing (CAT)	− 1.55	.38	− 4.09	< .001	− .48	.19	− 2.47	.013	− .95	− .18
Global index of HRQoL											
Total pain (MPQ)	Catastrophizing (CAT)	− .06	.02	− 3.77	< .001	− .02	.01	− 2.34	.019	− .04	− .01

SE standard error, *Z* statistic of the Sobel Test, *Boot* bootstrapping results with confidence intervals for the lower (LLCI) and upper limits (ULCI)

relations between Trait-Anxiety and Physical Function and General Health Perception; of the relations between Total Pain (MPQ) and the General Health Perception, Vitality and Global Index domains of HRQoL; and of the relations between Pain Intensity (VAS) and the Physical Function, General Health Perception, and Mental Health domains of the HRQoL. No mediation effects were found for Cognitive Distraction or Ignoring Pain Sensations.

Discussion

As expected, patients with FMS exhibited markedly lower scores in all domains of HRQoL than healthy individuals [2, 3, 7, 10, 11], together with greater trait-anxiety, depression, catastrophizing, and clinical pain [28, 41, 42, 60].

Previous studies have clearly shown the relevance of anxiety and depression to pain perception and its negative impact on HRQoL in FMS [2, 4, 14, 42]. In our study, pain catastrophizing was inversely related to the Physical Function, General Health Perception, Vitality, Emotional Role, Mental Health, Physical Component, Mental Component, and Global Index domains of HRQoL, with the percentage of variance explained ranging from 9 to 18%. These results showed the importance of catastrophizing in determining HRQoL in FMS [20, 36] and accord with previous studies showing that higher levels of catastrophizing were associated with increased pain and pain-related disability in FMS [61, 62], as well as with increased brain activity in response to evoked pain [28, 29].

Regarding cognitive distraction, although the effect size was lower than that for Catastrophizing, it showed a positive association with the Physical Function, General Health Perception, Vitality, Emotional Role, Mental Health, Physical Component, and Global Index domains of HRQoL, with the percentage of variance explained ranging from 4 to 7%. Cognitive distraction seems to be a positive coping strategy in the face of pain [37, 38] and is associated with improved HRQoL in FMS. However, more research on cognitive distraction is needed. We consider that, while catastrophizing drives attention toward threatening stimuli, thus worsening symptoms and illness perception, cognitive distraction may act in the opposite direction, by averting attention from pain towards more positive sensations. In fact, some authors [37] suggest that interventions promoting cognitive distraction are needed for chronic pain.

Mediation analysis showed that catastrophizing increased the negative influence of Trait-Anxiety, Total Pain (MPQ), and Pain Intensity (VAS) on several domains of HRQoL, especially Physical Function, General Health Perception, Vitality, Mental Health, and Global Index of HRQoL. Several specific putative mechanisms can be proposed to explain the negative impact of catastrophizing on HRQoL, as well as its effects of pain and anxiety.

Catastrophizing is related to several cognitive biases [16] which can maintain a negative priming state in the patient. These biases could include, for example, magnification of the relevance of certain negative sensations or symptoms, a filtering process in which only negative elements are considered (with positive elements being ignored), extreme generalization of the consequences of a negative event, cognitions

Fig. 1 Statistical diagrams of the significant partial mediation effects of Catastrophizing on HRQoL. All coefficients are significant at $p < .01$*
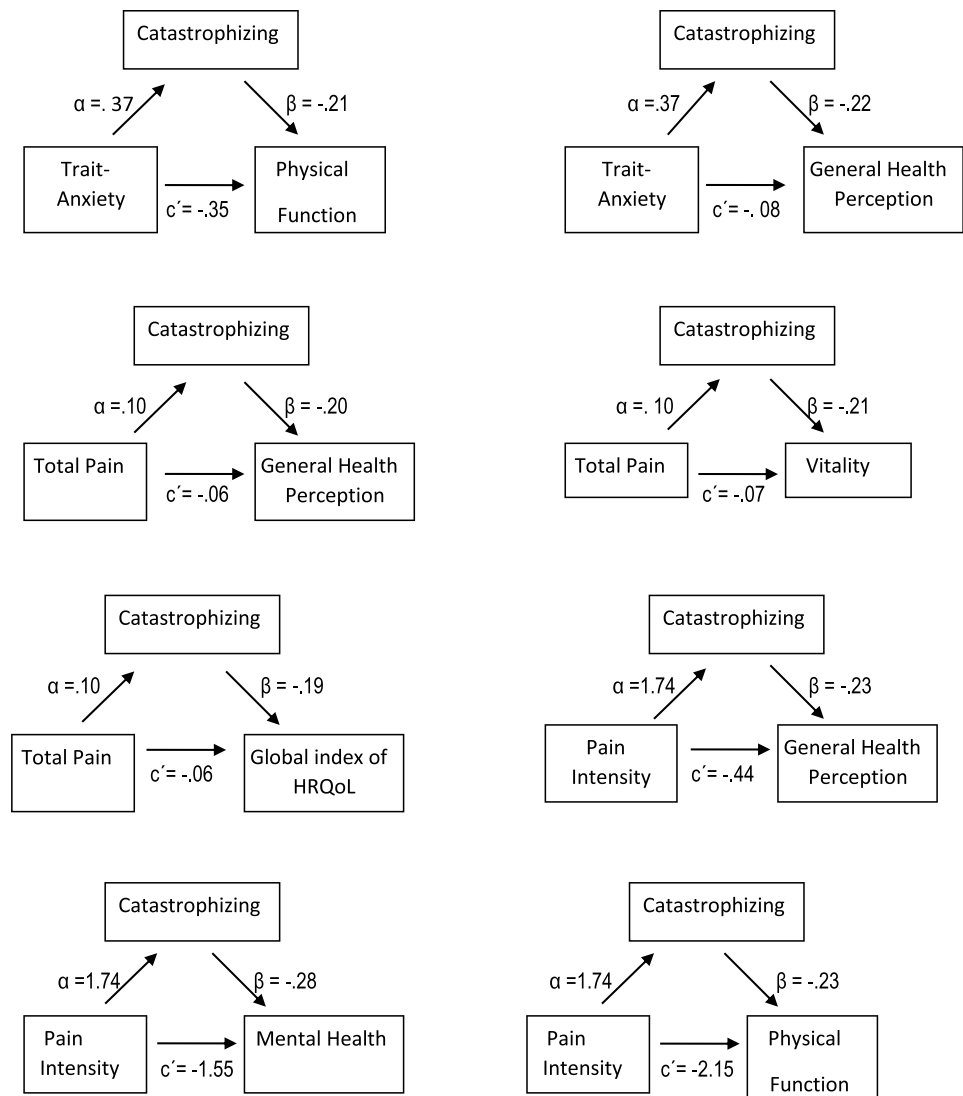
of helplessness and loss of control, a generally pessimistic orientation, etc.[16, 30]; all of these would promote a negative emotional state. Other relevant factors may include body hypervigilance and somatosensory amplification, which could increase pain perception [8, 30, 43], rumination pertaining to negative events, and thoughts that maintain negative emotional states [17], anticipation of negative events [18, 19], negative cognitive appraisals [6, 35], etc. These biases are also observed in individuals with high neuroticism or negative affectivity [63], which overlaps substantially with catastrophizing [41]. In the same vein, negative affectivity, vulnerability to stress and negative evaluations, and hypervigilance biases might be relevant factors in central sensitization to pain [27, 29, 64, 65], which is one of the more widely accepted hypotheses about the pathophysiology of FMS.

When patients with FMS show catastrophizing together with anxiety and depression, they tend to assign a higher negative value to external painful stimuli [26], which may lead to an increase in anxiety levels. Moreover, catastrophizing may be a multidimensional process involving the interaction of numerous factors, including depressed mood [28, 30, 62, 66], and previous research has shown that catastrophizing seems to influence the relation between depression and levels of chronic pain [67]. Contrary to this result and our expectations, no mediating influence of catastrophizing on the relation between depression and HRQoL has been observed. Although depression and anxiety share a common dimension of negative affect, they differ in terms of arousal level, which is greater in anxiety [68]. Given that catastrophizing is related to magnification of symptoms and increased hypervigilance [30], the increase in arousal may potentiate anxiety specifically, and not depression. Furthermore, catastrophizing is related to the development of two main cognitive biases: (1) evaluation of some sources of information as being especially negative and

(2) hypervigilance or attentional bias towards this type of information; both biases are central to the understanding of anxiety [69, 70].

Furthermore, pain catastrophizing seems to interfere with the performance of beneficial health behaviors, such as exercise, and increases pain- and illness-related behaviors and complaints, leading to a worsening of FMS symptoms [30, 44]. It is also related to fear-avoidance behaviors that may contribute to physical inactivity [66], which in turn usually leads to increases in pain, fatigue, and functional disability [41, 71].

Patients with maladaptive coping strategies (i.e., catastrophizing) usually employ an emotion-focused coping technique and show deficits in positive affect regulation, which hinders their ability to face problems in an adaptive healthy way [72, 73]; this could explain the positive relation between catastrophizing and anxiety and depression. In fact, catastrophizing is associated with greater emotional disturbance in FMS [30, 41].

Our results are in accordance to previous studies suggesting that pain catastrophizing may constitute a significant mediator of treatment adherence and efficacy [23, 30, 31]. Then evaluation and interventions aimed to reduce catastrophizing may constitute a relevant goal for the integral care of FMS patients as well as for improving treatment outcomes. In this sense, Cognitive Behavioral Therapy could be a relevant treatment given the central role of cognitive biases in catastrophizing [74, 75]. Acceptance and Commitment Therapy [76, 77] and psychoeducational interventions [78] seem to also be effective in reducing negative affectivity and unhealthy coping strategies.

Many authors have suggested that healthcare workers need to be aware of the effect of FMS on HRQoL, given that healthcare-related social support may positively influence HRQoL [14, 79]. Therefore, evaluation of different aspects of FMS, such as environmental factors, socioeconomic status, and individual differences, would be useful in guiding interventions aimed at increasing HRQoL. Moreover, patients employ a variety of strategies to cope with their FMS symptoms; some are positive, but others are negative, and healthcare providers need to be alert to possible negative coping strategies [14, 79, 80].

A relevant strength of this study is the large sample size that allowed the computation of mediation models to analyze complex relationships between pain catastrophizing, anxiety, depression, pain, and HRQoL. In addition to direct effects of catastrophizing on HRQL, this analysis demonstrated a secondary influence of this variable via mediating the negative influence of anxiety and pain on HRQL. While previous studies about coping and HRQoL in FMS mainly focused on negative strategies (i.e., pain catastrophizing) [20, 21], in the present one also positive coping (i.e., cognitive distraction) was considered. The results points to the need of intervention programs targeting positive and negative coping strategies in FMS in order to reduce the consequences of the illness on HRQL [8, 16]. The main limitation of the study is its cross-sectional design, which makes it difficult to draw causal conclusions. Moreover, a large part of the analysis is based on self-report measures. By definition, these data are sensitive to bias, for example due to the participants´ mood states [63].

Conclusions

Taken together, patients with FMS exhibited markedly lower HRQoL levels than healthy individuals. While pain catastrophizing was inversely related to several domains of HRQL, associations were positive for the coping strategy of distraction. Mediation analysis indicated that catastrophizing may indirectly increases the negative influence of clinical pain and trait-anxiety on HRQoL. Our results emphasize the need of cognitive behavioral treatment approaches to FMS in order to reduce its negative impact on HRQoL. Finally, it would be interesting to continue this line of research by exploring the implication of other coping strategies in HRQoL and to study effects of interventions aiming to control pain catastrophizing and negative mood states and to strengthen coping strategies like active distraction.

Compliance with ethical standards

Conflict of interest All the authors declare that they have no conflict of interest derived from the outcomes of this study.

Ethical approval The study protocol was approved by the Ethics Committee for Human Research of the University of Jaén

Informed consent All participants provided written informed consent.

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