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REVIEW

Pain catastrophizing in rheumatic diseases: prevalence, origin, and implications

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Abstract

Pain is a crucial factor in rheumatic disorders, and reducing it is a primary goal of successful treatment. Adaptive pain-coping strategies can enhance this improvement, but maladaptive approaches such as pain catastrophizing may worsen overall patient well-being. This narrative review aims to provide a concise overview of the existing knowledge on pain catastrophizing in the most prevalent specific rheumatic disorders. The objective of this study was to improve understanding of this phenomenon and its implications, as well as to pinpoint potential directions for future research. We conducted searches in the MEDLINE/PubMed, SCOPUS, and DOAJ bibliography databases to identify articles related to pain catastrophizing in rheumatoid arthritis, psoriatic arthritis, axial spondylarthritis, systemic sclerosis, systemic lupus erythematosus, Sjögren's syndrome, juvenile idiopathic arthritis, and osteoarthritis (non-surgical treatment). Data extraction was performed on November 1, 2023. The investigators screened the identified articles to determine their relevance and whether they met the inclusion criteria. Following a bibliography search, which was further expanded by screening of citations and references, we included 156 records in the current review. The full-text analysis centred on pain catastrophizing, encompassing its prevalence, pathogenesis, and impact. The review established the role of catastrophizing in amplifying pain and diminishing various aspects of general well-being. Also, potential treatment approaches were discussed and summarised across the examined disorders. Pain catastrophizing is as a significant factor in rheumatic disorders. Its impact warrants further exploration through prospective controlled trials to enhance global patient outcomes.

Keywords Pain · Catastrophization · Depression · Review · Musculoskeletal diseases

Introduction

Rheumatic disorders contribute substantially to morbidity and healthcare expenses on a global scale [1–3]. Their distinguishing feature is variability in pain levels. Treatment strategies primarily target the underlying causes of pain, which often stems from inflammation or degenerative processes. Pain can be debilitating by diminishing functionality and compromising the quality of life across different aspects [4]. Consequently, it is imperative to recognise pain as a fundamental aspect and a critical determinant of treatment outcomes, particularly from the patient's viewpoint [5].

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Over the past few decades, a range of theories on the origin of pain have surfaced in the scientific discourse. The landscape of understanding continues to expand as new pathways are uncovered through scientific inquiry. Notably, a biopsychosocial model of pain is well recognised as a possible hypothesis [6]. Consequently, these dimensions are being investigated to identify additional factors related to pain; to refine treatment approaches; and to enhance outcomes associated with pain.

Given the well-established recognition of mood and depression disorders as potential contributors to altered pain perception, ongoing investigation seeks to pinpoint the specific causes of intensified pain. One particularly intriguing factor is pain catastrophizing, a psychological maladaptive coping mechanism linked to an exaggerated experience of pain. This phenomenon is characterised by three primary domains: helplessness, rumination, and magnification.

In recent years, there have been concerted efforts to thoroughly investigate catastrophizing across various entities [7, 8]. While some authors have delved into the general phenomenon of pain catastrophizing, a detailed discussion of it is omitted here to maintain the focus of the current narrative review article [9, 10]. Additionally, prior review articles on pain catastrophizing in rheumatic disorders may not encompass recent discoveries from the last few years. These reviews may also not specifically address the most crucial rheumatic musculoskeletal disorders separately and distinctly.

In addition to elucidating the current understanding of pain catastrophizing in distinct rheumatic disorders, this narrative review aims to delve into unexplored dimensions that could improve diagnostic and treatment approaches. Beyond describing existing knowledge, we seek to unearth subtle nuances and potential intersections with other factors that may modify the impact of pain catastrophizing on rheumatic disorders.

In the broader context, our aim is to catalyse a shift in the clinical mindset to foster increased awareness among healthcare professionals about the pivotal role of pain catastrophizing in rheumatic disorders. By emphasising this aspect, we hope to inspire clinicians to proactively incorporate assessments and interventions related to pain catastrophizing into their routine practice, thereby optimizing patient care and outcomes. Using this approach, we hope to contribute to the advancement of both theoretical frameworks and practical strategies that can ultimately enhance the quality of care provided to individuals grappling with these complex conditions.

Pain catastrophizing

Pain catastrophizing is a psychological response to pain characterised by an exaggerated perception of the pain's threat and a sense of helplessness in managing it. Those who engage in pain catastrophizing often anticipate the worst outcomes, ruminate on pain-related thoughts, and expect their pain to persist or intensify. This cognitive and emotional reaction can contribute to increased distress, amplified pain sensitivity, and challenges in coping with and adapting to pain.

Albert Ellis and later Aaron Beck conceptualised catastrophizing as a maladaptive cognitive style utilised by individuals experiencing anxiety and depressive disorders [11, 12]. The early stages of study encountered challenges due to the absence of effective instruments for measuring and comparing catastrophizing. Addressing this limitation, Rosentiel et al. [13] introduced the Coping Strategies Questionnaire (CSQ), which focused on one dimension of catastrophizing—helplessness in the context of pain[13]. Following this, Sullivan et al. [14] formulated the Pain Catastrophizing Scale (PCS), a universal and multidimensional instrument designed to comprehensively measure and explore catastrophizing, encompassing its primary domains of magnification, rumination, and helplessness [14]. When comparing the CSQ and PCS, it became evident that using CSQ alone would not assess certain crucial domains of catastrophizing. These scales have proven to be valuable tools: they have been consistently applied and validated across diverse populations and diagnostic categories, including in rheumatic musculoskeletal disorders [15–17].

Search methodology

We conducted a literature search in the MEDLINE/PubMed, Scopus, and Directory of Open Access Journals (DOAJ) databases using terms associated with pain catastrophizing and specific diagnoses. The literature search involved predefined word strings for each disease (see Appendix) in PubMed and Scopus. Furthermore, as DOAJ does not offer an advanced search engine, the search was carried out using the basic term [disease] + catastrophizing.

The search and extraction of the primary article pool took place on November 1, 2023. Subsequent processing of articles, including title, abstract, full-text screening, as well as citation and reference screening, was performed between November 1 and December 13, 2023. The reference list has been updated to reflect the most current information as of the submission date (March 5, 2024).

Our search yielded 550 MEDLINE/PubMed-indexed articles, 628 Scopus-indexed articles, and 64 DOAJ-indexed articles. After eliminating duplicates, a total of 706 articles remained. One author (MW) conducted screening based on article abstracts and titles. Following the initial screening, 263 full-text articles were further evaluated for eligibility. The inclusion of additional articles from reference screening, citation screening, and from additional search as of the

submission date led to the final inclusion of 156 articles in the review. The literature selection flowchart is depicted in Fig. 1.

The inclusion criteria were as follows:

1. Full-text availability.
2. English language articles.
3. Articles assessing catastrophizing, either as a primary or secondary focus, separately across the examined diagnoses. These diagnoses included rheumatoid arthritis (RA), psoriatic arthritis (PsA), axial spondylarthritis (AxSpA), systemic lupus erythematosus (SLE), systemic sclerosis (SSc), Sjögren's syndrome (SS), juvenile idiopathic arthritis (JIA), and conservatively treated osteoarthritis (OA).
4. Use of validated and accepted instruments to measure catastrophizing, such as the CSQ and PCS, and derivates.

The exclusion criteria were as follows:

1. Ineligible population groups, such as combined cohorts that would not allow us to draw specific conclusions about distinct diagnostic groups. Vague cohorts where specific diagnosis information was uncertain, such as those labelled as "knee pain", were also excluded.
2. Studies with irrelevant analyses and results on catastrophizing. This criterion applied when a study did not yield any specific or valuable conclusions regarding pain catastrophizing in rheumatic disorders, primarily because the study did not focus on pain catastrophizing or employed alternative methods to assess catastrophizing.
3. Methodological issues leading to a perceived high risk of biased results which could compromise the reliability and quality of the review.
4. Studies involving surgical treatment, as the review focused on conservative treatment, aligning with ordinary rheumatology practices. Consequently, studies related to pain catastrophizing as a variable associated with surgical treatment (e.g., arthroplasty) were excluded. It is noteworthy that numerous meta-analyses and systematic reviews addressing surgical treatments in such cases have already been conducted [18–21].
5. Preprints, commentaries, case studies, errata, study protocols, and reviews or meta-analyses were not included in our study.

There were no restrictions on the publication date of included articles.

The concept of pain catastrophizing was examined individually within major rheumatic disorders. Initially, our focus was directed towards illustrating the potential prevalence and intensity of catastrophizing across these diseases. We highlighted demographic, psychosocial, and clinical factors from the current literature that could potentially be associated with catastrophizing. We also underscored the implications of pain catastrophizing and discussed potential treatment approaches.

Throughout the manuscript, the terms "pain catastrophizing" and "catastrophizing" are used interchangeably as synonyms to enhance the readability of this review article.

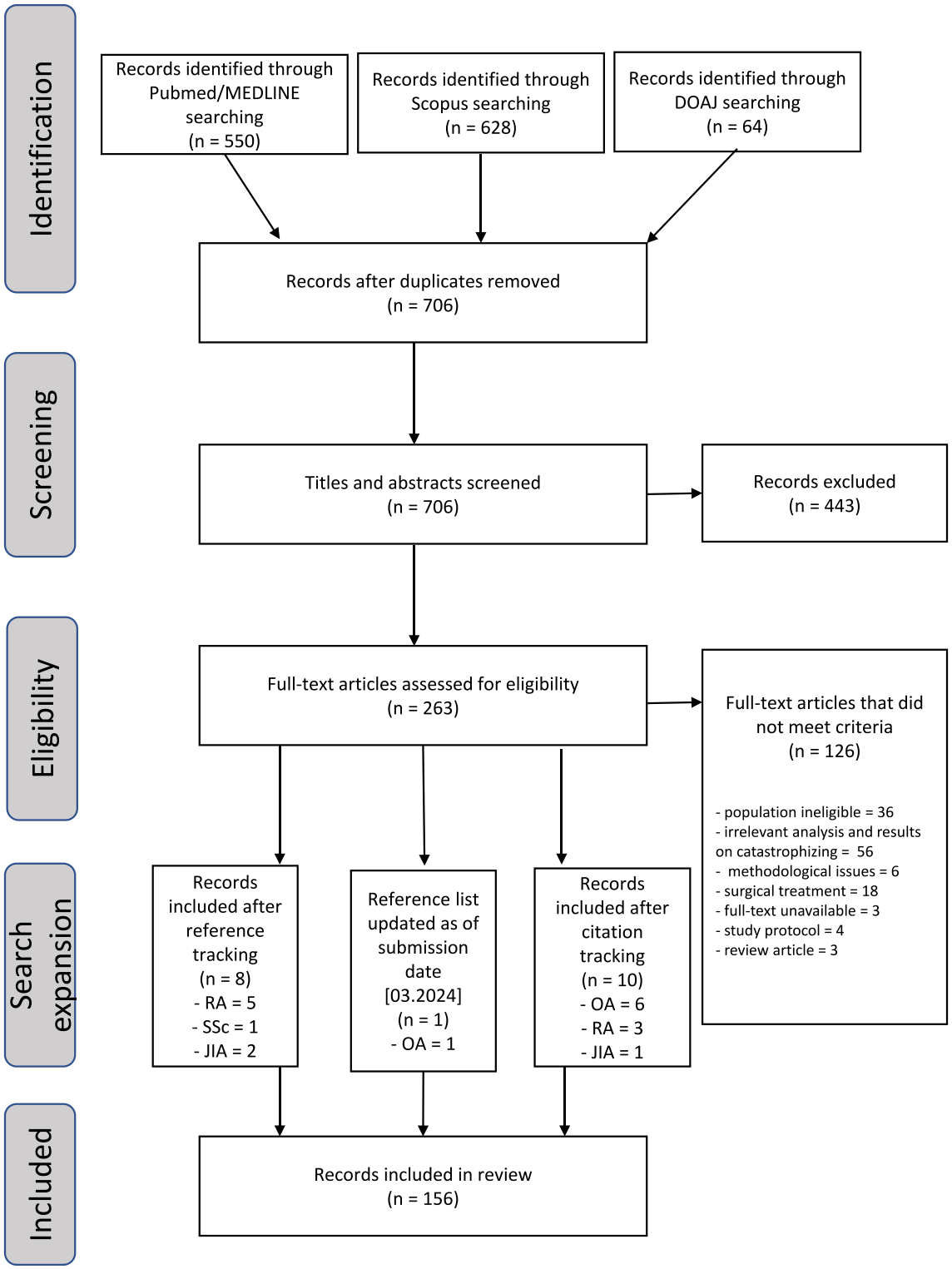
The methodology employed in our search process and the subsequent development of this narrative review was guided by previously published articles on the subject [22–25].

Rheumatoid arthritis

The initial search identified 132 potentially eligible articles. After removing duplicates and screening abstracts and titles, 45 articles remained. Further examination during full-text screening resulted in 31 articles meeting the criteria for inclusion in the review. Additionally, five articles were found through reference tracking, and three more through citation tracking, bringing the total number of eligible articles in the current review to 39.

The prevalence of pain catastrophizing appears to be relatively high among RA patients, who were also were found to engage in catastrophizing behaviours significantly more often than healthy individuals [26]. A direct comparison between major rheumatic disorders has been conducted previously [27]. It utilised a simplified approach to assess pain catastrophizing with a scale consisting of 2 questions instead of the original 13 questions, resulting in a score of 0–6 points [28]. RA patients had a mean simplified PCS score of 1.88. While no significant differences between RA and PsA patients were noted, patients with axSpA exhibited significantly higher catastrophizing behaviours than RA counterparts. When comparing the proportion of individuals classified as high pain catastrophizers (the authors of that study used an arbitrary cut-off score of ≥ 4), there were no significant differences among RA (10.5%), PsA (12.7%), and axSpA (15.3%) patients. In a distinct analysis, despite a modest elevation in PCS scores within the axSpA group as compared to the RA group, this observed difference was not statistically significant (20.8 vs. 17.0, $p = 0.08$) [29]. An additional direct comparison of RA and SSc patients also showed no significant difference in mean PCS scores [30].

Multiple factors associated with higher levels of catastrophizing were identified across the explored analyses, including increased global pain, impaired physical function, and lower perceived general health status [27]. The evidence on the influence of age on catastrophizing appears to be conflicting. Some articles suggest that younger age may be linked to greater catastrophizing, with the hypothesis that coping mechanisms may develop and improve over time



JIA: juvenile idiopathic arthritis, OA: osteoarthritis, RA: rheumatoid arthritis, SSc: systemic sclerosis,

Fig. 1 Literature search flowchart

[27]. In contrast, another analysis found that catastrophizing is more prevalent among older adults experiencing mild RA pain [31]. However, as the pain reaches a severe level, age differences in coping strategies diminish. Authors suggest that older adults better comprehend the challenges of managing severe pain and employ more effective coping responses by drawing from their experiences. Other analyses have suggested that completing fewer years of education contributes to greater catastrophizing [27, 32, 33].

Several psychological factors, including increased levels of anxiety or depression, have been documented as being linked to coping through catastrophizing [30, 34]. A study by Rice et al. [35] reported that RA patients with specific dispositional affect patterns, identified through cluster analysis, may encounter heightened negative outcomes, including significant mood impairment, pain anxiety sensitivity, and pain catastrophizing [35]. Trait neuroticism was also recognised as a factor responsible for engaging in catastrophizing behaviours in response to pain [36]. Moreover, pain catastrophizing was hypothesised to be a possible link between neuroticism and pain [37]. This influence of psychological traits on pain catastrophizing is possibly reciprocal, as some results suggest that patients engaging in catastrophizing are susceptible to psychiatric comorbidities [38]. Religion may also exert an influence, as a collective analysis reported that spiritual well-being and pain intensity jointly explained 68% of the total variance in pain catastrophizing [39]. While caution is advised due to a methodology involving pooling of RA and axSpA cohorts, the results offer noteworthy insights and were therefore included in the present review.

Catastrophizing was also investigated from a sociological standpoint. Some authors found that a lack of support from family and friends was a key factor in predicting catastrophizing [29]. Additionally, there is evidence emphasising the importance of spouse relations [40]. It has been observed that individuals reporting higher satisfaction with their spouse's responses were less prone to experiencing enhanced negative emotions resulting from catastrophizing. The association between pain and catastrophizing diminished as satisfaction with spouse responses increased. Negative emotions were correlated with an increase in catastrophizing, but this link was statistically significant only when individuals reported decreased satisfaction with their spouse's responses. Previous experiences of childhood maltreatment were linked to higher odds of pain catastrophizing [41]. Importantly, whether the disease was considered active did not alter the connection between childhood maltreatment and pain catastrophizing. This association retained statistical significance even after adjusting for diverse factors, such as sociodemographic elements and symptoms of depression and anxiety.

Several analyses have highlighted the potential implications of higher pain catastrophizing on the disease course and patient-related outcomes. Most notably, it is consistently linked to a heightened perceived pain experience [42, 43]. A study by Lefebvre et al. [44] suggests that catastrophizing plays a crucial role in shaping how individuals remember their previous pain experiences [44]. Clinically, these findings imply that patients with higher catastrophizing scores may have a more precise recollection of their pain. While a connection between pain and catastrophizing exists, the impact of catastrophizing on physical limitations becomes more pronounced when acceptance levels are low [45]. In obese RA patients, higher PCS scores were associated with increased pain, reduced physical function, and a greater tendency to overeat [46]. Quality-of-life deterioration was consistently found to be associated with catastrophizing in various analyses [27, 43, 47, 48]. Berthelot et al. [49] reported significantly elevated Routine Assessment of Patient Index Data 3 (RAPID3) questionnaire scores in catastrophizers [49]. From a psychological standpoint, pain catastrophizing has emerged as a noteworthy mediator in the relationship between pain intensity, daily affect, and depressive symptoms [50]. Changes in daily pain have been associated with variations in pain catastrophizing, with increased catastrophizing leading to intensified emotional distress and depressive symptoms. Depression outcomes may also worsen within a 6-month follow-up period for patients engaging in catastrophizing [42]. Edwards et al. [32] reported that catastrophizing in RA patients was linked to higher psychological distress, increased pain intensity, and greater physical dysfunction, even after accounting for disease-related factors [32]. Interestingly, the magnitude of these associations was stronger among patients with lower levels of education or social functioning. Covic et al. [51] highlighted that pain catastrophizing shows a stronger connection to heightened pain and depression in RA compared to praying and hoping [51].

In certain studies, greater pain catastrophizing has been associated with a reduced likelihood of achieving remission [52, 53]. However, in another analysis, there was no independent association between higher levels of pain catastrophizing and the achievement of low disease activity [54]. Furthermore, pain catastrophizing has been identified as independent of inflammatory parameters [52, 55], implying its potential role in disease activity assessed with routine measures, even in the absence of evident inflammatory activity [53]. A clustering algorithm performed by Lee et al. [56] found that 47.3% of the analysed RA cohort experienced moderate-to-high levels of pain, fatigue, and sleep problems [56]. While most of these patients had low inflammatory markers, their high catastrophizing levels suggested a chronic widespread pain syndrome. Additionally, a discrepancy between patient global assessment (PGA) and the physician's assessment could be attributed to higher catastrophizing [57], but its role in the substantial discrepancy

between the number of tender and swollen joints was not proven [58].

There is evidence suggesting that pain catastrophizing may decrease after initiating Disease Modifying Anti-Rheumatic Drug (DMARD) treatment [59–61]. This implies that efficiently managing disease activity, especially in relation to joint tenderness, can be beneficial in reducing pain catastrophizing. Additionally, psychological interventions and integrative medicine approaches have been shown to have a beneficial impact on pain catastrophizing in RA patient cohorts [62–64]. In a study by Davis et al. [65], mindfulness was highlighted for enhancing individuals' capacity to reduce catastrophizing when facing periods of elevated daily pain [65].

Psoriatic arthritis

The initial search yielded nine potentially eligible articles. After removing duplicates and abstract and title screening, five articles remained. Subsequent full-text analysis confirmed that all five identified articles met the criteria for inclusion in the current review.

Limited information exists regarding the prevalence of pain catastrophizing in individuals with PsA. In a study involving 394 individuals with PsA, the mean simplified PCS score was 2.06, significantly better than in axSpA but not statistically different from patients with RA. The percentage of high pain catastrophizers (score ≥ 4) was 12.7%, with no statistically significant differences between RA and axSpA. Individuals with higher PCS scores tended to be younger and reported experiencing greater global pain, worse physical functioning, and impaired emotional well-being. Additionally, they had significantly lower levels of education. Higher pain catastrophizing scores were linked to significantly lower Health-Related Quality of Life (HRQoL) [27]. A further exploration of PCS in PsA was conducted in a study comparing PsA and a healthy control group, revealing a significant difference between them (16.95 vs. 3.75) [66].

In study by Currado et al. [67], the impact of pain catastrophizing was investigated in a cohort of 135 PsA patients, with 29.6% having concomitant fibromyalgia. Participants with a Disease Activity in Psoriatic Arthritis (DAPSA) score greater than 14 (the cut-off score between low and moderate activity) demonstrated notably higher scores related to pain catastrophizing. The mean PCS score in the DAPSA < 14 group was 7.5, whereas in the DAPSA ≥ 14 group, it was significantly greater at 29. Adjusted multivariable linear regression demonstrated a significant association between PCS and higher DAPSA scores. However, the presence of concomitant fibromyalgia raised concerns about the generalisability of the results. Interestingly, in another analysis, PCS was not significantly associated with low disease activity by DAPSA in regression models, but a low p-value ($p = 0.11$) may suggest some tendency that requires further study in larger cohorts [54].

In a randomised controlled trial by Vela et al. [68], the impact of cannabinoid use on pain and related factors, including pain catastrophizing, was investigated in patients with PsA. However, the study found that CBD did not result in clinically or statistically significant effects on pain intensity. Moreover, no statistically significant effects were noted for sleep quality, depression, anxiety, or pain catastrophizing scores [68].

Axial spondyloarthritis

The initial search yielded 45 potentially eligible articles. After eliminating duplicates and screening of abstracts and titles, 11 articles remained. Subsequent full-text screening confirmed that all 11 identified articles met the criteria for inclusion in this review.

The mean overall PCS score in a Turkish axSpA cohort was 23.5 [69]. In a comparative analysis of PCS in major rheumatic musculoskeletal disorders, the simplified PCS in axSpA was 2.27, significantly higher than in RA and PsA [54]. Another analysis reported a median PCS score of 15 [70]. Available studies allow speculation regarding specific catastrophizer phenotypes in axSpA. In the Turkish cohort, the total PCS score weakly correlated with body mass index (BMI), pain, HRQoL, as well as fear and avoidance behaviours. Notably, BMI exhibited low and negative correlation with the total PCS score [69]. Another analysis revealed that younger patients with more physical issues, lower perceived general health, greater emotional problems, and lower levels of education were prone to experiencing heightened pain catastrophizing [27]. Additionally, one study underscored a possible negative link between spiritual well-being and PCS [39].

Other studies have indicated a correlation between PCS and elevated composite disease activity scores, such as Bath Ankylosing Spondylitis Disease Activity Index (BASDAI), emphasising the impact of maladaptive cognitive pain perception on achieving low disease activity and remission [54, 67]. Despite effective treatment of inflammation, individuals with possible central sensitisation may retain high disease activity scores. Moreover, a stronger perceived control over treatment was correlated with lower levels of catastrophizing thoughts, suggesting a potential link between perceived control and the degree of central sensitisation in these patients [70]. Higher pain catastrophizing was also associated with impaired HRQoL [27].

There is limited evidence regarding therapeutic approaches to catastrophizing in axSpA. One analysis aimed to create and assess an online pain management program for individuals with ankylosing spondylitis, integrating

elements of mindfulness exercises, and cognitive–behavioural therapy (CBT). The program successfully decreased maladaptive thoughts and pain catastrophizing, and also promoted a more positive outlook on living with ankylosing spondylitis. However, there was a slight increase in the helplessness subscale of the PCS at the 10 week follow-up, suggesting a continued need for psychological support in managing ankylosing spondylitis. Despite these psychological benefits, the overall program did not effectively reduce pain intensity [71].

Systemic sclerosis

The initial search identified five potentially eligible articles. After eliminating duplicates and screening of abstracts and titles, three articles remained. Subsequent full-text screening confirmed that all three articles were eligible for inclusion in the current review. Additionally, one more article was identified through reference tracking. Consequently, a total of four eligible articles were included in the current review.

Perrot et al. [30] conducted a study examining pain, its impact, and coping strategies in SSc and RA patients. The study included 82 SSc participants reporting a mean PCS score of 16.3. The observed disparity between SSc and RA was considered insignificant. The findings also indicated a correlation between depression, anxiety, and higher pain catastrophizing scores in individuals with SSc. In another study, individuals with SSc and lower levels of education were identified as particularly susceptible to engaging in pain-related catastrophizing [72].

Raynaud's phenomenon is a core symptom of SSc. An analysis found that the self-reported severity evaluation of SSc Raynaud's phenomenon is associated with various factors, including pain and catastrophizing [73]. Additionally, another study analysed the link between coping strategies and patient-perceived disability, patient global assessment, and physician global assessment in individuals with symptoms of Raynaud's syndrome. Maladaptive coping strategies, especially catastrophizing, were associated with elevated perceived disability and patient global assessment, even following adjustments for patient demographics, clinical phenotype, and disease severity evaluated by physician global assessment. These findings suggest that coping strategies, especially catastrophizing, may influence composite measures of disease severity, including the American College of Rheumatology Composite Index in Systemic Sclerosis (ACR CRISS) [74].

Systemic lupus erythematosus

The initial search yielded 41 potentially eligible articles. After removal of duplicates and screening of titles and abstracts, six articles. Subsequent full-text screening confirmed that all six identified articles were eligible for inclusion in the current review.

Unfortunately, there are limited data on the prevalence of pain catastrophizing in the adult SLE population. Nevertheless, some paediatric studies have explored childhood-onset lupus. In one cohort with a mean age of 16.1, the average PCS score was 18.3, and 58% of participants reported a score equal to or above 15 [75]. Another prospective paediatric cohort with a mean age of 16.2 had a baseline mean PCS score of 17.9, which decreased to 15.4 after 6 months, although this change was not statistically significant. Medication regimens remained generally stable between visits. This emphasises that PCS may be a dynamic trait influenced by various biopsychosocial factors [76]. However, it is crucial to note that external validation for adult SLE patients might be limited based on the provided references.

Efforts have been made to recognise features predicting catastrophizing in SLE. In one study, a regression analysis indicated that kinesiophobia, depression, body awareness, and BMI were associated with increased pain catastrophizing [77]. Another analysis found that factors associated with catastrophizing included the total number of previous SLE medications, pain experienced in the last 7 days, mental HRQoL, and Systemic Lupus Activity Questionnaire score [78].

A Pain Coping Skills Training (PCST) program utilising the internet-based painTRAINER was evaluated in the SLE population. Pain catastrophizing and diverse outcomes, such as Patient-Reported Outcomes Measurement Information System (PROMIS) pain interference, sleep disruption, fatigue, anxiety, and depression, exhibited notable enhancements among painTRAINER users compared to the control group, with the most significant progress seen in pain catastrophizing [79].

Sjögren's syndrome

The initial search identified four articles that were potentially eligible. After removing duplicates, three articles remained following abstract and title screening. Subsequent examination of the full texts identified two articles that were deemed eligible for inclusion in the current review.

In one analysis, the mean PCS scores were 12.71 in seropositive and 13.16 in seronegative SS, showing no statistically significant difference [80]. Another comparative study including patients with fibromyalgia, RA, axSpA, and SS reported a mean catastrophizing score (CSQ) of 6.78 in patients with SS in a sample of 23 participants. Patients with fibromyalgia, rheumatoid arthritis, and spondyloarthritis had scores of 8.1, 6.34, and 7.30, respectively. Unfortunately, statistical tests for significant differences between the groups were not conducted [81].

In a study of the association of PCS in Sjögren's syndrome with other factors, the most robust correlation was found between pain catastrophizing and pain anxiety. Linear regression analysis showed that catastrophizing was a stronger predictor of pain severity than age, fatigue, depression, or anxiety in both seropositive and seronegative primary SS patients. In a multivariate model derived through backward selection, four variables (pain catastrophizing, fibromyalgia status, serological status, and belief in severe consequences of illness) were responsible for 55% of the variance in pain severity. The study concluded that targeting pain catastrophizing and negative illness appraisal with behavioural interventions could be beneficial for individuals with primary SS [80]

Juvenile idiopathic arthritis

The initial search identified 23 potentially eligible articles. After eliminating duplicates, 11 articles remained following abstract and title screening. Subsequent examination of the full texts identified eight articles that fulfilled the criteria for inclusion in the present review. This number was supplemented by two additional articles identified through reference tracking and one through citation tracking. Consequently, a total of 11 eligible articles were incorporated into this review.

The mean PCS score was 13.8 for a JIA cohort without concomitant fibromyalgia, consisting of 114 patients. In contrast, the JIA subgroup diagnosed with concomitant juvenile fibromyalgia exhibited significantly higher PCS scores at 28.2, and this group showed more pronounced functional impairment [82]. In an investigation of pain hypersensitivity within the JIA cohort, the median total score for the paediatric PCS was identified as 8 (with an interquartile range of 3–16) out of a possible 64 points [83].

A link between pain catastrophizing and the intensity of clinical and experimental pain has been hypothesised [84]. One study supports a model suggesting the significant influence of pain catastrophizing on pain experiences in JIA patients [85]. The results propose that targeting behavioural interventions at a specific subgroup of children, where pain experiences appear inconsistent with disease activity, could be an effective approach. Another analysis conducted among patients treated with TNF inhibitors indicated that individuals reporting high pain levels typically employed the pain-coping strategy of catastrophizing more frequently compared to pain-free children receiving the same treatment. These findings suggest that while a significant proportion of children respond well to anti-TNF treatment in terms of disease activity and pain, there remains a subgroup experiencing pain despite being in remission with biological agents [86]. JIA patients experiencing orofacial pain demonstrated a heightened level of catastrophizing compared to their healthy counterparts [87].

A study by Kyvsgaard et al. [88] reported that among children experiencing methotrexate-induced nausea, as determined by either the Methotrexate Intolerance Severity Score (MISS) or a nausea diary, there was a higher frequency of utilising the coping strategy of catastrophizing compared to other children. These psychological factors could contribute to the mechanism underlying individual differences in the severity of MTX-induced nausea in children with JIA [88].

Some evidence exists that, upon examining the potential impact of pain-coping strategies on the pain response, observations indicated that both children and parents who tended to employ the coping strategy of catastrophizing in response to experimental pain generally reported higher pain intensity, reduced pain tolerance, and increased discomfort related to pain [89]. Also, one interesting study suggested the hypothesis that parents with more negative, catastrophic thoughts about their child's pain were less likely to promote treatment adherence [90].

One study aimed to assess the practicability and initial effectiveness of a CBT intervention for children with JIA and their parents [91]. Despite pain management being the primary focus, there was no observed reduction in pain following the intervention. However, preliminary analysis indicated that, despite an increase in disease severity, the intervention group experienced improvements in QoL, a decrease in pain catastrophizing, and e nhanced adaptive pain cognitions (beliefs in controlling pain and self-efficacy). The study underscores the importance of considering disease status when evaluating the efficacy of psychological interventions in paediatric arthritis. Its limitations included a small study population, a low response rate, and a short period of observation.

Osteoarthritis

The initial search yielded 520 articles that could potentially be included. After eliminating duplicates, 179 articles remained following abstract and title screening. Further analysis of the full texts identified 75 articles that were considered suitable for inclusion in the present review. This number was augmented by six additional articles identified through citation tracking. One more article was identified on additional screening as of submission date. Consequently, a total of 82 eligible articles were incorporated into the present review.

The prevalence of pain catastrophizing may vary due to the diverse anatomical locations of different types of OA. This is because various joint pains and disabilities may impact individuals' function and overall well-being in different ways. Unfortunately, this variability poses

a challenge in obtaining specific data on this matter. In cohorts with combined types of OA, the mean PCS scores ranged from 14.4 to 19.1 [92, 93]. In cases of severe hip OA, the median PCS value was identified as 26 [94]. For knee OA, mean PCS scores ranged from 15.2 to 23.0 [95–97]. Our literature search, which focused on conservatively treated OA, did not yield direct comparisons across different localisations of OA-affected joints. Additionally, there is a lack of data comparing the PCS scores of patients with OA with healthy controls or individuals with other rheumatic disorders.

There are conflicting reports on the association of gender with pain catastrophizing in OA cohorts: one study concluded that women are more prone to catastrophizing than men [98], while another found no such differences [99]. One analysis reported that pain catastrophizing is notably higher in morbidly obese OA patients compared to their overweight and obese counterparts [100]. High levels of pain catastrophizing were correlated with more intense and unpleasant pain, increased binge eating, lower self-efficacy in controlling eating, and reduced weight-related QoL. In a knee OA cohort in Nigeria, positive correlations were also observed between increased BMI and pain catastrophizing [101]. However, another study showed no links between pain catastrophizing and BMI, nor age and radiographic severity [102]. Regarding socioeconomic factors, lower levels of education were independently linked to the co-occurrence of pain catastrophizing and fear of movement in OA [103]. Catastrophic thinking was found to be prevalent in patients with low radiographic severity, particularly those experiencing high pain intensity [104]. Furthermore, in one analysis, catastrophizing had a more robust association with pain in specific participants who were younger, overweight, had more comorbidities, or reported poorer sleep quality [105].

Racial disparities in PCS were investigated in various analyses. In a study by Nemati et al. [106] focusing on PCS domains, structural equation modelling revealed that among Hispanics, pain severity correlated with rumination, magnification, and helplessness, while lower physical function scores were associated with greater magnification and helplessness [106]. Among non-Hispanic Whites, pain severity was linked to rumination and helplessness. In a 2-year follow-up study involving 187 adults with knee OA, Fullwood [107] reported that pain catastrophizing mediated the relationship between ethnicity and pain, disability, and physical function [107].

In contrast with individuals of non-Hispanic White descent, non-Hispanic Black participants reported higher levels of pain and disability coupled with lower physical function [108]. This influenced by heightened levels of catastrophizing among non-Hispanic Black individuals (1.7 vs. 0.9, $p < 0.01$, on a 0–6 CSQ scale) [108]. Similarly, in another study, Japanese participants exhibited higher pain catastrophizing scores compared to their Australian counterparts [109].

Several factors have been identified as contributors to heightened catastrophizing in OA. Psychological elements, including increased ambivalence over emotional expression and reduced self-efficacy for pain communication, may increase the likelihood of pain catastrophizing [110]. Additionally, there is evidence indicating that older perceived age is associated with increased pain catastrophizing while being also associated with trait resilience and positive affect [111]. Furthermore, a correlation between sleep disturbances and increased pain catastrophizing [112].

Pain catastrophizing is a dynamic trait that may vary over time in individuals with OA, particularly intensifying during periods of heightened pain [113]. Information regarding the locations and patterns of pain is also crucial: higher levels of pain catastrophizing were observed in cases of a diffuse type of knee pain [114] Furthermore, in some individuals with knee OA, there are reports of perceived swelling in the knee without clear evidence, also potentially indicating elevated levels of pain catastrophizing [115].

Neurobiological studies shed light on the pathophysiology of catastrophizing in OA. The mid-anterior cingulate cortex (mACC), which is crucial in pain sensation, has low γ-aminobutyric acid (GABA) levels in OA which correlates with greater pain, suggesting a role in prefrontal disinhibition. A study by El-Najjar et al. [116] using magnetic resonance spectroscopy explored mACC GABA levels in patients with chronic knee OA pain, revealing a negative correlation between mACC GABA and the PCS [116]. The myo-inositol:Glx ratio was also significantly correlated with PCS. GABA and myo-inositol:Glx were proposed as potential biomarkers for chronic knee OA pain. Addressing racial disparities in brain structure and function, Terry's study [117] reported that greater pain catastrophizing was associated with a thinner primary somatosensory cortex in non-Hispanic Whites but not in non-Hispanic Blacks, suggesting distinct effects on the emotional–motivational aspect of the pain system for non-Hispanic Blacks [117]. Another study by Terry [118] investigated the impact of ethnicity on the links between pain catastrophizing, clinical pain, and resting-state functional connectivity in specific brain areas—namely, the anterior cingulate cortex (ACC), dorsolateral prefrontal cortex (dlPFC), insula, and primary somatosensory cortex (S1) [118]. In 136 adults with knee OA, ethnicity influenced the mediation effects of catastrophizing on the relationship between clinical pain and resting-state functional connectivity in the ACC, dlPFC, insula, and S1, suggesting distinct relationships for non-Hispanic Black people and non-Hispanic Whites.

In the existing literature on OA, heightened levels of catastrophizing have been consistently linked to lower pain thresholds, reduced pain tolerance, higher laboratory pain

ratings, and increased clinical pain levels [99]. In the same analysis, catastrophizing appeared to be associated with subjective pain reports rather than the nociceptive flexion reflex threshold, indicating a connection with an intensified pain experience rather than the modulation of spinal gating mechanisms. Some authors have proposed that catastrophizing acts as a mediator in the relationship between pain-related unpleasantness and suffering [119]. Numerous analyses have demonstrated that an elevated PCS score correlates with higher pain levels in OA [96, 120–122]. In certain analyses, this association remained independent of other factors such as depression, anxiety, stress, and affect [123].

In one analysis, pain catastrophizing was integrated into a predictive model designed to forecast pain relief during conservative treatment, demonstrating moderate effectiveness [124]. Several longitudinal studies have indicated that pain catastrophizing diminishes the likelihood of achieving favourable pain outcomes [125, 126]. Additionally, catastrophizing was identified as a mediator in the association between gender and OA pain-related results. Notably, even after accounting for depression, catastrophizing persisted in mediating the relationship between gender and pain, suggesting distinct effects not solely explained by depression alone [98]. Conversely, some reports suggest that psychological traits, including catastrophizing, do not act as mediators in the phenotypic differences in pain sensitivity observed among individuals with advanced knee OA [127]. Chronic pain in knee OA often exhibits similarities to neuropathic pain, with psychological factors such as high pain catastrophizing playing a role. A study by Tanaka et al. [128] identified a significant association between elevated pain catastrophizing and the existence of a neuropathic pain aspect in symptomatic knee OA, as assessed by the painDETECT questionnaire [128]. The PCS was also established as a significant predictor of higher Western Ontario and McMaster Universities Arthritis Index (WOMAC) levels [95, 129–131].

Catastrophizing proves to be valuable in distinguishing between older adults with OA experiencing chronic pain, with and without depressive symptomatology [132]. Additionally, it has been noted that women who engage in catastrophizing are less prone than men to report a negative mood [99, 133]. An association between catastrophizing and empathy-related responses in knee OA patients has also been observed [134]. Furthermore, pain catastrophizing emerged as a significant mediator in the correlation between dispositional optimism and temporal summation of heat pain, even after adjusting for confounding factors. Psychologically resilient individuals with high dispositional optimism may exhibit fewer maladaptive pain responses [135]. Individuals with OA who practiced catastrophizing in the morning reported elevated negative mood and reduced positive mood in the evening, irrespective of fluctuations in pain throughout the day [113, 133]. The impact of pain catastrophizing in OA patients was also examined within the context of relationships in several analyses. Among patients, greater self-efficacy was associated with lower pain measures, including catastrophizing, while increased holding back correlated with higher psychological disability and catastrophizing. Partner holding back was also linked to elevated levels of catastrophizing [136]. Another analysis found that when patients reported higher morning catastrophizing, their spouses encountered increased negative affect throughout the day. Moreover, punishing responses from spouses predicted increased pain catastrophizing in patients the following morning, independent of patient pain and negative affect [137]. Another analysis revealed that both trait and state pain catastrophizing influenced the connection between daily partner support and pain intensity. During days characterised by low partner support, individuals with high levels of catastrophizing reported greater pain intensity compared to those with low levels of catastrophizing. However, when partner support was higher, pain intensity did not vary between individuals with high and low levels of catastrophizing. This suggests that partner support may play a vital role in mitigating pain intensity, particularly for individuals with higher levels of pain catastrophizing [138].

A significant association between sleep disturbances and heightened pain catastrophizing has been demonstrated which, in turn, correlates with increased severity of OA symptoms or depressive symptoms [93, 139]. Conversely, pain catastrophizing has also been identified as a predictor of sleep problems, surpassing the influence of depression and pain [140]. Catastrophizing plays a moderating role in the relationship between sleep efficiency and central sensitisation. More precisely, individuals with low sleep efficiency and high catastrophizing scores had greater levels of central sensitisation. These findings provide initial evidence supporting a synergistic impact of catastrophizing and sleep, leading to increased pain sensitivity in patients with OA [141]. One study indicated that improvements in short-term sleep were not statistically associated with reductions in depressive symptoms or pain catastrophizing [142]. However, in another sample of knee OA patients with coexisting insomnia, interventions targeting sleep led to a decrease in all three measures of pain catastrophizing. These reductions were evident after 8 weeks of treatment and remained consistent at the 6-month follow-up [143].

Pain catastrophizing has been established as a significant factor negatively associated with HRQoL [144, 145]. An analysis demonstrated this influence, highlighting its significance regardless of disease severity [102]. The importance of considering pain catastrophizing in these assessments was underscored by the results of an analysis revealing that it exhibited either the strongest or second strongest impact on QoL, surpassed only by pain intensity [94].

There is evidence suggesting that pain catastrophizing is a well-established factor associated with disability and reduced physical function [92, 96, 97, 146]. In some sources, this association is significant and independent, even after adjusting for pain levels [147]. These findings may be explained by the hypothesis that heightened sensitivity to physical activity might be predicted by pain catastrophizing [148]. A relationship between higher morning pain catastrophizing and increased sedentary time and reduced physical activity on the same day has been reported [149]. Additionally, the location of arthritis and its severity as shown in radiographs were found to not be associated with either physical function or pain, suggesting that limitations resulting from OA are more strongly linked to personal and psychological factors, particularly ineffective cognitive coping mechanisms such as catastrophizing [150]. Another analysis also suggested that reduced capability is linked to cognitive biases about pain, specifically catastrophic ones, rather than the Kellgren–Lawrence grade of radiographic OA [151]. Some of these associations may be elucidated by the link between pain catastrophizing and muscle weakness [152]. Another analysis identified a connection between catastrophizing and isometric knee strength; however, they were not independent predictors of isokinetic strength, knee pain, or physical performance [153].

Individuals with knee OA may encounter instability and occasional buckling. Postural stability has been identified as negatively associated with pain catastrophizing. Also, elevated levels of pain-related fear and catastrophizing were connected to an avoidance response, which could potentially lead to chronic disability [154]. However, conflicting results are presented in some studies: for example, suggesting no relationship between pain catastrophizing to fear of falling, the number of falls, and static balance [155, 156]. Certain studies highlight the potential significance of catastrophizing in gait velocity and walking behaviour, emphasising its role as a possible therapeutic factor [147, 157]. However, conflicting results have been presented in other analyses, suggesting that depressive symptoms, rather than catastrophizing or baseline living situation, are associated with a significant decline in daily walking [158]. In an analysis involving 151 participants, individuals with pain catastrophizing exhibited a significant decrease in stair climbing ability, even after adjusting for covariates and a sensitivity analysis [159]. However, this association was not observed for the ability to stand from a seated position and walk.

The Lequesne Index (LI) is a tool that evaluates OA severity in the hips and knees, considering pain, walking distance, and daily living impact. A higher score indicates more severe OA-related impairment. In a study focusing on knee OA, a weak correlation was found between LI and radiographic severity, with no correlation between PCS and the radiographic scale. However, a moderate association was observed between PCS and the LI. Interestingly, patients seen by rheumatologists had higher PCS scores than those seen by general practitioners, despite similar radiographic and LI scores [160].

Research indicates that catastrophizing in OA may be a factor that can be modified. One proposed approach is to focus on enhancing pain-coping skills. Participating in web-based training specifically targeting pain-coping skills was found to result in a decrease in the utilisation of maladaptive behavioural strategies such as catastrophizing [161]. In a cohort of individuals with both obesity and overweight suffering from OA, the impact was more significant when pain-coping skills' training was combined with behavioural strategies for weight control. Consequently, there was a notable reduction in pain catastrophizing compared to groups receiving standard care. Additionally, they exhibited significantly improved outcomes in areas such as pain, physical disability, stiffness, activity, weight self-efficacy, and weight [162]. However, despite a decrease in pain catastrophizing, some studies suggest that pain-coping skills may not effectively reduce pain severity in African Americans with OA [163]. In a study involving 300 veteran patients with OA, a 12-month phone-based behavioural protocol did not lead to a reduction in catastrophizing compared to the control group halfway through the treatment [164].

Moreover, a hypothesised connection between catastrophizing and self-efficacy has been explored. A study by Shelby in 2008 [165] reported that pain catastrophizing heightened pain and disability by diminishing self-efficacy, even after adjusting for demographic and clinical factors [165]. The reduction of pain catastrophizing has been associated with improved self-efficacy which, when combined with increased social support, can lead to an enhancement in health status [166]. Additionally, some suggest that prioritising the improvement of self-efficacy is more crucial than directly addressing catastrophizing [167]. The study recommended interventions that target both self-efficacy and catastrophizing for a more significant impact on physical functioning compared to treatments with a single focus.

A study found that both periodised circuit training and conventional strength training significantly decreased pain catastrophizing [168]. In relation to pain catastrophizing, it has been suggested that incorporating pain neuroscience education followed by Pilates exercises compared to Pilates exercises alone can result in statistically significant improvement in PCS [169]. The addition of action observation therapy to an exercise program for pain and related measures was also explored. While both the treatment and control groups exhibited significant improvement in all outcomes, including catastrophizing, there was no notable difference between them [170]. Incorporating pain neuroscience education alongside conventional physiotherapy exercises was discovered to lead to a greater reduction in

pain catastrophizing compared to the conventional physiotherapy alone in patients with knee osteoarthritis [171]. An investigation into the impact of exercise on the prefrontal cortex in knee OA explored with functional near-infrared spectroscopy indicated a reduction in dorsolateral prefrontal cortex (DLPFC) activity during painful stimuli after exercise. Changes in DLPFC activation were correlated with improvements in pain perception and pain catastrophizing scores [172]. Additionally, catastrophizing itself can influence the outcomes of physical therapy. Patients with low levels of pain catastrophizing tended to show more substantial improvement with physical therapy at weeks 2 and 6. A multivariate logistic regression analysis showed that the baseline PCS score was a significant predictor for both pain and function at week 6. In contrast, the baseline depression score did not independently predict a clinically poor outcome [173]. No clinically or statistically significant effects of CBD on pain intensity were observed in patients with hand OA and PsA when compared to placebo. Furthermore, there were no statistically significant effects on sleep quality, depression, anxiety, or pain catastrophizing scores [68].

Conclusion

The current scientific evidence highlights the importance of assessing pain catastrophizing in the management of rheumatic musculoskeletal disorders. This review clarifies and brings attention to this phenomenon, which appears to be often overlooked in patients attending rheumatology clinics. This article highlights a number of factors responsible for underdiagnosis of pain catastrophizing. Their recognition could enhance detection and, consequently, facilitation of targeted therapeutic interventions. Pain catastrophizing has diverse effects on various aspects of overall health, as demonstrated in this review, emphasising its substantial significance in patient care. Increased awareness and understanding of pain catastrophizing within rheumatic musculoskeletal disorders could lead to a more effective diagnostic approach and tailored treatment strategy, ultimately improving patient healthcare and health outcomes.

Our understanding of pain catastrophizing in rheumatic disorders is nascent and there is a significant knowledge gap necessitating further exploration. Understanding the genesis of pain catastrophizing, particularly from comprehensive biopsychosocial perspectives across rheumatic disorders, appears to be crucial. Future research should delve into these mechanisms to advance our understanding of pain perception and management in rheumatology. Survey studies among rheumatologists and patients could help to elucidate knowledge gaps, while expansive cohort studies could reveal the prevalence of pain catastrophizing across various rheumatic disorders and compare it with other musculoskeletal conditions. Identifying core variables and predisposing factors associated with pain catastrophizing could allow the construction of a predictive model for clinical probability scoring to facilitate targeted interventions. Exploring the influence of pain catastrophizing on rheumatic disorders and assessing treatment approaches targeting pain catastrophizing are crucial. A holistic approach is vital for advancing rheumatology, enhancing patient care strategies, and improving the quality of life for individuals with rheumatic musculoskeletal disorders.

Regarding our study's strengths, we emphasise the methodological rigor employed during the search and writing processes. We conducted a comprehensive search across major biomedical literature databases, including open-access articles indexed in DOAJ, and supplemented this with citation and reference screening. Our study is the first narrative review consolidating existing knowledge on pain catastrophizing within major rheumatic disorders, making a seminal contribution to this important topic. However, limitations include the single researcher conducting the search, potentially introducing bias, and the exclusion of studies related to surgically treated OA and orthopaedic surgery qualifications, which could limit the scope of our analysis.

In conclusion, the significance of pain catastrophizing in rheumatic disorders deserves heightened attention due to its potential clinical implications, which may contribute to overall health deterioration. However, it is essential to acknowledge that certain knowledge gaps persist, and further high-quality research is imperative to bridge these gaps and advance our understanding of the complex interplay between pain catastrophizing and rheumatic disorders.

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Data availability The data underlying this study is available upon reasonable request.

Declarations

Conflict of interest The authors declare that they have no competing interests.

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