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Effectiveness of multicomponent pain therapy interventions for the reduction of pain catastrophizing in fibromyalgia syndrome: A systematic review and meta-analysis

Cristina González-Lara[1], Julio A. Camacho-Ruiz[2], Irene Cortés-Pérez[1], Esteban Obrero-Gaitán[1] and Carmen M. Galvez-Sánchez[2]

[1]Department of Physical Therapy, Faculty of Health Sciences, University of Jaén, Spain and [2]Department of Personality, Evaluation and Psychological Treatment, Faculty of Psychology and Speech Therapy, University of Murcia, Spain

Review

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Corresponding author:
Carmen M. Galvez-Sánchez;
Email: carmengs@um.es

Abstract

Fibromyalgia syndrome (FMS) is a chronic condition characterised by widespread musculoskeletal pain, fatigue, sleep disturbances, emotional symptoms and cognitive impairment. Pain catastrophising, a maladaptive cognitive-affective response to pain, has been consistently associated with greater symptom burden and poorer pain-related outcomes in FMS. Multicomponent pain therapy (MPT), an interdisciplinary approach that combines several therapeutic modalities, may address the multifaceted symptom burden of FMS. This study aimed to synthesise the available evidence on whether MPT was associated with reductions in pain catastrophising among adults with FMS from a transdisciplinary perspective. A systematic review and meta-analysis were conducted in accordance with Cochrane Collaboration guidance and the PRISMA statement; the protocol was registered in PROSPERO (CRD42024596489). Randomised controlled trials (RCTs), including pilot RCTs, were eligible if they assessed pain catastrophising in adults diagnosed with FMS. Data were extracted and analysed using Comprehensive Meta-Analysis software, and subgroup analyses were conducted according to intervention duration. The certainty of evidence was assessed using GRADE. Thirteen RCTs comprising 1,314 participants were included. At post-intervention, MPT was associated with a medium reduction in pain catastrophising (SMD = −0.668; 95% CI: −0.953 to −0.383; $p < .001$), with moderate heterogeneity ($I^2 = 43.5\%$). At the 3-month follow-up, 6 studies comprising 472 participants yielded a larger pooled estimate (SMD = −0.957; 95% CI: −1.543 to −0.370; $p = .001$), with moderate heterogeneity ($I^2 = 49.4\%$). Medium-duration interventions (11–20 sessions) yielded the largest subgroup estimate. Funnel-plot asymmetry was detected, although trim-and-fill-adjusted analyses remained in favour of MPT. Overall, MPT may reduce pain catastrophising in adults with FMS, and medium-duration interventions yielded the largest subgroup estimate. However, the certainty of evidence was low at post-intervention and very low at the 3-month follow-up; therefore, the magnitude and stability of these findings remain uncertain.

Impact statement

Fibromyalgia syndrome (FMS) has a substantial impact on daily functioning, emotional well-being, social participation and quality of life. Beyond pain intensity, the way in which people interpret and respond to pain may influence the persistence and severity of symptoms. Pain catastrophising is particularly relevant because it is associated with greater distress, disability, avoidance behaviour and perceived loss of control.

This review examines the potential clinical value of multicomponent pain therapy (MPT) for FMS. By integrating several therapeutic strategies, MPT may address physical symptoms together with cognitive, emotional and behavioural factors that contribute to the burden of the condition. The findings suggest that pain catastrophising may be a relevant therapeutic target within interdisciplinary care, although the certainty of evidence remains limited.

The results may inform clinical decision-making and the design of structured MPT programmes. Medium-duration interventions yielded the largest subgroup estimate; however, this exploratory finding should not be interpreted as establishing an optimal treatment duration. Coordinated, person-centred models of care may help address coping, self-management and functioning alongside symptom reduction.

Overall, this study contributes to understanding how psychological and behavioural processes may be addressed within FMS care. Further high-quality trials are needed before firm conclusions can be drawn about the magnitude, durability and clinical significance of the observed effects.

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Introduction

Fibromyalgia syndrome (FMS) is a chronic disorder characterised by widespread, persistent musculoskeletal pain and is associated with central sensitisation, structural and functional brain alterations, physical and mental fatigue, sleep disturbance, emotional symptoms (e.g., anxiety and depression) and cognitive difficulties (e.g., attention, concentration and processing speed) (Galvez-Sánchez et al., 2018). FMS is diagnosed predominantly in women; in studies using criteria-based classifications, women account for ~61–90% of cases, while prevalence in the general population has been estimated at 2–4%. However, these epidemiological estimates warrant cautious interpretation. Gender-related bias in diagnostic criteria and clinical recognition may contribute to the overrepresentation of women and the underdiagnosis or underrecognition of men with FMS (Wolfe et al., 2018; Srinivasan et al., 2019).

FMS frequently co-occurs with conditions such as irritable bowel syndrome, migraine, chronic fatigue syndrome and gastrointestinal disorders, and is commonly accompanied by fatigue, insomnia, morning stiffness, depression and anxiety (Iannuccelli et al., 2025). FMS adversely affects physical, psychological and social functioning, including social relationships, the ability to fulfil family and work responsibilities and activities of daily living, owing not only to pain but also to fatigue (González-Álvarez et al., 2025). From a biopsychosocial perspective, the condition may also adversely affect self-esteem and self-efficacy. Psychological factors are therefore relevant to the perception, processing and interpretation of chronic pain and to how individuals with FMS cope with it (Galvez-Sánchez et al., 2019).

Regarding coping-related processes, pain catastrophising has been defined as an exaggerated negative cognitive-affective response to actual or anticipated pain, characterised by rumination, magnification and feelings of helplessness (Quartana et al., 2009). In chronic pain, this construct is particularly relevant within the fear-avoidance model, which proposes that catastrophic interpretations of pain may give rise to pain-related fear, avoidance behaviour, physical deconditioning and long-term disability (Vlaeyen and Linton, 2000; Vlaeyen et al., 2016). In FMS, pain catastrophising, together with negative affect and stress, has been associated with greater symptom severity, fear and discomfort, which may worsen physical and cognitive symptoms (Alcon et al., 2023). Catastrophising may also exacerbate pain by increasing attentional focus on pain, strengthening negative emotional responses and disrupting adaptive attentional processing (López-Gómez et al., 2023). These processes may reinforce functional limitations and reduce engagement in movement-related activities. In clinical practice, fear of exacerbating symptoms is frequently identified as a barrier to movement and exercise among individuals with FMS (Nijs et al., 2013), consistent with the fear-avoidance framework and the importance of addressing catastrophising and pain-related fear in treatment.

For these reasons, pain catastrophising warrants specific attention in FMS as a clinically relevant cognitive-affective process that may shape adaptation to symptoms, rather than as a substitute for other important outcomes such as pain intensity, fatigue, or sleep disturbance (Petrini and Arendt-Nielsen, 2020). Higher catastrophising has been associated with poorer emotional adjustment, reduced functional capacity and lower quality of life in this population (Lami et al., 2018a; López-Gómez et al., 2023). Because catastrophising is potentially modifiable through psychological and multicomponent approaches, it may represent a meaningful treatment-related outcome alongside more traditional symptom indicators (Schütze et al., 2018; Schumann et al., 2022). However, compared with outcomes such as pain intensity or global functional impact, the effects of MPT on pain catastrophising in FMS have received less focused quantitative attention (Saracoglu et al., 2022; Araya-Quintanilla et al., 2025).

Management strategies for FMS include pharmacological and non-pharmacological approaches, and current clinical guidelines emphasise individualised care combining education, exercise, psychological therapies and symptom-oriented management (Macfarlane et al., 2017; Jones et al., 2024; Li et al., 2025). Exercise and psychological approaches, including cognitive-behavioural therapy, are relevant non-pharmacological components of FMS management. Nevertheless, no single intervention adequately addresses the broad and heterogeneous symptom profile of FMS. Pain neuroscience education (Suso-Martí et al., 2022), repetitive transcranial magnetic stimulation (Sun et al., 2022), virtual reality (Brea-Gómez et al., 2025) and exercise-based approaches (Rodríguez-Domínguez et al., 2025) have shown promising results for pain catastrophising.

Taken together, these considerations underscore the need for integrated approaches capable of addressing the multifaceted symptom burden of FMS (Galvez-Sánchez and Del Paso, 2020). Although several emerging interventions have shown promising effects on specific dimensions of chronic pain, their relevance to the heterogeneous clinical presentation of FMS may be limited when they are applied in isolation. Accordingly, there is a rationale for comprehensive, interdisciplinary frameworks that combine complementary modalities to address biological, psychological and social determinants of chronic pain (Lladser et al., 2022).

Multicomponent pain therapy (MPT) is an interdisciplinary treatment approach grounded in the biopsychosocial model of chronic pain, in which pain arises from interacting biological, psychological and social factors (Deckert et al., 2016). MPT typically integrates several evidence-based components delivered in a coordinated manner, such as exercise therapy, pain education, psychological interventions (e.g., cognitive-behavioural strategies) and, when appropriate, physical or manual therapies. These components aim to address pain-related symptoms and associated functional and emotional impairment. Evidence suggests that MPT may reduce pain intensity and FMS severity relative to comparator interventions and may also reduce pain catastrophising, depression and anxiety (Saracoglu et al., 2022). Accordingly, this study aimed to evaluate whether MPT reduced pain catastrophising in individuals with FMS from a transdisciplinary perspective.

Despite growing interest in MPT, the available evidence remains difficult to interpret because protocols differ substantially in therapeutic composition, intensity, delivery format and follow-up duration. Their specific contribution to pain-related cognitive-affective outcomes therefore remains unclear. This issue is particularly relevant for pain catastrophising, which is associated with greater pain severity, emotional distress, fear of movement, functional limitations and poorer adaptation in individuals with FMS (Nijs et al., 2013; Lami et al., 2018a; Petrini and Arendt-Nielsen, 2020). Previous reviews of FMS interventions have focused primarily on pain intensity, global functional impact and quality of life rather than on pain catastrophising specifically (Saracoglu et al., 2022; Araya-Quintanilla et al., 2025). A focused systematic review was therefore needed to clarify whether MPT is associated with reductions in pain catastrophising among individuals with FMS.

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The present study provided a focused quantitative synthesis of the association between MPT and pain catastrophising in FMS. It also explored, where data permitted, whether intervention duration accounted for variation in effect estimates. By synthesising a heterogeneous evidence base, this review sought to quantify post-intervention and follow-up effects, identify remaining evidence gaps and inform the design of future trials in which pain catastrophising is treated as a potentially modifiable outcome relevant to symptom persistence and disability.

Methods

This systematic review and meta-analysis were conducted in accordance with Cochrane Collaboration guidance and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Page et al., 2021). The completed PRISMA checklist is provided as Supplementary Material. The eligibility criteria and analyses were specified in advance, and the protocol was registered in the International Prospective Register of Systematic Reviews (PROSPERO; registration ID: CRD42024596489).

The PubMed/MEDLINE, Scopus, Web of Science and PEDro databases were searched independently by two reviewers from inception to May 2026, without restrictions on publication date or language. The reference lists of relevant published studies were also searched. The PICOS framework was used to formulate the review question (Amir-Behghadami and Janati, 2020): population (individuals with FMS), intervention (MPT), comparison (no intervention or therapies that did not include MPT), outcome (pain catastrophising) and study design (RCTs or pilot RCTs). The following MeSH and entry terms were used: "Fibromyalgia Syndrome," "Fibromyalgia Fibromyositis Syndrome," "Diffuse Myofascial Pain Syndrome," "Catastrophization," "Pain Catastrophizing," "Catastrophic Thinking," "Pain Related Cognitive Rumination" and "Pain Related Catastrophic Thinking." The Boolean operators "AND" and "OR" were used. The final literature search was conducted on 7 May 2026.

Eligibility criteria

Studies were eligible if they (1) were RCTs or pilot RCTs; (2) were peer-reviewed original studies; (3) included adults (aged ≥18 years) diagnosed with FMS according to established criteria; and (4) compared MPT with a pharmacological intervention, another active intervention, a wait-list control or usual care. Studies were excluded if they (1) did not report pain catastrophising; (2) included samples that were not composed exclusively of participants with FMS; (3) did not provide quantitative data on the variables required for inclusion in the meta-analysis; or (4) were duplicate reports.

Two reviewers (C.G.-L. and J.A.C.-R.) independently screened all records and selected those that met the eligibility criteria for full-text assessment. Titles and abstracts were screened to remove irrelevant records, after which the full texts of potentially eligible reports were assessed against the inclusion and exclusion criteria. Any disagreement was reviewed by C.M.G.-S., who made the final decision regarding study inclusion. The screening and selection process is presented in the PRISMA flow diagram (Figure 1). Before data extraction and quality assessment, all authors reviewed the selected articles to confirm their eligibility.

Data extraction

Study characteristics, methods and results were extracted independently by C.G.-L. and I.C.-P.; any discrepancies were reviewed by C.M.G.-S. and E.O.-G. The following data were extracted: general study characteristics (authors, year of publication, country, blinding, setting and funding), sample characteristics (number of groups, number of participants per group and age), characteristics of MPT (type of intervention, number of sessions and number of sessions per week) and characteristics of the comparator (type of intervention, number of sessions and number of sessions per week). For the outcome data, the variable name, measurement instrument, post-intervention mean and standard deviation and assessment time point were recorded. Table 1 summarises the characteristics of the included studies.

The primary outcome was pain catastrophising, assessed using either the Pain Catastrophizing Scale (PCS; Sullivan et al., 1995) or the pain catastrophising subscale of the Coping Strategies Questionnaire (CSQ; Rosenstiel and Keefe, 1983).

Assessment of methodological quality, risk of bias and certainty of evidence

Two reviewers (C.G.-L. and J.A.C.-R.) independently assessed the risk of bias in each study using the Cochrane Risk of Bias (RoB) tool. The tool evaluates seven domains: random sequence generation (selection bias), allocation concealment (selection bias), blinding of participants and personnel (performance bias), blinding of outcome assessment (detection bias), incomplete outcome data (attrition bias), selective reporting (reporting bias) and other bias. Each domain was rated as having a low, high or unclear risk of bias. Disagreements were resolved through discussion with a third reviewer (I.C.-P.). The results are presented in Table 2 and Figures 2 and 3.

The certainty of evidence for each meta-analytic outcome was assessed using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) framework and the checklist developed by Meader et al. (2014). Five domains were considered: risk of bias, inconsistency, indirectness, imprecision and publication bias. The certainty of evidence was downgraded by one level for each domain with serious concerns. The GRADE assessment is presented in Table 3.

Statistical analysis

The meta-analyses were conducted by two authors (C.G.-L. and E.O.-G.) using Comprehensive Meta-Analysis, version 4 (Biostat, Englewood, NJ, USA) (Borenstein et al., 2023). A meta-analysis was performed only when at least two comparisons were available (Higgins and Green, 2011). For continuous outcomes, pooled effects were expressed as Cohen's standardised mean differences (SMDs) with 95% confidence intervals (CIs) and estimated using a random-effects model (Cohen, 1977; DerSimonian and Laird, 1986). The absolute magnitude of the SMD was interpreted using Cohen's criteria: small (~0.20), medium (~0.50) and large (≥0.80) (Cohen, 1988). Potential publication bias and small-study effects were examined using funnel plots, *Egger's* test and the trim-and-fill method (Egger et al., 1997; Duval and Tweedie, 2000; Sterne and Egger, 2001). These analyses were interpreted cautiously when a meta-analysis included 10 or fewer studies. The trim-and-fill method was used to estimate an adjusted pooled effect. If the absolute relative difference between the unadjusted and adjusted pooled estimates exceeded 10%, the certainty of evidence was

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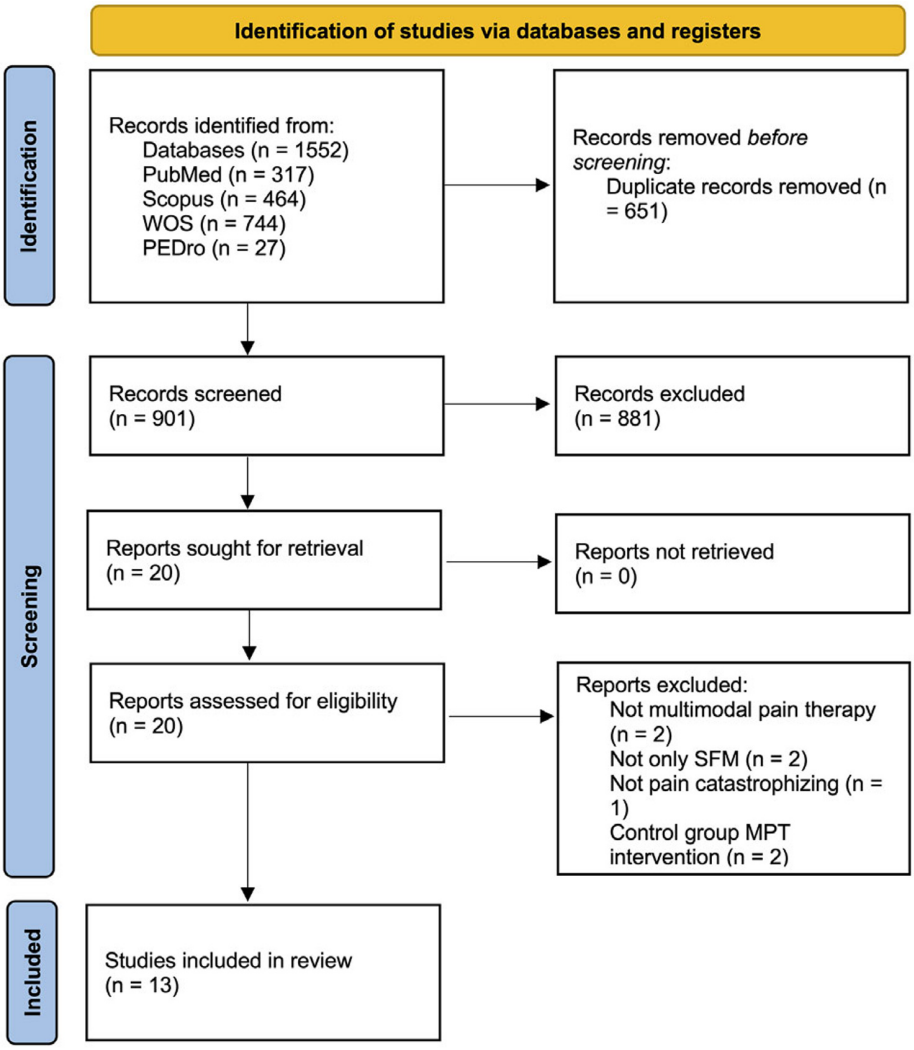


Figure 1. PRISMA 2020 flow diagram of study selection. *Note:* This work is licensed under CC BY 4.0. To view a copy of this license, visit https://creativecommons.org/licenses/by/4.0. *Source:* Page et al. (2021; 372:n71).

downgraded by one level (Rothman et al., 2008). Statistical heterogeneity was evaluated using Cochran's Q statistic and I^2 (Higgins et al., 2002). I^2 values were interpreted as follows: 0–40%, heterogeneity might not be important; >40–60%, moderate heterogeneity; >60–90%, substantial heterogeneity; and > 90–100%, considerable heterogeneity. These categories were used as mutually exclusive thresholds to facilitate the interpretation of heterogeneity. The magnitude and direction of the pooled effects and the p-value of Cochran's Q test were also considered when assessing heterogeneity (Higgins et al., 2003). For multi-arm studies with more than one eligible intervention group and a shared comparator, the comparator sample was divided proportionally across the relevant comparisons to avoid double-counting participants. The comparator means and standard deviations remained unchanged; accordingly, no within-study correlation coefficient was assumed.

Results

The results are organised into four sections. First, the study selection process is described. Second, the characteristics of the included RCTs and their participants are summarised. Third, methodological quality and risk of bias are appraised. Finally, the quantitative synthesis presents the post-intervention and 3-month follow-up effects of MPT on pain catastrophising, together with subgroup analyses by intervention duration.

Study selection

A total of 1,552 records were identified through PubMed/MEDLINE (n = 317), Scopus (n = 464), Web of Science (n = 744) and PEDro (n = 27). After duplicates were removed, 901 records were screened by title and abstract, of which 881 were excluded as irrelevant. Seven full-text reports were excluded because they did not meet the eligibility criteria (Jensen et al., 2007; van Wilgen et al., 2007; García-Campayo et al., 2009; Dowd et al., 2015; Lami et al., 2018b; Ughreja et al., 2024; Norouzi et al., 2025); the reasons are provided in Figure 1. Thirteen studies were included (Castel et al., 2012, 2013, 2015; Bourgault et al., 2015; Rasmussen et al., 2017; Pérez-Aranda et al., 2019; Ceballos-Laita et al., 2020; Sanabria-Mazo et al., 2020; Serrat et al., 2020); Arroyo-Fernández et al., 2022; Araya-Quintanilla et al., 2024; Kircali et al., 2024; Gür Kabul et al., 2026). The selection process is summarised in the PRISMA flow diagram (Figure 1).

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Table 1. Characteristics of the included studies

Study (author, year, country, study design, blinding and funding)	Participants (*N*, age)	MPT group	Control group	Outcomes	
		N, characteristics of the multimodal intervention, proportion women/men	*N*, control intervention characteristics, proportion women/men	Variable (test) and time points	Qualitative findings
Arroyo-Fernández et al., 2022 (Spain) Triple-blind RCT Funding: Not reported	120 people diagnosed with FMS Mean age: 50.29 ± 7.28 years	MPT group$_1$: 40 women (50.60 ± 7.01 years) were allocated to active tDCS + TE 38/2 MPT group$_2$: 40 patients (49.53 ± 8.74 years) were included in sham tDCS +TE 39/1	40 patients (50.75 ± 5.94 years) were included in no-intervention group 36/4	Pain Catastrophizing (PCS) Baseline (T0) and post-intervention (T1)	The active and sham groups showed a marked reduction in pain catastrophising (−6.45 and − 4.60; $p <$ .001). The control group showed no effects ($p >$ .05).
Araya-Quintanilla et al., 2024 (Chile) Single-blind RCT Funding: Yes (University of Las Americas)	65 women diagnosed with FMS Mean age: 48.98 ± 4.63 years	33 women (47.60 ± 7.28 years) were allocated to GMI + PNE	32 women (50.40 ± 1.90 years) received standard treatment	Pain catastrophizing (PCS) Baseline (T0) and post-intervention (T1)	PCS total scores decreased from 30.42 to 10.58 in the MPT group and increased from 21.09 to 23.00 in the control group ($p <$ .001).
Bourgault et al., 2015 (Canada) Single-blind RCT Funding: Yes (Canadian Institutes of Health Research in partnership with AstraZeneca Canada Inc.)	56 patients diagnosed with FMS Mean age: 48.33 ± 10.34 years	28 individuals (49.98 ± 9.23 years) were allocated to MT group (CBT + TE + PE) 26/2	28 individuals (46.74 ± 11.42 years) were allocated to the waitlist group 26/2	Pain catastrophizing (PCS) Baseline (T0), post-intervention (T1) Follow-up: 3 months (T2)	Statistically significant mean differences across the different follow-up times regarding PCS (p = .0007) MPT group (17.86 ± 9.83) vs. Control group (18.88 ± 12.75)
Castel et al., 2012 (Spain) Single-blind RCT Funding: Not reported	93 patients diagnosed with FMS Mean age: 49.64 ± 6.81 years	29 patients (50.2 ± 6.2 years) were allocated to CBT + hypnosis group 28/1	Control group$_1$: 34 patients (50.0 ± 7.6 years) were allocated to CBT alone 32/2 Control group$_2$: 30 women (48.7 ± 6.5 years) were included in the standard treatment group	Pain catastrophizing (CSQ subscale) Baseline (T0), post-intervention (T1) Follow-up: 3 months (T2)	The CBT group and CBT + Hypnosis groups showed significant reductions in catastrophising post-treatment ($p <$ .001), while the control group showed minimal change.
Castel et al., 2013(Spain) Single-blind RCT Funding: Yes (*Foundation Marató TV3*)	155 women diagnosed with FMS Mean age: 48.9 ± 6.99 years	81 women (49.0 ± 6.8 years) were allocated to CBT + TE group	74 women (48.8 ± 7.2 years) were allocated to the usual care group	Pain catastrophizing (CSQ subscale) Baseline (T0), post-intervention (T1) Follow-up: 3 months (T2)	The MTP group showed a significant reduction in catastrophising post-treatment ($p <$ .001). The control group showed no effect ($p >$ .05).
Castel et al., 2015(Spain) Not-blinded RCT Funding: Yes (*Foundation Marató TV3*)	130 women diagnosed with FMS Mean age: 49.22 ± 6.79 years	69 women (49.52 ± 6.38 years) were allocated to CBT + TE group	61 women (48.89 ± 7.26 years) were allocated to the usual care group	Pain Catastrophizing (CSQ subscale) Baseline (T0), post-intervention (T1) Follow-up: 3 months (T2)	The multidisciplinary group showed a significant reduction in catastrophising after treatment ($p <$ .01), whereas the control group showed minimal change.
Ceballos-Laita et al., 2020 (Spain) Not-blinded RCT Funding: Yes (*Scientific Foundation of Caja Rural de Soria*)	32 women diagnosed with FMS Mean age: 50.47 ± 8.76 years	16 women (52.13 ± 10.31 years) were allocated to PNE + TE group	16 women (48.8 ± 7.2 years) were allocated to the TE group	Pain catastrophizing (PCS) Baseline (T0) and post-intervention (T1) Follow-up: 3 months (T2)	Both groups showed reductions in PCS total scores post-treatment, with the PNE + TE group showing a slightly larger decrease than the TE group.

(*Continued*)

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Table 1. (*Continued*)

Study (author, year, country, study design, blinding and funding)	Participants (*N*, age)	MPT group *N*, characteristics of the multimodal intervention, proportion women/men	Control group *N*, control intervention characteristics, proportion women/men	Outcomes Variable (test) and time points	Qualitative findings
Gur-Kabul et al., 2026 (Turkey) Not-blinded RCT Funding: Yes (*Pamukkale University Scientific Research Projects Coordination Unit*)	25 women diagnosed with FMS Mean age: 49.48 ± 9.97 years	11 women (46.81 ± 10.55 years) were allocated toTE + TNE group	14 women (51.57 ± 9.51 years) were assigned to the TE group.	Pain Catastrophizing (PCS) Baseline (T0) and post-intervention (T1)	TE showed positive effects on functional status, pain and cognitive functions ($p < 0.05$). TNE provided an extra benefit to the effectiveness of exercise ($p < 0.05$).
Pérez-Aranda et al., 2019 (Spain) Single-blind RCT Funding: Yes (*ISCIII)*	225 patients diagnosed with FMS Mean age: 53.27 ± 7.97 years	75 patients (54.21 ± 7.41 years) were allocated to FibroQol (PE + self-hypnosis) group 73/2	75 patients (52.65 ± 8.52 years) were allocated to the usual care group 74/1 75 patients (52.96 ± 7.98 years) were allocated to the MBSR group 74/1	Pain Catastrophizing (PCS) Baseline (T0), post-intervention (T1)	All groups showed reductions in PCS scores post-treatment, with MBSR producing significantly greater decreases than TAU ($p < .001$) and FibroQoL ($p = .025$).
Sanabria-Mazo et al., 2020 (Spain) Single-blind RCT Funding: Yes (*ISCIII)*	41 women diagnosed with FMS Mean age: 52.51 ± 9.97 years	22 women (52.77 ± 13.45 years) were allocated to MAIR (Mindfulness + Amygdala and Insula Retraining) group	19 women (52.21 ± 5.95 years) were assigned to the relaxation therapy group	Pain Catastrophizing (PCS) Baseline (T0), post-intervention (T1) Follow-up: 3 months (T2)	Both groups showed reductions in PCS scores post-treatment, but only the MAIR group maintained a significant improvement at follow-up ($p = 0.002$) compared to RT.
Kircali et al., 2024 (Turkey) Single-blind RCT Funding: No	50 patients diagnosed with FMS	14 individuals were randomly assigned to the MIEP + PNE group (motor imagery-based exercise protocol+PNE) 13/1	Control group$_1$: 12 individuals were allocated to the MIEP group 11/1 Control group$_2$: 12 individuals were allocated to the PNE group 12/0 Control group$_3$: 12 individuals were allocated to the usual care group 8/4	Pain Catastrophizing (PCS) Baseline (T0) and post-intervention (T1)	Post-treatment scores were lowest in the PNE group and highest in the MIEP group, with MIEP + PNE showing intermediate reductions.
Serrat et al., 2020 (Spain) Single-blind RCT Funding: Yes (*Vall d'Hebron Institute of Research Funding*)	169 patients diagnosed with FMS Mean age: 53.63 ± 8.84 years	84 individuals (54.12 ± 8.62 years) were assigned to NAT-FM group 82/2	85 women (53.15 ± 9.06 years) were allocated to usual care group	Pain catastrophizing (PCS) Baseline (T0) and post intervention (T1)	The NAT-FM group showed significant reductions in PCS scores at both 6 weeks, and post-treatment compared to TAU ($p < .001$), indicating the added intervention effectively reduced catastrophising.
Rasmussen et al., 2017 (Denmark) Single-blind RCT Setting: Funding: Yes (*The Novo Nordisk Foundation, Aase and Ejnar Danielsen's Foundation, The Oak Foundation, The Lundbeck Foundation, and the University of Southern Denmark*)	187 women diagnosed with FMS Mean age: 44.35 ± 10.90 years	94 women (44.5 ± 11.0 years) were allocated to MT group (lectures, group discussions and TE)	93 women (44.2 ± 10.80 years) were allocated to waitlist group	Pain catastrophizing (PCS) Baseline (T0) and post intervention (T1)	MPT group showed a larger reduction in pain catastrophising than the control group, but the between-group difference did not reach statistical significance ($p = 0.095$).

Abbreviations: .FMS, fibromyalgia syndrome; MPT, multimodal pain therapy; RCT, randomized controlled trial; tDCS, transcranial direct current stimulation; TE, therapeutic exercise; GMI, graded motor imagery; PNE, pain neuroscience education; TNE, therapeutic neuroscience education; CBT, cognitive behavioral therapy; PE, psychoeducation; PCS, Pain Catastrophizing Scale; CSQ, Coping Strategies Questionnaire; MBSR, mindfulness-based stress reduction; TAU, treatment as usual; RT, relaxation therapy; MAIR, Mindfulness + Amygdala and Insula Retraining; MIEP, motor imagery-based exercise protocol; T0, baseline; T1, post-intervention; T2, 3-month follow-up.

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Table 2. ROB tool

Study	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Overall
Araya-Quintanilla et al. (2024)	Low	Low	High	High	Low	Low	Low	High
Arroyo-Fernández et al. (2022)	Low	Low	High	Low	Low	Low	Unclear	High
Bourgault et al. (2015)	Low	Unclear	High	Unclear	Unclear	Low	Unclear	High
Castel et al. (2012)	Low	Low	High	Low	High	Unclear	Unclear	High
Castel et al. (2013)	Low	Unclear	High	Low	High	Low	Low	High
Castel et al. (2015)	Low	Unclear	High	High	Low	Low	Low	High
Ceballos-Laita et al. (2020)	Low	Low	High	Unclear	Unclear	Low	Unclear	High
Gur-Kabul et al. (2026)	Low	Unclear	High	Unclear	Unclear	Unclear	Unclear	High
Kircali et al. (2024)	Low	Unclear	High	High	Unclear	Unclear	Unclear	High
Pérez-Aranda et al. (2019)	Low	Unclear	High	High	Unclear	Low	Unclear	High
Sanabria-Mazo et al. (2020)	Low	Low	High	Low	Low	Low	Low	High
Serrat et al. (2020)	Low	Unclear	High	High	Low	Unclear	Unclear	High
Rasmussen et al. (2017)	Low	Unclear	High	High	Unclear	Low	Unclear	High

Abbreviations: Item 1, Random sequence generation; Item 2, Allocation concealment; Item 3, Blinding of participants and personnel; Item 4, Blinding of outcome assessment; Item 5, Incomplete outcome data; Item 6, Selective reporting; Item 7; Other sources of bias.

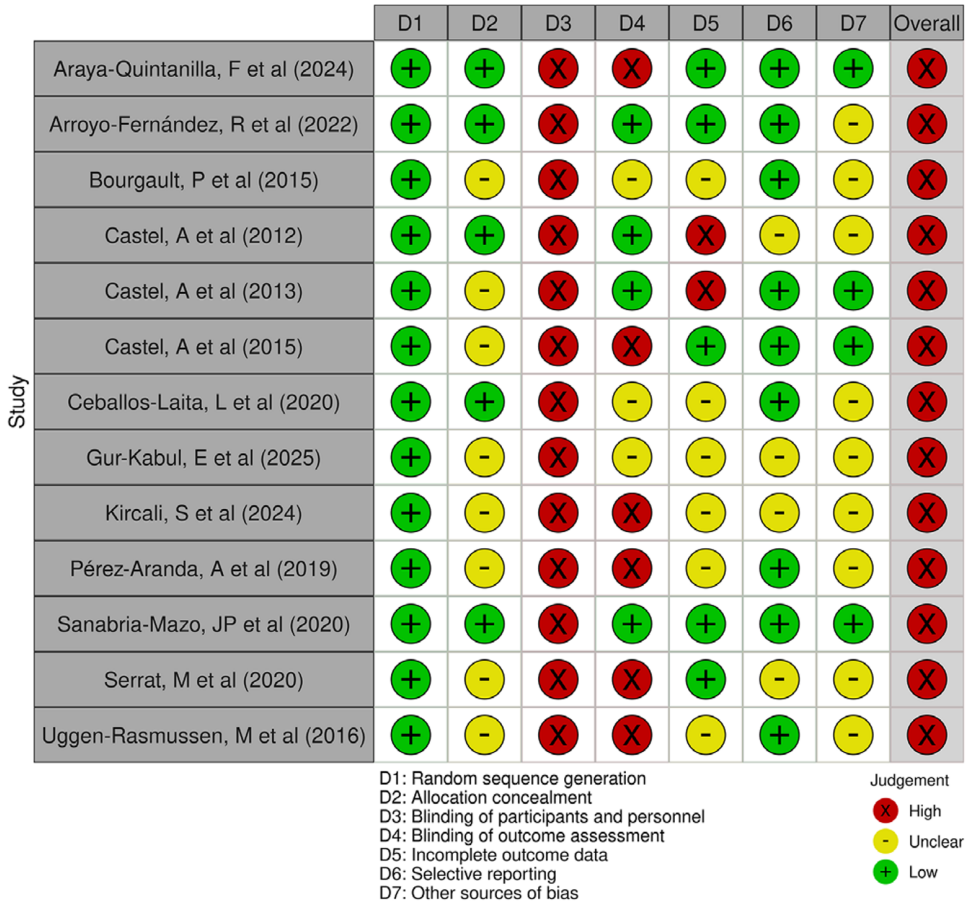


Figure 2. Risk-of-bias summary for the included studies.

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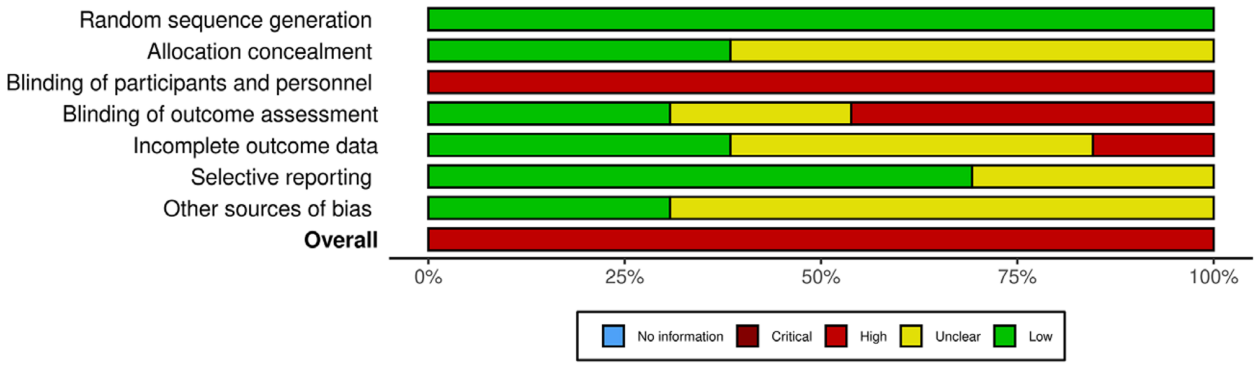


Figure 3. Risk-of-bias graph showing review authors' judgements for each domain across the included studies.

Characteristics of the included studies

The included RCTs were conducted between 2012 and 2026 in Spain (Castel et al., 2012, 2013, 2015; Pérez-Aranda et al., 2019; Ceballos-Laita et al., 2020; Sanabria-Mazo et al., 2020; Serrat et al., 2020; Arroyo-Fernández et al., 2022), Chile (Araya-Quintanilla et al., 2024), Canada (Bourgault et al., 2015), Turkey (Kircali et al., 2024; Gür Kabul et al., 2026) and Denmark (Rasmussen et al., 2017). Together, they enrolled 1,314 individuals with FMS (mean age = 49.97 ± 8.18 years). The MPT and comparator groups included 738 and 576 participants, respectively. Comparator conditions included therapeutic exercise, pain neuroscience education, cognitive-behavioural therapy, relaxation therapy, wait-list control and no intervention. Interventions were grouped as short duration (1–10 sessions) (Bourgault et al., 2015; Pérez-Aranda et al., 2019; Ceballos-Laita et al., 2020), medium duration (11–20 sessions) (Castel et al., 2012; Rasmussen et al., 2017; Sanabria-Mazo et al., 2020; Serrat et al., 2020; Arroyo-Fernández et al., 2022) or long duration (≥21 sessions) (Castel et al., 2013, 2015; Araya-Quintanilla et al., 2024; Kircali et al., 2024; Gür Kabul et al., 2026). All outcomes were assessed immediately after the intervention. Six studies provided 3-month follow-up data (Castel et al., 2012, 2013, 2015; Bourgault et al., 2015; Ceballos-Laita et al., 2020; Sanabria-Mazo et al., 2020). Ten studies reported external funding (Bourgault et al., 2015; Castel et al., 2013, 2015; Rasmussen et al., 2017; Pérez-Aranda et al., 2019; Ceballos-Laita et al., 2020; Serrat et al., 2020; Araya-Quintanilla et al., 2024; Gür Kabul et al., 2026). Table 1 summarises the study characteristics.

Methodological quality and risk of bias of the included studies

Overall, the included RCTs had several methodological limitations and risks of bias. Although random sequence generation was adequately described across trials, allocation concealment was insufficiently reported or unclear in most studies, resulting in concerns about selection bias (Bourgault et al., 2015; Castel et al., 2013, 2015; Rasmussen et al., 2017; Pérez-Aranda et al., 2019; Serrat et al., 2020; Kircali et al., 2024; Gür Kabul et al., 2026). Given the nature of the interventions, blinding participants and personnel was not feasible in any study, resulting in performance bias across the included RCTs. Blinding of outcome assessors was not implemented, was insufficiently reported or was ineffective for self-reported outcomes, contributing to detection bias in nearly all studies (Castel et al., 2012, 2015; Rasmussen et al., 2017; Pérez-Aranda et al., 2019; Serrat et al., 2020; Araya-Quintanilla et al., 2024; Kircali et al., 2024). Incomplete outcome data were also a concern in several trials because attrition was high or the handling of missing data was inadequately described. Common author-reported limitations included short follow-up periods, which prevented assessment of long-term effects (Bourgault et al., 2015; Rasmussen et al., 2017; Serrat et al., 2020; Araya-Quintanilla et al., 2024; Kircali et al., 2024; Gür Kabul et al., 2026), and small samples or pilot designs, which limited generalisability and statistical power. Table 2 and Figures 2 and 3 summarise the methodological quality and risk-of-bias assessments.

Quantitative findings

Post-intervention

Thirteen studies contributing 18 comparisons (Castel et al., 2012, 2013, 2015; Bourgault et al., 2015; Rasmussen et al., 2017; Pérez-Aranda et al., 2019; Ceballos-Laita et al., 2020; Sanabria-Mazo et al., 2020; Serrat et al., 2020; Arroyo-Fernández et al., 2022; Araya-Quintanilla et al., 2024; Kircali et al., 2024; Gür Kabul et al., 2026), comprising 1,314 participants, were included in the post-intervention meta-analysis. Pain catastrophising was assessed with the PCS in nine studies (Bourgault et al., 2015; Pérez-Aranda et al., 2019; Ceballos-Laita et al., 2020; Sanabria-Mazo et al., 2020; Serrat et al., 2020; Arroyo-Fernández et al., 2022; Araya-Quintanilla et al., 2024; Kircali et al., 2024; Gür Kabul et al., 2026) and with the pain catastrophising subscale of the CSQ in four studies (Castel et al., 2012, 2013, 2015; Rasmussen et al., 2017). Low-certainty evidence indicated a medium pooled effect in favour of MPT (SMD = −0.668; 95% CI: −0.953 to −0.383; $p < .001$). Heterogeneity was moderate ($I^2 = 43.508\%$; $Q = 30.093$; df = 17; $p = .026$). Adjustment for potential publication bias and small-study effects using the trim-and-fill method yielded an SMD of −0.95 (95% CI: −1.24 to −0.65), representing a 42.2% increase in the magnitude of the pooled effect compared with the unadjusted estimate (Figure 4).

Three-month follow-up

Six studies contributing seven comparisons (Bourgault et al., 2015; Castel et al., 2012, 2013, 2015; Ceballos-Laita et al., 2020; Sanabria-Mazo et al., 2020), comprising 472 participants, were included in the 3-month follow-up meta-analysis. Pain catastrophising was assessed using the PCS or the pain $_{\text{catastrophising}}$ subscale of the CSQ. Very-low-certainty evidence indicated a large pooled effect in favour of MPT (SMD = −0.957; 95% CI: −1.543 to −0.370; $p = .001$). The manuscript reported moderate heterogeneity ($I^2 = 49.436\%$; $Q = 23.371$; df = 6; $p = .062$). Adjustment for potential

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Table 3. The certainty of evidence (GRADE statement)

Time	*K*	*N*	*N*s	SMD	95% CI	*p*	*Q* (df)	I^2 (*p*)	Egger p	Trim and Fill		Risk of Bias	Inc	Ind	Imp	Pub	Level of evidence
										SMD adjust	% Var						
Post intervention	18	1,348	74.89	−0.67	(−0.95, −0.38)	<.001	30.093 (17)	43.508%; (p < .05)	0.304	−0.95	41%	High	Yes	No	Possible	Yes	Low
Three-month follow-up	7	472	67.43	−0.957	(−1.543, −0.370)	0.001	23.371 (6)	49.436% (0.062)	0.131	−1.24	29%	High	Yes	No	Yes	Yes	Very low

Abbreviations: K, number of studies; *N*, number of participants; *N*s, number of participants per comparison; SMD, standardised mean difference; 95% CI, confidence interval; *p*, *p*-value; *Q* (df), Cochran's *Q* statistic (degrees of freedom); I^2, I^2 heterogeneity statistic; SMD adjust, standardised mean difference adjusted; %Var, variation percentage; ROB, risk of bias; Inc, inconsistency; Ind, indirectness; Imp, imprecision; Pub, publication bias.

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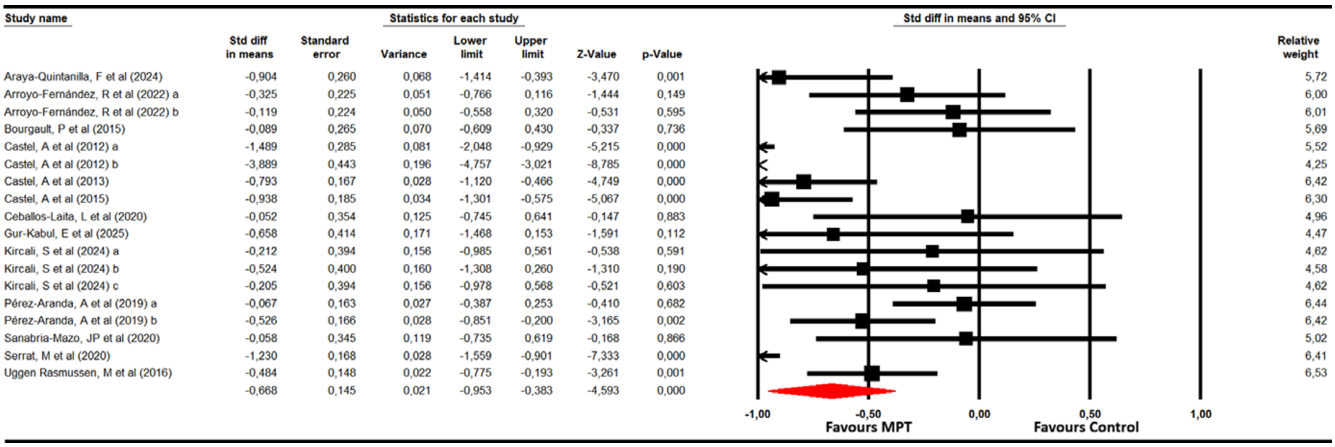


Figure 4. Forest plot of pain catastrophising at post-intervention.
Note: Short-duration interventions comprised 1–10 sessions, medium-duration interventions comprised 11–20 sessions and long-duration interventions comprised ≥21 sessions. Negative standardised mean differences favour multicomponent pain therapy. CI, confidence interval; MPT, multicomponent pain therapy; SMD, standardised mean difference.

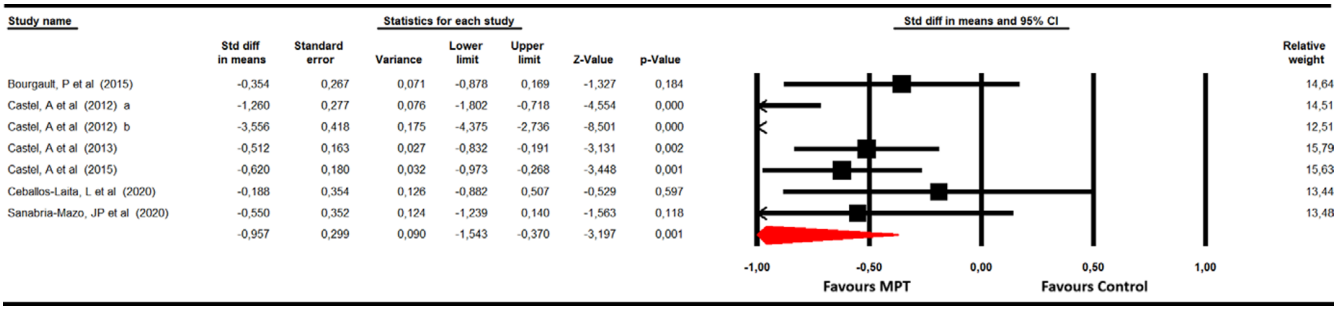


Figure 5. Forest plot of pain catastrophising at the 3-month follow-up.

publication bias and small-study effects using the trim-and-fill method yielded an SMD of −1.24 (95% CI: −1.83 to −0.64), which was more negative than the unadjusted estimate (Figure 5).

Subgroup analysis

A subgroup analysis was conducted to explore whether the effect of MPT on pain catastrophising varied by intervention duration. Three predefined subgroups were analysed: short duration (1–10 sessions) (Bourgault et al., 2015; Pérez-Aranda et al., 2019; Ceballos-Laita et al., 2020), medium duration (11–20 sessions) (Castel et al., 2012; Rasmussen et al., 2017; Sanabria-Mazo et al., 2020; Serrat et al., 2020; Arroyo-Fernández et al., 2022) and long duration (≥21 sessions) (Castel et al., 2013, 2015; Araya-Quintanilla et al., 2024; Kircali et al., 2024; Gür Kabul et al., 2026).

The pooled estimate for the short-duration subgroup was not statistically significant (SMD = −0.226; 95% CI: −0.491 to 0.039; $p = .095$; $I^2 = 0\%$; $Q = 2.551$; df = 3; $p = .466$). The medium-duration subgroup yielded a large, statistically significant estimate (SMD = −1.023; 95% CI: −1.661 to −0.385; $p = .002$), with substantial heterogeneity ($I^2 = 54.841\%$; $Q = 13.287$; df = 6; $p = .039$). The long-duration subgroup yielded a medium estimate (SMD = −0.754; 95% CI: −0.945 to −0.562; $p < .001$), with reported heterogeneity values of $I^2 = 0\%$, $Q = 5.579$, df = 3 and $p = .472$. The overall heterogeneity statistic was $Q = 33.217$ (df = 17; $p = .011$; $I^2 = 48.821\%$). Although the point estimate was largest in the medium-duration subgroup, the test for subgroup differences was not statistically significant, indicating that the effect of MPT did not differ significantly by intervention duration. The GRADE assessment is presented in Table 3.

Discussion

Pain catastrophising is a clinically meaningful cognitive-affective process in FMS because it is associated with poorer adjustment and quality of life (Lami et al., 2018a). This review synthesised 13 RCTs comprising 1,314 participants. At post-intervention, low-certainty evidence yielded a medium pooled estimate in favour of MPT; at the 3-month follow-up, very-low-certainty evidence yielded a large pooled estimate. To our knowledge, this is the first FMS-specific meta-analysis focused on the effect of MPT on pain catastrophising. The findings should be interpreted in light of the risk of bias, heterogeneity among interventions and potential publication bias and small-study effects.

Medium-duration interventions (11–20 sessions) yielded the largest subgroup point estimate. However, this finding is exploratory: the test for differences between subgroups was not reported, heterogeneity within the medium-duration subgroup was moderate and the number and characteristics of studies differed across duration categories. Consequently, the results do not establish an optimal therapeutic dose. Direct comparisons and prospectively designed dose–response studies are needed to determine whether intervention duration modifies the effect of MPT (Loftus et al., 2022; Niu et al., 2024).

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The mechanisms underlying the association between MPT and reduced pain catastrophising are likely multifactorial. Because MPT combines education, exercise, psychological interventions and sometimes physical or manual therapies, the pooled effect cannot be attributed to a single component. Plausible treatment targets include threat appraisal, pain-related hypervigilance, fear avoidance, maladaptive emotional reactivity, low perceived control and pain self-efficacy (Quartana et al., 2009; Petrini and Arendt-Nielsen, 2020; Schumann et al., 2022).

At the 3-month follow-up, the pooled estimate remained in favour of MPT. Nevertheless, only six studies contributed follow-up data, the confidence interval was wide, the certainty of evidence was very low and the reported heterogeneity statistics require verification. These data therefore do not establish that the effect was maintained or increased over time, nor do they establish clinical significance.

A possible explanation for a persisting effect is that cognitive and behavioural skills promoted by MPT, such as cognitive reframing, emotion regulation, activity pacing and adaptive coping, may consolidate through continued practice after treatment (Carson et al., 2006; Kashikar-Zuck et al., 2013; Nicholas et al., 2013; Ehde et al., 2014; Martinez-Calderon et al., 2018; Aaron et al., 2022). However, this hypothesis was not tested in the included trials and should be examined using longitudinal mediation analyses.

The fear-avoidance model and cognitive models of catastrophising provide one explanatory framework (Vlaeyen and Linton, 2000; Sullivan et al., 2001; Vlaeyen et al., 2016). Psychoeducation, graded activity, behavioural exposure and adaptive coping may reduce threat appraisals, fear-based monitoring of bodily sensations and avoidance. In parallel, MPT may weaken attentional bias towards pain-related threat and promote more flexible interpretations of bodily sensations.

Self-efficacy and emotion regulation provide complementary pathways. Repeated mastery experiences and corrective learning may strengthen perceived control over symptoms, whereas mindfulness, acceptance-based strategies, relaxation and regulated body awareness may reduce emotional reactivity and perseverative thinking (Bandura, 1977; Jackson et al., 2014; de Jong et al., 2016; Veehof et al., 2016; Cheng et al., 2018; Bravo et al., 2019; Haugmark et al., 2019; Aaron et al., 2020, 2022; Serrat et al., 2020; Vambheim et al., 2021; Voss et al., 2023). These pathways are theoretically plausible but were not directly compared in the present meta-analysis.

Process-oriented research provides indirect support for these interpretations. Reductions in pain catastrophising and increases in pain self-efficacy have mediated outcomes after interdisciplinary pain rehabilitation (Jensen et al., 2001; Spinhoven et al., 2004; Schumann et al., 2022) and changes in catastrophising, fear-avoidance beliefs and self-efficacy have mediated associations between pain intensity and disability in chronic low back pain treatment (Ryum et al., 2024). Because these findings were not derived exclusively from FMS samples or from the trials included here, they do not establish the mechanisms of MPT in FMS.

Future mechanistic studies should use longitudinal and mediation-based designs to identify which MPT components are associated with changes in catastrophising, for whom these pathways are most relevant and when during treatment they become active. Such work could clarify the relative contribution of attentional, cognitive, emotional, interpersonal and self-regulatory processes and inform more targeted interventions.

Clinically, the findings support considering pain catastrophising as one treatment-related outcome within integrated FMS care. Assessment with validated instruments such as the PCS or CSQ may inform treatment planning and progress monitoring, and elevated catastrophising may indicate a need for psychologically informed or interdisciplinary support (Martinez-Calderon et al., 2020a, 2020b; Campos et al., 2024). However, the present evidence does not establish that MPT should replace effective pharmacological or single-component options.

Intervention duration should likewise not be prescribed on the basis of subgroup point estimates alone. When MPT is used, its components and intensity should be individualised according to clinical presentation, patient preferences, feasibility and response, consistent with recommendations for integrated and person-centred FMS management (Macfarlane et al., 2017; Sarzi-Puttini et al., 2020; Cohen et al., 2021; Nijs et al., 2024).

Several limitations must be acknowledged. The included studies varied substantially in MPT components, intervention dose, comparator conditions and methodological quality, which may have contributed to variation in effect estimates. Pain catastrophising was not the primary outcome in many trials, and follow-up data were scarce. The certainty of evidence was low at post-intervention and very low at the three-month follow-up. Funnel plots and trim-and-fill analyses, particularly when based on few studies, are imprecise and do not by themselves demonstrate publication bias or identify the true effect. The adjusted estimates should therefore be interpreted cautiously rather than as evidence that the unadjusted effects necessarily underestimated the benefit of MPT.

Future research should use standardised, well-described MPT protocols, prespecify pain catastrophising as an outcome, report clinically interpretable change and include longer follow-up periods. Adequately powered RCTs should also improve allocation concealment, use blinded outcome assessment where feasible and investigate active components and mechanisms. Further high-quality trials may substantially change the magnitude and stability of the pooled estimates. The duration subgroup findings should remain exploratory until supported by a valid test of subgroup differences and direct dose–response evidence.

Conclusion

This meta-analysis suggests that MPT may reduce pain catastrophising in individuals with FMS. The pooled estimate was medium at post-intervention and large at the 3-month follow-up; however, the certainty of evidence was low and very low, respectively. Medium-duration interventions yielded the largest subgroup point estimate, but this exploratory finding does not establish an optimal treatment duration. MPT may be considered within individualised, biopsychosocial care, while more rigorous and adequately powered RCTs with standardised protocols, longer follow-up and transparent reporting are needed to strengthen the evidence.

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Competing interests. The authors declare no conflicts of interest.

Data availability statement. The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Ethics and approvals. Ethical approval was not required for this systematic review and meta-analysis. Patient consent statement is not applicable or needed for this study.

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