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Review article

Fibromyalgia and post-traumatic stress disorder: A systematic review

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ABSTRACT

Introduction: Fibromyalgia (FM) is considered an idiopathic condition characterised by diffuse and chronic musculoskeletal pain. Emerging evidence suggests that exposure to traumatic events may be associated with an increased likelihood of developing this multifaceted disorder. This systematic review examines the role of post-traumatic stress disorder (PTSD) in the etiology and progression of FM, aiming to synthesise findings from published literature on the PTSD-FM association over the past thirty years.

Methods: This review was conducted in accordance with the PRISMA guidelines. Relevant studies published between 1993 and 2023 were identified through a comprehensive search of the PubMed, ProQuest, and Scopus databases. Inclusion and exclusion criteria were applied, yielding a final selection of 20 articles. These studies were assessed based on their methodological quality, as well as the relevance of their objectives, sample populations, and findings.

Results: The results indicate an association between FM and PTSD, with some evidence linking PTSD to greater FM symptom severity. Limited evidence also suggests an association between PTSD and increased likelihood of FM development.

Conclusion: These findings highlight the need for an interdisciplinary, biopsychosocial approach to the prevention, diagnosis, and treatment of FM and PTSD. Methodological limitations were identified across the included studies, such as the absence of a biopsychosocial perspective, reliance on self-reported PTSD assessments, small and unrepresentative samples, and inconsistent control of psychological factors. Future research should adopt rigorous diagnostic methods, incorporate biopsychosocial frameworks, use larger and more representative samples, and employ longitudinal designs to enhance generalisability and deepen understanding of the relationship between PTSD and FM.

1. Introduction

Fibromyalgia (FM) is an idiopathic condition marked by chronic, diffuse musculoskeletal pain without a clear articular origin (World Health Organisation [WHO], 2019). Symptoms include hyperalgesia, allodynia, fatigue, and cognitive dysfunction (Cabo-Meseguer et al., 2017; Erdrich et al., 2020; Kundakci et al., 2021; Moyano et al., 2015). The prevalence generally ranges from 0.2% to 6.6% (Marques et al., 2017) and varies depending on the diagnostic criteria applied (Fors et al., 2024), with diagnosis remaining inherently complex (Goutte & Cathébras, 2021). The American College of Rheumatology (ACR) defines FM as chronic pain persisting for over three months in at least three of four body quadrants, with tenderness at eleven of eighteen specific points (Wolfe et al., 2016).

Recent models propose a biopsychosocial aetiology for FM, emphasising the interplay of biological, psychological, and social factors in its development and maintenance. Biologically, FM has been linked to dysregulation of the central nervous and endocrine systems; psychologically, factors such as trauma, mood disorders, and maladaptive coping strategies are implicated; and socially, gender roles, socioeconomic stressors, and healthcare access may influence symptom expression and chronicity (Antunes et al., 2021; Aznárez, 2022; i-Llombart & Mora, 2017; Kaleycheva et al., 2021; Meints and Edwards, 2018; Yaghmaian & Miller-Smedema, 2019; Yavne et al., 2018). Within this framework, FM is increasingly understood as a functional disorder that may be triggered or exacerbated by various stressors, including infections and trauma (Alenzi et al., 2021; Çombaş et al., 2022; Goutte & Cathébras, 2021; López-Martínez et al., 2009; Sancassiani et al., 2017). The association between traumatic events and chronic pain suggests shared mechanisms with post-traumatic stress disorder (PTSD)

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(Cervera-Pérez et al., 2023; McFarlane, 2010; Schweinhardt et al., 2008).

Dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis, a component of the stress response, has been identified as a shared vulnerability in both FM and PTSD (Beiner et al., 2023; Crofford et al., 1994; Howie et al., 2019). The HPA axis regulates the body's hormonal response to stress, and dysfunction in this system—manifesting as either hyper- or hypoactivity—can impair effective stress regulation (Herman et al., 2016; Juruena et al., 2021). FM has been linked to an overreactive stress response and dysregulation of the HPA axis, although with limited evidence (Beiner et al., 2023; Narayanan, 2025). In PTSD, these alterations have also been observed (Coppens et al., 2017; Liedl et al., 2010; Siqveland et al., 2017; Yavne et al., 2018). In PTSD and FM, HPA axis dysfunction typically manifests as hypocortisolism, including blunted cortisol awakening responses and flattened diurnal rhythms, which may contribute to sustained physiological arousal, impaired stress recovery, and symptom persistence (Meewisse et al., 2007; Riva et al., 2012; Weissbecker et al., 2006; Yehuda, 2001).

From this perspective, FM may confer increased vulnerability to developing PTSD following trauma, while PTSD may also function as a mediator in the relationship between trauma exposure and the onset of FM (Asmundson and Hadjistavropolous, 2006; Asmundson et al., 2002; Liedl and Knaevelsrud, 2008; López-Martínez et al., 2009; Esteve-Zarazaga & Ramírez-Maestre, 2009; Otis et al., 2003; Sharp & Harvey, 2001). Several models explain the PTSD–chronic pain link. The mutual maintenance theory suggests that shared mechanisms, like threat bias and anxiety sensitivity, perpetuate both conditions (López-Martínez et al., 2009; Sharp & Harvey, 2001). The shared vulnerability model attributes PTSD and chronic pain conditions to common biological and psychological factors, including nervous system dysregulation in response to traumatic experiences (Asmundson et al., 2002; Asmundson and Hadjistavropolous, 2006). The triple vulnerability model (Otis et al., 2003) suggests that a perceived lack of control during trauma plays a role in the development of both PTSD and chronic pain. A heightened sense of threat and difficulty managing stress may underlie this connection, potentially explaining links between PTSD and FM (Ruscio et al., 2002). The perpetual avoidance model links cognitive factors, such as perceived uncontrollability and negative appraisals following trauma, to heightened arousal and avoidance behaviours, sustaining both conditions (Liedl and Knaevelsrud, 2008). The models do not universally agree on a single direction of causality. Instead, they offer complementary frameworks, with some focusing on mutual reinforcement, others on shared predisposition, and some on trauma-driven emergence of both conditions.

Although FM is more prevalent in women, the interaction between gender, trauma, and FM remains underexplored, with gender roles and trauma-related experiences potentially influencing its development (Aznárez, 2022; Briones-Vozmediano, 2010; i-Llombart & Mora, 2017). An approach integrating biological, psychosocial, and gender-related factors is helpful for enhancing diagnosis and treatment.

This systematic review examines the relationship between FM and PTSD building on previous research highlighting associations between trauma exposure, stress-related disorders, and chronic pain (Siqveland et al., 2017; Yavne et al., 2018). A recent systematic review and meta-analysis by Kaleycheva et al. (2021) confirmed a significant association between lifetime stressor exposure—particularly physical abuse—and adult FM. However, this analysis focused on external stressors themselves and did not explore the role of PTSD or individual psychological responses to trauma. Given that the same traumatic event may have different psychological impacts depending on individual vulnerability, the development of PTSD may represent an important factor in the association between trauma exposure and FM (American Psychological Association [APA] 2013; Nardi et al., 2020). This systematic review therefore aims to synthesise existing research on the association between PTSD and FM. The proposed hypotheses are: (1) PTSD and FM are associated, (2) PTSD is associated with an increased likelihood of FM development, and (3) FM co-occurring with PTSD is associated with greater symptom severity. Findings aim to inform prevention, diagnosis, and treatment, grounded in an interdisciplinary and biopsychosocial framework (Ram et al., 2023).

2. Methods

This systematic review follows PRISMA guidelines (Page et al., 2021) to identify studies examining the FM-PTSD relationship, reviewing recent findings on their etiology and progression.

A comprehensive search of PubMed, ProQuest, and Scopus was conducted in November 2023. The search strategy included terms related to PTSD (e.g., post-traumatic stress disorder, trauma) and FM (e.g., fibromyalgia, chronic widespread pain). Boolean operators and MeSH terms were adjusted for each database. The complete strategy is available on request from the author.

The eligibility criteria for study inclusion were defined a priori and are summarised in Table 1. Studies were included if they were primary research articles published in peer-reviewed journals between 1 November 1993 and 1 November 2023, written in English or Spanish, and examined the relationship between FM and PTSD. Eligible studies included clinical samples of youth or adults with a confirmed diagnosis of FM and PTSD, and employed a case-control or comparative design. Studies were excluded if they were secondary in nature (e.g., reviews, commentaries), involved non-clinical populations, did not include relevant patient samples, or lacked full-text availability in English or Spanish. Key data extracted from the included studies encompassed authorship, publication year and location, study objectives, sample characteristics, diagnostic tools for FM and PTSD, assessed domains, instruments used, and main findings. Methodological quality and risk of bias were evaluated using a modified Newcastle-Ottawa Scale (Wells et al., 2000).

3. Results

3.1. Study selection

A total of 1,121 studies were identified through database searches. After removing duplicates (n = 239), 882 titles and abstracts were screened, excluding 686 for not meeting inclusion criteria. Of the 196 full-text articles assessed, 176 were excluded, yielding 20 studies for the final analysis (Fig. 1).

3.2. Study characteristics

The main study characteristics are detailed in Table 2. All included studies employed a cross-sectional design. The studies exhibited

Table 1
Inclusion and exclusion criteria used in the systematic review.

Inclusion Criteria	Exclusion Criteria
Primary studies published in peer-reviewed scientific journals.	Secondary studies (e.g., literature reviews, editorials, commentaries, or books).
Published between November 1, 1993, and November 1, 2023.	Published before November 1, 1993, and after November 1, 2023.
Full-text available in English or Spanish.	Full-text available only in other languages.
Examines the relationship between FM and PTSD.	Does not examine FM or PTSD or lacks relevant patient samples.
Includes samples of patients with a confirmed diagnosis of FM and PTSD.	Includes samples of patients without a confirmed diagnosis.
Case-control and comparative studies.	Studies without a control or comparison group.
Conducted in clinical populations.	Conducted in non-clinical populations.
Includes samples from adult and youth populations.	Includes samples from children.

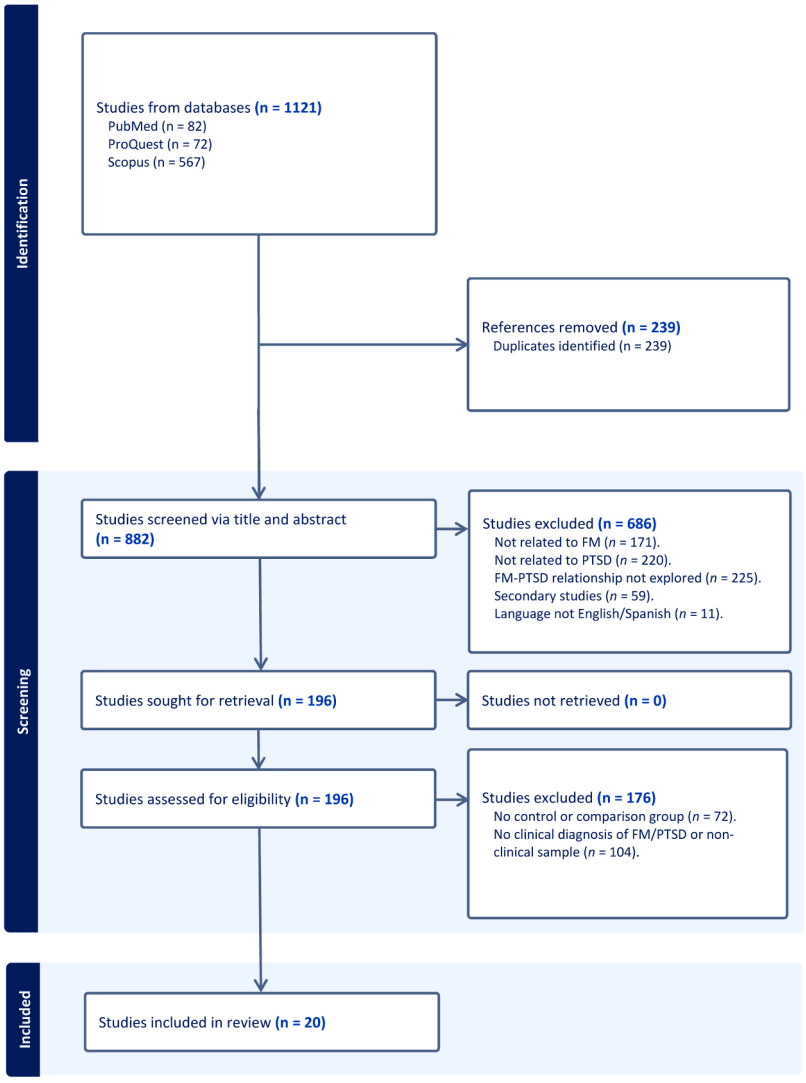

Fig. 1. PRISMA flow diagram of study selection process (Page et al., 2021).

heterogeneity in sample origin and cultural context: five (25%) were from Israel, five (25%) from the United States, three (15%) from Germany (Häuser et al., 2013; Häuser et al., 2015; Windenfeld et al., 2007), two (10%) from Spain (González et al., 2019; López-López et al., 2020) and Italy (Alciati et al., 2021; Carta et al., 2018), and one (5%) from Jordan (Al-Smadi et al., 2021), Belgium (Coppens et al., 2017), and Turkey (Semiz et al., 2014).

Although the studies shared characteristics such as marital status and educational level, there was a notable gender disparity. Some studies had a balanced representation of men and women (n = 3, 15%; Ablin et al., 2010; Cohen et al., 2002; Nelson et al., 2017), while the majority focused on women (n = 14; 70%). A small number specifically examined men (n = 3, 15%; Amital et al., 2006; Jamil et al., 2006; Lawrence-Wolff et al., 2023). Despite these differences, a consistent association between FM and PTSD was observed across genders.

Sample sizes ranged from 32 participants (Jamil et al., 2006) to 3,915 (Lawrence-Wolff et al., 2023), with a total of 6,965 subjects included in the analysis. Sample composition varied across studies: seven (35%) compared FM patients with healthy controls, while others compared FM with dyspepsia/achalasia (n = 1, 5%; Coppens et al., 2017), rheumatoid arthritis (n = 2, 10%; Hellou et al., 2017; Semiz et al., 2014), or osteoarthritis (n = 1, 5%; Nicolson et al., 2010). Three studies (15%; Al-Smadi et al., 2021; Alciati et al., 2021; Häuser et al., 2015) investigated FM subtypes. Five assessed PTSD in comparison to healthy controls (25%), while one examined the effects of Holocaust exposure (10%; Ablin et al., 2010).

Studies examining the severity of FM and PTSD (n = 13, 65%) indicated that greater FM severity was associated with more severe PTSD symptoms and vice versa. Factors such as increased anxiety (n = 2, 10%; Al-Smadi et al., 2021; Hellou et al., 2017), insomnia (n = 1, 5%; Al-Smadi et al., 2021), depression (n = 6, 30%), and psychological distress (n = 3, 15%; Alciati et al., 2021; Carta et al., 2018; Häuser et al., 2015) were also linked to greater FM severity. Some studies found no correlation between the severity of traumatic events (n = 2, 10%; Ciccone et al., 2005; Hellou et al., 2017) or childhood adversity (n = 1, 5%; Coppens et al., 2017) and FM severity, although they reported an association between PTSD and FM (n = 2, 10%; Ciccone et al., 2005; Coppens et al., 2017).

All studies included participants with confirmed FM and PTSD diagnoses. FM diagnosis was based on the ACR 1990 criteria (n = 11, 55%), ACR 2010 criteria (n = 5, 25%), and ACR 2016 criteria (n = 3, 15%; Alciati et al., 2021; Al-Smadi et al., 2021; Carta et al., 2018). One study (n = 1, 5%) used the Structured Clinical Interview for DSM (SCID; Ciccone et al., 2005), the National Health Survey of Persian Gulf War Era Veterans Questionnaire (Jamil et al., 2006), or did not specify the criteria (López-López et al., 2020).

PTSD diagnosis was based on the DSM-IV criteria in the majority of studies (n = 11, 55%), followed by DSM-IV-TR criteria (n = 1, 5%;

Table 2
Characteristics of the studies included in the systematic review.

Author (year), country, design	Aim	Case characteristics	Control/ comparison characteristics	Diagnosis of FM/ PTSD	Assessment measures	Main outcomes
Ablin et al. (2010), Israel Cross-sectional	Evaluate the frequency of FM, PTSD, and concurrent psychiatric symptoms in Holocaust survivors in Israel, compared to a non-exposed control group.	*n*=83. Holocaust survivors (43.37% men) aged between 62 and 97 years (M=77.5; SD=6.3), with 0-19 years of education (M=11.6; SD=3.7). Suicide attempts: 9.7%; divorces: 12.5%. 23.8% have FM, and of these, 66.3% (n=55) have PTSD.	*n*=65. Individuals not exposed to the Nazi occupation, aged between 66 and 90 years (M=77.4; SD=6.4), with 43.0% men and 5-20 years of education (M=12.8; SD=3.4). Suicide attempts: 0%; divorces: 1%. 11.1% have FM, and of these, 6.15% (n=4) have PTSD.	FM: ACR criteria (1990). PTSD: CAPS (Hebrew).	Psychiatric symptoms: SCL-90. Physical function: FIQ. Quality of life: SF-36 (Hebrew).	Higher prevalence of FM in Holocaust survivors compared to the control group, with a higher frequency of PTSD among those with FM, highlighting the lasting impact of stress on FM and prolonged neural changes in the central nervous system.
Alciati et al. (2021), Italy Cross-sectional	Compare psychiatric comorbidities and adversities between patients with RA and SFM versus PFM, focusing on lifetime diagnoses of DM, PTSD, and CPTSD.	*n*=30. PFM patients aged 18 to 70 years (M=50.2; SD=11.9), with 96.7% women (n=29). Age of FM onset: M=42.8 (SD=12.43); duration: M=7.3 years (SD=7.7).	*n*=40. SFM patients aged 18 to 70 years (M=53.6; SD=8.5), with 92.5% women (n=37). Age of FM onset: M=45.8 (SD=7.7); duration: M=7.83 years (SD=5.5).	FM: ACR criteria (1990 y 2016). PTSD: SCID-5.	AR: ACR criteria (2010). MD y PD: SCID-5. Depressive symptoms: ZDS. Childhood abuse: CTQ. Recent events: Paykel interview (Italian). Pain: VAS. FM impact: FIQ.	DM and PD are more frequent in PFM, with PTSD being equally prevalent. Before the onset of FM, PFM experiences more sexual abuse and physical neglect. The differences between PFM and SFM suggest a common pathogenesis through different pathways. Anxiety and PTSD increase the impact of FM; insomnia, marital status, employment, education, and chronic illnesses do not affect it.
Al-Smadi et al. (2021), Jordan Cross-sectional	Evaluate the impact of FM and its associated factors, including anxiety, PTSD, and insomnia, in refugee women.	*n*=76. Refugee women with mild FM, aged 18 to 72 years (M=52.50; SD=3.65), from Amman (48), Irbid (6), Mafraq (7), and Zarqa (15). 18% have chronic illnesses, and 24.4% have not received education.	*n*= 212. Refugee women with moderate or severe FM, aged 18 to 72 years (M=52.50; SD=3.65), from Amman (51), Irbid (47), Mafraq (54), and Zarqa (60). 82% have chronic illnesses, and 75.6% have not received education.	FM: ACR criteria (2016). PTSD: PTSD Questionnaire.	Impact of FM: FIQ. Sleep disorder: ISI. Anxiety levels: HAM-A.	Advanced age, anxiety, PTSD, living in Irbid, and being an Iraqi refugee predicted a high impact of FM. Approximately 75% experienced moderate to severe impact. A strong association is shown between PTSD and a high impact of FM in traumatic contexts, though its causality is unclear.
Amir et al. (1997), Israel Cross-sectional	(1) Analyse the prevalence of FM and non-articular tenderness in patients with and without FM; (2) Compare symptoms, quality of life, and functional disability; (3) Examine differences between PTSD patients with and without FM.	*n*=29. Patients with severe PTSD (M=34.4, SD=10.8), 18 women, 11 men, 62% married, with an FM prevalence of 21% (n=6).	*n*=37. Patients without PTSD (M=36.2, SD=6.8), 24 women, 13 men, 78% married, with an FM prevalence of 0% (n=0).	FM: ACR criteria (1990). PTSD: DSM-IV criteria.	Sensitivity: Assessed manually and with a dolorimeter. FM Symptoms: VAS. Quality of Life: Flanagan's 16-item questionnaire. Physical Functioning and Health: FIQ. PTSD Symptoms: IES. Psychiatric Symptoms: SCL-90, GSI.	The prevalence of FM was 21% in the PTSD group, compared to 0% in the control group and 2% in the general population. PTSD patients with FM exhibited greater sensitivity, pain, functional disability, psychological distress, and lower quality of life than those with PTSD without FM, highlighting the link between psychological stress and pain syndromes.
Amital et al. (2006), Israel Cross-sectional	Investigate the comorbidity of SFM and PTSD in men following a severe, initial, and well-defined traumatic event. The aim is to understand how these disorders are related and whether one	*n*=77. Men aged 18–60, 55 with PTSD and 22 with major depression. Military service between ages 22–36. Sheba Medical Center, Tel Hashomer.	*n*=49. Healthy men attending the Medical Surveillance Institute for routine annual check-ups unrelated to the study. Military service between ages	FM: ACR criteria (1990). PTSD: DSM-IV criteria.	Sleep quality: SHQ. Subjective Disability: Sheehan Disability Scale. Quality of life: SF-36. PTSD severity: CAPS. Severity of Psychiatric Illness: CGI.	In men, PTSD shows a strong association with FM: 49% of PTSD patients, 5% of those with major depression, and 0% of controls met the criteria for FM. The severity and

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Table 2 (*continued*)

Author (year), country, design	Aim	Case characteristics	Control/ comparison characteristics	Diagnosis of FM/ PTSD	Assessment measures	Main outcomes
	increases the risk of developing the other.		22–36. Sheba Medical Center, Tel Hashomer.		Depression: HAM-D. Sensitivity: FM Sensitivity Assessment.	impact of these disorders are also highly correlated. Significant associations are observed between tender points and the measured parameters in the PTSD group.
Carta et al. (2018), Italia Cross-sectional	Analyse the relationship between FM, PTSD, anxiety, and mood disorders by comparing individuals with FM to healthy controls, and assess their impact on quality of life and the burden of psychiatric comorbidities.	*n*=71. Women with FM from the Rheumatology Service at the University Hospital of Cagliari (M=51.12, SD=6.69), of whom 8.45% (n=6) have PTSD and 43.66% (n=31) have major depressive disorder.	*n*=284. Women without FM, matched for age and residence (M=51.06, SD=5.94), of whom 1.4% (n=4) have PTSD and 8.07% (n=23) have major depressive disorder.	FM: ACR criteria (2016). PTSD: DSM-IV criteria.	Psychiatric diagnoses: ANTAS. Quality of life: SF-12. FM Assessment in Controls: Inquiry about well-being, medical history, healthcare utilization, and medical tests.	A strong association between FM and PTSD was observed. In individuals with FM, the relationship between PTSD and mood disorders was more pronounced but did not fully account for the higher prevalence of PTSD. This association was weaker than in studies based on questionnaires or stress assessments.
Ciccone et al., (2005), U.S.A. Cross-sectional	The trauma hypothesis: higher rates of PTSD and experiences of sexual and physical abuse in FM patients expected. Using a community sample, the study examines whether women with FM are more likely to develop PTSD than those without FM.	*n*= 50. Women with FM (M=50.5, SD=10.6): 74% White, 55% married, 46% employed, with an average of 15.3 years of education.[1]	*n*=53. Women without FM (M=50.5, SD=10.6): 74% White, 55% married, 64% employed, with an average of 15.3 years of education.[1]	FM: Physical examination (tender point count) and SCID diagnosis. PTSD: PTSD Checklist.	Sexual and Physical Abuse: Sexual and Physical Abuse Interview. Depression: BDI. Pain Intensity: Pain Intensity Survey. Frequency of Outpatient Medical Visits: Self-report.	No form of self-reported sexual or physical abuse, except for rape, was associated with FM in this sample. However, PTSD was more prevalent among women with FM, who were more likely to exhibit symptoms or receive a PTSD diagnosis. Thus, chronic stress from PTSD, rather than major depression, may mediate the relationship between rape and FM.
Cohen et al., (2002), Israel Cross-sectional	Evaluate the frequency of PTSD in patients with FM. The influence of gender on PTSD measures in FM patients was also examined.	*n*=44. Patients with PTSD, aged 24 to 70 years (M=46.8; SD=11.8), 40.9% male, 93.2% married, with an average illness duration of 10.5 years (SD=10.0).	*n*=33. Patients without PTSD, aged 22 to 67 years (M=45.3; SD=12.8), 57.6% male, 84.8% married, with an average illness duration of 7.2 years (SD=6.4).	FM: ACR criteria (1990). PTSD: SCID-IV and CAPS.	Depression: HAM-D. Anxiety: HAM-A. Physical function: FIQ.	The prevalence of FM in the PTSD group was 21%, compared to 0% in the control group. Patients with PTSD and FM exhibited higher sensitivity, more pain, lower quality of life, greater functional disability, and increased psychological distress compared to those with PTSD alone.
Coppens et al. (2017), Belgium Cross-sectional	Investigate the prevalence of ACEs and PTSD in women with FM compared to those with functional dyspepsia and achalasia, and analyse their association with pain severity in FM/ CWP.	*n*=154. Women with FM (M=42.4; SD=10.5), 31.2% employed. Thirty individuals with CWP were included as they showed no differences in ACEs, PTSD, or pain severity.	*n*=136. Comparison group included 83 patients with functional dyspepsia (M=41.9; SD=14.97) and 53 with achalasia (M=53.79; SD=17.17), with employment rates of 50.9% and 55.6%, respectively.	FM: ACR criteria (1990). PTSD: PTSD-ZIL.	ACEs: CTQ (abbreviated version). Pain severity: MPQ (Dutch).	In the FM group, PTSD, but not ACEs, was associated with the severity of self-reported pain, and PTSD severity mediated the relationship between ACEs and pain. The prevalence of ACEs was higher in FM than in achalasia, but similar to that in functional dyspepsia.
González et al. (2019), Spain Cross-sectional	Compare cardiovascular responses to a non-traumatic laboratory stressor in three groups: women with FM, women with FM and PTSD, and healthy women.	*n*=36. Women with FM: 18 without PTSD (M=57.06; SD=6.23), pain onset at 39.12 years (SD=13.71), and 18 with PTSD	*n*=38. Healthy women, without FM or PTSD, aged 25 to 65 years (M=48.66; SD=8.42).	FM: ACR criteria (1990). PTSD: DSM-IV-TR criteria.	Pain intensity: Brief Pain Inventory. Depressive symptoms: BDI. Childhood abuse and neglect: CTQ. Traumatic experiences:	PTSD contributes to the attenuation of cardiovascular reactivity in patients with FM, likely influenced by depressive symptoms.

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Table 2 (*continued*)

Author (year), country, design	Aim	Case characteristics	Control/ comparison characteristics	Diagnosis of FM/ PTSD	Assessment measures	Main outcomes
		(M=50.56; SD=8.51), pain onset at 32.17 years (SD=13.31).			TEC. Life changes: HSUP, LES. Activation level: VAS.	Given that a cardiovascular stress response is functional, the study supports clinical strategies for detecting and treating PTSD and depression in FM management.
Häuser et al. (2013), Germany Cross-sectional	(1) Evaluate whether PTSD is a risk factor for FM; (2) whether FM is a risk factor for PTSD; (3) whether both conditions are comorbid due to a common factor (trauma); (4) whether their relationship is mediated by a third factor, such as depression.	*n*=395. Patients with FM (M=52.3; SD=8.8), 371 women, 300 with a partner or family, 179 with PTSD, and 259 with depression.	*n*=395. Patients without FM, matched by age and sex (M=52.3; SD=8.8), 371 women, 278 with a partner or family, 12 with PTSD, and 19 with depression.	FM: ACR criteria (2010). PTSD: DSM-IV criteria.	Psychological distress: PHQ-4. Pain related disability: Pain Disability Index (German).	Patients with FM showed a higher prevalence of PTSD (45.3%) and depression (65.6%) compared to controls (3.0% and 4.8%). In 66.5% of cases, PTSD preceded CWP; in 29.5%, it followed, and in 4.0%, they coincided. Those with FM and PTSD experienced more pain, distress, disability, and unemployment than patients with FM without PTSD.
Häuser et al. (2015), Germany Cross-sectional	Evaluate the association between FM, childhood abuse, lifetime psychological trauma, and country differences, adjusted for psychological distress.	*n*=71. German outpatients with FM, aged over 18 years (M=50; SD=10.3), 95.8% women (n=68).	n=71. US outpatients with FM, aged over 18 years (M=51.9; SD=10.2), 95.8% women (n=68).	FM: ACR criteria (1990, 2010). PTSD: PTSD module of the M-CIDI.	Psychological distress, anxiety, and depression: PHQ-4. Pain related disability: PDI. Childhood abuse: CTQ (short version).	The transcultural robustness of the association between FM in adults, childhood abuse, and traumatic experiences is confirmed, primarily explained by current psychological distress, such as PTSD.
Hellou et al. (2017), Israel Cross-sectional	To evaluate the association between FM, childhood adversity, and PTSD and its cross-cultural nature.	*n*=75. Israeli patients with FM from the Rheumatology Institute at Tel Aviv Medical Center (M=46.6; SD=12.7), 86.7% women (n=65), and 41.9% married (n=31).	*n*=23. Israeli patients with RA from the Rheumatology Institute at Tel Aviv Medical Center (M=59.1; SD=12.0), 87% women (n=20), and 69.6% married (n=16).	FM: ACR criteria (1990, 2010). PTSD: DSM-IV criteria.	RA: ACR Criteria (1990, 2010) and RA Activity Index. Psychological distress, anxiety, and depression: PHQ-4 (4 items). Pain related disability: PDI. Childhood abuse: CTQ. FM severity: WPI, SSS, FIQ. Estado de salud: SF-36.	Israeli patients with FM reported higher childhood adversity and a greater prevalence of PTSD compared to those with RA, as well as increased cases of emotional abuse and physical and emotional neglect. The study confirmed a transcultural association between FM, childhood maltreatment, and PTSD, highlighting significant differences from RA patients.
Jamil et al. (2006), U.S.A. Cross-sectional	Examine the effects of the Gulf War on Iraq veterans in the United States, assuming that PTSD increases chronic fatigue, FM, lower quality of life, and healthcare utilization.	*n*=19. Male veterans with PTSD, recruited from a social center for Iraqis and Arab Americans, of whom 73.7% meet FM criteria.	*n*=13. Male veterans without PTSD, recruited from a social center for Iraqis and Arab Americans, with 61.5% meeting FM criteria.	FM: National Health Survey of Persian Gulf War Era Veterans Questionnaire, with a confirmed prior diagnosis. TPSD: PCL-M.	Chronic fatigue: Chronic Fatigue Syndrome Questionnaire, Gulf War Veterans Health Survey. Quality of life: National Health Interview Survey, Gulf War Veterans Health Survey. Healthcare utilization: National Medical Expenditure Survey. Social desirability: MC-SDS (short version).	The results reveal that PTSD is associated with more health problems and an increased risk of developing FM, with more symptoms reported by veterans with PTSD compared to those without PTSD.
Lawrence-Wolff et al. (2023), U.S.A. Cross-sectional	Evaluate the prevalence of FM in military service members with and without PTSD.	*n*=1305. Active-duty service members diagnosed with PTSD: n=821, not enrolled in treatment, aged 18 to 62 years	*n*=2610. Active-duty service members without a PTSD diagnosis, aged 18 to 62 years	FM: ACR criteria (2010). PTSD: PCL-S y PSS-I.	ND.	FM had a prevalence of 10.8% among the 821 service members with PTSD, compared to 0.8% in those without PTSD and 39.7% in

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Table 2 (*continued*)

Author (year), country, design	Aim	Case characteristics	Control/ comparison characteristics	Diagnosis of FM/ PTSD	Assessment measures	Main outcomes
		(M=27.2; SD=6.1), 91.2% male. n=484, enrolled in three PTSD treatment trials, aged 20 to 53 years (M=33).	(M=27.2; SD=6.1), 91.2% male.			those seeking treatment. Across all three cohorts, FM was associated with older age, female gender, marital status, longer service duration, and a higher number of deployments.
López-López et al. (2020), Spain Cross-sectional	Examine stress-induced changes in pain thresholds and tolerance in FM patients, considering PTSD comorbidity and the role of cardiovascular reactivity.	*n*=36. Women with FM (aged 25–65 years): 18 with PTSD (M=50.55; SD=8.51) and 18 without PTSD (M=57.05; SD=6.22). Time since FM diagnosis: 17.47 years (SD=13.67) in the non-PTSD group and 16.55 years (SD=12.76) in the PTSD group. PTSD diagnosis duration: 17 years (SD=14.97).	*n*=38. Healthy women (aged 25–65 years, M=48.65; SD=8.41) recruited from relatives of students at Rey Juan Carlos University.	FM: ND. PTSD: ND.	Childhood abuse and neglect: CTQ. Traumatic experiences: TEC. Life changes: HSUP, LES. Depressive symptoms: BDI-II. Pain catastrophizing: PCS. Anxiety: STAI. Perceived stress: VAS.	Patients with FM exhibit a hypoactive stress response, which may be maladaptive and contribute to the development and persistence of chronic pain. PTSD may exacerbate this response and help differentiate FM subgroups.
Nelson et al. (2017), U.S.A. Cross-sectional	Examine the differential presentation in young adults with juvenile-onset FM, with and without a history of trauma, compared to healthy controls, considering psychological and health outcomes.	*n*=86. Patients with juvenile-onset FM (M=23.4 years; SD=ND), 32 with a history of trauma and 54 without trauma.	*n*=24. Healthy controls (M=23.4 years; SD=ND).	FM: ACR criteria (2010). PTSD: SCID-IV.	Trauma history and healthcare utilization: Clinical interview. Pain intensity: Brief Pain Inventory. FM symptom severity: WPI, SSI. Physical functioning and perceived health status: SF-36.	37% (n=32) of juvenile-onset FM participants reported a history of trauma, with higher rates of PTSD (17.2% vs. 5%) and sexual abuse (14.7% vs. 8%) compared to national estimates. Physical abuse rates in juvenile FM were slightly lower (11.2% vs. 14.8%).
Nicolson et al. (2010), U.S.A. Cross-sectional	Evaluate the relation between childhood maltreatment and daily cortisol secretion in women with FM, examining whether it is mediated or moderated by current psychopathology or daily symptoms, such as PTSD.	*n*=35. Women diagnosed with FM (M=53.5; SD=8.2), predominantly Caucasian (90%), married or in a relationship (69%), and employed (59%)[1], with an average body mass index of 31 (SD=8.4).	*n*=35. Women with osteoarthritis (M=58.4; SD=8.7), predominantly Caucasian (90%), married or in a relationship (69%), and employed (59%)[1], with an average body mass index of 31.6 (SD=8.5).	FM: ACR criteria (1990). PTSD: Clinical interview based on the SSAGA-II, based on DSM-IV.	Depressive symptoms: HAM-D Childhood trauma: CTQ Daily experience: Diary Salivary cortisol: Internal radioimmunoassay	Women with severe childhood maltreatment exhibited higher daily cortisol levels, particularly in cases of emotional and sexual abuse, regardless of pain diagnosis (FM or osteoarthritis), PTSD, depression, or daily experiences of pain, stress, mood, and sleep. While maltreatment was associated with depression, PTSD, and daily affect, none of these variables mediated its relationship with cortisol.
Semiz et al. (2014), Turkey Cross-sectional	Investigate the prevalence of PTSD, alexithymia, and somatoform dissociative symptoms in patients with FM.	*n*=56. Patients with FM (M=35.1; SD=6.7), 92.9% women (n=52), 73.2% married (n=41), and 37% (n=20) with a psychiatric history.	*n*=46. Patients with RA (M=34.5; SD=9.4), 87% women (n=40), 65.2% married (n=30), and 15.2% (n=7) with a psychiatric history.	FM: ACR criteria (1990). PTSD: PDS.	RA: ACR criteria (1987) Somatoform dissociation: SDQ Alexithymia: TAS History of abuse and neglect: CTQ Impact of FM: FIQ	More patients with FM (n=19; 33.9%) reported at least one traumatic event compared to the RA group (n=6; 13%). PTSD was present in 10.7% (n=6) of FM patients and absent in RA patients. Findings suggest that PTSD, alexithymia, and dissociative symptoms contribute to increased pain and disability in FM.

(*continued on next page*)

Table 2 (*continued*)

Author (year), country, design	Aim	Case characteristics	Control/ comparison characteristics	Diagnosis of FM/ PTSD	Assessment measures	Main outcomes
Wingenfeld et al. (2007), Germany Cross-sectional	Evaluate the hypothesis of heightened sensitivity to negative feedback in the HPA axis among FM patients, a pattern also observed in PTSD patients.	*n*=15. Women with FM recruited from support groups and medical clinics (M=47.9; SD=5.7), with an average pain duration of 15.4 years (SD=11.5).	*n*=20. Healthy women recruited through local advertising (M=37.9; SD=8.9). Controls with a history of severe trauma were excluded due to its potential impact on the HPA axis. .	FM: ACR criteria (1990). PTSD: SCID-IV.	Depression, anxiety, and PTSD: Standard rating scales. Severity of physical, mental, and total fatigue: Fatigue Scale. Somatic symptoms: Freiburg Complaint List-Revised. Traumatic experiences: Early Trauma Inventory, Trauma Assessment for Adults.	The results indicate greater glucocorticoid feedback sensitivity in FM at the adrenal level, with an HPA axis dysfunction pattern distinct from PTSD, which exhibits both pituitary and adrenal suppression.

ACEs, Adverse childhood experiences; ACR, American College of Rheumatology; ANTAS, Advanced Neuropsychiatric Tools and Assessment Schedule; BDI-II, Beck Depression Inventory - Second Edition; BDI, Beck Depression Inventory; CAPS, Clinician-Administered PTSD Scale; CGI, Clinical Global Impression Scale; CPTSD, complex post-traumatic stress disorder; CTQ, Childhood Trauma Questionnaire; CWP, chronic widespread pain; DSM-IV-TR, Diagnostic and Statistical Manual of Mental Disorders, fourth edition, text revision; DSM-IV, Diagnostic and Statistical Manual of Mental Disorders - fourth edition; FIQ, Fibromyalgia Impact Questionnaire; FM, fibromyalgia; GSI, Global Severity Index; HAM-A, Hamilton Anxiety Rating Scale; HAM-D, Hamilton Depression Rating Scale; HPA, hypothalamic-pituitary-adrenal; HSUP, Hassles and Uplifts Scales; IES, Impact of Event Scale; ISI, Insomnia Severity Index; LES, Life Experiences Survey; M-CIDI, Munich-Composite International Diagnostic Interview; M, mean; MC-SDS, Marlowe–Crowne Social Desirability Scale; MD, major depression; MPQ, McGill Pain Questionnaire; ND, not defined; PCL-M, PTSD Checklist - Military Version; PCL-S, PTSD Checklist–Specific Version; PCS, Pain Catastrophizing Scale; PD, panic disorder; PDI, pain disability index; PDS, Post-traumatic Diagnostic Scale; PFM, primary fibromyalgia; PHQ-4, Patient Health Questionnaire-4; PSS-I, PTSD Symptom Scale – Interview; PTSD-ZIL, Self-Rating Inventory for Post-traumatic Stress Disorder; PTSD, post-traumatic stress disorder; RA, rheumatoid arthritis; SCID-IV The Structured Clinical Interview for DSM-IV; SCID-IV, Structured Clinical Interview for DSM-IV; SCID, Structured Clinical Interview for DSM Disorders; SCL-90, Symptom Checklist-90; SD, standard deviation; SDQ, Somatoform Dissociation Scale; SF-12, 36-Item Short Form Survey; SF-36, 36-Item Short Form Survey; SFM, secondary fibromyalgia; SHQ, Sleep History Questionnaire; SSAGA-II, Semi-Structured Assessment for the Genetics of Alcoholism-II; SSI, Symptom Severity Index; SSS, Symptom Severity Scale; STAI, State-Trait Anxiety Inventory; TAS, Toronto Alexithymia Scale; TEC, Traumatic Experiences Checklist; U.S.A., United States of America; VAS, Visual Analogue Scale; WPI, widespread pain index; ZDS, Zung Depression Rating Scale.

[1]The mean and standard deviation values were provided for the total sample, without distinguishing between the case and control/comparison groups.

González et al., 2019) and DSM-5 criteria (n = 1, 5%; Alciati et al., 2021). Another diagnostic method used was the Clinician-Administered PTSD Scale (CAPS; n = 1, 5%; Ablin et al., 2010). Several studies employed self-report measures, including the PTSD Checklist – Military Version (PCL-M; n = 1, 5%; Jamil et al., 2006) and other standardised questionnaires (n = 4, 20%). One study did not specify the diagnostic method (n = 1, 5%; López-López et al., 2020).

The oldest study included (Amir et al., 1997) found a 21% prevalence of FM among individuals with PTSD, compared to 0% in the control group and 2% in the general population, with greater symptom severity in the PTSD group. This was corroborated by Cohen et al. (2002) and subsequent studies, which confirmed the FM-PTSD association and a correlation between higher PTSD levels and greater FM impact (n = 8, 40%). Ablin et al. (2010) also reported a high FM prevalence among Holocaust survivors in Israel, highlighting the lasting impact of stress on FM development. Multicultural studies support this association (n = 3, 15%; Häuser et al., 2015; Hellou et al., 2017; Semiz et al., 2014), with Häuser et al. (2013) finding that 66.5% of PTSD cases precede FM, 29.5% occur simultaneously, and 4.0% emerge within the same year.

Limited evidence indicates that individuals with PTSD following exposure to traumatic events may be more likely to develop FM (n = 2, 10%; Ciccone et al., 2005; Coppens et al., 2017). However, these findings are based on cross-sectional data, and the absence of strong prospective studies limits support for a direct causal pathway. Conversely, Nicolson et al. (2010) did not observe a significant relationship between PTSD and increased likelihood of FM development, and Wingenfeld et al. (2007) identified distinct patterns of HPA axis dysfunction in FM and PTSD, suggesting potentially different physiological mechanisms.

3.3. Risk of bias

The methodological quality of the studies was assessed as predominantly good (n = 12, 60%) and moderate (n = 8, 40%), as detailed in Table 3.

4. Discussion

This review aimed to synthesise evidence from the past 30 years on the relationship between FM and PTSD, focusing on whether PTSD increases both the risk of developing FM and the severity of its symptoms. It also explored the potential mediating role of PTSD in the relationship between traumatic experiences and the onset of FM. To our knowledge, this is the first systematic review to examine this association, expanding on previous research that investigated the impact of traumatic events on FM without considering PTSD's influence (Kaleycheva et al., 2021).

The majority of reviewed studies support the association between FM and PTSD (n = 19, 95%), indicating that PTSD is more prevalent in individuals with FM compared to healthy controls or those with conditions such as rheumatoid arthritis (n = 2, 10%; Hellou et al., 2017; Semiz et al., 2014), osteoarthritis (n = 1, 5%; Nicolson et al., 2010), functional dyspepsia, or achalasia (n = 1, 5%; Coppens et al., 2017). Most studies also suggest that PTSD is associated with more severe FM symptoms (n = 13, 65%). Additionally, some studies suggest that individuals that develop PTSD following a traumatic event may be more likely to develop FM (n = 2, 10%; Ciccone et al., 2005; Coppens et al., 2017). However, causal relationships remain unclear (Al-Smadi et al., 2021).

Regarding the proposed hypotheses, findings indicate (1) an association between FM and PTSD (n = 19, 95%), (2) limited evidence indicating that individuals with PTSD following trauma are associated with an increased likelihood of developing FM (n = 2, 10%; Ciccone et al., 2005; Coppens et al., 2017), and (3) an association between PTSD and increased severity of FM symptoms (n = 13, 65%).

According to the shared vulnerability model and mutual maintenance theory, individuals with FM, PTSD, or both typically exhibit higher levels of anxiety and depression than controls (n = 15; 75%). Several studies have linked depression and FM (n = 4; 20%), with Hellou et al. (2017) and Häuser et al. (2013) suggesting depression may mediate the impact of traumatic events on FM, while Ciccone et al. (2005) identify PTSD as the potential primary mediator. Results also suggest a connection between anxiety disorders and FM (Alciati et al.,

Table 3
Quality assessment of studies based on an adapted version of the Newcastle-Ottawa-E Scale (Wells et al., 2000).

Author (year)	FM diagnosis (2)	PTSD diagnosis (2)	Representativeness of cases (2)	Control Selection (3)	Control definition (1)	Psychological Comorbidity (1)	Condition Duration (1)	Exposition ascertainment (3)	Response rate (2)	Total score (17)	Standardised score (%)	Quality of the publication
Ablin et al. (2010)	2	1	1	1	0	1	1	1	1	9/17	52,94	Good
Alciati et al. (2021)	2	2	1	1	0	0	1	1	0	8/17	47,06	Moderate
Al-Smadi et al. (2021)	2	1	1	0	0	0	0	2	0	6/18	33,33	Moderate
Amir et al. (1997)	2	2	1	1	1	0	0	1	0	8/17	47,06	Moderate
Amital et al. (2006)	2	2	1	2	1	0	0	1	0	9/17	52,94	Good
Carta et al. (2018)	2	2	1	2	1	0	0	2	0	10/18	55,56	Moderate
Ciccone et al. (2005)	1	1	1	1	0	1	0	2	2	9/17	52,94	Good
Cohen et al. (2002)	2	2	1	1	0	0	1	3	0	10/17	55,56	Good
Coppens et al. (2017)	2	1	1	1	0	0	0	2	0	7/17	41,18	Moderate
González et al. (2019)	2	2	1	0	1	1	0	1	0	8/17	47,06	Moderate
Häuser et al. (2013)	2	2	2	1	0	1	1	1	0	10/17	55,56	Good
Häuser et al. (2015)	2	1	1	0	1	0	1	1	0	7/17	41,18	Moderate
Hellou et al. (2017)	2	2	1	1	1	0	1	0	1	9/17	52,94	Good
Jamil et al. (2006)	1	1	1	1	0	0	0	1	0	5/17	29,41	Moderate
Lawrence-Wolff et al. (2023)	2	1	1	1	1	0	0	2	1	9/17	52,94	Good
López-López et al. (2020)	1	1	1	0	0	1	0	1	0	5/17	29,41	Moderate
Nelson et al. (2017)	2	2	2	2	1	0	1	1	0	11/17	64,71	Good
Nicolson et al. (2010)	2	2	2	1	1	1	0	2	0	11/17	64,71	Good
Semiz et al. (2014)	2	1	1	2	1	0	0	2	0	9/17	52,94	Good
Wingenfeld et al. (2017)	2	2	2	2	1	1	1	1	0	12/17	70,59	Good

Each element includes a maximum score (in parentheses) standardised in comparative percentages: low quality (0-25%), moderate (26-50%), good (51-75%), and excellent (76-100%). The scores (1) (2) (3) reflect the fulfilment of criteria according to the Newcastle-Ottawa Scale (Wells et al., 2000), assigning 0 if not met and the maximum score if all criteria are fulfilled.

2021; Al-Smadi; Amir et al., 1997; Carta et al., 2018; Semiz et al., 2014). While specific mediators remain unclear, these findings suggest shared psychological mechanisms between FM and PTSD. However, some authors report that at least one-third of individuals with FM exhibit a normal psychological profile, suggesting that psychopathology might not be a necessary condition for FM development (Colligan et al., 1984).

Beyond psychological factors, both conditions are associated with physiological dysregulation, particularly HPA axis alterations. Increased negative feedback sensitivity of the HPA axis has been linked to basal hypocortisolism in both disorders (Beiner et al., 2023; Heim et al., 1998; Yehuda et al., 1991). However, Wingenfeld et al. (2007) identified distinct dysfunction patterns, suggesting that HPA axis abnormalities in FM and PTSD may differ. Similarly, Amital et al. (2006) propose that PTSD and FM share neurobiological mechanisms, including heightened adrenergic activity and endocrine abnormalities such as disrupted circadian rhythms and irregular melatonin secretion. Further research is needed to clarify the existence and characteristics of physiological mechanisms.

Despite these uncertainties, the findings have clinical implications for the prevention, diagnosis, and treatment of FM and PTSD. An interdisciplinary approach is important (Ram et al., 2023; van-Rood & de-Roos, 2009), with routine assessment of PTSD and stressful life events and treatment addressing both physiological and psychological symptoms, considering mental health comorbidities (Nardi et al., 2020; Ram et al., 2023). Interventions that enhance coping strategies for stress and trauma may be beneficial. Evidence suggests that trauma-focused treatments, such as Eye Movement Desensitisation and Reprocessing (EMDR), can improve medically unexplained symptoms (van-Rood & de-Roos, 2009) and FM-specific outcomes (Aznárez, 2022; del Val Muedra & Larrainzar, 2023; Fiszon Herzberg et al., 2021; Gardoki-Souto et al., 2021; Scelles and Bulnes, 2021). Further research is needed to establish the efficacy of trauma-focused interventions in FM management. Given the biopsychosocial etiology of FM (Antunes et al., 2021; Kaleycheva et al., 2021; Yaghmaian & Miller-Smedema, 2019; Yavne et al., 2018), integrating social dimensions is equally important. As FM is more prevalent in women (Aznárez, 2022; Briones-Vozmediano, 2010; i-Llombart & Mora, 2017), the impact of gender inequities and unspoken experiences of violence on chronic stress and FM onset warrants further investigation (Aznárez, 2022; i-Llombart & Mora, 2017).

The examined studies have several limitations. While this review included only studies with formal PTSD and FM diagnoses, some lacked rigorous diagnostic instruments. Questionnaire-based PTSD assessments were used in 35% of studies (n = 7), despite clinical interviews by a qualified professional being considered more reliable (Soler-Ferrería et al., 2014). Few studies accounted for PTSD or FM duration, and only one examined their temporal relationship (Häuser et al., 2013). Additionally, the use of control groups with other medical conditions may have underestimated the PTSD-FM association, as PTSD is a risk factor for multiple disorders (Barfety-Servignat, 2023). Furthermore, psychological factors such as depressive and anxiety disorders were inconsistently controlled or measured in 35% of reviewed studies (n = 7), potentially affecting conclusions. Given the suggested link between depressive and anxiety disorders and chronic pain (Alciati et al., 2021; Al-Smadi; Amir et al., 1997; Carta et al., 2018; Semiz et al., 2014), this warrants further investigation.

Sample-related limitations also impact generalisability. Studies relied on clinical populations, where FM cases are often more severe and often treatment-resistant (Blasco-Claros et al., 2006). Some focused on severe FM or PTSD cases (n = 4; 20%), while others used small samples (n = 11; 55%), limiting the applicability of findings. Selection bias may further limit generalisability: those who volunteer for trauma-related research may differ systematically from those who do not (Ciccone et al., 2005). Despite general consistency in results, future longitudinal studies with larger and more representative samples are required to enhance understanding and improve clinical applications.

In summary, future research should further examine psychological outcomes in FM, use larger and more representative samples, employ longitudinal designs, adopt a biopsychosocial framework, and investigate underlying mechanisms linking FM and PTSD to improve treatment and prevention. Diagnostic rigour could also be strengthened by incorporating standardised clinical interviews rather than relying solely on questionnaire-based assessments. Additionally, clarifying the temporal relationship between PTSD and FM is important to determine causal links or shared vulnerabilities. Research should also account for disease duration, as chronicity may influence symptom severity, treatment response, and comorbidities. Finally, exploring effective FM treatments remains important, given its association with PTSD and the necessity of a biopsychosocial approach.

5. Conclusions

The systematic review supports an association between PTSD and FM, with evidence indicating that co-occurring PTSD is associated with greater symptom severity in individuals with FM. Limited evidence indicates an association between PTSD and increased likelihood of FM development. However, the predominance of cross-sectional designs limits the ability to draw causal conclusions. These findings have clinical implications for prevention, diagnosis, and treatment, highlighting the need for an interdisciplinary and biopsychosocial approach. However, further research is needed to clarify PTSD's potential mediating role and the underlying mechanisms of this association, as existing studies have not comprehensively addressed these aspects. A deeper understanding could inform more effective and targeted clinical strategies.

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CRediT authorship contribution statement

Amaia Aguirre de Cárcer Vidal: Writing – review & editing, Writing – original draft, Visualization, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **María Frenzi Rabito Alcón:** Writing – review & editing, Supervision, Conceptualization. **Eva Izquierdo Sotorrío:** Writing – review & editing, Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.psychres.2025.116635.

References

Ablin, J.N., Cohen, H., Eisinger, M., Buskila, D., 2010. Holocaust survivors: the pain behind the agony. Increased prevalence of fibromyalgia among Holocaust survivors. Clin. Exp. Rheumatol. 28 (6), 51–56. Suppl 63.

Al-Smadi, A.M., Tawalbeh, L.I., Gammoh, O.S., Ashour, A.F., Shajrawi, A., Attarian, H., 2021. Relationship between anxiety, post-traumatic stress, insomnia, and fibromyalgia among female refugees in Jordan: a cross-sectional study. J. Psychiatr. Ment. Health Nurs. 28 (4), 738–747. https://doi.org/10.1111/jpm.12732.

Alciati, A., Cirillo, M., Masala, I.F., Sarzi-Puttini, P., Atzeni, F., 2021. Differences in depression, anxiety and stress disorders between fibromyalgia associated with rheumatoid arthritis and primary fibromyalgia. Stress Health 37 (2), 255–262. https://doi.org/10.1002/smi.2992.

Alenzi, F., Alhamal, S., Alramadhan, M., Altaroti, A., Siddiqui, I., Aljanobi, G., 2021. Fibromyalgia in health care worker during COVID-19 outbreak in Saudi Arabia. Front. Public Health 9, 693159. https://doi.org/10.3389/fpubh.2021.693159.

American Psychological Association [APA]. (2013). Diagnostic and Statistical Manual of mental disorders (5th ed.). 10.1176/appi.books.9780890425596.
Amir, M., Kaplan, Z., Neumann, L., Sharabani, R., Shani, N., Buskila, D., 1997. Posttraumatic stress disorder, tenderness and fibromyalgia. J. Psychosom. Res. 42 (6), 607–613. https://doi.org/10.1016/S0022-3999(97)00009-3.
Amital, D., Fostick, L., Polliack, M.L., Segev, S., Zohar, J., Rubinow, A., Amital, H., 2006. Posttraumatic stress disorder, tenderness, and fibromyalgia syndrome: are they different entities? J. Psychosom. Res. 61 (5), 663–669. https://doi.org/10.1016/j.jpsychores.2006.07.003.
Antunes, M., Couto, L., Bertolini, S., Loures, F., Schmitt, A., Marques, A., 2021. Effectiveness of interdisciplinary health education programs for individuals with fibromyalgia: a systematic review. J. Educ. Health Promot. 10 (1), 64. https://doi.org/10.4103/jehp.jehp_592_20.
Asmundson, G.J., Hadjistavropolous, H.D., 2006. Addressing shared vulnerability for comorbid PTSD and chronic pain: a cognitive-behavioral perspective. Cogn. Behav. Pract. 13 (1), 8–16. https://doi.org/10.1016/j.cbpra.2005.03.001.
Asmundson, G.J., Coons, M.J., Taylor, S., Katz, J., 2002. PTSD and the experience of pain: research and clinical implications of shared vulnerability and mutual maintenance models. Can. J. Psychiatry 47 (10), 930–937. https://doi.org/10.1177/070674370204701004.
Aznárez, B., 2022. Fibromialgia, trauma y EMDR: un protocolo exitoso y una experiencia maravillosa. Rev. Soc. Esp. Med. Psicosom. Psicoter. 12.
Barfety-Servignat, V., 2023. Enfoque psicosomático de las enfermedades reumatológicas. EMC-Apar. Locomot. 56 (1), 1–10. https://doi.org/10.1016/S1286-935X(23)47485-0.
Beiner, E., Lucas, V., Reichert, J., Buhai, D.V., Jesinghaus, M., Vock, S., Drusko, A., Baumeister, D., Eich, W., Friederich, H.C., Tesarz, J., 2023. Stress biomarkers in individuals with fibromyalgia syndrome: a systematic review with meta-analysis. Pain 164 (7), 1416–1427. https://doi.org/10.1097/j.pain.0000000000002857.
Blasco-Claros, L., Mallo-Caño, M., Mencía-Presa, A., Franch-Barceló, J., Casaus-Satamán, P., Peña-Roca, J., Jariod-Pàmias, M., 2006. Perfiles clínicos en pacientes con fibromialgia que acuden a un centro de salud mental: obtención de un índice predictivo de gravedad psicopatológica. Actas Esp. Psiquiatr. 34 (2), 112–122.
Briones-Vozmediano, E. (2010). Estudio piloto: una aproximación cualitativa a la fibromialgia desde la perspectiva de género. Cuestiones de género: de la igualdad y la diferencia. 10.18002/cg.v0i5.3789.
Cabo-Meseguer, A., Cerdá-Olmedo, G., Trillo-Mata, J.L., 2017. Fibromialgia: prevalencia, perfiles epidemiológicos y costes económicos. Med. Clín. 149 (10), 441–448. https://doi.org/10.1016/j.reuma.2014.07.008.
Carta, M.G., Moro, M.F., Pinna, F.L., Testa, G., Cacace, E., Ruggiero, V., Sancassiani, F., 2018. The impact of fibromyalgia syndrome and the role of comorbidity with mood and post-traumatic stress disorder in worsening the quality of life. Int. J. Soc. Psychiatry 64 (7), 647–655. https://doi.org/10.1177/0020764018795211.
Cervera-Pérez, I.M., Lopez-Soler, C., Alcántara, V., Castro-Saez, M., Fernandez, F., Martinez-Perez, A.M., 2023. Consecuencias del maltrato crónico en la infancia: trauma del desarrollo. Psychol. Pap. 41 (3), 219. https://doi.org/10.23923/pap.psicol2020.2934.
Ciccone, D.S., Elliott, D.K., Chandler, H.K., Nayak, S., Raphael, K.G., 2005. Sexual and physical abuse in women with fibromyalgia syndrome: a test of the trauma hypothesis. Clin. J. Pain 21 (5), 378–386. https://doi.org/10.1097/01.ajp.0000149796.08746.ea.
Cohen, H., Neumann, L., Haiman, Y., Matar, M.A., Press, J., Buskila, D., 2002. Prevalence of post-traumatic stress disorder in fibromyalgia patients: overlapping syndromes or post-traumatic fibromyalgia syndrome? Semin. Arthritis Rheum. 32 (1), 38–50. https://doi.org/10.1053/sarh.2002.33719. WB Saunders.
Colligan, R.C., Osborne, D., Swenson, W.M., Offord, K.P., 1984. The aging MMPI: development of contemporary norms. Mayo Clin. Proc. 59 (6), 377–390. https://doi.org/10.1016/S0025-6196(12)61460-8.
Çombaş, M., Ozturk, E., Derin, G., 2022. Childhood trauma and dissociation in female patients with fibromyalgia. Med. Sci. Int. Med. J. 11 (4), 1635–1640. https://doi.org/10.5455/medscience.2022.09.211.
Coppens, E., Van Wambeke, P., Morlion, B., Weltens, N., Giao Ly, H., Tack, J., Van Oudenhove, L., 2017. Prevalence and impact of childhood adversities and post-traumatic stress disorder in women with fibromyalgia and chronic widespread pain. Eur. J. Pain 21 (9), 1582–1590. https://doi.org/10.1002/ejp.1059.
Crofford, L.J., Pillemer, S.R., Kalogeras, K.T., Cash, J.M., Michelson, D., Kling, M.A., Wilder, R.L., 1994. Hypothalamic–pituitary–adrenal axis perturbations in patients with fibromyalgia. Arthritis Rheum. Off. J. Am. Coll. Rheumatol. 37 (11), 1583–1592.
del Val Muedra, R., & Larrainzar, I. Z, (2023). Tratamiento del trauma psicológico en personas con fibromialgia mediante protocolos EMDR en el Sistema Nacional de Salud.
Erdrich, S., Hawrelak, J., Myers, S., Harnett, J., 2020. A systematic review of the association between fibromyalgia and functional gastrointestinal disorders. Ther. Adv. Gastroenterol. 13, 1756284820977402. https://doi.org/10.1177/1756284820977402.
Fors, E.A., Wensaas, K.A., Helvik, A.S., 2024. Prevalence and characteristics of fibromyalgia according to three fibromyalgia diagnostic criteria: a secondary analysis study. Scand. J. Pain 24 (1), 20230143.
Gardoki-Souto, I., Martín de la Torre, O., Hogg, B., Redolar-Ripoll, D., Valiente-Gómez, A., Martínez Sadurní, L., Blanch, J.M., Lupo, W., Pérez, V., Radua, J., Amann, B.L., Moreno-Alcázar, A., 2021. Augmentation of EMDR with multifocal transcranial current stimulation (MtCS) in the treatment of fibromyalgia: study protocol of a double-blind randomized controlled exploratory and pragmatic trial. Trials 22 (1), 104. https://doi.org/10.1186/s13063-021-05042-w.
González, J.L., Alonso-Fernández, M., Matías-Pompa, B., Carretero, I., Nieto-Bona, M.P., López-López, A., 2019. Cardiovascular responses of women with fibromyalgia to a laboratory stressor: does post-traumatic stress disorder comorbidity matter? Pain Med. 20 (5), 988–999. https://doi.org/10.1093/pm/pny210.
Goutte, J., Cathébras, P., 2021. Desafíos del tratamiento de los trastornos funcionales. EMC-Tratado Med. 25 (1), 1–8. https://doi.org/10.1016/S1636-5410(21)44691-X.
Häuser, W., Galek, A., Erbslöh-Möller, B., Köllner, V., Kühn-Becker, H., Langhorst, J., Glaesmer, H., 2013. Posttraumatic stress disorder in fibromyalgia syndrome: prevalence, temporal relationship between posttraumatic stress and fibromyalgia symptoms, and impact on clinical outcome. PAIN® 154 (8), 1216–1223. https://doi.org/10.1016/j.pain.2013.03.034.
Häuser, W., Hoffmann, E.M., Wolfe, F., Worthing, A.B., Stahl, N., Rothenberg, R., Walitt, B., 2015. Self-reported childhood maltreatment, lifelong traumatic events and mental disorders in fibromyalgia syndrome: a comparison of US and German outpatients. Clin. Exp. Rheumatol. 33 (1), 86–92. Suppl 88.
Heim, C., Ehlert, U., Hanker, J.P., Hellhammer, D.H., 1998. Abuse-related posttraumatic stress disorder and alterations of the hypothalamic-pituitary-adrenal axis in women with chronic pelvic pain. Psychosom. Med. 60 (3), 309–318.
Hellou, R., Häuser, W., Brenner, I., Buskila, D., Jacob, G., Elkayam, O., Aloush, V., Ablin, J.N., 2017. Self-reported childhood maltreatment and traumatic events among Israeli patients suffering from fibromyalgia and rheumatoid arthritis. Pain Res. Manag. 2017, 1–8. https://doi.org/10.1155/2017/3865249, 3865249.
Herman, J.P., McKlveen, J.M., Ghosal, S., Kopp, B., Wulsin, A., Makinson, R., Myers, B., 2016. Regulation of the hypothalamic-pituitary-adrenocortical stress response. Compr. Physiol. 6 (2), 603. https://doi.org/10.1002/cphy.c150015.
Howie, H., Rijal, C.M., Ressler, K.J., 2019. A review of epigenetic contributions to post-traumatic stress disorder. Dialogues Clin. Neurosci. 21 (4), 417–428. https://doi.org/10.31887/DCNS.2019.21.4/kressler.
i-Llombart, M.P., Mora, E., 2017. Contextualizar la vulnerabilidad: el diagnóstico psicosocial de género. El caso de la fibromialgia. Pilar Montesó Curto y Lluís Roselló i Aubach (Coords.), Compartir experiencias, combatir el dolor. Una visión de la fibromialgia desde el ámbito bio-psico-social, pp. 159–188.
Jamil, H., Nassar-McMillan, S.C., Salman, W.A., Tahar, M., Jamil, L.H., 2006. Iraqi Gulf War veteran refugees in the US: PTSD and physical symptoms. Soc. Work Health Care 43 (4), 85–98. https://doi.org/10.1300/J010v43n04_06.
Juruena, M.F., Bourne, M., Young, A.H., Cleare, A.J., 2021. Hypothalamic-pituitary-adrenal axis dysfunction by early life stress. Neurosci. Lett. 759, 136037. https://doi.org/10.1016/j.neulet.2021.136037.
Kaleycheva, N., Cullen, A., Evans, R., Harris, T., Nicholson, T., Chalder, T., 2021. The role of lifetime stressors in adult fibromyalgia: systematic review and metaanalysis of case-control studies. Psychol. Med. 51 (2), 177–193. https://doi.org/10.1017/S0033291720004547.
Kundakci, B., Kaur, J., Goh, S., Hall, M., Doherty, M., Zhang, W., Abhishek, A., 2021. Efficacy of nonpharmacological interventions for individual features of fibromyalgia: a systematic review and meta-analysis of randomised controlled trials. Pain 163 (8), 1432–1445. https://doi.org/10.1097/j.pain.0000000000002500.
Lawrence-Wolff, K.M., Higgs, J.B., Young-McCaughan, S., Mintz, J., Foa, E.B., Resick, P.A., STRONG STAR Consortium, 2023. Prevalence of fibromyalgia syndrome in active-duty military personnel. Arthritis Care Res. 75 (3), 667–673. https://doi.org/10.1002/acr.24801.
Liedl, A., & Knaevelsrud, C. (2008). Chronic pain and PTSD: the Perpetual Avoidance model and its treatment implications. Torture: quarterly journal on rehabilitation of torture victims and prevention of torture, 18(2), 69-76.
Liedl, A., O'Donnell, M., Creamer, M., Silove, D., McFarlane, A., Knaevelsrud, C., Bryant, R., 2010. Support for the mutual maintenance of pain and posttraumatic stress disorder symptoms. Psychol. Med. 40 (7), 1215–1223. https://doi.org/10.1017/S0033291709991310.
López-López, A., Matías-Pompa, B., Fernández-Carnero, J., Gil-Martínez, A., Alonso-Fernández, M., Alonso-Pérez, J.L., González-Gutierrez, J.L., 2020. Blunted pain modulation response to induced stress in women with fibromyalgia with and without Posttraumatic Stress disorder comorbidity: new evidence of hypo-reactivity to stress in fibromyalgia? Behav. Med. 47 (4), 311–323. https://doi.org/10.1080/08964289.2020.1758611.
López-Martínez, A.E., Gómez-Pérez, L., Ruiz-Párraga, G.T., 2009. Trastorno de estrés postraumático y dolor crónico: nexos entre psico y pato(logía). Escr. Psicol. Psychol. Writ. 3 (1), 8–19. https://doi.org/10.24310/espsiescpsi.v3i1.13330.
Marques, A., Santo, A., Berssaneti, A., Matsutani, L., Yuan, S., 2017. Prevalence of fibromyalgia: literature review update. Rev. Bras. Reumatol. 57 (4), 356–363. https://doi.org/10.1016/j.rbre.2017.01.005.
McFarlane, A.C., 2010. The long-term costs of traumatic stress: intertwined physical and psychological consequences. World Psychiatry 9 (1), 3–10. https://doi.org/10.1002/j.2051-5545.2010.tb00254.x.
Meewisse, M.L., Reitsma, J.B., de Vries, G.J., Gersons, B.P., Olff, M., 2007. Cortisol and post-traumatic stress disorder in adults: systematic review and meta-analysis. Br. J. Psychiatry J. Ment. Sci. 191, 387–392. https://doi.org/10.1192/bjp.bp.106.024877.
Meints, S.M., Edwards, R.R., 2018. Evaluating psychosocial contributions to chronic pain outcomes. Prog. Neuro-Psychopharmacol. Biol. Psychiatry 87, 168–182. https://doi.org/10.1016/j.pnpbp.2018.01.017.
Moyano, S., Kilstein, J.G., de Miguel, C.A., 2015. Nuevos criterios diagnósticos de fibromialgia: ¿vinieron para quedarse? Reumatol. Clín. 11 (4), 210–214. https://doi.org/10.1016/j.reuma.2014.07.008.
Narayanan, V., 2025. Chronic fatigue syndrome and fibromyalgia in clinical practice-similar but different. Indian Pract. 78 (5).
Nardi, A.E., Karam, E.G., Carta, M.G., 2020. Fibromyalgia patients should always be screened for post-traumatic stress disorder. Expert Rev. NeurOther 20 (9), 891–893. https://doi.org/10.1080/14737175.2020.1794824.

Nelson, S., Cunningham, N., Peugh, J., Jagpal, A., Arnold, L.M., Lynch-Jordan, A., Kashikar-Zuck, S., 2017. Clinical profiles of young adults with juvenile-onset fibromyalgia with and without a history of trauma. Arthritis Care Res. 69 (11), 1636–1643. https://doi.org/10.1002/acr.23192.

Nicolson, N.A., Davis, M.C., Kruszewski, D., Zautra, A.J., 2010. Childhood maltreatment and diurnal cortisol patterns in women with chronic pain. Psychosom. Med. 72 (5), 471–480. https://doi.org/10.1097/PSY.0b013e3181d9a104.

Otis, J.D., Keane, T.M., Kerns, R.D., 2003. An examination of the relationship between chronic pain and post-traumatic stress disorder. J. Rehabil. Res. Dev. 40 (5), 397–405. https://doi.org/10.1682/jrrd.2003.09.0397.

Page, M.J., McKenzie, J.E., Bossuyt, P.M., Boutron, I., Hoffmann, T.C., Mulrow, C.D., Shamseer, L., Tetzlaff, J.M., Akl, E.A., Brennan, S.E., Chou, R., Glanville, J., Grimshaw, J.M., Hróbjartsson, A., Lalu, M.M., Li, T., Loder, E.W., Mayo-Wilson, E., McDonald, S., Moher, D., 2021. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 372, n71. https://doi.org/10.1136/bmj.n71.

Ram, P.R., Jeyaraman, M., Jeyaraman, N., Nallakumarasamy, A., Khanna, M., Gupta, A., Ram, R., 2023. Beyond the pain: a systematic narrative review of the latest advancements in fibromyalgia treatment. Cureus 15 (10), e48032. https://doi.org/10.7759/cureus.48032.

Riva, R., Mork, P.J., Westgaard, R.H., Lundberg, U., 2012. Comparison of the cortisol awakening response in women with shoulder and neck pain and women with fibromyalgia. Psychoneuroendocrinology 37 (2), 299–306. https://doi.org/10.1016/j.psyneuen.2011.06.014.

Ruscio, A.M., Ruscio, J., Keane, T.M., 2002. The latent structure of posttraumatic stress disorder: a taxometric investigation of reactions to extreme stress. J. Abnorm. Psychol. 111 (2), 290.

Sancassiani, F., Machado, S., Ruggiero, V., Cacace, E., Carmassi, C., Gesi, C., Dell'Osso, L., Carta, M.G., 2017. The management of fibromyalgia from a psychosomatic perspective: an overview. Int. Rev. Psychiatry 29 (5), 473–488. https://doi.org/10.1080/09540261.2017.1320982.

Scelles, C., Bulnes, L.C., 2021. EMDR as treatment option for conditions other than PTSD: a systematic review. Front. Psychol. 12, 644369. https://doi.org/10.3389/fpsyg.2021.644369.

Schweinhardt, P., Sauro, K., Bushnell, M., 2008. Fibromyalgia: a disorder of the brain? Neuroscientist 14 (5), 415–421. https://doi.org/10.1177/1073858407312521.

Semiz, M., Kavakci, O., Peksen, H., Tuncay, M.S., Ozer, Z., Aydinkal-Semiz, E., Kaptanoglu, E., 2014. Post-traumatic Stress disorder, alexithymia and somatoform dissociation in patients with fibromyalgia. Türk. Fiz. Tip ve Rehabil. Derg. 60 (3), 245–251. https://doi.org/10.5152/tftrd.2014.48254.

Sharp, T.J., Harvey, A.G., 2001. Chronic pain and posttraumatic stress disorder: mutual maintenance? Clin. Psychol. Rev. 21 (6), 857–877. https://doi.org/10.1016/S0272-7358(00)00071-4.

Siqveland, J., Ruud, T., Hauff, E., 2017. Post-traumatic stress disorder moderates the relationship between trauma exposure and chronic pain. Eur. J. Psychotraumatol. 8 (1), 1375337. https://doi.org/10.1080/20008198.2017.1375337.

Soler-Ferrería, F.B., Sánchez-Meca, J., López-Navarro, J.M., Navarro-Mateu, F., 2014. Neuroticismo y trastorno por estrés postraumático: un estudio meta-analítico. Rev. Esp. Salud Pública 88 (1), 17–36.

van-Rood, Y.R., de-Roos, C., 2009. EMDR in the treatment of medically unexplained symptoms: a systematic review. J. EMDR Pract. Res. 3 (4), 248–263.

Weissbecker, I., Floyd, A., Dedert, E., Salmon, P., Sephton, S., 2006. Childhood trauma and diurnal cortisol disruption in fibromyalgia syndrome. Psychoneuroendocrinology 31 (3), 312–324. https://doi.org/10.1016/j.psyneuen.2005.08.009.

Wells, G.A., Shea, B., O'Connell, D., Peterson, J., Welch, V., Losos, M., Tugwell, P., 2000. The Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses. The Ottawa Hospital Research Institute. Recuperado de. https://www.ohri.ca/programs/clinical_epidemiology/oxford.asp.

Wingenfeld, K., Wagner, D., Schmidt, I., Meinlschmidt, G., Hellhammer, D.H., Heim, C., 2007. The low-dose dexamethasone suppression test in fibromyalgia. J. Psychosom. Res. 62 (1), 85–91. https://doi.org/10.1016/j.jpsychores.2006.06.006.

Wolfe, F., Clauw, D.J., Fitzcharles, M.A., Goldenberg, D.L., Häuser, W., Katz, R.L., Mease, P.J., Russell, A.S., Russell, I.J., Walitt, B., 2016. 2016 Revisions to the 2010/2011 fibromyalgia diagnostic criteria. Semin. Arthritis Rheum. 46 (3), 319–329. https://doi.org/10.1016/j.semarthrit.2016.08.012.

World Health Organisation [WHO]. (2019). International Classification of Diseases (11th Revision). https://icd.who.int/.

Yaghmaian, R., Miller-Smedema, S., 2019. A feminist, biopsychosocial subjective well-being framework for women with fibromyalgia. Rehabil. Psychol. 64 (2), 154–166. https://doi.org/10.1037/rep0000226.

Yavne, Y., Amital, D., Watad, A., Tiosano, S., Amital, H., 2018. A systematic review of precipitating physical and psychological traumatic events in the development of fibromyalgia. Semin. Arthritis Rheum. 48 (1), 121–133. https://doi.org/10.1016/j.semarthrit.2017.12.011.

Yehuda, R., 2001. Biology of posttraumatic stress disorder. J. Clin. Psychiatry 62 (17), 41–46. Suppl.

Yehuda, R., Giller, E.L., Southwick, S.M., Lowy, M.T., Mason, J.W., 1991. Hypothalamic-pituitary-adrenal dysfunction in posttraumatic stress disorder. Biol. Psychiatry 30 (10), 1031–1048. https://doi.org/10.1016/0006-3223(91)90123-4.