Reconsidering the boundaries between fibromyalgia and post-traumatic stress disorder: evidence from label-free distributional similarity analysis in 2,470 participants

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Abstract

Objective

Fibromyalgia (FM) and post-traumatic stress disorder (PTSD) share key clinical features, including sleep disturbance, fatigue, cognitive symptoms and affect dysregulation, yet they are classified as distinct disorders. We examined whether FM and PTSD represent separable phenotypes or overlapping stress-related symptom profiles using a distributional similarity approach.

Methods

In an international cross-sectional online survey of adults aged 18–65 years, participants with a self-reported clinical diagnosis of FM or PTSD, and healthy controls, completed validated measures of somatic symptom burden, trauma-related symptoms, psychological vulnerability traits, comorbidities, and emotional activation patterns (EASEL-3). Case definitions were operationalised using established thresholds for polysymptomatic distress and PTSD symptom severity. To address unequal group sizes and reduce case-definition circularity, we applied adaptive sub-sampling with bootstrap resampling and quantified between-group similarity using Hellinger distance, complemented by stability analyses.

Results

Across somatic, psychological and affective domains (threat, drive and soothing systems), FM and PTSD showed substantial overlap with limited discriminatory capacity, while both differed clearly from healthy controls. Nearly half of participants meeting criteria for one condition also met criteria for the other, indicating high co-occurrence.

Conclusion

These findings question the strict nosological separation of FM and PTSD and are compatible with a spectrum model of stress-related disorders. They further suggest that systematic trauma assessment and integrated, mechanism-based treatment strategies should be considered in the management of both conditions.

Key words

fibromyalgia, post-traumatic stress disorder, phenotypic overlap, transdiagnostic spectrum

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Received on April 9, 2026; accepted in revised form on May 19, 2026.

Funding. A.M. Pinto holds a PhD grant (SFRH/BD/145954/2019) sponsored by the Portuguese Foundation for Science and Technology (FCT), the Human Capital Operational Programme (POCH) and the European Union (EU).
Competing interests: J.A. Pereira da Silva is the co-founder and majority owner of www.myfibromyalgia.org, a company that provides therapeutic services to people with fibromyalgia.

Competing interests: none declared.

Introduction

Fibromyalgia (FM) is a prevalent condition of unknown aetiology and pathophysiology, characterised by chronic widespread pain and fatigue, which significantly impairs quality of life and is often resistant to treatment. We recently proposed an innovative biopsychosocial model (FITSS) that integrates two dominant perspectives: the neurophysiological model, which conceptualises FM as a central sensitisation pain syndrome; and the psychosocial model, which categorises it among psychosomatic disorders (1).

The FITSS model emphasises the pivotal role of emotional stress, and the ensuing hyperactivation of the Salience Network, in the maintenance (and probably also the onset) of FM. From this standpoint, FM may share mechanistic and clinical similarities with post-traumatic stress disorder (PTSD), a prototypical condition potentially involving similar mechanisms. These conditions share numerous clinical features, such as sleep disturbances, anxiety, depression, chronic fatigue and memory impairment (2). Moreover, PTSD-related symptoms are reported in over 50% of FM patients (2, 3), while up to 20% of individuals with PTSD experience chronic widespread pain (4).

This overlap raises the hypothesis that FM and PTSD may share transdiagnostic mechanisms and represent partly overlapping stress-related phenotypes. A previous attempt to compare and contrast these two conditions was hampered by the lack of robust comparative data on symptom prevalence across these conditions (2).

This study aims to examine whether the similarities and differences in the symptomatic expression of FM and PTSD support the concept that they are similar diseases, significantly distinct ones or different sections of the same spectrum.

Methods

Recruitment

This study was designed as an international cross-sectional online survey. Individuals, aged 18–65 years-old, with a clinical diagnosis of FM or PTSD, as well as healthy controls, were invited to complete an online survey. Participants with diagnoses of FM and PTSD were recruited through patient associations' social media, support groups, and referrals from other healthcare professionals, using a non-probabilistic snowball sampling method. Healthy controls were recruited by asking participants with FM and PTSD to invite friends and family members. The questionnaire was translated and distributed internationally across a wide range of countries (including in Europe: Portugal, France, Germany, Ireland, Netherlands, Spain and the United Kingdom; in America: Canada, the United States, Argentina, Bolivia, Brazil, Chile, Ecuador, Mexico, Peru and Uruguay; Australia, China, India and Japan) to obtain a sample that was as diverse as possible in terms of ethnicity, socioeconomic background and cultural context. Validated translations of the questionnaires were used whenever available. For languages without a validated translation, the questionnaires were translated using an online tool and subsequently reviewed by a native-speaking health professional. Respondents freely selected the language version they felt most comfortable with. Data were collected from April 2023 to July 2024.

Participants provided informed consent prior to beginning the survey. The study was approved by the local ethics committee (CE-057/2023).

Survey content

The full survey content can be found in Supplementary File 1. It included the following data.

- Sociodemographic and clinical form

This section gathered sociodemographic information (sex, age, nationality, marital status, employment status, and socioeconomic level), as well as clinical data specific to FM and PTSD, such as age at symptom onset and diagnosis, symptoms, treatments received, and overall satisfaction with those treatments, along with comorbidities. Considering the diversity of countries and cultures represented in the sample, socioeconomic status was categorized as low, medium, or high, and left to the participants' own judgement.

- EASEL-3

This self-report scale assesses the relevance of 22 discrete emotions "in the person's experience of life" (5). Participants were instructed to rate the extent to which each emotion characterises their general way of "facing, feeling, and experiencing life" using an 11-point numeric scale (0=None to 10= Extremely high). The scale allows calculation of the EASEL-3 index, which estimates the degree of activation of the three affect regulation systems as described by Gilbert (6, 7): the threat system, the drive system (associated with pursuit and acquisition), and the soothing/safeness system, based on the weighted average of the constituent emotions.

- Personality characteristics

An *ad hoc* set of questions was developed to assess personality traits and psychological processes relevant to the FITSS model. Participants were asked to indicate how disturbed they felt over the past month by psychological processes, including rumination (*e.g.* 'A tendency to repeatedly go over problems?'), worry (*e.g.* 'Do you often feel anxious or excessively worried?'), catastrophising (*e.g.* 'A tendency to feel overwhelmed by problems or negative events?'), negative bias (*e.g.* 'A tendency to overvalue negative aspects of life and undervalue the positive?'), threat sensitivity (*e.g.* 'A tendency to be overly sensitive to any cue of threat, aggression, suspicion, shame?'), and disruption in the sense of safety (*e.g.* 'Difficulty or inability to perceive and value cues of proximity and support, being protected, loved, appreciated?').

- Somatic symptoms

We developed a list of relevant somatic symptoms based on existing literature on FM symptomatology. In this list, we included the Symptom Severity Scale (SSS). This measure evaluates the presence and impact of three core somatic symptoms (fatigue, sleep problems and cognitive problems) over the past month using a Likert scale (0=Not at all to 4=Extremely) (8).

- Widespread pain index (WPI)

Using a body pain diagram, this index assesses the presence and distribution of pain in 19 regions of the body (8).

Polysymptomatic distress score (PDS)

Results from the sum of WPI and the core items of SSS (fatigue, sleep problems and cognitive problems), in a continuous scale ranging 0–31. The PDS was used for the definition of FM cases (9).

PTSD checklist for DSM-5 (PCL-5).

A 20-item self-report measure used to screen for symptoms of post-traumatic stress disorder (PTSD). Participants were asked to rate how much a range of symptoms had bothered them over the past month, using a 5-point Likert scale (0 = not at all to 4 = extremely). Items are grouped into four subscales: Intrusion symptoms (*e.g.* 'Repeated, disturbing, and unwanted memories of the stressful experience'), Avoidance symptoms (*e.g.* 'Avoiding external reminders of the stressful experience?'), Negative alterations in cognition and mood (*e.g.* 'Blaming yourself or someone else for the stressful experience or what happened after it?'), and Arousal and reactivity symptoms (*e.g.* 'Irritable behavior, angry outbursts, or acting aggressively?'). A total score ranging from 0 to 80 can also be computed, with higher scores indicating greater PTSD symptom severity (10). The PCL-5 was used for the definition of PTSD cases.

Case definition

Prior to this analysis, self-reported diagnostic labels were removed from the analytical dataset to minimise classification bias. Participants were divided into three categories (FM, PTSD and healthy controls (HC)) according to the following criteria:

Inclusion criteria: all cases aged 18-65 years; FM cases with a score ≥13 on the polysymptomatic distress score, indicative of the probable presence of FM, according to the categories defined by Wolfe *et al.* (9); PTSD case with a score ≥38 on PTSD checklist for DSM-5 (PCL-5), translating into a strong indication of PTSD (10).

Exclusion criteria: HC with a score ≥8 on the polysymptomatic distress or a score >20 on the PCL-5 score; previous diagnosis of FM or PTSD.

Participants meeting both criteria were included in both disease-defined analyses; our goal was not diagnostic separation but symptom distribution overlap across criteria-defined groups.

Statistical analysis

No formal sample size calculation was performed; all eligible responses received during the recruitment period were included in the analysis. Only complete responses were included in the analysis.

To compare categorical variables across the three study groups (fibromyalgia, PTSD, and healthy controls) while minimising bias due to unequal group sizes and potential diagnostic overlap, we implemented a resampling-based analytic framework combining adaptive sub-sampling, bootstrap resampling, distributional similarity metrics, and cluster analysis.

- Distribution analysis

An adaptive sub-sampling algorithm was first applied to generate balanced samples across the three groups (HC, FM, PTSD). At each iteration, a case was randomly drawn from the original dataset and assigned to a class based on the observed value of one of the two binary classification variables (FM or PTSD), selected with an adaptive probability. Acceptance probabilities were dynamically updated in inverse proportion to observed group frequencies, favouring under-represented classes and penalising over-represented ones, thereby maintaining balanced representation across groups.

To increase statistical robustness, this subsampling procedure was embedded within a bootstrap framework generating 1500 independent balanced samples. For each bootstrap sample, variables were recoded as categorical where required and relative frequency distributions were computed for each variable within each group.

Distributional similarity between groups was quantified using the Hellinger distance, which ranges from 0 (identical distributions) to 1 (completely different distributions). Values below 0.20 were interpreted as indicating substantial distributional similar-

ity. Complementarily, chi-square tests of homogeneity were applied to test whether observed distributions differed significantly between groups ($p<0.05$). Across bootstrap samples, we computed mean Hellinger distances, standard deviations, non-parametric 95% confidence intervals, and the proportion of samples meeting predefined criteria (Hellinger distance <0.20 or significant chi-square test results). Results were visualised using bootstrap-averaged relative frequency polygons with 95% confidence intervals.

- Cluster analysis

To further examine whether the data supported a two-group structure (HC *vs*. patients) rather than a three-group structure (HC, FM, PTSD separately), a bootstrap cluster analysis was conducted using the same adaptive sub-sampling procedure.

For each bootstrap sample, pairwise dissimilarities between observations were computed using Gower distance, which accommodates mixed data types (categorical and continuous variables). Partitioning Around Medoids (PAM) clustering was then applied for k=2 and k=3 clusters.

Cluster quality was assessed using the mean silhouette coefficient. The analysis was performed independently for each domain of variables (sociodemographic characteristics, treatment variables, comorbidities, trauma exposure, EASEL subscales, PCL-5 subscales, symptom severity measures, psychological vulnerability traits, and widespread pain index).

Across 500 bootstrap iterations, two outcomes were recorded: (i) the proportion of iterations in which the two-cluster solution produced a higher mean silhouette coefficient than the three-cluster solution, and (ii) the proportion of iterations in which FM and PTSD participants were assigned to the same cluster under the two-cluster solution. Aggregated results were reported as mean silhouette coefficients with 95% confidence intervals.

- Sensitivity analysis

To address the potential circularity introduced by the substantial proportion of participants meeting criteria for both FM and PTSD, we conducted a pre-planned sensitivity analysis restricted to mutually exclusive diagnostic groups. Participants were classified as pure FM (PDS ≥13 and PCL-5 <38), pure PTSD (PCL-5 ≥38 and PDS <13), or HC (as defined above). The same analytic pipeline, adaptive sub-sampling with 500 bootstrap iterations, Hellinger distance quantification, and chi-square stability assessment, was applied to these mutually exclusive groups across all domains (somatic symptoms, EASEL-3 affect systems, psychological vulnerability traits, comorbidities, and trauma exposure). This analysis tests whether the phenotypic overlap observed in the primary analysis persists when the shared-criteria subgroup is removed, thereby providing a more stringent test of the spectrum hypothesis.

- Justification of the analytic strategy

Traditional group-comparison methods can be misleading when applied to conditions such as fibromyalgia and PTSD, which share extensive symptom overlap. Directly comparing groups defined by their diagnostic criteria risks circular reasoning, that is, reproducing the artificial separation imposed by the very definitions under investigation. This concern is amplified by the fact that the two conditions are not mutually exclusive: in our sample, 44.5% of participants fulfilled diagnostic criteria for both FM and PTSD, highlighting the instability of strict categorical boundaries and further underscoring the need for a label-independent analytic approach.

To overcome this, we designed a data-driven strategy that minimises reliance on diagnostic labels. All survey responses were first reviewed and coded by two independent investigators who were blinded to participants' self-reported diagnoses and to the case definitions later applied for group inclusion. This blinding minimised classification bias and ensured that analyses reflected symptom distributions rather than diagnostic labels.

The use of adaptive sub-sampling ensured balanced representation of groups, while bootstrap resampling provided robustness and generalisability by repeating analyses across multiple independent datasets. Combining Hellinger distance (a measure of distributional similarity) with the proportion of significant chi-square tests allowed us to assess not only whether differences existed, but also how similar or distinct the groups truly were across multiple domains.

This integrated strategy reduces dependence on arbitrary cut-offs or parametric assumptions, enabling an objective, spectrum-oriented evaluation of FM and PTSD. In this framework, a variable showing low Hellinger distance and few significant chi-square results indicates strong similarity between the disorders, whereas large Hellinger distances and frequent chi-square significance suggest meaningful differentiation. Together, these complementary metrics offer a nuanced, probabilistic view of diagnostic overlap, consistent with the study's aim to test whether FM and PTSD represent distinct disorders or points along a shared stress-related spectrum.

Results

Sample characteristics

A total of 2470 valid responses were analysed: 2013 participants fulfilled FM criteria, 1135 fulfilled PTSD criteria, and 420 were classified as HC. Of note, 1098 participants (44.5%) met criteria for both FM and PTSD. Sociodemographic characteristics of the three groups are shown in Table I.

Sociodemographic profile

Across age, sex, marital status, education, socioeconomic level and work status, FM and PTSD showed extensive overlap. Mean Hellinger distances for FM versus PTSD were low across all sociodemographic variables, and distributions were classified as similar in 92.1–99.8% of bootstrap iterations, with chi-square tests remaining non-significant in most resamples. This indicates that FM and PTSD did not differ from each other in any sociodemographic variable at a level suggestive of distinct population profiles. In contrast, both clinical groups differed from HC, particularly in socioeconomic level and work status.

Table I. Sociodemographic profile of the FM, PTSD, and HC groups.

Variable	FM (n=2013)	PTSD (n=1135)	HC (n=420)
Age (years), mean ± SD	47 ± 11	45 ± 12	43 ± 12
Female sex, n (%)	1850 (91.9 %)	1020 (89.8 %)	356 (84.8 %)
Married/partnered, n (%)	1268 (63.0 %)	704 (62.0 %)	280 (66.7 %)
Work status (active), n (%)	755 (37.5 %)	412 (36.3 %)	305 (72.6 %)
Socioeconomic level, n (%)			
Low	865 (43.0 %)	475 (41.8 %)	60 (14.3 %)
Medium	875 (43.5 %)	482 (42.4 %)	202 (48.1 %)
High	273 (13.5 %)	178 (15.8 %)	158 (37.6 %)

Treatment profiles were also strikingly similar between FM and PTSD. Across all pharmacological and non-pharmacological treatment variables assessed, Hellinger distances were below 0.2 in 99.6–100% of bootstrap iterations, and chi-square tests were non-significant in most iterations. This included antidepressants, gabapentinoids, muscle relaxants, opioids, sleep inducers, psychotherapy, and treatment satisfaction, again indicating no meaningful separation between the two clinical groups.

Regarding comorbidities, FM and PTSD shared a highly overlapping profile. Most psychiatric and somatic comorbidities showed very low FM-PTSD Hellinger distances, generally below 0.10, with 99–100% of iterations classifying distributions as similar. Healthy controls, however, remained clearly distinct from both patient groups.

Trauma history showed the strongest overlap of all non-somatic domains. FM and PTSD participants reported nearly identical trauma profiles in terms of exposure, age of onset, trauma type, and recurrence, with Hellinger distances below 0.06 for all trauma-related variables and similarity observed in virtually all bootstrap iterations. Both clinical groups differed markedly from HC in trauma exposure and recurrence.

Affect regulation (EASEL)

FM and PTSD showed broadly overlapping affect regulation profiles across the three EASEL systems, although this domain revealed somewhat greater differentiation than sociodemographic, treatment, trauma, or somatic domains. At the level of discrete emotions, FM-PTSD Hellinger distances were highest for threat-related emotions, ranging from 0.198 to 0.260, with only 10-54% of iterations classifying the distributions as similar. Anxiety, sadness, fear, irritability, and feeling upset showed the greatest divergence within this domain, suggesting some moderate differentiation in negative emotional profiles. By contrast, drive and soothing emotions showed greater overlap, with Hellinger distances generally ranging from 0.179 to 0.203 and approximately half to two-thirds of bootstrap iterations indicating similarity. When emotions were aggregated into EASEL system scores, distributions remained broadly overlapping between FM and PTSD for drive and soothing, whereas the threat system showed the largest difference observed within the EASEL domain (mean Hellinger distance 0.264; similarity in 10.3% of iterations). Even so, both clinical groups remained much closer to each other than to healthy controls, whose emotional activation patterns were clearly distinct across all systems (Fig. 1).

Symptom profile

Participants with FM and PTSD reported highly similar somatic symptom patterns and intensities across all items assessed. Core FM-related symptom burden, including fatigue, unrefreshed sleep, cognitive symptoms, headaches,

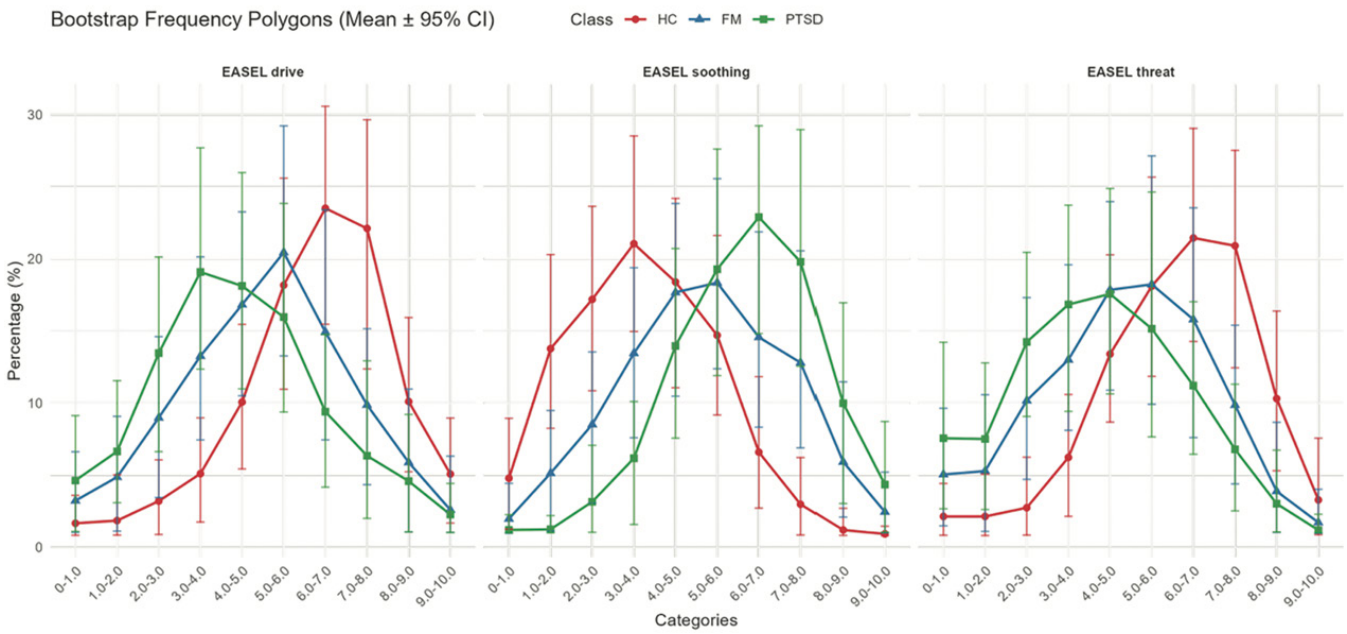

Fig. 1. Bootstrap frequency polygons (mean±95% CI) for EASEL affect system scores across study groups.

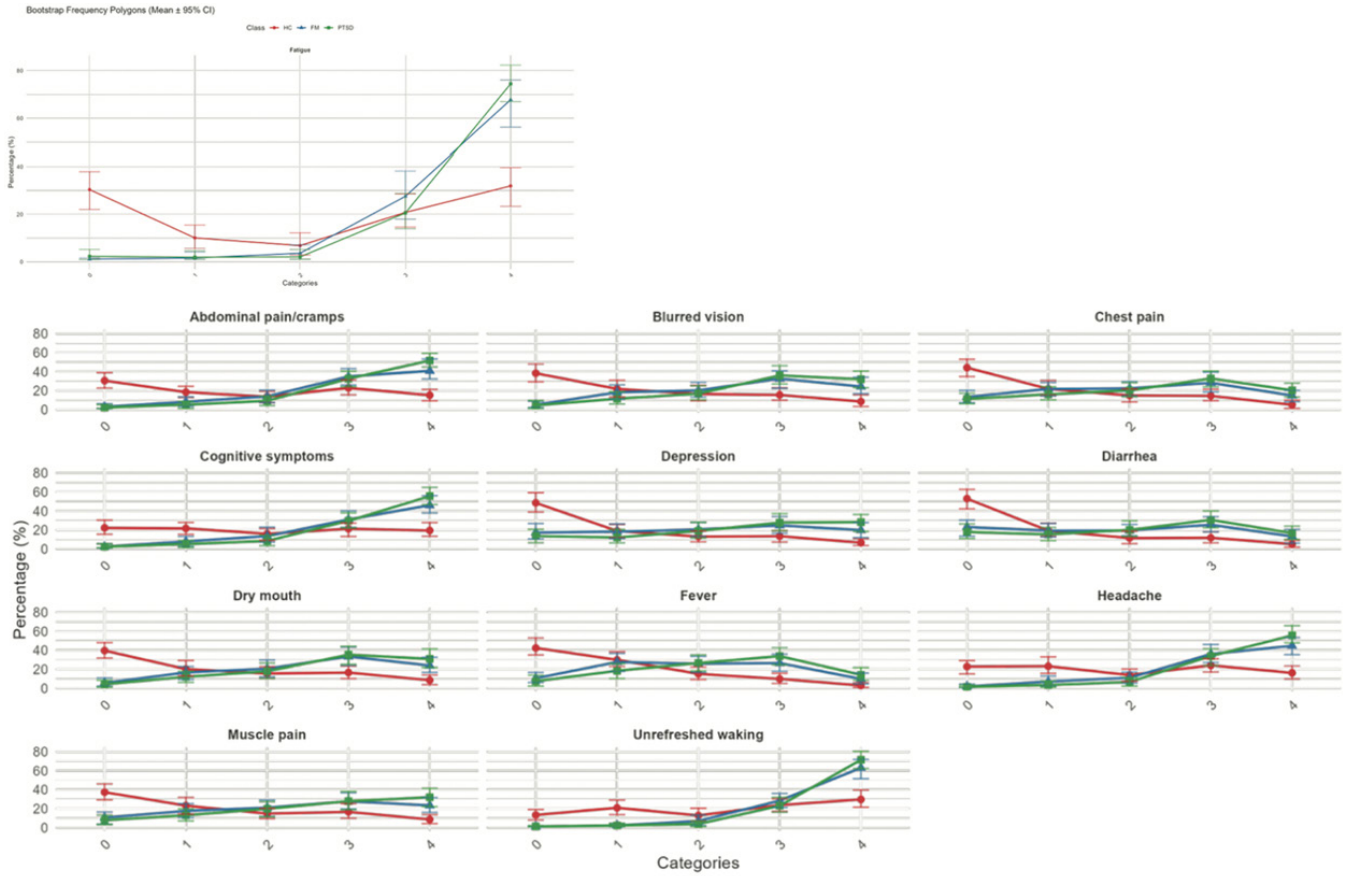

Fig. 2. Bootstrap frequency polygons (mean±95% CI) for each somatic symptom item across the three study groups.

abdominal pain, dizziness, and other somatic complaints, showed low FM-PTSD Hellinger distances (approximately 0.117–0.153), with 84-97% of bootstrap iterations classifying distributions as similar. Likewise, widespread pain distribution was almost indistinguishable between the two groups: across all 19 WPI body regions, Hellinger distances ranged from 0.041 to 0.054, and similarity was observed in 99.8–100% of iterations.

These findings are particularly notable because both the Symptom Severity scale and the Widespread Pain Index were designed to capture the characteristic somatic burden of fibromyalgia, yet their distributions were essentially shared by the PTSD group. Comparisons with HC, in contrast, showed large and consistent differences across these same domains (Fig. 2).

A similar pattern emerged for PTSD symptomatology. Although the PCL-5 was specifically designed to capture PTSD symptoms, FM and PTSD participants still showed substantial overlap across individual items. Hellinger distances across PCL-5 items ranged from 0.143 to 0.297. The closest overlap was observed for sleep disturbance, concentration difficulties, irritability/aggression, reckless behaviour, memory gaps, and emotional numbness, whereas larger differences were seen for intrusive thoughts, flashbacks, emotional distress, and physical reactions. As expected, aggregated PCL-derived cutoffs and total score categories showed larger FM-PTSD distances, reflecting the compounding effect of small item-level differences across the full scale.

Psychological vulnerability traits

Both FM and PTSD participants reported marked psychological vulnerability across all assessed domains, including rumination, catastrophising, negative cognitive bias, threat sensitivity, reduced perceived safety, and excessive worry. Most traits showed low-to-moderate FM-PTSD Hellinger distances, ranging from 0.146 to 0.252. Rumination, perceived safety, and other concerns showed the greatest overlap, whereas catastrophising, worry, threat sensitivity, and negative bias showed somewhat greater differentiation. Overall, however, the two clinical groups remained considerably more similar to each other than to HC, who scored markedly lower across all vulnerability traits (Fig. 3).

Summary diagnostic overlap variables

PDS summary indicators also showed substantial overlap between FM and PTSD. Hellinger distances for PDS categories, the PDS ≥13 cut-off, and interval-based PDS scores remained low (0.109–0.179), with similarity observed in 67.3–98.8% of iterations. Symptom duration variables, including pain duration, fatigue duration, and sleep impairment duration, were nearly identical between groups, with Hellinger distances below 0.06 and similarity in 99-100% of iterations.

The cross-classification variables directly quantifying overlap between FM

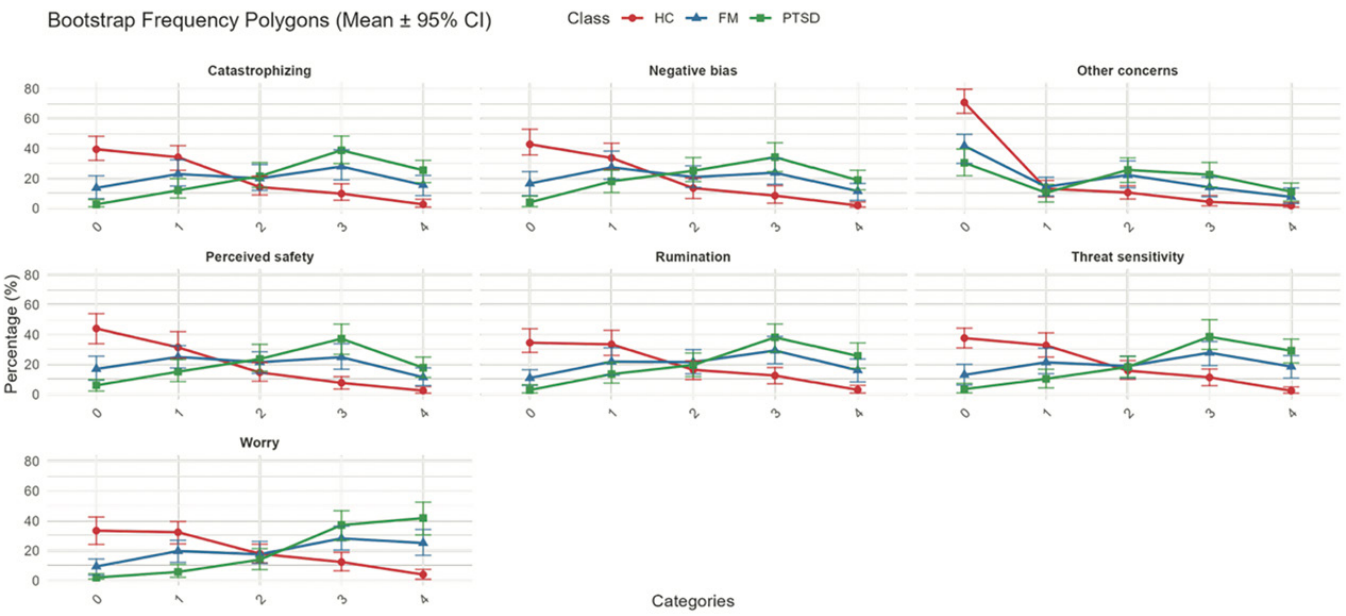

Fig. 3. Bootstrap frequency polygons (mean±95% CI) regarding psychological vulnerability traits across the three study groups.

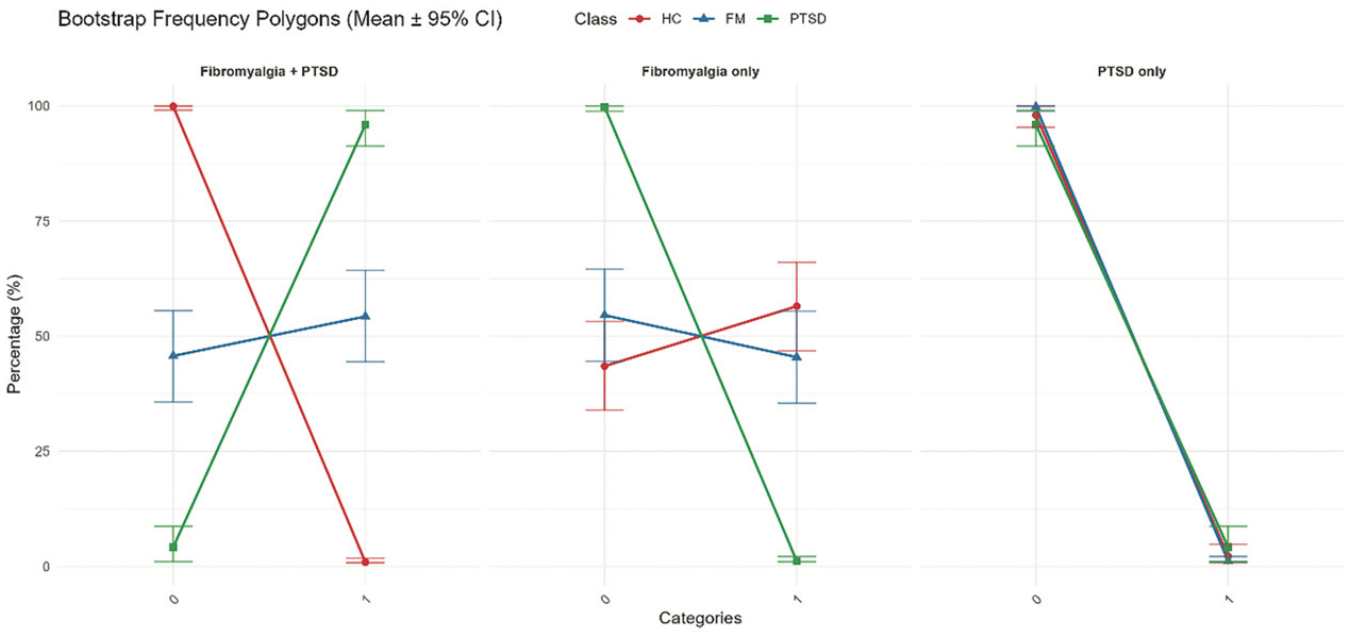

Fig. 4. Bootstrap frequency polygons (mean ± 95% CI) for diagnostic overlap variables across the three study groups.

and PTSD criteria provided a complementary perspective. Meeting criteria for both conditions simultaneously showed a large FM-PTSD distance, not because the groups were well separated, but because the PTSD-classified group contained a high proportion of individuals who also fulfilled FM criteria. Likewise, FM-only status differed between groups, whereas PTSD-only status showed near-zero distances, indicating that exclusive PTSD classification was not confined to the PTSD group. Together, these findings support an asymmetric but substantial overlap between the two diagnostic frameworks (Fig. 4).

Cluster analysis

To test whether the data were better represented by a two-group structure (HC *vs*. FM/PTSD) rather than three distinct groups (HC, FM, PTSD), we conducted bootstrap cluster analyses across all variable domains (sociodemographic variables, treatments, comorbidities, trauma characteristics, EASEL system scores, PCL subscales, somatic symptom severity, psychological vulnerability traits, and WPI). In all of them, the two-cluster solution outperformed the three-cluster solution in 82-100% of bootstrap iterations, indicating that the data consistently favoured a bipartite structure over three separable groups. FM and PTSD participants were assigned to the same cluster under the two-cluster solution in the majority of iterations across all domains. Co-

occurrence was highest for trauma (100.0%), symptom severity (99.9%), and WPI (99.7%), followed by PCL subscales, psychological vulnerability traits, and EASEL threat. Moderate co-occurrence was observed for EASEL soothing and drive, treatment and co-morbidities.

Importantly, the domains showing the lowest Hellinger distances in the distribution analysis, especially trauma, somatic symptom severity, and WPI, were the same domains in which FM and PTSD most consistently clustered together.

This convergence across two methodologically distinct approaches strongly supports the conclusion that the boundary between FM and PTSD is not sustained by the clinical and psychometric data across most of the domains assessed.

Discussion

This study examined whether FM and PTSD represent distinct disorders or overlapping phenotypic expressions within a shared stress-related spectrum. Using a label-independent analytic strategy combining bootstrap-based distributional comparisons and unsupervised cluster analysis, we found that FM and PTSD exhibited extensive overlap across sociodemographic, clinical, emotional, and cognitive domains. Importantly, cluster analyses consistently favoured a two-group structure (HC *vs*. FM/PTSD) rather than three separable groups (HC, FM, PTSD), suggesting that the empirical structure of the data does not support a clear boundary between these diagnostic categories.

Across sociodemographic characteristics, treatment history, comorbidities, trauma exposure, affect regulation, somatic symptom burden and psychological vulnerability traits, FM and PTSD showed substantial phenotypic similarity, while both groups clearly differed from HC. Even core diagnostic features traditionally considered defining for each condition, widespread pain in FM and intrusion symptoms in PTSD, showed considerable overlap between groups when analysed independently of diagnostic labels.

These findings raise questions about a strict nosological divide and are consistent with a spectrum conceptualisation (11). Pain and intrusion may represent alternative dominant clusters rather than markers of distinct diseases. This aligns with the FITSS model, which conceptualises FM as a maladaptive response to life stressors at the interface of central sensitization and psychosomatic adaptation (1). Prior research has reported high prevalence of PTSD symptoms in people with FM and of chronic pain in patients with PTSD, but most studies compared predefined diagnostic groups (2, 12-14). Our approach avoids this circularity and demonstrates that phenotypic overlap persists when diagnostic labels are removed.

These results extend and empirically substantiate the conclusions of our recent comprehensive review, which identified the absence of direct, label-independent phenotypic comparisons between FM and PTSD as a critical gap in the literature (15). While previous studies have documented high prevalence of PTSD symptoms in FM cohorts and chronic pain in PTSD populations (2, 12, 13), those findings were constrained by circular designs that compared groups already defined by the features under investigation. Our distributional approach overcomes this limitation and reveals that the phenotypic overlap is not merely a function of shared diagnostic criteria but extends across the full spectrum of clinical, emotional, and cognitive domains.

The extensive overlap we observed is compatible with at least three interpretive frameworks. First, FM and PTSD may represent alternative phenotypic expressions of a common stress-related disorder, differing primarily in the dominant symptom cluster used for their definition (pain versus intrusion) rather than in their comprehensive nature or the underlying mechanisms. Second, the overlap may reflect frequent comorbidity of genuinely distinct disorders that share common risk factors (trauma exposure, female sex, psychological vulnerability) without sharing a common mechanism. Third, the overlap may partly reflect measurement artefacts, whereby instruments designed to capture distress-related constructs lack specificity and therefore inflate apparent similarity. Although the cross-sectional design of this study cannot definitively differentiate between these alternatives, several features of our data favour the shared-spectrum interpretation. Notably, the overlap extended to the symptoms considered defining features of each condition, and the cluster analysis independently indicated that the structure of the data aligns more closely with a single disease (FM/PTSD) *versus* healthy separation than with distinct FM and PTSD groupings.

Importantly, the present data cannot determine which of these interpretations is most accurate. The observed overlap may reflect a combination of shared vulnerability mechanisms, frequent comorbidity between partially distinct conditions, and the limited specificity of symptom-based instruments capturing transdiagnostic distress dimensions.

The FITSS model provides a possible theoretical framework capable of accommodating these findings (1). Within this model, persistent emotional stress is hypothesised to contribute to sustained activation of the Salience Network, potentially amplifying both nociceptive processing and threat-related cognition (16). Although the present study does not directly assess neurobiological mechanisms, the marked overlap observed across emotional, cognitive, trauma-related, and somatic domains is compatible with the possibility of partially shared stress-related processes underlying both conditions. Whether the phenotype manifests predominantly as pain or intrusion may depend on individual-level moderators such as the type, timing, and severity of stress exposure, genetic vulnerability, or the relative balance of threat, drive, and soothing affect systems. In the present study, both FM and PTSD participants showed elevated threat-system activation alongside comparatively reduced drive and soothing-system activity on the EASEL, a pattern compatible with the emotional architecture proposed by the FITSS model.

However, because the present data are cross-sectional and symptom-based, these findings should be interpreted as supportive of a possible shared stress-related framework rather than as evidence of a common pathophysiological mechanism.

This perspective also resonates with broader transdiagnostic models of psychopathology. The Hierarchical Taxonomy of Psychopathology (HiTOP) framework challenges categorical diagnostic boundaries in favour of dimensional spectra organised around shared liability factors (17). Similarly, the concept of a general psychopathology factor suggests that a large proportion of variance across mental disorders reflects shared vulnerability processes rather than condition-specific mechanisms (18). Our findings extend this transdiagnostic reasoning to the interface between pain medicine/ rheumatology and psychiatry.

If FM and PTSD indeed lie along a shared spectrum, the practical implications for rheumatologists and mental health clinicians are substantial. First, systematic screening for trauma exposure and PTSD symptoms should become a core component of the FM clinical assessment. The high rate of dual-criteria fulfilment in our sample (44.5%) suggests that a large proportion of FM patients carry an unrecognised burden of trauma-related symptoms that may contribute to their pain and disability. Second, treatment strategies may benefit from greater integration. Evidence-based interventions for PTSD, including trauma-focused cognitive-behavioural therapy and eye movement desensitisation and reprocessing (EMDR), have shown preliminary efficacy in FM (19, 20) but remain largely outside the rheumatologist's therapeutic repertoire. Conversely, exercise-based and self-management programmes effective in FM may benefit PTSD patients with prominent somatic symptoms.

Our findings also intersect with recent developments in pain classification. The ICD-11 introduction of chronic primary pain as a distinct entity implicitly acknowledges that conditions such as FM may not fit neatly within traditional organ-based categories (21). The concept of nociplastic pain further recognises altered nociceptive processing without clear peripheral or neuropathic drivers (22, 23). Our data suggest that even the boundary between nociplastic pain and trauma-related psychopathology may be more porous than current classification systems assume.

Several limitations should be considered when interpreting these findings. The study relied on self-reported data and an online survey design, which may introduce reporting bias and limit diagnostic precision. Because case definitions relied on questionnaire-derived cutoffs rather than clinician-confirmed diagnoses, findings should be interpreted primarily as evidence of phenotypic overlap between criteria-defined symptom profiles rather than proof of diagnostic equivalence in routine clinical settings, as clinical judgement may not be limited to dimensions covered by criteria. It should be noted that classification criteria are generally designed to maximise diagnostic specificity and reproducibility, whereas routine clinical diagnosis frequently integrates broader contextual and phenomenological judgement beyond formally validated criteria. The cross-sectional nature of the data precludes conclusions about causal relationships between trauma exposure, affect regulation, and somatic symptom expression. The use of snowball sampling and recruitment through patient networks may also introduce selection bias. These factors may limit the generalisability of the findings to clinically diagnosed populations or to healthcare settings outside the online survey context. Recruitment through patient associations, support groups, and snowball dissemination may also have preferentially attracted participants with more severe symptom burden, greater illness identification, or broader multisystem symptomatology, potentially increasing the observed degree of overlap between FM and PTSD. The translation of instruments using online tools followed by professional review, rather than full forward–backward translation procedures, represents an additional methodological limitation. Nevertheless, the consistency of the findings across a geographically diverse international sample suggests that translation artefacts are unlikely to fully account for the observed patterns. The substantial overlap between diagnostic groups (44.5% meeting both criteria) introduces a degree of circularity that our distributional approach mitigates but cannot fully eliminate. Several overlapping domains (sleep disturbance, fatigue, cognitive symptoms, emotional distress) are embedded within the instruments used to operationalize both conditions, which certainly contributes to the observed convergence, but this is intrinsic to the question being examined and cannot be ignored. It is noteworthy, however, that the overlap extends from shared distress-related domains, to include domains more traditionally considered specific to one condition, such as widespread pain and PTSD intrusion symptoms. Results of the sensitivity analysis restricted to participants meeting criteria for one condition but not the other may further clarify this issue.

If FM and PTSD lie along a shared stress-related spectrum, strict categorical separation may hinder both mechanistic understanding and clinical management. A transdiagnostic approach addressing affect regulation, trauma processing, and central sensitisation may therefore better serve these patients. Future studies should integrate biological and neuroimaging markers to determine whether the shared clinical profile reflects a common pathophysiology. Longitudinal studies will also be essential to determine whether pain-dominant and intrusion-dominant phenotypes remain stable over time or evolve across clinical presentations.

Several lines of future research emerge from these findings. First, latent class or latent profile analysis applied to the present dataset could determine whether data-driven clustering identifies symptom groups that correspond to FM and PTSD as currently defined, or whether alternative transdiagnostic groupings better capture the underlying structure. Second, neuroimaging studies comparing Salience Network activation and connectivity in FM-only, PTSD-only, and dual-criteria individuals could test whether the shared phenotype reflects a

common neural substrate. Third, longitudinal follow-up could reveal whether pain-dominant and intrusion-dominant phenotypes are stable over time or migrate between presentations. Finally, therapeutic trials applying trauma-focused interventions to FM patients and somatic-focused interventions to PTSD patients could test the transdiagnostic treatment premise directly.

Conclusion

Using a label-free, bootstrapped distributional comparison in a large international sample, complemented by cluster analysis, we found that FM and PTSD show extensive phenotypic overlap across somatic, emotional, and cognitive domains, while both clearly differ from healthy individuals. These findings question the strict nosological separation of these conditions and support a spectrum model of stress-related disorders: individual patients may be given one or the other diagnosis and be treated accordingly depending solely on the focus and interest of the attending physician. They highlight the need for integrated clinical assessment, including systematic screening for trauma in FM and for pain in PTSD, and for mechanism-based, transdiagnostic treatment approaches that transcend current diagnostic boundaries.

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