Psychopathology as a Moderator of the Relationship Between Physical Symptoms and Impairment in Fibromyalgia Patients

M. Pilar Martínez[1], Ana I. Sánchez[1], Rafael Cáliz[2], and Elena Miró[1]
[1] University of Granada and [2] Virgen de las Nieves University Hospital, Granada

Abstract

Background: Fibromyalgia (FM) is a chronic pain syndrome that is accompanied by notable psychological distress. However, little research has been done on how the psychopathological profile of FM patients may influence their functional status. **Method:** Using the Symptom Checklist-90-Revised the study examined the psychopathological dimensions of 181 women with FM, and the role of psychopathology as a moderator of the relationship between physical symptoms and impairment of functioning. **Results:** FM patients exhibited T-scores above the cutoff point (≥ 60) in all dimensions, and 76.2% were identified as "clinical cases". Somatization was a significant predictor of pain intensity, somatization and obsession-compulsion contributed significantly to predicting poor sleep quality, while somatization, depression and anxiety were significant predictors of impairment. Psychopathology was a statistically significant moderator that increased the impact of poor sleep quality on impairment. **Conclusions:** The dysfunctional psychological style is key in the impairment associated with FM. The evaluation of psychopathological profiles can allow the early identification of the patients who are most vulnerable to impaired functioning due to the presence of possible psychopathology, as well facilitating therapeutic adaptations.

Keywords: Fibromyalgia, psychopathology, moderator, pain, sleep, impairment.

Resumen

Psicopatología Como Moderador de la Relación Entre Síntomas Físicos y Discapacidad en Pacientes con Fibromialgia. **Antecedentes:** la fibromialgia (FM) es un síndrome de dolor crónico que se acompaña de importante malestar psicológico. Sin embargo, se ha investigado poco cómo el perfil psicopatológico de los pacientes con FM puede influir en su estado funcional. **Método:** utilizando el Cuestionario de Síntomas-90-Revisado, se examinaron las dimensiones psicopatológicas de 181 mujeres con FM, y el papel de la psicopatología como moderador de la relación entre síntomas físicos y deterioro del funcionamiento. **Resultados:** las pacientes presentaron puntuaciones-T superiores al punto de corte (≥ 60) en todas las dimensiones, siendo el 76,2% de ellas identificadas como "caso clínico". La somatización fue un predictor significativo de la intensidad del dolor, la somatización y la obsesión-compulsión contribuyeron significativamente a predecir la mala calidad del sueño, y la somatización, la depresión y la ansiedad fueron predictores significativos del deterioro. La psicopatología fue un moderador estadísticamente significativo que intensificó el impacto de la mala calidad del sueño sobre el deterioro. **Conclusiones:** el estilo psicológico disfuncional es clave en el deterioro asociado a la FM. La evaluación del perfil psicopatológico puede permitir la identificación precoz de los pacientes más vulnerables al deterioro funcional debido a la presencia de posible psicopatología, así como facilitar las adaptaciones terapéuticas.

Palabras clave: fibromialgia, psicopatología, moderador, dolor, sueño, deterioro.

Fibromyalgia (FM) is a disabling musculoskeletal pain syndrome. Similar to global epidemiological data, in Spain FM affects 2.4% of the population and entails high economic costs estimated at more than 12,993 million Euros annually (Cabo-Meseguer et al., 2017). In addition to widespread pain, this syndrome is accompanied by cognitive symptoms, unrefreshed sleep, fatigue and a number of somatic symptoms (Wolfe et al., 2010). Sleep dysfunction has a marked presence in this syndrome. FM patients show alterations in cyclic organization

of sleep and an increased of periodic leg movements associated with cortical arousals (Besteiro et al., 2011) and most of them (92.9%) have sleep disorders, observing that those patients with more FM symptoms report poor sleep quality (Andrade et al., 2018).

Although the etiology of FM is complex and multifactorial, there is consensus regarding the participation of central sensitization, which implies an altered modulation of pain processing within the central nervous system due to increased excitability and/or reduced inhibition in specific neural networks (Woolf, 2018). Psychological factors may influence the way that people with central sensitization syndromes (CSS) experience the illness (Adams & Turk, 2018), however the mechanisms through which such factors affect the pathways of pain facilitation remain poorly understood.

Psychological distress often coexists with FM. Recent reviews evidence a high prevalence of psychiatric comorbidities (13%-

80%) which are associated with a worse physical status and quality of life in FM patients (Gálvez-Sánchez et al., 2019), being hypochondriasis, depression, and hysteria the most frequently elevated clinical dimensions in FM (Novo et al., 2017). This profile appears to be specific of FM and is not identified in other chronic pain conditions such as rheumatoid arthritis (González et al., 2019). Several studies have examined the links between FM and possible psychopathology via the Symptom Checklist-90-Revised (SCL-90-R; Derogatis, 1994), one of the most widely used instruments for screening psychological distress. The SCL-90-R explores cognitive, emotional and somatic aspects, and both internalizing and externalizing symptoms, through simple and easily understandable items that make this instrument less invasive than other measures that directly ask about the symptoms of mental disorders (Preti et al., 2019). The SCL-90-R has been administered to compare the psychopathological profile of FM patients versus that of patients with other CSS (Fillingim et al., 2020), having been widely used to assess the therapeutic changes in FM symptoms (Lami et al., 2018). Furthermore, it is a recommended instrument by the Spanish Society of Rheumatology (Rivera et al., 2006) to examine psychopathology in FM. Using the SCL-90-R, Keller et al. (2011) found that Type II-FM patients (characterized by high levels of pain, fatigue, morning tiredness, stiffness, anxiety and depressive symptoms) showed greater psychopathology (general index) than Type I-FM patients (characterized by low levels of the previous clinical parameters). Salgueiro et al. (2012) observed that Type II-FM patients exhibited higher level of psychopathology (in all dimensions) than Type I-FM patients, displaying scores above the diagnostic cutoff in somatization, obsessive-compulsive and depression. Also in Type II-FM patients all psychopathological dimensions (except hostility) were inversely correlated with the physical component of health but none of them correlated with clinical pain. Glazer et al. (2009) found that FM patients and relatives with FM reported higher level on most psychopathological dimensions compared to healthy relatives. Garaigordobil and Govillard (2016) observed that FM patients showed higher percentile-scores in somatization, obsessive-compulsive, interpersonal sensibility, depression and anxiety compared with the non-clinical group, but only higher percentile-scores in somatization compared with the psychiatric group.

Although cognitive processes/emotional states may be involved in the onset of CSS (including FM), they are mainly considered as maintenance factors of these syndromes, amplifying the perception of noxious sensory information and interfering with disease's adaptation (Adams & Turk, 2018). Advancing in the knowledge about how psychological factors affect the FM symptoms and/or the daily functioning of patients is of great relevance since they are the elements on which treatment programs can impact. Emotional distress, stressful periods, and negative cognitive style are known to aggravate symptoms and worsen functional adjustment (Linton et al., 2018). However, few studies have analyzed the moderating role of psychological factors in FM experience, focusing the evidence on variables such as alexithymia and catastrophizing. For example, Martínez et al. (2015) observed that alexithymia moderated the relationship between anxiety and pain appraisal, and Lazaridou et al. (2019) found that pain catastrophizing moderated the association between physical activity and pain intensity. Psychopathology has implications for the daily living and treatment of FM patients (González et al., 2020), and it has been suggested it can be considered more as a moderator of the strength of the relationship between FM variables than as a

mechanism responsible for the relationship. However, no study has analyzed the moderator role of psychopathology (understood as the characteristic style of the person to express psychic suffering) in the clinical status of FM.

The purpose of this cross-sectional study was to analyze the psychopathological profile of FM patients and to examine whether psychopathology intensify the impact of physical symptoms on impairment in daily functioning. The specific hypotheses proposed were: 1) FM patients will show higher scores in psychopathology than non-clinical sample and similar to psychiatric sample (according to standardized norms of SCL-90-R); 2) greater psychopathology will be significantly associated with more physical symptoms (pain intensity and poor sleep quality) and higher impairment; and 3) psychopathology will be a statistically significant moderator of the relationship between physical symptoms (pain intensity and poor sleep quality) and impairment.

Method

Participants

Since FM is more prevalent in women than in men and both sex groups differ in several clinical aspects (Miró et al., 2012), only women were included. The eligibility criteria were: (a) being a woman aged between 18 and 67 years; (b) having been diagnosed with FM according to the American College of Rheumatology criteria (Wolfe et al., 1990, 2010) with no current severe co-morbid medical conditions; and (c) not having a history of psychotic and/or substance-related disorders or other severe psychological disorder. A consecutive sampling was applied, so all accessible/available FM patients from Virgen de las Nieves University Hospital in Granada, and several associations of FM patients in Andalusia were invited to participate in the research. After checking the eligibility criteria, the selected sample consisted of 181 women with FM.

Instruments

McGill Pain Questionnaire-Short Form (MPQ-SF; Melzack, 1987). It evaluates pain experience with 15 sensory/affective descriptors, pain intensity during the previous week with a visual analogue scale (VAS) ranging from 1 (*no pain*) to 10 (*extreme pain*), and pain intensity at the time of the test. In this study the VAS was used. The MPQ-Spanish version showed acceptable consistency (almost all coefficients > .90), intercategory/interparameter correlation, and concurrent validity (Lázaro et al., 2001).

Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989). It includes 19 items that explore subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. The total-scale score ranges from 0 to 21 (high scores indicating greater disturbance). The PSQI-Spanish version showed adequate internal consistency ($\alpha = .81$), test-retest reliability, and convergent validity (Hita-Contreras et al., 2014).

Fibromyalgia Impact Questionnaire (FIQ; Burckhardt et al., 1991). It consists of 10 items that explore the interference of FM in functional capacity for daily life. The total-scale score ranges from 0 to 94 (high scores indicating greater impact). The FIQ-Spanish version showed good internal consistency ($\alpha = .82$), test-retest reliability, validity, and sensitivity to change (Rivera & González, 2004).

Symptom Checklist-90-Revised (SCL-90-R; Derogatis, 1994). It includes 90 items grouped in nine symptomatic dimensions of psychopathology (somatization, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation and psychoticism), an additional scale, and three global indexes (Global Severity Index, GSI, Positive Symptom Total, PST, and Positive Symptom Distress Index, PSDI). For the moderation analysis the PSDI was used, which measures the intensity of the symptoms and indicates the characteristic style of the person to express psychic suffering (the score ranges from 0 to 4, high scores indicating greater psychological distress). The SCL-90-R-Spanish version showed adequate reliability (α between .81 and .90) and validity (González de Rivera et al., 2002).

Procedure

The participants were individually screened via an interview focused on socio-demographic data, clinical data about FM, life history, personal relationships, lifestyle, and psychological status. After the interview, participants were given a battery of questionnaires to be completed at home and returned within a week. The way to fill in the questionnaires was explained and exemplified upon delivery, and possible doubts/omissions were resolved upon collection. All subjects were informed about the study and gave their written informed consent. The study was approved by the Ethics Committee of the University of Granada.

Data Analysis

All data were analyzed with the SPSS 22.0 statistical package and the ModGraph-I a program that graphically displays moderation effects (Jose, 2013). Two groups were established according to the degree of impairment (FIQ) (severe ≥ 59 and moderate-mild < 59), and the differences between both were examined via Student's *t*-test. Effect size was estimated with Cohen's *d*. To examine the associations between variables Pearson's correlation coefficient was used. Several linear regression analyses (enter method) were performed to determine the contribution of psychopathology dimensions to predict pain intensity, poor sleep quality and impairment.

For testing moderation effects the guidelines by Frazier et al. (2004) were followed. Several hierarchical regression analyses were conducted considering impairment as dependent variable (DV), pain intensity and poor sleep quality as predictors, psychopathology as moderator, and the interaction of predictor x moderator. To reduce multicollinearity, the predictors and moderator variables were centered. The interaction term was obtained by multiplying the centered scales. As a post-hoc analysis of the moderation effects, several simple slopes were computed for low (-1*SD*), medium, and high (+1*SD*) levels of psychopathology.

The minimum sample size required for regression analyses was 141 participants, given a *p*-value < .05, 9 predictors, .90 as desired statistical power, and 0.15 (medium) as anticipated effect size. There were observed complete data in SCL-90-R and FIQ, and five and one missing data (at random) in MPQ-SF and PSQI, respectively. Considering the low rate of missing observations, and that the collected sample size (*n* = 181) far exceeds the minimum required, and in order to preserve the genuineness of the data, no imputation method was applied.

Results

Sociodemographic and Clinical Characteristics

FM group had a mean age of 48.79 years (*SD* = 8.09), and 82.3% were married, 7.2% divorced/separated, 6.6% single and 3.9% widowed. A total of 22.1% of the patients had elementary education, 28.7% secondary education, 16% vocational training and 25.4% university education. Within the sample, 41.1% was employed but more than 57% was not working (23.3% unemployed, 22.8% on sick leave and 11.1% retired). The mean time from FM diagnosis was 6.32 years (*SD* = 5.13). Most of the patients (87.84%) were receiving pharmacological treatment, mainly anti-depressants, anxiolytics, analgesics, and anti-inflammatory drugs.

As expected, the mean score of the participants in pain intensity (MPQ-SF) was moderately high (*M* = 7.63; *SD* = 1.56), in poor sleep quality (PSQI) (*M* = 14.26; *SD* = 4.26) exceeded the score (> 5) corresponding to "bad sleepers" (Buysse et al., 1989), and in impairment (FIQ) (*M* = 62.15; *SD* = 14.20) exceeded the score (≥ 59) indicative of severe impact (Bennett et al., 2009).

Considering the standardized norms of non-clinical population (women, *n* = 278), *T*-score ≥ 60 (85th percentile) was taken as the diagnostic cutoff point in psychopathology (SCL-90-R) (González de Rivera et al., 2002). The FM group showed *T*-scores above the cutoff point in all scales (between *T*-score = 60 in hostility and *T*-score = 75 in somatization) and general indexes (*T*-score = 70 in GSI and PST and *T*-score = 63 in PSDI). Since a patient can be identified as a "clinical case" when the score exceeds the cutoff point (90th percentile) on the GSI, 76.2% of the participants were "clinical case". Considering the standardized norms of psychiatric patients (women, *n* = 136) in the SCL-90-R (González de Rivera et al., 2002), the FM group obtained between *T*-score = 49 in depression and paranoid ideation and *T*-score = 55 in somatization, and similar levels in the general indexes (*T*-score = 51 in GSI and PST and *T*-score = 49 in PSDI).

Relationship between Psychopathology, Physical Symptoms and Impairment

Pain intensity was significantly correlated with somatization, obsessive-compulsive, depression, anxiety, additional scale, and GSI (between *r* = .24, *p* < .0013 and *r* = .31, *p* < .0013) (see Table 1). Poor sleep quality and impairment were significantly correlated with all psychopathological dimensions, additional scale, and general indexes (between *r* = .24, *p* < .0013 and *r* = .54, *p* < .0013, and between *r* = .28, *p* < .0013 and *r* = .50, *p* < .0013, respectively). In the following analyses, only the psychopathological dimensions significantly correlated with the DVs (pain intensity, poor sleep quality and impairment) were included as predictors.

Psychopathology as a Predictor of Physical Symptoms and Impairment

When pain intensity was the DV, the model including somatization, obsessive-compulsive, depression, and anxiety as independent variables (IVs) was significant, *F*(4,171) = 5.70, *p* < .01, but only somatization was a significant predictor (see Table 2). When poor sleep quality was the DV, the model composed of all psychopathological scales as IVs was significant, *F*(9,170) = 9.60, *p* < .01, and somatization and obsessive-compulsive were

Table 1
Mean, Standard Deviation and Correlation between Variables in Women with Fibromyalgia (n = 181)

	M	SD	Pain intensity (MPQ-SF)	Poor sleep quality (PSQI)	Impairment (FIQ)
Psychopathology (SCL-90-R)					
Somatization	2.46	0.70	.31*	.52*	.48*
Obsessive-compulsive	2.24	0.83	.24*	.51*	.45*
Interpersonal sensitivity	1.42	0.85	.16	.39*	.31*
Depression	2.16	0.89	.24*	.47*	.50*
Anxiety	1.69	0.90	.30*	.40*	.50*
Hostility	1.14	0.85	.17	.24*	.32*
Phobic anxiety	1.06	0.94	.23	.38*	.35*
Paranoid ideation	1.19	0.86	.09	.32*	.28*
Psychoticism	0.97	0.77	.17	.33*	.36*
Additional scale	2.02	0.70	.25*	.54*	.44*
Global Severity Index (GSI)	1.72	0.70	.27*	.50*	.49*
Positive Symptom Total (PST)	62.67	17.09	.20	.37*	.36*
Positive Symptom Distress Index (PSDI)	2.42	0.53	.23	.48*	.46*

Note: The Bonferroni correction was applied. * $p < .0013$

significant predictors. Finally, when impairment was the DV, the model including all psychopathological scales as IVs was significant, $F(9,171) = 9.24$, $p < .01$, and somatization, depression and anxiety were significant predictors.

Psychopathology as a Moderator between Physical Symptoms and Impairment

Based on the cutoff point ≥ 59 (severe impact) in the FIQ (Bennett et al., 2009), 115 women with severe FM were identified. Compared to the 66 patients with moderate-mild FM (< 59), the patients with severe FM showed a significantly higher level of pain intensity, poor sleep quality and psychopathology (PSDI) (between $t(98.834) = 7.60$, $p < .001$, 95% CI [2.19-1.28], $d = 1.25$ in pain intensity, and $t(157.664) = 3.03$, $p < .001$, 95% CI [0.62-0.13], $d = 0.44$ in paranoid ideation).

In the severe FM group two moderation analyses tested whether the pain intensity × psychopathology interaction and the poor sleep

quality × psychopathology interaction were significant predictors of impairment (see Table 3). In Model 1, pain intensity and poor sleep quality were identified as significant predictors. In Model 2, the effect of poor sleep quality disappeared when psychopathology was included, and pain intensity and psychopathology were significant predictors. In Model 3a, the contribution of pain intensity remained significant but that of psychopathology disappeared, and the effect of pain intensity × psychopathology interaction was not significant. In Model 3b, pain intensity remained a significant predictor, the contribution of psychopathology was close to significance, and a significant effect of poor sleep quality × psychopathology interaction was observed. This finding revealed that the relationship between poor sleep quality and impairment was moderated by psychopathology.

Figure 1 shows the poor sleep quality × psychopathology interaction. Simple slope in the line showing high psychopathology, $t(112) = 3.09$, $p < .01$, was significant. Patients with different levels of psychopathology did not differ in impairment under conditions

Table 2
Models Predicting Pain Intensity, Poor Sleep Quality and Impairment in Women with Fibromyalgia (n = 181)

	B	ß	t	R²	F(4,171)	B	ß	t	R²	F(9,170)	B	ß	t	R²	F(9,171)
Dependent variable	**Pain intensity (MPQ-SF)**					**Poor sleep quality (PSQI)**					**Impairment (FIQ)**				
Predictor variables (SCL-90-R)															
Somatization	0.53	.24	2.12*			2.02	.33	3.37**			3.99	.19	1.98*		
Obsessive-compulsive	-0.02	-.01	-0.11			1.39	.27	2.34*			0.36	.02	0.18		
Interpersonal sensitivity						0.65	.13	1.02			-3.49	-.21	-1.62		
Depression	-0.18	-.01	-0.70			0.35	.07	0.54			4.54	.28	2.09*		
Anxiety	0.39	.23	1.80			-0.47	-.10	-0.75			5.13	.32	2.45*		
Hostility						-0.74	-.14	-1.62			-0.16	-.01	-0.10		
Phobic anxiety						0.19	.04	0.43			-0.84	-.05	-0.56		
Paranoid ideation						0.11	.02	0.21			-0.29	-.01	-0.16		
Psychoticism						-0.24	-.04	-0.37			0.18	.01	0.08		
				.11	5.70**				.33	9.60**				.32	9.24**

Note: * $p < .05$, ** $p < .01$

of "low-medium" poor sleep quality. However, under conditions of "high" poor sleep quality subjects reporting high psychopathology scored significantly higher in impairment than subjects reporting low psychopathology.

Table 3

Psychopathology as Moderator in the Relationship between Pain Intensity/Poor Sleep Quality and Impairment in Women with Severe Fibromyalgia (n = 115)

Predictor variables	B	ß	t	R²	F
Model 1					
Pain intensity (MPQ-SF)	2.47	.34	3.86**		
Poor sleep quality (PSQI)	0.46	.21	2.47*	.18	12.41**
Model 2					
Pain intensity (MPQ-SF)	2.41	.33	3.81**		
Poor sleep quality (PSQI)	0.22	.10	1.00	.21	9.81**
Psychopathology (SCL-90-R)	3.43	.20	1.98*		
Model 3a					
Pain intensity (MPQ-SF)	1.69	.23	2.27*		
Poor sleep quality (PSQI)	0.22	.10	1.03		
Psychopathology (SCL-90-R)	1.69	.10	0.85	.23	8.29**
Pain intensity (MPQ-SF) X					
Psychopathology (SCL-90-R)	2.55	.21	1.77		
Model 3b					
Pain intensity (MPQ-SF)	2.19	.30	3.60**		
Poor sleep quality (PSQI)	0.19	.09	0.93		
Psychopathology (SCL-90-R)	3.26	.19	1.96	.28	10.78**
Poor sleep quality (PSQI) X					
Psychopathology (SCL-90-R)	1.10	.27	3.31**		

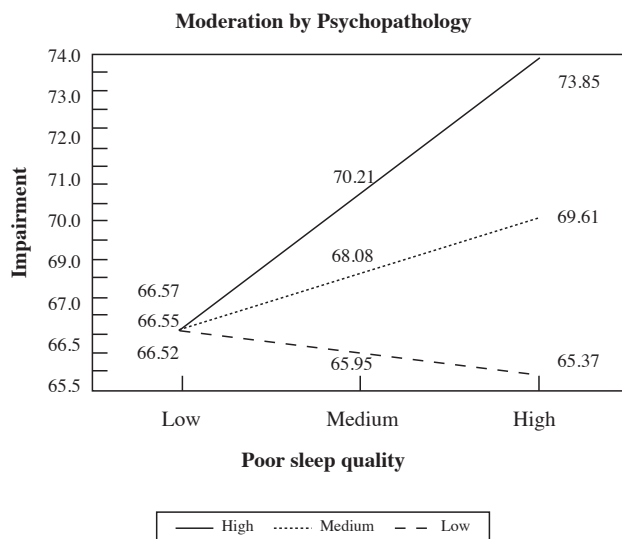*Note*: * *p* < .05, ** *p* < .01

Figure 1. Moderating Role of Psychopathology in the Relationship between Poor Sleep Quality and Impairment

Discussion

This study extends previous research examining the psychopathological profile of FM patients, the prevalence of "clinical case", and the contribution of possible psychopathology in the reduced functional status. Finding showed that FM patients

have a cognitive-emotional profile with marked morbidity. FM group exhibited greater severity in all psychopathological scales than non-clinical group, and 76.2% of FM patients were identified as "clinical case". However, compared with the psychiatric group, the FM group showed equivalent levels in all scales. The hypothesis 1 was confirmed. These results are similar to those of previous reports that identified in FM patients scores outside the normal values in five of nine dimensions but higher scores than psychiatric patients only in somatization (Garaigordobil & Govillard, 2016).

In the FM group poor sleep quality and impairment were significantly correlated with all psychopathological dimensions, but pain intensity only with somatization, obsessive-compulsive, depression, and anxiety, which supports hypothesis 2. Consistent with our results, previous studies in FM found that all psychopathological scales significantly correlated with physical component (Salgueiro et al., 2012), and that pain correlated with somatization and depression (Rogers et al., 2018), but others studies did not observe a relationship between pain and psychopathological dimensions in Type II-FM (Salgueiro et al., 2012).

Somatization, obsessive-compulsive, depression and anxiety were the most important predictors of FM status (pain, sleep and impairment). The role of depression and anxiety is well documented in FM (Gálvez-Sánchez et al., 2019) and included in the widely accepted Fear-Avoidance Model of Chronic Pain (Vlaeyen & Linton, 2012). Most striking is the contribution of somatization and obsessive-compulsive. Neurovegetative symptoms considered somatizations are frequent expressions of stress and emotional dysphoria. Thus, it has been suggested that somatization is a significant factor in explaining the negative impact upon mental health of FM patients (Tesio et al., 2019). Note that somatization reflects the tendency to experience and communicate psychological distress through indirect body language, and it is closely related to low emotional awareness and problems in managing feelings. In fact, the dimension of alexithymia referred to the difficulty in identifying, recognizing and labelling feelings is implicated in the somatization process observed in chronic pain patients (Porcelli & Taylor, 2018), being alexithymia a moderator of the impact of pain appraisal upon emotional distress in FM (Martínez et al., 2015). The obsessive-compulsive dimension is congruent with the perfectionism, strong sense of responsibility and need of control. Maladaptive perfectionistic attitudes are involved in chronic fatigue and pain conditions via stress generation that could lead to overexertion/other dysfunctional behaviours, contributing to the dysregulation of stress response system (Kempke et al., 2016). In this sense, it was found that high perfectionistic strivings and concerns are linked to high stress and poor mental/physical health in FM (Sirois et al., 2019). So, obsessive-compulsive (via perfectionism) and somatization (via alexithymia) can play a relevant role in FM status, although this issue requires further investigation.

Moderation analysis indicated that psychopathology intensified the impact of non-restorative sleep in the impairment of daily functioning, however, there was not observed this moderator effect in the link between pain intensity and impairment. The hypothesis 3 was partially confirmed. Analyses revealed that under conditions of "high" poor sleep quality patients with high psychopathology showed higher impairment than patients with low psychopaholy. This result emphasizes the interactive role of sleep and psychological distress and can help to understand the mechanisms through which disability is exacerbated in FM. There

is no previous research focused on the pathways examined in the present study. Joustra et al. (2018) observed that FM patients with short or long sleep duration reported higher somatization than those with moderate sleep duration, but that study examined a different sleep parameter and did not include other psychopathological dimensions.

The relationships between pain, sleep, and psychopathology are complex and interactive. Several reviews indicate that there is a bi-directional link between pain and sleep, but sleep impairment is a stronger predictor of pain than conversely (Finan et al., 2013). Previous research demonstrated that in FM subjective sleep quality and objective sleep efficiency mediate the impact of pain on anxiety and depression (Díaz-Piedra et al., 2014), and that insomnia symptoms are strongly associated with risk of FM (Skarpsno et al., 2019). Pain alters sleep, but sleep disruption also interferes with the functioning of the descending pathways of pain-inhibition and generates a hypoactivity of the HPA axis responsible for regulating the response to stress, leading to an intensification of sensitivity to painful stimuli (Choy, 2015). Sleep also has an important relationship with emotions and psychopathology, there is evidence that psychological/physiological component of emotional experiences and attentional processes are mediators of sleep-pain relationship (Whibley et al., 2019). Perhaps due to all these complexes interaccions when the sleep quality is very poor, the presence of added psychopathology (as expression of dysfunctional strategies to process information and regulate emotions) leads to a greater disability. Although the lack of a widely accepted conceptual proposal on the mediation/moderation paths between these factors makes it difficult to draw definitive conclusions.

This study suggests that the characterization of the psychopathological profile in the FM patient is crucial to a better understanding of the clinical status and to establish the best therapeutic approach. This is in line with the growing emphasis on the tailored-treatment in FM. For example, the European League Against Rheumatism recommends for the management of FM individualized strategies focused on main FM symptoms, psychological characteristics, and disability degree (Macfarlane et al., 2017). Several reviews showed that the cognitive-behavioural therapy (CBT) (Bernardy et al., 2018) and the mindfulness/acceptance-based interventions (MABIs) (Haugmark et al., 2019) are superior to control treatments in improving FM, however, research on the efficacy of these interventions adapted to the clinical profiles of FM is scarce. Some reports show promising results incorporating strategies aimed at insomnia in CBT (Lami et al., 2018) and MABI (Miró et al., 2017), but none of these therapies has been customized to address insomnia and psychopathology.

This study has some limitations. The transversal nature of the research prevents establishing causal relationships. Possible psychopathology was evaluated via SCL-90-R, although the application of other standardized norms of this instrument or the use of another alternative self-report could have yielded different results. The assessment of experiential avoidance (Vázquez-Morejón et al., 2019) would have been of interest considering its close link with psychopathology. To examine pain and sleep no objective measures were used that would have complemented the self-report data. The participants were women with FM so the findings may not be generalizable to men with FM. A non-probability sampling method was used which may lead to limitations of sample representation. Finally, the inclusion of sociodemographic variables (age), other clinical aspects (non-pharmacological aids), and social factors would have contributed to a more complete understanding of FM impact.

For future research, it may be of great interest to conduct longitudinal studies that allow a more precise exploration of the temporal links between pain, sleep and psychopathology. It would also be relevant to examine these links by considering psychopathology in terms of clinical diagnosis. The replicability of the moderating role of psychopathology should be analyzed in other chronic pain and healthy samples. Further, given the connection between trauma and FM (Miró et al., 2020), it may be key to explore if psychopathology is a dysfunctional response pattern associated with FM or with a highly stressful event that precedes FM, and how this sequence interact with sleep over time. Finally, it may be important to examine whether FM patients with high comorbidity of insomnia and psychopathology respond better to tailored version of CBT/MABI.

In conclusion, FM patients show clinical levels of psychopathology that interact with sleep problems, exacerbating the deterioration of daily functioning. Psychopathological sphere is proposed as an important target for FM management.

References

Adams, L. M., & Turk, D. C. (2018). Central sensitization and the biopsychosocial approach to understanding pain. *Journal of Applied Biobehavioral Research*, *23*(2), e12125. https://doi.org/10.1111/jabr.12125

Andrade, A., Vilarino, G. T., Sieczkowska, S. M., Coimbra, D. R., Bevilacqua, G. G., & Steffens, R. A. K. (2018). The relationship between sleep quality and fibromyalgia symptoms. *Journal of Health Psychology*, *25*(9), 1176-1186. https://doi.org/10.1177/1359105317751615

Bennett, R. M., Bushmakin, A. G., Cappelleri, J. C., Zlateva, G., & Sadosky, A. B. (2009). Minimal clinically important difference in the Fibromyalgia Impact Questionnaire. *Journal of Rheumatology, 36*(6), 1304-1311. https://doi.org/10.3899/jrheum.081090

Bernardy, K., Klose, P., Welsch, P., & Häuser, W. (2018). Efficacy, acceptability and safety of cognitive behavioural therapies in fibromyalgia syndrome–A systematic review and meta-analysis of randomized controlled trials. *European Journal of Pain*, *22*(2), 242-260. https://doi.org/10.1002/ejp.1121

Besteiro, J. L., Suárez, T. V., Arboleya, L., Muñiz, J., Lemos, S., & Álvarez, A. (2011). Sleep architecture in patients with fibromyalgia. *Psicothema*, *23*(3), 368-373.

Burckhardt, C. S., Clark, S. R., & Bennett, R. M. (1991). The Fibromyalgia Impact Questionnaire: Development and validation. *Journal of Rheumatology, 18*(5), 728-733.

Bushnell, M. C., Čeko, M., & Low, L. A. (2013). Cognitive and emotional control of pain and its disruption in chronic pain. *Nature Reviews Neuroscience*, *14*(7), 502-511. https://doi.org/10.1038/nrn3516

Buysse, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh Sleep Quality Index: A new instrument for psychiatric practice and research. *Psychiatry Research*, *28*(2), 193-213.

Cabo-Meseguer, A., Cerdá-Olmedo, G., & Trillo-Mata, J. L. (2017). Fibromialgia: prevalencia, perfiles epidemiológicos y costes económicos [Fibromyalgia: Prevalence, epidemiologic profiles and economic costs]. *Medicina Clínica*, *149*(10), 441-448. https://doi.org/10.1016/j.medcli.2017.06.008

Choy, E. H. (2015). The role of sleep in pain and fibromyalgia. *Nature Reviews Rheumatology*, *11*(9), 513-520. https://doi.org/10.1038/nrrheum.2015.56

Crofford, L. J. (2015). Psychological aspects of chronic musculoskeletal pain. *Best Practice and Research Clinical Rheumatology*, *29*(1), 147-155. https://doi.org/10.1016/j.berh.2015.04.027

Derogatis, L. R. (1994). *SCL-90-R. Administration, scoring and procedures manual* (3rd ed.). NCS Pearson.

Díaz-Piedra, C., Catena, A., Miró, E., Martínez, M. P., Sánchez, A. I., & Buela-Casal, G. (2014). The impact of pain on anxiety and depression is mediated by objective and subjective sleep characteristics in fibromyalgia patients. *The Clinical Journal of Pain*, *30*(10), 852-859. https://doi.org/10.1097/AJP.0000000000000040

Fillingim, R. B., Ohrbach, R., Greenspan, J. D., Sanders, A. E., Rathnayaka, N., Maixner, W., & Slade, G. D. (2020). Associations of psychologic factors with multiple chronic overlapping pain conditions. *Journal of Oral & Facial Pain and Headache*, *34*, s85-s100. https://doi.org/10.11607/ofph.2584

Finan, P. H., Goodin, B. R., & Smith, M. T. (2013). The association of sleep and pain: An update and a path forward. *The Journal of Pain*, *14*(12), 1539-1552. https://doi.org/10.1016/j.jpain.2013.08.007

Frazier, P. A., Tix, A. P., & Barron, K. E. (2004). Testing moderator and mediator effects in counselling Psychology research. *Journal of Counselling Psychology, 51*(5), 115-134. https://doi.org/10.1037/0022-0167.51.1.115

Gálvez-Sánchez, C. M., Duschek, S., & Reyes del Paso, G. A. (2019). Psychological impact of fibromyalgia: Current perspectives. *Psychology Research and Behavior Management*, *12*, 117-127. https://doi.org/10.2147/PRBM.S178240

Garaigordobil, M., & Govillard, L. (2016). Síntomas psicopatológicos en personas con fibromialgia: una reflexión [Psychopathological symptoms in people with fibromyalgia: A reflection]. *Interdisciplinaria, 33*(2), 355-374.

Glazer, Y., Cohen, H., Buskila, D., Ebstein, R. P., Glotser, L., & Neumann, L. (2009). Are psychological distress symptoms different in fibromyalgia patients compared to relative with and without fibromyalgia. *Clinical and Experimental Rheumatology, 27*(5), S3-S7.

González, B., Novo, R., & Ferreira, A. S. (2020). Fibromyalgia: Heterogeneity in personality and psychopathology and its implications. *Psychology, Health & Medicine*, *25*(6), 703-709. https://doi.org/10.1080/13548506.2019.1695866

González, B., Novo, R., Peres, R., & Baptista, T. (2019). Fibromyalgia and rheumatoid arthritis: Personality and psychopathology differences from the Minnesota Multiphasic Personality Inventory-2. *Personality and Individual Differences, 142*, 260-269. https://doi.org/10.1016/j.paid.2018.11.013

González de Rivera, J. L., de las Cuevas, C., Rodríguez, M., & Rodríguez, F. (2002). *SCL-90-R. Cuestionario de 90 síntomas* [SCL-90-R. Symptom checklist-90-revised]. TEA Ediciones.

Haugmark, T., Hagen, K. B., Smedslund, G., & Zangi, H. A. (2019). Mindfulness-and acceptance-based interventions for patients with fibromyalgia: A systematic review and meta-analyses. *PloS One*, *14*(9), e0221897. https://doi.org/10.1371/journal.pone.0221897

Hita-Contreras, F., Martínez-López, E., Latorre-Román, P. A., Garrido, F., Santos, M. A., & Martínez-Amat, A. (2014). Reliability and validity of the Spanish version of the Pittsburgh Sleep Quality Index (PSQI) in patients with fibromyalgia. *Rheumatology International*, *34*(7), 929-936. https://doi.org/10.1007/s00296-014-2960-z

Jose, P. E. (2013). *ModGraph-I. A programme to compute cell means for the graphical display of moderational analyses: The internet version*. https://psychology.victoria.ac.nz/modgraph/

Joustra, M. L., Zijlema, W. L., Rosmalen, J. G., & Janssens, K. A. (2018). Physical activity and sleep in chronic fatigue syndrome and fibromyalgia syndrome: Associations with symptom severity in the general population cohort lifelines. *Pain Research and Management*, 5801510. https://doi.org/10.1155/2018/5801510

Keller, D., de Gracia, M., & Cladellas, R. (2011). Subtypes of patients with fibromyalgia, psychopathological characteristics and quality of life. *Actas Españolas de Psiquiatría, 39*(5), 273-279.

Kempke, S., Van Houdenhove, B., Claes, S., & Luyten, P. (2016). The role of perfectionism in chronic fatigue syndrome. In F. Sirois & D. Molnar (Eds.), *Perfectionism, health, and well-being* (pp. 101-118). Springer.

Lami, M. J., Martínez, M. P., Miró, E., Sánchez, A. I., Prados, G., Cáliz, R., & Vlaeyen, J. W. S. (2018). Efficacy of combined cognitive-behavioral therapy for insomnia and pain in patients with fibromyalgia: A randomized controlled trial. *Cognitive Therapy and Research, 42*(1), 63-79. https://doi.org/10.1007/s10608-017-9875-4

Lazaridou, A., Galenkamp, L., Berry, M., Napadow, V., & Edwards, R. (2019). The association between daily physical activity and pain among women with fibromyalgia: The moderating role of pain catastrophizing. *The Journal of Pain*, *20*(4), S58. https://doi.org/10.1016/j.jpain.2019.02.030

Lázaro, C., Caseras, X., Whizar-Lugo, V. M., Wenk, R., Baldioceda, F., Bernal, R., Ovalle, A., Torrubia, R., & Baños, J. E. (2001). Psychometric properties of a Spanish version of the McGill Pain Questionnaire on several Spanish-speaking countries. *The Clinical Journal of Pain, 17*(4), 365-374.

Linton, S. J., Flink, I. K., & Vlaeyen, J. W. (2018). Understanding the etiology of chronic pain from a psychological perspective. *Physical Therapy, 98*(5), 315-324. https://doi.org/10.1093/ptj/pzy027

Macfarlane, G. J., Kronisch, C., Dean, L. E., Atzeni, F., Häuser, W., Fluß, E., Choy, E., Kosek, E., Amris, K., Branco, J., Dincer, F., Leino-Arjas, P., Longley, K., McCarthy, G. M., Makri, S., Perrot, S., Sarzi-Puttini, P., Taylor, A., & Jones, G. T. (2017). EULAR revised recommendations for the management of fibromyalgia. *Annals of the Rheumatic Diseases*, *76*(2), 318-328. http://dx.doi.org/10.1136/annrheumdis-2016-209724

Martínez, M. P., Sánchez, A. I., Miró, E., Lami, M. J., Prados, G., & Morales, A. (2015). Relationships between physical symptoms, emotional distress, and pain appraisal in fibromyalgia: The moderator effect of alexithymia. *The Journal of Psychology*, *149*(2), 115-140. https://doi.org/10.1080/00223980.2013.844673

Melzack, R. (1987). The short-form McGill Pain Questionnaire. *Pain, 30*(2), 191-197.

Miró, E., Diener, F. N., Martínez, M., Sánchez, A. I., & Valenza, M. C. (2012). La fibromialgia en hombres y mujeres: comparación de los principales síntomas clínicos [Fibromyalgia in men and women: Comparison of the main clinical symptoms]. *Psicothema, 24*(1), 10-15.

Miró, E., Martínez, M. P., Sánchez, A. I., & Cáliz, R. (2020). Clinical manifestations of trauma exposure in fibromyalgia: The role of anxiety in the association between posttraumatic stress symptoms and fibromyalgia status. *Journal of Traumatic Stress, 33*, 1082-1092. https://doi.org/10.1002/jts.22550

Miró, E., Sánchez, A. I., Martínez, M. P., Prados, G., Cáliz, R., & Cervilla, O. (2017). Impact of a mindfulness-based intervention in the sleep quality of fibromyalgia patients. *Sleep Medicine, 40*, e225. https://doi.org/10.1016/j.sleep.2017.11.657

Novo, R., González, B., Peres, R., & Aguiar, P. (2017). A meta-analysis of studies with the Minnesota Multiphasic Personality Inventory in fibromyalgia patients. *Personality and Individual Differences*, *116*, 96-108. https://doi.org/10.1016/j.paid.2017.04.026

Porcelli, P., & Taylor, G. J. (2018). Alexithymia and physical illness: A psychosomatic approach. In O. Luminet, R. M. Bagby, & G. J. Taylor (Eds.), *Alexithymia: Advances in research, theory, and clinical practice* (pp. 105-126). Cambridge University Press.

Preti, A., Carta, M. G., & Petretto, D. R. (2019). Factor structure models of the SCL-90-R: Replicability across community samples of adolescents. *Psychiatry Research*, *272*, 491-498. https://doi.org/10.1016/j.psychres.2018.12.146

Rivera, J., Alegre, C., Ballina, F. J., Carbonell, J., Carmona, L., Castel, B., Collado, A., Esteve, J. J., Martínez, F. G., Tornero, J., Vallejo, M. A., & Vidal, J. (2006). Documento de consenso de la Sociedad Española de Reumatología sobre la fibromialgia [Consensus document of the Spanish Society of Rheumatology on fibromyalgia]. *Reumatología Clínica, 2*, S55-S66.

Rivera, J., & González, T. (2004). The Fibromyalgia Impact Questionnaire: A validated Spanish version to assess the health status in women with fibromyalgia. *Clinical and Experimental Rheumatology*, *22*, 554-560.

Rogers, H., Cardosa, S., Plaza, S. O., Patiño, A. C., & Altamar, M. P. (2018). State anxiety is independently associated with Visual Analog Scale pain rating in women with fibromyalgia. *Annals of Physical and Rehabilitation Medicine*, *61*, e110. https://doi.org/10.1016/j.rehab.2018.05.237

Salgueiro, M., Aira, Z., Buesa, I., Bilbao, J., & Azkue, J. J. (2012). Is psychological distress intrinsic to fibromyalgia syndrome? Cross-sectional analysis in two clinical presentations. *Rheumatology International, 32*(11), 3463-3469. https://doi.org/10.1007/s00296-011-2199-x

Sirois, F. M., Toussaint, L., Hirsch, J. K., Kohls, N., Weber, A., & Offenbächer, M. (2019). Trying to be perfect in an imperfect world: A person-centred test of perfectionism and health in fibromyalgia patients versus healthy controls. *Personality and Individual Differences*, *137*, 27-32. https://doi.org/10.1016/j.paid.2018.08.005

Skarpsno, E. S., Nilsen, T. I. L., Sand, T., Hagen, K., & Mork, P. J. (2019). The joint effect of insomnia symptoms and lifestyle factors on risk of self-reported fibromyalgia in women: Longitudinal data from the HUNT Study. *BMJ Open*, *9*(8), e028684. https://doi.org/10.1136/bmjopen-2018-028684

Tesio, V., Ghiggia, A., Di-Tella, M., & Castelli, L. (2019). Utility of the diagnostic criteria for psychosomatic research in assessing psychological disorders in fibromyalgia patients. *Journal of Affective Disorders*, *256*, 219-220. https://doi.org/10.1016/j.jad.2019.06.013

Vázquez-Morejón, R., León, J. M., Martín, A., & Vázquez, A. J. (2019). Validation of a Spanish version of the Brief Experiential Avoidance Questionnaire (BEAQ) in clinical population. *Psicothema, 31*(3), 335-340. https://doi.org/10.7334/psicothema2019.60

Vlaeyen, J. W., & Linton, S. J. (2012). Fear-avoidance model of chronic musculoskeletal pain: 12 years on. *Pain*, *153*(6), 1144-1147. https://doi.org/10.1016/j.pain.2011.12.009

Whibley, D., AlKandari, N., Kristensen, K., Barnish, M., Rzewuska, M., Druce, K. L., & Tang, N. K. (2019). Sleep and pain: A systematic review of studies of mediation. *The Clinical Journal of Pain*, *35*(6), 544-558. https://doi.org/10.1097/AJP.0000000000000697

Wolfe, F., Clauw, D. J., Fitzcharles, M. A., Goldenberg, D. L., Katz, R. S., Mease, P., Russell, A. S., Russell, I. J., Winfield, J. B., & Yunus, M. B. (2010). The American College of Rheumatology preliminary diagnostic criteria for fibromyalgia and measurement of symptom severity. *Arthritis Care and Research, 62*(5), 600-610. https://doi.org/10.1002/acr.20140

Wolfe, F., Smythe, H. A., Yunus, M. B., Bennett, R. M., Bombardier, C., Goldenberg, D. L., Tugwell, P., Campbell, S. M., Abeles, M., Clark, P., Fam, A. G., Farber, S. J., Fiechtner, J. J., Franklin, C. M., Gatter, R. A., Hamaty, D., Lessard, J., Lichtbroun, A. S., Masi, A. T., ...Sheon, R. P. (1990). The American College of Rheumatology 1990 criteria for the classification of fibromyalgia. *Arthritis & Rheumatism*, *33*(2), 160-172. https://doi.org/10.1002/art.1780330203

Woolf, C. J. (2018). Pain amplification: A perspective on the how, why, when, and where of central sensitization. *Journal of Applied Biobehavioral Research*, *23*(2), e12124. https://doi.org/10.1111/jabr.12124