Catastrophisation, chronic pain and sexuality: a cross-sectional investigation in fibromyalgia and rheumatoid arthritis

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ABSTRACT

Objective. *In the present study we investigate the putative differences in pain catastrophising (PC), pain perception (PP), sexual functioning (SF), satisfaction (SS), and overall quality of life between fibromyalgia (FM) and rheumatoid arthritis (RA) patients as compared to healthy controls (HC).*

Methods. *Fifty-seven native Italian-speaking female individuals suffering either from FM or RA and thirty-eight healthy female controls (FM=40; RA=17; HC=38) were submitted to a semi-structured interview aimed at assessing PP intensity (Visual Analogue Scale; VAS), general health conditions (36-items Short-Form Health Survey; SF-36), PC (Pain Catastrophising Scale; PCS), SF and SS (Index of Sexual Satisfaction; ISS/ Female Sexual Function Index; FSFI).*

Results. *FM patients had a significantly higher PP both as compared to RA and HC ($p<0.002$ for both), and higher PC as compared to HC but not as compared to RA patients ($p<0.03$ and $p<0.64$). When compared to RA patients and HC, they showed a lower quality of life ($p<0.002$ for both comparisons), a compromised SF ($p<0.003$ and $p<0.002$, respectively) and a lower index of SS with respect to HC ($p<0.002$). RA patients had higher PP (VAS; $p<0.002$), lower quality of life and SF as compared to HC ($p<0.002$ and $p<0.003$, respectively).*

Conclusion. *FM and RA patients showed a significantly lower quality of life, SF and SS as compared to HC. PC was significantly related to PP and low quality of life in FM patients, while in RA patients, it negatively affected quality of life and especially the sexual sphere, both when considering SF and SS.*

Introduction

Chronic pain has a prevalence of approximately 30% in the United States of America and 17% in the European countries, and it is extremely widespread throughout the world population (1-5). Chronic pain negatively affects cognition, physical and mental health as it increases stress levels and severely impairs the ability to carry out daily life and working activity (6, 7) in different clinical populations (8-11). Prolonged stressful conditions are sadly famous for negatively affecting many aspects of the psychological and physical health of individuals (12-14). In fact, chronic pain is often considered as the onset of psychological problems and disabilities causing a further quality of life (QoL) lowering and a worsened marital and sexual satisfaction (15-18). While the degree of pain intensity is a fundamental factor in influencing QoL, other factors, such as mood state and coping strategies also play a fundamental role (19-23). Chronic pain is also the main symptom of rheumatological diseases such as fibromyalgia (FM) and rheumatoid arthritis (RA).

General aspects in fibromyalgia and rheumatoid arthritis

FM is a rheumatologic disease characterised by chronicity, musculoskeletal pain, sleep disorders and fatigue on the physical side (24-26). About 2% of the general population suffer from FM; its incidence is particularly high in middle-aged women (27, 28). Although its etiopathogenesis is still unclear, this condition has often been studied in relation to traumatic, stressful situations and inflammatory processes (29-30; 39) Besides chronic pain, FM patients suffer from hyperalgesia, allodynia, muscle rigidity, sexual impairments, impaired

concentration and memory, anxiety, depressive and post-traumatic stress disorders (29, 31-43). Moreover, recent research highlighted that patients rely on both pharmacological and non-pharmacological treatments, often without major improvements (44-46).

RA is a systemic autoimmune inflammatory pathology, with a progressive course evolving towards chronicity (47). RA patients show fatigue, reduced mobility, pain, relational stress, social isolation, and higher disability-related anxiety levels as compared to patients affected by other diseases (48-50). RA patients are often characterised by additional comorbidities including psychiatric disorders such as anxiety and depression, associated with a lower quality of life (51, 52), a heightened perception of pain intensity and a consequent massive use of analgesics, amongst others. RA has also a negative impact on sexuality (53-57).

In both FA and RA conditions, the prevalence of mental health issues and psychological distress is extremely high (58-61). Depression has been demonstrated to display a higher incidence in FM as compared to RA patients, as the former disease may cause significant decline of daily life functioning (42). It is also known that depressive symptomatology associated with an altered immuno-inflammatory response has a negative influence on pain perception both in FM and chronic fatigue syndrome patients, worsening the course of the physical disease (30, 62-68).

The reasons for a disturbed sexual functioning, including dissatisfaction, are multifaceted factors such as generalised pain, fatigue, poor sleep, and rigidity which are at the basis of chronic diseases such as FM and RA (69-71). Furthermore, anxiety and depression have a negative impact on patients' sexual life (72). Apart from the abovementioned studies, sexuality in chronic pain disorders has received little attention, as it is often overlooked and not clinically treated, causing further discomfort in patients (73-75).

Catastrophising, rumination, and sexual impairments

In addition to the psychological consequences of chronic pain and to the negative impact on sexual functioning, several studies highlighted the correlation between cognitive features and chronic pain severity (76). The influence of pain on almost every aspect of everyday life functioning leads the patients to react, often implementing maladaptive coping strategies, such as pain-catastrophising, aiming at the reduction of the perceived pain (77-80). Pain-catastrophising is characterised by a boosting of pain negative effects, brooding on pain and by a sense of being powerless in pain-coping (81-83). Furthermore, it leads the patients to over-exaggerate the perceived pain and in doing so they tend to generate negative and irrational predictions on the future, with a pessimistic and hopeless attitude. In this context, patients show an inability to inhibit thoughts linked to pain, and to divert the attention from pain (84-93). Some studies have shown that pain catastrophising can be a significant predictor of pain intensity and comorbidity with depressive symptoms (94-95). Other studies have revealed that catastrophising negatively influences the perception of pain in many chronic pain pathologies such as FM, RA, and osteoarthritis (85). Pain-catastrophising seems to be responsible for hypervigilance, low level of QoL and sexual dysfunction (97).

Based on evidence from previous literature, this study aims at: 1) investigate differences between RA and FM in relation to sexuality, pain-catastrophising response and QoL, comparing the two pathological group with a cohort of age and gender-matched healthy controls subjects, and 2) at exploring specific relationships between sexuality, pain-catastrophising and QoL.

Materials and methods

Participants

Fifty-seven native Italian-speaking female individuals (FM=40; RA=17) were recruited at the Operative Unit of Rheumatology, S. Chiara Hospital (Pisa, Italy). RA and FM diagnosis were made in accordance with the American College of Rheumatology (ACR) criteria (2010). As a control group, 38 healthy female volunteers were enrolled in the study, from a sample of 50 individuals. The participants underwent to a semi-structured interview and were included on the basis of the following criteria met: i) age ≤55 years; ii) female gender (these two criteria were chosen with the aim of having a control group matching the patients' groups in terms of age and gender); iii) engagement in a stable personal relationship; iv) absence of other inflammatory diseases or v) psychotic symptoms or vi) speech disorders. Informed and written consent was obtained from all participants in the study. For each participant, three demographical features were collected: age, marital status, and presence/absence of menopause.

Psychometric measures

Five psychometric tests were administered to each participant:

- *Visual Analogue Scale (VAS).* The Visual Analogue Scale is a measurement instrument which can be used to investigate pain intensity (96, 98). In general, the VAS scale is used to measure any characteristic that is believed to range across a continuum of values. It can be viewed as a horizontal line with a fixed length whose edges are defined as the lower and higher limits of pain experience (99).
- *36-item Short-Form Health Survey (SF-36).* The SF-36 (100) is a survey test on the subject's health status. The questionnaire has 8 subscales: physical functioning, role limitations due to physical problems, bodily pain, general health perceptions, vitality, social functioning, role limitations due to emotional problems and general mental health. Each subscale has a maximum score of 100 (the higher the score, the higher the level of perceived health) (101).
- *Pain Catastrophising Scale (PCS).* The Pain-Catastrophising Scale (81) is a psychometric instrument used to investigate the tendency to magnify the threat value of physical pain. The PCS helps to quantify the subjective pain experience asking the individual what their feelings and thoughts are when they experience pain. The Scale consists of 13 items divided into 3 subscales: helpless-

ness, rumination, and magnification. Items' scores range from 0 (not at all) to 4 (all the time) on a Likert scale. Higher scores indicate a higher tendency towards catastrophising. The maximum total score is of 52. The PCS has been demonstrated to be a reliable instrument for measuring catastrophic thinking related to pain both in clinical and non-clinical populations (102).

- *Index of Sexual Satisfaction (ISS).* The Index of Sexual Satisfaction (ISS) (104) is used to measure the level of sexual discord or dissatisfaction perceived by an individual with respect to the sexual relationship with his/her partner. The scale consists of 25 items presented on a 7-point Likert scale. The total score can vary between 0 and 100. Higher scores indicate a lower satisfaction with respect to the sexual component of a relationship. Individuals with an overall score higher than 30 points (cut-off point) are considered as suffering from a sexual dysfunction. In the present study the Italian version of the ISS was used. This version was obtained from the English one using a standard translation procedure (*i.e.* one bilingual researcher translated the ISS from English into Italian, another bilingual researcher independently back translated the Italian version into English; any emerging discrepancy was corrected by an agreement between the two).
- *Female Sexual Function Index (FSFI).* The Female Sexual Function Index (FSFI) (103) is a self-assessment questionnaire consisting of 19 items. The FSFI was developed as a multidimensional instrument for the assessment of key aspects of females' sexual functioning. The questionnaire covers six domains: sexual desire, sexual arousal, lubrication, orgasm, satisfaction, and discomfort/pain. Each domain is evaluated using a Likert-scale (score range 0-5). The maximum total score is 30. Low scores indicate impaired sexuality.

Statistical procedures

Between-group differences in marital status and percentage of subjects with menopause were assessed using Fisher's exact test. For each subject, the score of each administered psychometric test was then estimated. Except when otherwise stated, descriptive statistics are presented as mean ± standard error.

Age and psychometric tests (VAS, SF-36, PCS, ISS and FSFI) were submitted to a one-way ANOVA with *group* (FM, RA, HC) as a between-subject factor. For each ANOVA, the *group*-effect significance was estimated conducting a permutation test (2000 randomisations) on the F-statistics (105) This procedure was chosen as permutation tests are robust to violations of parametric statistics assumptions such as non-normality and heteroscedasticity (106), and thus well-suited for statistical analyses on datasets with relatively small and unbalanced sample sizes.

All variables showing a significant *group*-effect (here and in the following, *p*-values lower than 0.05 will be considered significant), were then submitted to a post-hoc analysis with the aim of assessing which couples of groups showed significant differences. Post-hoc analyses were conducted using t-statistics permutation tests based on 2000 randomisation (unpaired samples) (105).

For each variable, *post-hoc p*-values were adjusted applying Bonferroni-Holm correction for multiple comparisons (107).

For each group, associations between perceived pain, quality of life, sexuality, and pain catastrophising were then assessed submitting each dataset to a Principal Component Analysis (PCA) with a varimax rotation. The suitability of each dataset for a structure detection procedure (*i.e.* PCA), was verified using Bartlett's test of spherici (108) and Kaiser-Meyer-Olkin Measure of Sampling Adequacy (109). Bartlett's test verifies whether the correlation matrix between dataset's variables is significantly different from an identity matrix. *p*-values less than 0.05 indicate the existence of correlations between variables and hence the suitability of the dataset for a structure detection procedure. The Measure of Sampling Adequacy is a statistic that indicates the proportion of variance in the dataset's variables that might be caused by common underlying factors. Values higher than 0.50 indicate that the dataset's variables share an adequate level of variance with each other, hence the appropriateness of a PCA.

For each PCA the number of retained components was determined using the scree- test in line with Laurino *et al.* (110) (Fig. 1).

For each group and retained component, the variables loadings were then extracted. Component loadings are the correlation coefficients between each variable and the component itself. When two or more variables have significant loadings on the same component, this provides indication of the existence of a common underlying process contributing to the variables' behaviour. For each group, the loadings' significance was assessed using a single threshold test for the maximum r-statistics (111) (see Supplementary Material, SM-S1), thus dealing with the multiple testing issue that

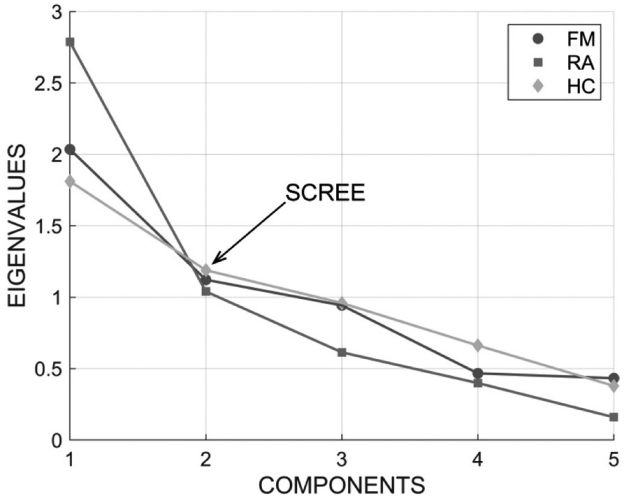

Fig. 1. Eigenvalues distributions for the three groups (FM, RA, and HC) are presented. The scree-test applied to the eigenvalue's distributions related to each group was used to estimate the number of PCA components to retain.
The scree point (corresponding the second eigenvalue for all the three groups), is indicated by a black arrow.

Table I. Descriptive statistics of demographics features are presented for the three groups along with the statistics of the related between-group test. Differences in marital status and menopause were assessed using Fischer exact test while for age a using a one-way ANOVA with permutation test on the F statistics. For marital status and menopause, the Chi^2 and the related *p*-value are reported, while for age the F-value along with the critical F-value for significance at 0.05 (based on 2000 randomisations of the original dataset) along with the related *p*-value are reported. For age, descriptive statistics are presented as mean ± standard error, while for marital status, the number of married and non-married subjects are reported. Similarly, for menopause, the number of subjects in menopause and those not, are reported.

	Groups			Group-effect	
Variables	FM	RA	HC	statistics	*p*-value
Age	44.5 ± 7.0	43.8 ± 7.6	42.1 ± 6.4	F = 1.26 ($F_{0.05}$ = 3.04)	0.285
Marital status (married yes-no)	26 - 14	12 - 5	22 - 16	Chi^2 = 0.91	0.634
Menopause (yes-no)	10 - 30	5 - 12	5 - 33	Chi^2 = 2.51	0.285

FM: fibromyalgia; RA: rheumatoid arthritis; HC: healthy controls.

Table II. Descriptive statistics of psychometric scales are presented for the three groups along with the statistics of the related one-way ANOVA with permutation test on the F-value. For each between-*group* test the critical F-value for significance at 0.05 (based on 2000 randomisations of the original dataset), along with the test F-value and the related *p*-value are reported. Significant *group*-effects are highlighted in bold letters.

	Groups			one way ANOVA		
Variables	FM	RA	HC	$F_{0.05}$	F-value	*p*-value
VAS	4.2 ± 0.3	3.5 ± 0.4	2.4 ± 0.2	2.92	**45.97**	**0.001**
SF-36	35.2 ± 5.6	48.9 ± 10.4	76.5 ± 4.1	3.09	**60.91**	**0.001**
PCS	9.1 ± 1.1	8.0 ± 1.9	7.1 ± 1.1	3.18	**3.32**	**0.045**
ISS	34.9 ± 5.8	26.5 ± 8.3	20.6 ± 3.8	3.01	**8.01**	**0.006**
FSFI	2.9 ± 0.6	3.3 ± 0.9	4.4 ± 0.3	3.14	**10.20**	**0.001**

FM: fibromyalgia; RA: rheumatoid arthritis; HC: healthy controls.

Table III. Results of post-hoc analyses for the psychometric variables. For each *post-hoc* the critical t-value for significance at 0.05 (in absolute value, based on 2000 randomisations of the original dataset), along with the test t-value and the related *p*-value (after Bonferroni-Holm correction), are reported.

	FM-HC			RA-HC			FM-RA		
Variables	$\|t_{0.05}\|$	t-value	*p*-value	$\|t_{0.05}\|$	t-value	*p*-value	$\|t_{0.05}\|$	t-value	*p*-value
VAS	2.02	**9.79**	**0.002**	2.01	**4.96**	**0.002**	1.93	**2.61**	**0.006**
SF-36	2.06	**-11.79**	**0.002**	2.00	**-5.96**	**0.002**	1.95	**-2.50**	**0.020**
PCS	2.00	**2.64**	**0.021**	2.01	0.83	0.639	2.08	1.01	0.639
ISS	2.04	**4.06**	**0.002**	1.95	1.49	0.246	2.12	1.60	0.246
FSFI	1.95	**-4.65**	**0.002**	1.97	**-3.18**	**0.003**	2.04	-0.72	0.500

arises when considering simultaneous testing on multiple correlations. The single threshold test for the maximum r-statistics was chosen as, (a) it does not require any assumption on data normality and, (b) is a simple yet robust approach to control for type I statistical errors (*i.e.* rejection of a true null hypothesis). All statistical analyses were conducted using tailored codes written in Matlab (MathWorks, Natick, MA, USA).

Results

Demographics

The three groups did not differ either in age, marital status, or percentage of subjects with menopause (Table I).

Psychometric evaluation: between-group differences

Descriptive statistics of psychometric variables for the three groups are reported in Table II. A significant *group*-effect (Table II) was found for all psychometric tests and post-hoc analyses were conducted accordingly (Table III). FM and RA patients had significantly higher perceived pain scores (VAS) as compared to the healthy controls ($p<0.002$ for both comparisons). FM patients had higher VAS scores also when compared with RA patients ($p<0.006$, see Table III and Fig. 2, panel A). Both FM and RA patients had a significantly lower quality of life (SF-36, $p<0.002$ for both) as compared to healthy controls. FM patients had a lower quality of life also when compared to RA patients ($p<0.02$), (Table III and Fig. 2, panel B). The FM group had significantly higher Pain Catastrophising (PCS) and lower Index of Sexual Satisfaction (ISS) scores as compared to controls ($p<0.03$ and $p<0.002$, respectively, Fig. 1 panels C-D). Sexual functioning scores of both FM and RA groups were significantly lower than those of healthy subjects ($p<0.001$ and $p<0.02$ respectively, Fig. 2, panel E).

Group-wise associations between psychometric variables

Each group was submitted to a PCA with a varimax rotation. As a first step, the suitability of each dataset for a PCA was verified based on Bartlett's test of sphericity and of Kaiser-Meyer-Olkin Measure of sampling adequacy (see SM-S2). For each group, two components were extracted based on the screeplot test (Fig. 1 and SM, S2). For each group, the loadings of the psychometric tests scores on the retained components were estimated and their significance assessed using a single threshold test for the maximum r-statistics (111).

The FM group was characterised by significant positive loadings of VAS and PCS, and a negative loading of SF-36 on the first PC ($p<0.001$ for all three variables) and by significant loadings of ISS and FSFI on the second PC (the former positive, the latter negative, $p<0.001$ for both), as apparent from Figure 3, panel A and Table IV.

The RA group had significant positive loadings of PCS and ISS on the first PC ($p<0.001$ and $p<0.05$, respectively) paralleled by negative loadings of both SF-36 and FSFI ($p<0.001$ for both) and

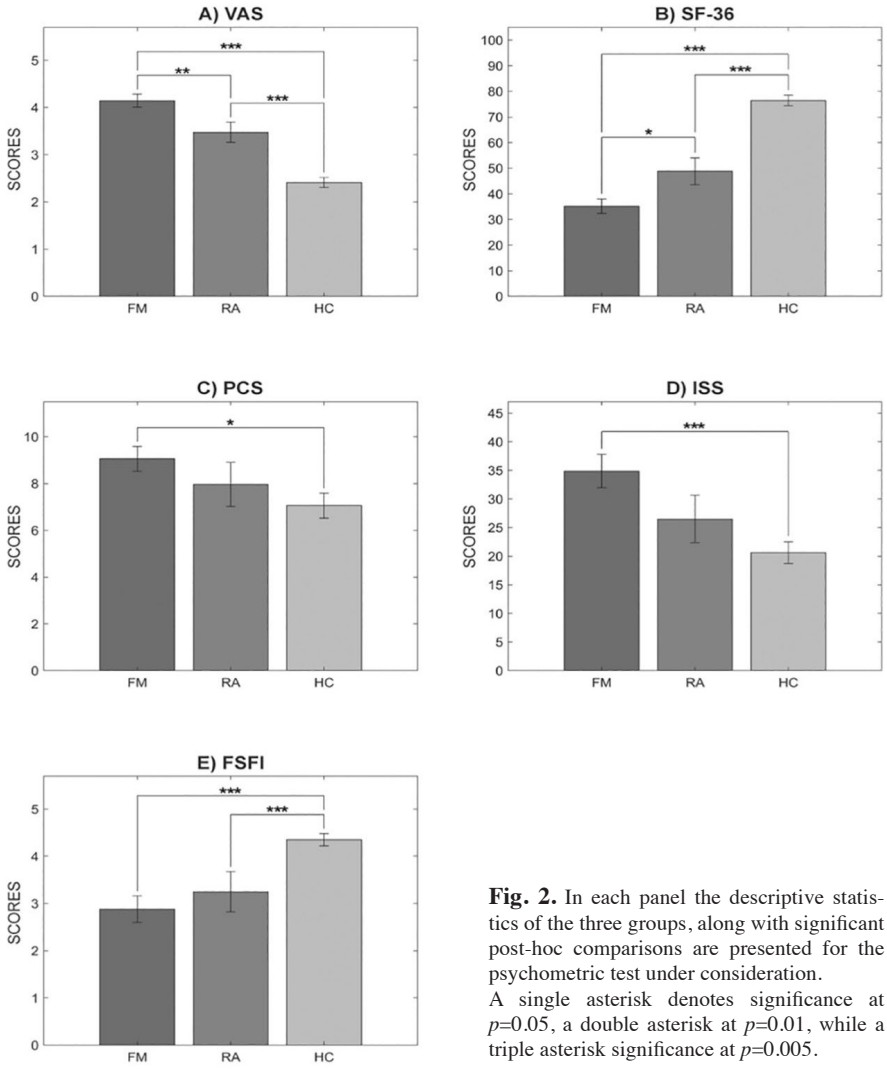

Fig. 2. In each panel the descriptive statistics of the three groups, along with significant post-hoc comparisons are presented for the psychometric test under consideration.
A single asterisk denotes significance at p=0.05, a double asterisk at p=0.01, while a triple asterisk significance at p=0.005.

a positive loading of VAS on the second PC (p<0.001, Fig. 3, panel B and Table IV).
Finally, the HC group had a positive loading of PCS and a negative one of SF-36 on the first PC (p<0.001 for both) on the first component as well as positive loadings of both VAS and ISS on the second PC (p<0.001 for both) (Fig. 3, panel C and Table IV).

Discussion

As expected, a higher perceived pain represents a common feature of the FM and RA groups and this result is in line with previous the literature (112-115). Not surprisingly, in our sample the scores related to perceived pain were higher for FM and RA as compared to healthy subjects, consistently with previous empirical studies (116-117). Furthermore, results from the VAS were significantly higher in the FM group also when compared to RA patients, indicating an already known tendency of FM patients to suffer and complain of pain differently from other rheumatological diseases' patients (118-120). Regarding pain intensity and catastrophising, FM patients were more inclined to catastrophising pain (p<0.03) as compared to healthy controls (their PCS score was higher also than that of the RA group although the difference was not significant). This result may be consistent with the presence of a set of cognitive ruminations and negative beliefs related to pain perception in FM individuals as compared to healthy controls (121-122). The use of maladaptive coping strategies could explain the higher intensity level of pain experienced by individuals with FM, as they are more susceptible to develop catastrophic thoughts and perceive painful stimuli more intensely (97, 123-124).
QoL was significantly compromised in the FM group both as compared to the RA and to the healthy controls' groups. This finding could be related to the higher pain intensity and the greater tendency to catastrophise pain (65, 67, 77, 125-126). Previous studies have shown that the quality of life in patients suffering from chronic pain is profoundly compromised (127-129).
When looking at PCA results, the sexual life of FM patients was not significantly affected either by the tendency to catastrophise pain or the perceived pain (both FSFI and ISS had significant loadings on the second principal components), which instead had a significant negative effect on QoL (PCS and VAS had significant positive loadings and SF-36 a significant negative loading on the first principal component). On the other side a lower sexual functioning (FSFI) was associated with a lower sexual satisfaction (ISS, Table IV4 and Fig. 3, panel A). When considering the RA group, a higher tendency to catastrophise pain was associated to a lower QoL, together with a lower sexual satisfaction and functioning. These parameters were not correlated with perceived pain intensity (VAS), as the formers had all significant loadings on the first principal component while the latter had a significant loading on the second component (Fig. 3, panel B). Regarding the healthy controls, a higher tendency to catastrophise pain was associated with a lower QoL (first principal component), while a heightened pain perception was significantly associated with a higher sexual disfunction (Fig. 3, panel C). By inference, pain catastrophising seems not to affect sexual life in FM patients, while it plays a pivotal yet negative influence on sexual satisfaction and functioning in RA patients (130).
According to previous literature, a higher level of sexual dysfunction is observed in individuals with FM and RA compared to healthy controls (57, 131, 132).
At this point we believe that some considerations on the possible limitations of the study are due:

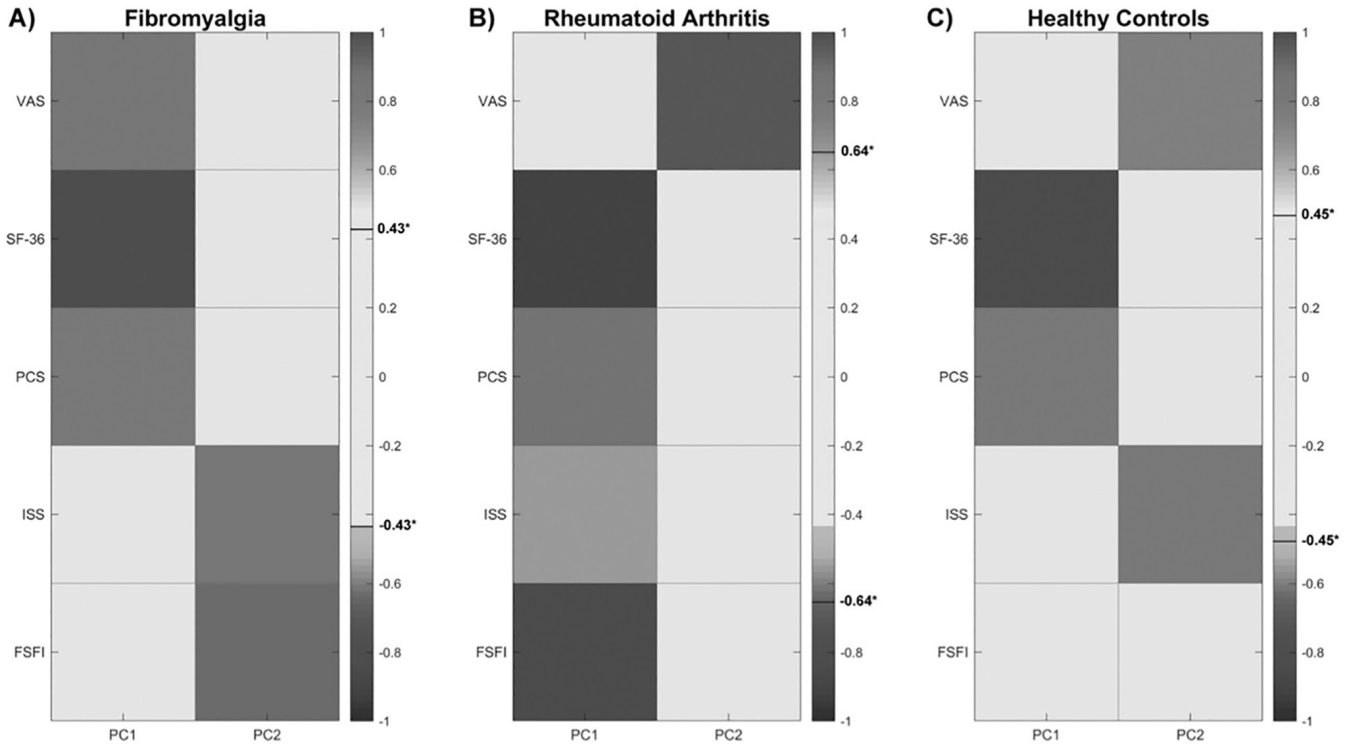

Fig. 3. In each panel, significant loadings of the psychometric variables on the retained principal components are presented (red tones indicate positive and blue tones negative loadings). For each panel the threshold for significance at $p<0.05$ is indicated on the colourbar. Non-significant loadings are left uncoloured.

- owing to the cross-sectional nature of the study, we are unable to demonstrate a causal inference between variables;
- the patients were recruited using a non-probability sampling method (convenience sampling), meaning that the enrolment was influenced by the department's availability of patients at the time of recruitment;
- the use of self-reported measures could have influenced data collection, possibly leading to an external bias. In fact, patients were asked to fill in questionnaires while waiting for their rheumatologic check-ups, thus stressing the patients' attention and focus abilities.

The results of the present study confirm the influence of chronic pain on QoL and on the sexuality dimensions in FM and RA patients as already suggested by several investigations (85, 94-95). Although our results point towards a strong influence of chronic pain on quality of life and sexual satisfaction, further prospective and longitudinal studies are needed to better clarify which factors, in association with chronic pain, could contribute most to this worsening.

Table IV. For each group, the variables loadings on the selected PCs are presented along with the corresponding *p*-values.

		PC1		PC2	
Group	Variables	r-value	*p*-value	r-value	*p*-value
FM	**VAS**	**0.83**	**0.001**	0.02	1.000
	SF-36	**-0.83**	**0.001**	0.18	0.949
	PCS	**0.81**	**0.001**	0.17	0.967
	ISS	-0.05	1.000	**0.82**	**0.001**
	FSFI	-0.04	1.000	**-0.62**	**0.001**
RA	**VAS**	0.15	1.000	**0.97**	**0.001**
	SF-36	-0.92	**0.001**	0.08	1.000
	PCS	0.89	**0.001**	0.07	1.000
	ISS	0.65	**0.043**	0.35	0.791
	FSFI	-0.84	**0.001**	-0.02	1.000
HC	**VAS**	0.32	0.398	**0.74**	**0.001**
	SF-36	**-0.84**	**0.001**	-0.26	0.694
	PCS	**0.79**	**0.001**	-0.01	1.000
	ISS	-0.36	0.237	**0.80**	**0.001**
	FSFI	0.32	0.397	0.11	1.000

In conclusion, taken together, the findings of the present study highlight the adverse effects of the tendency to catastrophising pain on perceived pain, sexuality, and quality of life in patients with chronic pain. Based on these findings, we suggest that the medical treatment of chronic diseases such as Fibromyalgia and Rheumatic Arthritis should be complemented by psychological therapies/counselling aiming at helping the patients in developing adaptive coping strategies for chronic pain management and its psychological consequences.

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