EJR European Journal of Rheumatology

DOI: 10.5152/eurjrheum.2015.0005

Original Investigation

Rumination modulates stress and other psychological processes in fibromyalgia

Katrina Malin, Geoffrey Owen Littlejohn

Abstract

Objective: Fibromyalgia (FM) is characterized by widespread pain and high levels of sleep disturbance, fatigue, and altered cognition. Psychological stress can modulate these features. In this study, we examined the thinking style of rumination in women with FM to assess the effect of rumination on stress levels and other psychological variables in FM.

Material and Methods: Ninety-eight women with FM completed questionnaires to assess levels of rumination, stress, anxiety, depression, optimism, control, and coping. T-tests and bivariate (Pearson) analysis was performed to assess relationships between rumination and other psychological factors.

Results: We found that those with higher levels of rumination had increased the use of negative coping techniques ($p<0.001$), higher anxiety ($p<0.001$), depression ($p<0.001$), and poor sleep levels ($p<0.05$). Higher rumination correlated with lower optimism ($p<0.001$) and control (Mastery) ($p<0.001$). High rumination correlated strongest with stress ($p<0.001$). Rumination predicted 26% of variance for perceived stress.

Conclusion: Rumination influenced several psychological processes deemed important in FM and was an important contributor to stress in FM. Specific interventions targeting rumination in FM may improve FM symptoms and outcomes.

Keywords: Fibromyalgia, rumination, pain, attitude, stress, clinical features

Introduction

Fibromyalgia (FM) is characterized by widespread pain and high levels of sleep disturbance, fatigue, and altered cognition. Psychological stress can modulate these features and may also trigger flare-ups. In turn, various other psychological processes may have an impact on stress levels in patients with FM. These include certain personality styles, levels of control, coping, and anxiety.

Furthermore, different styles of thinking contribute to the severity and maintenance of FM. Important examples are catastrophization and rumination. Catastrophization is a thinking style that involves thoughts that are exaggerated by a threatening situation, whereas rumination is a thinking style that generates recurrent, repetitive, intrusive, and uncontrollable thoughts. Both of these thinking styles can induce emotional distress. They do this in different ways.

Thought content is important in catastrophization. The individual's perceived level of threat produces negative thoughts associated with the situation and as such, exaggerates the subsequent reaction to it. Whether or not the threat is actual or anticipated makes no difference. In patients with pain catastrophization, there is a strong correlation with pain levels, increased pain behavior, more medication use, and increased use of the health care system, including longer hospital stays (1). Cognitive appraisals mediate catastrophization (2).

In contrast to catastrophization, the actual thought content in rumination does not matter (3). The obsessive return to the same thought processes and the characteristic of rumination have an impact on an individual's ability to switch their attention between different ideas and also inhibits thinking derived from past tasks. Ruminating individuals who try to switch the focus of their thoughts develop significant difficulties in managing psychological influences, such as anxiety and depression. Moreover, ruminating individuals are more likely to present with perseveration errors and slower psychomotor speeds on cognitive tests (4). Therefore, the level of psychological performance is impaired, and stress levels are increased.

Thinking styles also have an impact on psychological disorders. Catastrophization correlates with heightened anxiety and depression levels. Inadvertently, this relationship produces an increased level of stress,

Departments of Medicine and Rheumatology, Monash University and Monash Health, Melbourne, Australia

Address for Correspondence: Katrina Malin, Departments of Medicine and Rheumatology, Monash University and Monash Health, Melbourne, Australia

E-mail: katrina.malin@bigpond.com

Submitted: 22.01.2015
Accepted: 07.05.2015
Available Online Date: 21.08.2015

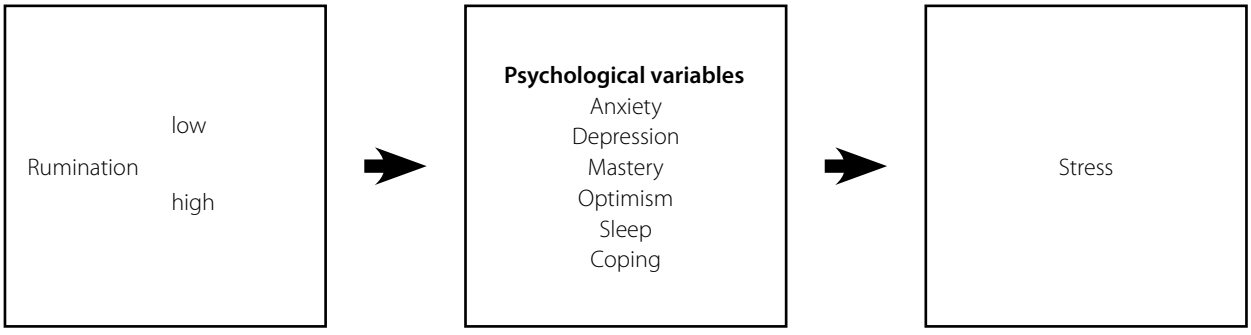

Figure 1. The study model used different levels of rumination to examine the role of this thinking style in patients with FM. Associations were sought between rumination level and selected "psychological" variables felt to be important in contributing to stress in patients with FM

directly threatening well-being (1). Rumination typically directs the individual to repetitively focus on symptoms of distress and the causes and consequences of their predicament without improving the ability to solve the problem at hand. Rumination predicts depression and anxiety (5, 6). Furthermore, rumination is the central component to hypochondriasis (defined as the preoccupation of having a serious injury or condition) that has the potential to create distress (7). There is an associated biological stress response to rumination with heightened immune responses, elevated cortisol levels, increased heart rate, and hypertension (8, 9).

Thinking styles may also interact with coping that is defined as cognitive and/or behavioral tactics used to deal with external or internal demands (perceived or actual) on one's self. There is limited information regarding FM and coping ability; however, it is generally accepted that poor coping is an adverse modulator of FM symptoms (10-13). Both catastrophization and rumination may interfere with appropriate coping in FM.

It has been proposed that the development of FM involves an important interaction between cognitive/thinking style and the symptom of pain; however, it is unclear where and how in the FM cascade that this relationship first becomes important (14) and also whether this association is cause or effect. While there are a number of studies that have focused on catastrophizing in FM, in this study, we focus only on rumination. We specifically chose to study the effect of rumination on selected "central" variables that appear important in the pathogenesis of FM.

We have previously demonstrated that there is a significant relationship between stress and FM phenotype of pain, poor sleep, fatigue, and altered cognition (15, 16). We hypothesized that higher levels of rumination would be associated with psychological variables that are linked to stress itself. These variables include mood, control, optimism, sleep, and coping (Figure 1). We aimed to examine the role of rumination thinking style in FM and to explore whether this thinking style is important. We aimed to examine the role of rumination thinking style and to explore whether this thinking style contributes to stress levels in FM. Furthermore, we wished to examine elements of coping that are associated with rumination and their subsequent influence on stress levels in patients with FM.

Material and Methods

Ethics approval was obtained from the relevant committees of Monash University and Monash Medical Centre, Melbourne, Australia. Participants were women who volunteered and were sourced from various areas, including a FM self-management program, notices in local newspapers, a FM treatment clinic, and local rheumatologists. Ninety-eight female patients with FM who fulfilled the American College of Rheumatology (ACR) 1990 classification criteria were included. There were no exclusion criteria for this study.

Participants were sent written information regarding the study along with a consent form, which when signed was followed by a series of questionnaires. These included the Fibromyalgia Impact Questionnaire (FIQ), (17, 18) Perceived Stress Scale (PSS), Mastery scale, and a rumination statement.

The following instruments were applied to all participants with FM;

Fibromyalgia impact questionnaire (FIQ): A validated 20-item functional ability questionnaire, which measures how an individual's symptom characteristics impact his/her daily functioning for the preceding week. Individual subscales include sleep, depression, anxiety, and pain and use a 0–10 cm visual analogue scale, with the extreme left of line representing "no impact of subscale" to the far right representing "worst possible impact" (18).

Perceived stress scale (PSS): A validated scale that assesses the degree to which an individual experiences feelings of being overwhelmed by stressful life events over the previous month. It is 10-item scale, 5-point Likert scale ranging from 0 (never) to 4 (very often) with scores ranging from 0 to 40 (19).

Mastery scale: A scale that was designed to explore how an individual felt their life was either under their own control or controlled by external forces. A 4-point Likert scale ranging from 1= strongly agree to 4= strongly agree. A high score indicates high level of mastery (20).

Rumination question, perceived control of internal states scale (PCOISS): We used the rumination question from PCOISS. This is stated as "I find it hard to stop myself from thinking about the problem." Ninety-one patients responded to this question. The responses on a Likert scale from 1= strongly agree to 5= strongly disagree were explored with the data showing an equal spread between agree and disagree (37 and 29, respectively) and between totally agree and totally disagree (n=3 for each). We then divided the group into three according to their responses to the question. We compared the two tertiles of patients who responded to the question as strongly agree/agree (n=40) and strongly disagree/disagree (n=32) and excluded the patients with neutral scores (n=19). The internal reliability of this single item was 0.89 (21).

Table 1. Demographic variables of fibromyalgia participants in the study

Age	%	Marital Status	%	Education	%	Work Status	%	Occupation	%	Income	%
18–29	8.7	Single	6.5	Secondary	43.5	Full time	17.4	Semi-professional	25.0	<$20,000	38.6
30–39	18.5	Sig relationship	7.6	Tertiary	41.4	Part time	34.8	Professional	20.7	$20–40,000	33.7
40–49	22.8	Married/Defacto	70.6	Higher degree	14.1	Casual	7.6	Self-employed	3.3	$41–60,000	14.5
50–59	31.5	Separated	2.2					Retired	14.1	$61–80,000	3.6
60–69	18.5	Divorced	13.0					Unemployed	3.3	+$100,000	6.0
								Home/Caring	19.6		
								Student	4.3		

Table 2. Means, Standard deviation, t–test analyses for low and high levels of rumination within the FM sample group

	Rumination						
	Low		High		t tests		
Coping variables	Mean	SD	Mean	SD	t	df	Sig
Distraction	5.38	1.66	4.63	1.48	-8.7	74	0.05
Self-blame	2.90	1.22	4.39	1.84	4.56	73	0.001
Behavior disengagement	2.41	0.67	3.24	1.66	3.40	73	0.001
Acceptance	6.45	1.29	5.51	1.46	2.67	72	0.01
Denial	2.41	0.87	2.66	1.15	0.91	74	NS
Substance abuse	3.44	1.74	3.53	2.06	0.23	74	NS
Emotional	5.03	1.80	4.82	2.04	-0.03	74	NS
Instrumental	5.03	1.92	4.89	1.66	0.19	72	NS
Venting	3.94	1.48	4.00	1.31	0.37	73	NS
Positive reframe	5.00	1.53	4.47	1.72	-0.89	73	NS
Planning	5.70	1.68	5.19	1.65	-0.40	71	NS
Humor	4.16	1.83	3.50	1.66	-0.96	73	NS

FM: fibromyalgia; SD: standard deviation; NS: not significant; df: degrees of freedom; Sig: significance

Table 3. Means, standard deviation, and t-test analyses of mood, psychological factors, and sleep for low and high levels of rumination in the FM group

	Low rumination		High rumination				
	Mean	SD	Mean	SD	t test	df	p
Stress	22.67	4.27	24.91	7.01	-4.96***	67	0.001
Anxiety	1.00	1.35	1.91	1.81	-4.88***	68	0.001
Depression	0.58	1.08	1.64	1.96	-4.42***	68	0.001
Optimism	22.42	3.82	19.60	4.43	2.68**	67	0.01
Mastery	17.66	2.51	14.97	3.30	3.72***	65	0.001
Sleep	1.83	1.47	3.73	3.10	-2.29*	67	0.05

df: degrees of freedom; SD: standard deviation

The cope: This is a multidimensional inventory that assesses different ways an individual responds to stressors with a 4-point Likert scale 1= I usually do not do this at all to 4= I usually do this. The cope assesses two main approaches to coping, either problem focused or emotion focused as well as coping responses. Each of these measures contains subgroups exploring further elements. The subgroups include

Table 4. Bivariate and partial correlations between stress and low and high levels of rumination for psychological variables within the FM group

Correlations	Bivariate correlations	Partial correlation	Bivariate correlation for ruminators	
	Total FM group (n)	Controlling for rumination	Low	High
	Stress			
Rumination	0.518 *** (94)		NA	
Mastery	- 0.70*** (93)	- 0.62*** (87)	- 0.49** (32)	- 0.60*** (35)
Anxiety	0.65*** (95)	0.52*** (87)	0.44* (32)	0.62*** (37)
Depression	0.64*** (95)	0.49*** (87)	0.44** (32)	0.49** (37)
Sleep	0.48*** (95)	0.38*** (87)	0.40* (32)	0.46** (37)
Optimism	- 0.60*** (94)	- 0.51*** (87)	NS (32)	- 0.67*** (36)
Acceptance	- 0.33*** (94)	- 0.24* (87)	NS (32)	- 0.47** (37)
Distraction	0.27** (95)	0.33** (91)	0.40* (32)	NS
Self-blame	0.57*** (97)	0.42*** (87)	NS (32)	0.56*** (37)
Behavioral disengagement	0.55*** (94)	0.46*** (90)	NS (32)	0.59*** (36)

Significant levels of the correlation coefficients.
*0.05 **0.01 ***0.001
n= number within the group.
NA: not applicable; NS: not significant; FM: fibromyalgia

Table 5. Multiple regression analysis of rumination and coping in the prediction of stress associated with FM

Dependent	Adj. R^2	R^2	Independent	Standardized beta
Perceived stress	48.40	51.20	Rumination	0.26**
F (5, 88)=18.46 p<0.000			Self-blame	0.26**
			Acceptance	-0.16*
			Self-distraction	0.18*
			Behavioral disengagement	0.23*

*0.05 **0.01
Adj: adjusted

those of active coping, planning, restraint, and instrumental support (problem focused); acceptance, denial, and reinterpretation (emotion focused); and venting, behavioral disengagement, and mental disengagement (coping responses) (22).

Initial descriptive analysis was conducted along with normality checks using SPSS (PASW version 21) (IBM, New York, United States). T-test, mean, and standard deviation analyses were used to explore the differences between the groups with respect to the symptom characteristics and stability of personality traits. T-test was performed to compare the differences between the groups that explored levels of rumination (high and low) for coping and psychological factors associated with FM within the FM group. Bonferroni corrections were used as appropriate. Bivariate (Pearson) correlation was used to compare the relationships between the selected psychological variables of FM and levels of rumination. A regression analysis was conducted to assess the variance of rumination in contributing to stress.

Results

The demographic details of the 98 patients with FM are shown in Table 1.

We first compared the lower tertile of rumination to the upper tertile in the FM sample and sought differences in components of the cope instrument (Table 2). Considering the adjustment scores (Bonferroni), self-blame and behavior disengagement demonstrated a significant difference when these two levels of rumination were compared, indicating signifcantly higher use of these coping techniques. While there appeared to be a pattern in that those who used negative coping techniques, i.e., denial, venting, and substance abuse, tended to demonstrate more significant differences than those individuals who used positive coping techniques, these findings were not significant.

Next, we compared the lower tertile to the upper tertile of rumination and sought differences in selected psychological variables (Table 3). It was observed that there was a significant difference between low and high rumination levels and psychological factors and sleep. Compared with high ruminators, low ruminators have significantly lower levels of stress, anxiety, and depression and significantly higher levels of mastery.

Table 4 shows the correlations between rumination and the selected coping and psychological variables. It was observed that rumination had a significant impact on all the psychological variables within the FM population. As expected, for the level of mastery, a significant difference between the low and high ruminator groups was reported. This study demonstrated the relationship between depression and rumination. While there was a difference between FIQ depression in levels of rumination

even with high ruminators, the level of depression is not of clinical significance. With respect to the coping techniques, it was observed that individuals who very rarely ruminated reported significant use of distraction techniques.

Finally, we performed a regression analysis using perceived stress as the dependent variable and assessed the unique variance on the basis of the items identified in Table 4 of the model (Table 5). From this analysis, it was evident that when the impact of stress in the FM individual was examined, the five independent variables explained that 51% of the variance was found in stress. Uniquely, in the model, 26% of the variance is explained each by rumination and self-blame, 16% by acceptance, 18% by self-distraction, and 23% by behavioral disengagement.

Discussion

The psychological construct that thoughts induce emotions that in turn modulate neurophysiological responses is relevant to the pathophysiology of FM. There were links between emotional distress and clinical characteristics of FM. Emotional distress itself was generated by a number of cognitive styles, coping, and control techniques among others. Distress modulated hypothalamic pituitary adrenal axis, autonomic nervous system, and descending pain modulatory pathways. The core symptoms of FM, namely pain, sleep, fatigue, and cognitive dysfunction, follow from these top-down changes. Cognitive or thinking styles appeared to be important in the FM cascade.

Rumination affected the executive style of functioning, in that people who ruminated were said to be unable to "inhabit their thoughts" and thus were unable to divert their attention and maintain their focus on other things. This type of functioning led to a lack of ability in problem solving, inability to inhibit any ongoing responses, and a lack of flexibility in thinking. Moreover, this style of thinking has strong correlations between longer and more entrenched levels of depression (23, 24) and heightened anxiety (14). Notably this style of processing is persistent (25) because even when depressive symptomatology improves, the ruminative style of thinking remains (26). This raises the question of vulnerability to stress for the individual who ruminates, particularly if their coping is poor.

Thinking styles were found to underlie the severity of many of the symptoms associated with FM. In patients with FM of less than two years duration, rumination associated with coping techniques that were linked to fearful avoidance of physical activity. For those individuals with FM of four years and more, appraisal of the actual context of their situation became evident with their thinking style focusing more on an increased sense of helplessness. Rumination is a strong predictor of severity of disability within the first 3 years of FM (27). There are limited studies of neurophysiological processes in patients with chronic pain who have high levels of rumination. One study in such patients with temporomandibular disorder demonstrated dysfunction of the default mode network and its interaction with the descending pain modulatory system (28). This neural connectivity change, linking abnormal thought patterns to biological outcomes in the pain pathways, may have significant relevance to FM.

In this study, we demonstrated that rumination strongly associated with the selected psychological processes that were active in FM, such as mastery, coping styles, anxiety, and depression.

Patients with FM and high levels of rumination had higher levels of anxiety, depression, and negative coping styles and lower levels of mastery and optimism compared with low ruminators. Conversely, low ruminators reported higher levels of skills associated with mastery, and a 50% increase was found in the level of the sleep satisfaction score when compared with high ruminators. Further studies are required to explore the relationship between coping, rumination, and stress.

In this patient cohort, although the levels of depression and anxiety were not at a clinical level that would suggest that either condition had a major impact on the individual there was still a significant trend that the level of rumination influences these psychological variables. Further studies are required to explore this relationship between rumination, mood, and coping.

The association between stress and rumination was the strongest of all the variables tested. High rumination was associated with high stress. We could not define the cause and effect with this cross-sectional methodology; however, we believe that it was likely that rumination generated emotional distress rather than the other way around. We have previously demonstrated that in this same cohort, stress predicted the levels of the characteristic phenotypic clinical features of FM, namely pain, poor sleep, cognition, and fatigue. These results are congruent with the effect of stress on other psychological and functional variables as reported in previous studies (16, 29).

Limitations of this study include the cross-sectional design that allowed only for identification of associations between variables. In addition, the choice of a single item, taken from the PCIOSS, as an operational definition for rumination may have limited the interpretation of the breadth of rumination in this context. However, we did note that the single rumination item used had a strong level of internal consistency (0.89). Thus, we postulated that high rumination levels were likely to increase FM symptoms, and this effect could be mediated through the effects on stress levels and in turn the effect of stress on the FM process.

In conclusion, rumination appeared to modulate a range of important psychological variables, such as coping and optimism, which can either protect or amplify the levels of perceived stress in FM. In the top-down model of FM, stress was deemed to modulate the neurophysiological process that drives the FM process. Rumination appeared to play an important role in this cascade. Better management of rumination in patients with FM may improve their level of symptoms and outcomes.

Ethics Committee Approval: Monash University and Monash Medical Centre, Melbourne, Australia.

Informed Consent: Written informed consent was obtained from participants who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - K.M., G.O.L.; Design - K.M., G.O.L.; Supervision - G.O.L.; Materials - K.M., G.O.L.; Data Collection and/or Processing - K.M., G.O.L.; Analysis and/or Interpretation - K.M., G.O.L.; Literature Review K.M., G.O.L.; Writer - K.M., G.O.L.; Critical Review - K.M., G.O.L.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The author declared that this study has received no financial support.

References

1. Van Damme S, Crombez G, Bijttebier P, Goubert L, Van Houdenhove B. A confirmatory factor analysis of the Pain Catastrophizing Scale: invariant factor structure across clinical and non-clinical populations. Pain 2002; 96: 319-24. [CrossRef]
2. Sullivan MJL, Bishop SR, Pivik J. The Pain Catastrophizing Scale: Development and validation. Psychological Assessment 1995; 7: 524-32. [CrossRef]
3. Martin LL, Tesser A. Some ruminative thoughts. Hillside: NL: Erlbaum; 1996.
4. Davis RN, Nolen-Hoeksema S. Cognitive inflexibility among ruminators and non-ruminators. Cognitive Therapy and Research 2000; 24: 699-711. [CrossRef]

5. Marcus D, Hughes K, Arnau R. Health anxiety, rumination, and negative affect: A mediational analysis. J Psychosom Res 2008; 64: 495-501. **[CrossRef]**
6. McLaughlin KA, Nolen-Hoeksema S. Rumination as a transdiagnotic factor in depression and anxiety. Behav Res Ther 2011; 49: 186-93. **[CrossRef]**
7. Fink P, Ornbol E, Toft T, Sparle KC, Frostholm L, Olesen F. A new empirically established hypochondriasis diagnosis. Am J Psychiatry 2004; 161: 1680-91. **[CrossRef]**
8. Young EA, Nolen-Hoeksema S. Effect of rumination on the saliva cortisol response to a social stressor. Psychoneuroendocrinology 2001; 26: 319-29. **[CrossRef]**
9. Brosschot JF, Gerin W, Thayer JF. The preseverative cognition hypothesis: a review of worry prolonged stress-related physiological activation, and health. J Psychosom Res 2006; 60: 113-24. **[CrossRef]**
10. Johnson LM, Zautra AJ, Davis MC. The role of illness uncertainty on coping with fibromyalgia symptoms. Health Psychol 2006; 25: 696-703. **[CrossRef]**
11. Macfarlane GJ, McBeth J, Silman AJ. Widespread body pain and mortality: prospective population based study. BMJ 2001; 323: 662-5. **[CrossRef]**
12. Bernard AL, Prince A, Edsall P. Quality of life issues for fibromyalgia patients. Arthritis Care Res 2000; 13: 42-50. **[CrossRef]**
13. Boehm A, Eisenberg E, Lampel S. The contribution of social capital and coping strategies to functioning and quality of life of patients with fibromyalgia. Clin J Pain 2011; 27: 233-9. **[CrossRef]**
14. Nolen-Hoeksema S. The role of rumination in depressive disorders and mixed anxiety/depressive symptoms. J Abnorm Psychol 2000; 109: 504-11. **[CrossRef]**
15. Malin K, Littlejohn GO. Psychological control is a key modulator of fibromyalgia symptoms and comorbidities. J Pain Res 2012; 5: 463-71.
16. Malin K, Littlejohn GO. Stress modulates key psychological processes and characteristic symptoms in females with fibromyalgia. Clin Exp Rheumatol 2013; 31(6 Suppl 79): 64-71.
17. Burckhardt CS, Clark SR, Bennett RM. The fibromyalgia impact questionnaire: development and validation. J Rheumatol 1991; 18: 728-33.
18. Burckhardt CS, Clark SR, Bennett RM. The fibromyalgia impact questionnaire: development and validation. J Rheumatol 1991; 18: 728-33.
19. Cohen S, Kamararck T, Mermelstein R. A global measure of percieved stress. Journal of Health and Social Behaviour 1983; 24: 385-96. **[CrossRef]**
20. Pearlin LI, Schooler C. The structure of coping. J Health Soc Behav 1978; 19: 2-21.
21. Pallant JF. Development and validation of a scale to measure perceived control of internal states. J Pers Assess 2000; 75: 308-37. **[CrossRef]**
22. Carver CS, Scheier MF, Weintraub JK. Assesing coping strategies: A theoretically based approach. J Pers Soc Psychol 1989; 56: 267-83. **[CrossRef]**
23. Nolen-Hoeksema S, Larson J, Grayson C. Explaining the gender difference in depressive symptoms. J Pers Soc Psychol 1999; 77: 1061-72. **[CrossRef]**
24. Just M, Alloy LB. The response styles theory of depression: tests and extension of the theory. J Abnorm Psychol 1997; 106: 221-9. **[CrossRef]**
25. Brinker JK, Dozois DJ. Ruminative thought style and depressed mood. J Clin Psychol 2009; 65: 1-19. **[CrossRef]**
26. Nolen-Hoeksema S, Wisco BE, Lyubomirsky S. Rethinking rumination. Perspectives on psychological science. 2008; 3: 400-24. **[CrossRef]**
27. Sullivan MJ, Stanish W, Waite H, Sullivan ME. Catastrophizing, pain and disability in patients with soft tissue injuries. Pain 1998; 77: 253-60. **[CrossRef]**
28. Kucyi A, Moayedi M, Weissman-Fogel I, Goldberg MB, Freeman BV, Tenenbaum HC, et al. Enhanced medial prefrontal-default mode network functional connectivity in chronic pain and its association with pain rumination. J Neurosci 2014; 34: 3969-75. **[CrossRef]**
29. Homann D, Stefanello JM, Goes SM, Breda CA, Paiva Edos S, Leite N. Stress perception and depressive symptoms: functionality and impact on the quality of life of women with fibromyalgia. Rev Bras Reumatol 2012; 52: 319-30.