Vulnerability to Stress Among Women in Chronic Pain From Fibromyalgia and Osteoarthritis

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ABSTRACT

In two investigations, we studied vulnerability to the negative effects of stress among women in chronic pain from 2 types of musculoskeletal illnesses, fibromyalgia syndrome (FMS) and osteoarthritis (OA). In Study 1, there were 101 female participants 50 to 78 years old: 50 had FMS, 29 had OA knee pain and were scheduled for knee surgery, and 22 had OA but were not planning surgery. Cross-sectional analyses showed that the three groups were comparable on demographic variables, personality attributes, negative affect, active coping, and perceived social support. As expected, FMS and OA surgery women reported similar levels of bodily pain, and both groups scored higher than OA nonsurgery women. However, women with FMS reported poorer emotional and physical health, lower positive affect, a poorer quality social milieu, and more frequent use of avoidant coping with pain than did both groups of women with OA. Moreover, the perception and use of social support were closely tied to perceived social stress only among the FMS group. In Study 2, we experimentally manipulated negative mood and stress in 41 women 37 to 74 years old: 20 women had FMS, and 21 women had OA. Participants from each group were randomly assigned to either a negative mood induction or a neutral mood (control) condition, and then all participants discussed a stressful interpersonal event for 30 min. Stress-related increases in pain were exacerbated by negative mood induction among women with FMS but not women with OA, and pain during stress was associated with decreases in positive affect in women with FMS but not women with OA. These findings suggest that among women with chronic pain, those with FMS may be particularly vulnerable to the negative effects of social stress. They have fewer positive affective resources, use less effective pain-coping strategies, and have more constrained social networks than their counterparts with OA, particularly those who experience similar levels of pain. They also seem to experience more prolonged stress-related increases in pain under certain circumstances, all of which may contribute to a lowering of positive affect and increased stress reactivity over time.

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INTRODUCTION

Chronic musculoskeletal pain is the leading cause of disability in the United States. The cost is enormous, including not only the billions of dollars associated with lost productivity and pursuit of pain relief through treatment but also the untold suffering and lowered quality of life among those affected. Efforts to understand chronic pain point to the role of stress as a key factor influencing adaptation, although the possibility that the impact of stress may not be constant across all types of pain conditions has not been extensively explored. In particular, coping with chronic pain that is widespread, unpredictable, and poorly understood may be especially difficult in the face of additional stress. Recent research effort has been directed toward understanding the impact of stress in adaptation to an increasingly common chronic pain condition, fibromyalgia syndrome (FMS) (1,2). FMS is characterized by widespread pain, stiffness, and fatigue and by significant tenderness in specific sites in soft tissue. FMS can account for decades of a poor quality of life, increased risk of clinical depression and disordered sleep, disturbed social relationships, and loss of independent functioning. Approximately 2% of the adult population suffer from FMS (3), but the rates are substantially higher for women, particularly those over 45 years old.

Unlike arthritis, FMS pain does not radiate from inflammation in the joints. The search for etiological factors has focused on possible disturbances of the hypothalamic–pituitary–adrenal and sympathoadrenal axes (4), the inflammatory response system (5), and central and peripheral pain mechanisms (6). Yet, no pathophysiological processes have yet been found to account for the symptoms. Indeed, there is no known physical cause for the pain experienced by those with FMS, and as yet there are no uniformly effective pharmacological agents for the treatment of the condition other than those that provide temporary pain relief. Consequently, those with FMS must cope with a pervasive and debilitating disorder with no apparent cause and little effective treatment. This article examines how patients with FMS respond to their pain condition and life stresses, comparing their responses to another group coping with significant bodily pain, those with osteoarthritis (OA).

Available evidence does in fact suggest that individuals with FMS and similar disorders are especially vulnerable to negative effects from life stress. For example, Wigers (7) found that the experience of major life events was prospectively related to poorer outcomes in a sample of patients with FMS followed over 4 years. In a case-control study of patients with myofascial face pain, a disorder similar to FMS, Lennon, Link, Marback, and Dohrenwend (8) reported that stressful events were more disruptive of the everyday social role pursuits of pain patients compared to healthy controls. An emerging perspective espoused by several investigators from different disciplines is that individual differences in stress responses may be a significant factor determining adaptation in FMS (1,2) and that the apparent heightened vulnerability among those with FMS results at least in part from the maladaptive ways in which they respond to stress and other negative stimuli.

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Data reported by McDermid, Rollman, and McCain (9) support this perspective; they found that individuals with FMS showed lower tolerance both to noise and pressure than did those with OA and healthy controls. This hypersensitivity may extend to stressors that are psychosocial in nature, including interpersonal stress. The extent and impact of interpersonal stress has not been studied extensively in FMS per se, but there is evidence that such stress is associated with poor adaptation in those with chronic illness (10), promoting maladaptive coping (11), lowered coping efficacy (12), and lowered pain thresholds following laboratory stress (13). The few data derived from those with FMS suggest that interpersonal stress may provoke pain reports more readily in patients with FMS even relative to other chronic pain patients (14).

What factors are likely to impede the ability of patients with FMS to respond effectively to stress? One possibility is the affective disturbance that may accompany the disorder. There is evidence that FMS patients report both more negative and less positive affect overall relative to patients with OA (14). Negative affective states have been linked to maladaptive coping responses in patients with FMS and arthritis (14,15), and positive affective states to greater resiliency in the face of negative events. For example, when positive mood is heightened experimentally, healthy individuals show an increased pain threshold (16), report less pain (17), and judge their general health more favorably (18). Furthermore, positive affect hastens recovery from the physiological arousal that accompanies negative affective states (19).

A second factor that may impair responses to stress and other negative stimuli among patients with FMS is the degree to which these individuals are able to adopt effective strategies for managing their illness. For example, Burckhardt and Bejelle (20) reported that only 13% of a sample of patients with FMS believed they were coping successfully with their illness, compared with 30% of those with rheumatoid arthritis (RA). Only 50% believed they themselves could do things to cope, in comparison with 81% of those with RA. Belief that one is coping effectively with everyday life problems is a central ingredient in adaptation to chronic health problems (12,21), including FMS. For example, Nicassio, Schoenfeld-Smith, and Schuman (22) followed 69 patients with FMS 3 months posttreatment and found that differences in coping predicted 10 to 16% of the variability in pre- to postchange in psychological adjustment.

A third key to the stress vulnerability of those with FMS may lie within their social networks. Individuals with a chronic illness respond more effectively to stress when they experience their social environments as supportive, and this may be particularly true for those with FMS (14). Preliminary evidence suggests that relative to other pain populations, those with FMS perceive less support from their social environment (23) and report fewer positive social interactions (14; but see also 24). Moreover, patients with FMS are more likely than healthy individuals to report that family members in their networks do not initiate contact with them (25). To the extent that patients with FMS either lack a reservoir of rewarding social relations or fail to use their available social resources in response to pain and stress, they may experience greater vulnerability to stress and a poorer quality of life relative to those with other chronic pain conditions.

Because stable personality traits may have a marked influence on affective states, coping efforts, and the quality of interpersonal relations (26), any differences in these vulnerabilities between FMS and other pain populations may be attributable in part to individual differences in personality dispositions. For example, locus of control plays a key role in adjustment of older adults (27) and distinguishes between patients with FMS and other chronic pain patients (20). Other dispositional measures may be particularly relevant as determinants of responses to the stress of negative social relations, including interpersonal sensitivity, reflecting a tendency to view social interactions as threatening, and emotionality, reflecting a tendency to become negatively emotionally aroused by a variety of social and nonsocial situations.

Taken together, the extant evidence suggests that there are differences in affect, coping strategies, social environment, and perhaps personality dispositions that distinguish patients with FMS from others in chronic pain. These features may make those with FMS especially susceptible to the negative effects of pain and stress. The purpose of the two studies described in this article was to examine the nature and extent of differences in vulnerability to negative social stress between women with FMS and women with OA, a comparison group that also deals with significant pain. We included only women because FMS is markedly more prevalent in women compared to men, and we focused on the stress of conflictual relationships because the social domain may be the most common and profound source of stress for middle-aged and older women (28). In Study 1, we used a cross-sectional approach to examine the stress of conflictual relationships among women with FMS and among two groups of women with OA. One OA group was scheduled for knee replacement surgery, and the other represented a nonsurgery OA control group. We sought to evaluate whether affect, coping, support, or personality disposition play a role in determining the stress vulnerability of those with FMS. We expected that women with FMS would perceive more interpersonal conflict and show more affective disturbance, and decrements in coping and social support relative to both groups of women with OA. In Study 2, we used an experimental approach to determine whether stress-related changes in pain, affect, and physiological arousal were more pronounced among women with FMS or OA. We focused on affective vulnerability to interpersonal stress by including a manipulation of negative affect, and we examined whether the experience of a negative affective state prior to stress more readily heightens the stress responses of those with FMS versus OA. We expected that pain, negative affect, and cardiovascular activity would increase in response to stress, and that individuals with FMS compared to those with OA would show increased pain during stress, especially when it was experienced in the context of a negative mood.

STUDY 1

Method

Participants

The 50 participants with FMS were women between 50 to 78 years of age (M = 62.00, SD = 7.44) and were recruited from community seminars on FMS held jointly by the Arthritis Foundation and a rheumatology practice in the Phoenix metropolitan area. Participants completed a total of four questionnaire packets. The first packet, distributed at the seminars, included a screening instrument, a pain-coping inventory, and measures of personality dispositions. A second mailer with three weekly questionnaires was sent to participants, who returned one questionnaire packet per week for 3 consecutive weeks. The first weekly packet included a life-event inventory, assessments of perceived stress, and affect. Only data from initial packet and the first weekly packet were used for this study. From among the 124 who completed the initial and first weekly questionnaire packets, 50 women reported that their physicians had diagnosed them with FMS. To confirm the physician diagnosis of FMS, all 50 women completed a self-report screening instrument (L. J. Bradley, personal communication, July 1997; described later). In addition, 25 of the 50 participants underwent a multiple tender point examination (MTPS, described later) conducted by a trained nurse. All 50 women obtained high scores on the FMS screening scale, and all 25 evaluated through the MTPS also showed significant tenderness. Women in the FMS group were not excluded if they also reported having OA.

The 51 participants with OA were drawn from an Arthritis Foundation funded study of Psychosocial Factors in Recovery from Total Knee Replacement Surgery (Alex J. Zautra, Principal Investigator). Twenty-nine of these participants had significant knee pain and were about to have surgery. An additional 22 participants were patients with OA who reported significant OA pain but were not scheduled for surgery. To be eligible for participation in our study, women with OA had to report that a physician had diagnosed their OA and that they did not have FMS. All participants with OA responded to the same questionnaires following the same format as did the participants with FMS.

Measures

Diagnosis. The MTPS was employed as one tool to determine an FMS diagnosis. The MTPS consists of the application of mild pressure to 18 tender points. Patients were considered to have met criteria for FMS if they reported significant pain in 11 of 18 tender points (29). Following the recommendations of Okifuji, Turk, and Marcus (30), significant pain was defined as a pain rating greater than 2 on an 11-point scale ranging from 0 (*no pain*) to 10 (*worst pain you have ever experienced*). Okifuji and colleagues found that using 2 as a threshold point allowed them to successfully discriminate patients with FMS from chronic headache patients with high sensitivity and specificity.

A second measure of FMS symptomatology, the FMS Self-Report Screening Instrument, is composed of 17 items asking about the frequency of FMS-related symptoms, each rated on a 4-point scale ranging from 1 (*never*) to 4 (*always*). Six of 17 items were selected by L. J. Bradley (personal communication, July 1997) to form a screening inventory consistent with criteria established in an FMS population prevalence study (3). To be classified as FMS positive, participants had to have met the following four criteria: (a) poor sleep quality, (b) muscular pain, (c) morning stiffness, and (d) muscular pain below the waist.

Pain and functioning. Aspects of pain and functioning were assessed with four subscales of the Short Form–36 (SF–36) (31): Bodily Pain (BP), General Health (GH), Physical Functioning (PF), and Mental Health (MH). The BP subscale is composed of 2 items that assess the degree of bodily pain experienced during the past week, ranging from 1 (*none*) to 6 (*very severe*), and of its interference with normal work, ranging from 1 (*not at all*) to 5 (*extremely*). The GH subscale is based on a single item rating current health on a 5-point scale ranging from 1 (*excellent*) to 5 (*poor*). The PF subscale is derived from 10 items that assess the extent to which participants are currently limited in their ability to engage in a variety of daily activities, rated on a 3-point scale ranging from 1 (*yes, limited a lot*) to 3 (*no, not limited at all*). The MH subscale comprises 5 items assessing the extent to which participants have experienced emotional well-being during the past week, with each rated on a 6-point scale ranging from 1 (*all of the time*) to 6 (*none of the time*). All subscales were transformed by the SF–36 scoring program to range from 0 to 100, with higher scores indicating better health. Internal consistencies for the PF, MH, and BP subscales are within an acceptable range (coefficient α = .81–.90). In terms of validity, the SF–36 has reliably discriminated patients who suffered from minor medical conditions (e.g., uncomplicated hypertension) from those who suffered from more serious medical conditions such as congestive heart failure (31).

Negative social ties. Negative social relationships were assessed with four items that measured the extent to which participants experienced others in their network as critical, exploitative, unreliable, or provoking during the preceding month. Finch, Okun, Barrera, Zautra, and Reich (32) found that these items had the highest loadings on a "negative social ties" factor in a study conducted on 267 older adults. Items were anchored on a 5-point scale, with responses ranging from 1 (*none of the time)* to 5 (*all of the time*). The mean item response was computed to yield a total score, with higher values reflecting more interpersonal stress. In these samples, the scale demonstrated good internal consistency (coefficient α = .85).

Social support. Participants' perception of social support was assessed using Sherbourne and Stewart's (33) social support survey. This instrument comprises 19 items that measure the extent to which participants feel that others in their network were available to provide information, comfort, tangible assistance, and affection during the previous month. Items were anchored on a 5-point scale, with responses ranging from 1 (*none of the time*) to 5 (*all of the time*). The mean of item responses was computed to yield a total score, with higher scores reflect-

ing greater perceived social support. The scale was highly internally consistent in our samples (coefficient $\alpha = .88$). An additional item, termed *network size*, asks participants to report how many close friends and close relatives they have.

Coping. Coping with pain was assessed via 33 items selected from among the 69 items composing the Vanderbilt Multidimensional Pain Coping Inventory (34). Participants are asked to indicate how frequently they typically use the strategy described in each item when they are in moderate pain. Items assessing strategies for coping with pain were rated on a 5-point scale, ranging from 1 (*I never do this when I am in pain*) to 5 (*I very frequently do this when I am in pain*). Items were selected from the following subscales, which correlated significantly with adaptation in chronic pain patients (35): Active, Passive, Social Support, Stoicism, Distraction, Denial, Avoidance, Catastrophizing, Mental Disengagement, Wishful Thinking, Venting, Self-Isolation, Problem-Solving, and Positive Reappraisal. These subscales were combined into three factors based on maximum likelihood factor analysis, with an oblimin rotation, described in a previous report (14). Three factors emerged: (a) Active Coping (composed of Active, Positive Reappraisal, Distraction, Denial, Problem-Solving, and Stoicism), (b) Avoidant Coping (composed of Catastrophizing, Passive Avoidant, Mental Disengagement, Wishful Thinking, and Self-Isolation), and (c) Coping Through Social Relations (composed of Venting and Social Support). Items were unit weighted and combined to form three coping dimensions: (a) active, (b) avoidant, and (c) coping through social relations. These factors showed adequate internal consistency in these samples (coefficient $\alpha = .67–.86$).

Affect. Positive and negative affect were measured with the Positive and Negative Affect Scale (PANAS; 36), a widely used measure of individual differences in affective levels. Participants rated 20 adjectives such as *scared* and *enthusiastic* to indicate the extent to which they experienced each affect during the previous week. Items were rated on a 5-point scale ranging from 1 (*not at all*) to 5 (*extremely*). Mean positive and negative affect scores were calculated, such that higher scores indicated greater affect during the past week. Internal consistencies of both affect scales in these samples were good (coefficient $\alpha > .83$).

Interpersonal sensitivity. The Interpersonal Awareness subscale of the Interpersonal Sensitivity Measure (37) assessed interpersonal sensitivity. The seven items measured apprehension about interpersonal relationships and a hypervigilant interaction style characterized by frequent attempts to gauge others' reactions (e.g., "I care about what other people feel about me"). Each item is rated on a 5-point scale ranging from 1 (*very unlike me*) to 5 (*very much like me)*. A mean of the scores on the seven items was computed, with higher scores indicating higher interpersonal sensitivity. This scale has been found to be positively correlated with level of neuroticism, and negatively correlated with level of self-esteem. Internal consistency was good in these samples (coefficient $\alpha > .85$), consistent with findings in college student as well as clinic samples (37).

Emotionality. Emotionality was assessed with the General Emotionality (GE) subscale of the Scale of Emotional Arousability (38). The subscale is composed of six items that capture the emotionally labile facet of neuroticism (e.g., "I frequently get upset"). Items were rated on a 5-point scale ranging from 1 (*not at all like me*) to 5 (*very much like me*). A mean of the six GE subscale items was computed, with higher scores indicating greater emotionality. Braithwaite (38) found that the GE subscale was positively correlated with measures of neuroticism and anxiety. Internal consistency in these samples was good (coefficient $\alpha > .85$).

Data Analytic Strategy

Comparison of groups was accomplished through one-way analysis of variance (ANOVA) and chi-square analyses. Post hoc evaluation of significant effects emerging from ANOVA was accomplished with Tukey's honestly significant difference (HSD) test. To determine if affect, coping, and social support factors were related to the perception of negative social ties in participants with FMS and OA, we conducted a series of simultaneous regression analyses predicting negative social stress. Predictor variables included two dummy variables for diagnosis (with the FMS sample serving as the reference group), the vulnerability variable of interest (i.e., affect, coping, or social support), and two terms representing the interactions between diagnosis dummy variables and the vulnerability measure. Continuous predictors were centered prior to inclusion in regression models (39). Significant interaction terms were evaluated by conducting separate regression analyses for each diagnostic group. An alpha of .05 or less was considered significant unless otherwise noted.

Due to incomplete questionnaire responses, data were lost from 2 women for affect measures, 3 women for size of social network, 3 women for MH, and 1 woman for GH and BP. Thus, all analyses are based on a sample size ranging from 98 to 101 women.

Results

Sample Characteristics

We first determined whether groups were equivalent in terms of demographics and health measures. Sample characteristics for the FMS and OA samples are depicted in Table 1. Groups were similar in age and education level, $F(2, 98) < 1.52$, $p > .16$, and in the proportion of women who were employed, married, and White, $\chi^2(2, N = 101) < 2.59$, $p > .27$. However, group differences did emerge for two physical health measures, BP and GH, $F(2, 97) > 6.19$, $p < .003$. Evaluation of the SF–36 BP subscale scores revealed that the FMS and OA surgery groups experienced significant and comparable levels of bodily pain, and each of these groups reported more pain than the OA nonsurgery group (ps $< .05$). Moreover, a lower score on the SF–36 GH subscale indicated that the participants with FMS

TABLE 1
Demographic and Psychosocial Characteristics of OA Surgery, OA Control, and FMS Participants

Variable	*OA Surgery*[a]	*OA Control*[b]	*FMS*[c]
Demographics			
Age (years)	64.83 (6.81)	64.68 (6.43)	62.00 (7.44)
Attended college(%)	62.1	45.4	54.0
Employed (%)	31.0	27.3	22.0
Married (%)	65.5	50.0	62.0
White (%)	89.7	95.5	94.0
SF–36 subscales			
Mental Health	$72.69\ (20.23)_{a}$	$76.00\ (15.91)_{a}$	$54.43\ (18.01)_{b}$
General Health	$68.22\ (21.50)_{a}$	$67.14\ (21.49)_{a}$	$50.46\ (11.13)_{b}$
Physical Functioning	$25.27\ (17.04)_{a}$	$39.09\ (18.30)_{b}$	$41.13\ (23.06)_{b}$
Bodily Pain	$27.14\ (17.91)_{a}$	$42.23\ (18.49)_{b}$	$29.94\ (13.59)_{a}$
Affect			
Positive	$3.45\ (.72)_{a}$	$3.38\ (.79)_{a}$	$3.05\ (.70)_{b}$
Negative	2.13 (.90)	1.88 (.74)	1.80 (.72)
Social networks			
No. of people in network	$10.71\ (13.00)_{a}$	$6.71\ (3.86)_{a,b}$	$6.16\ (4.87)_{b}$
Negative social ties	$1.51\ (.51)_{a}$	$1.81\ (.59)_{a,b}$	$2.24\ (1.05)_{b}$
Social support	4.14 (.83)	4.09 (1.05)	3.70 (1.16)
Personality			
Interpersonal sensitivity	2.89 (.71)	3.24 (.95)	3.24 (.95)
Emotionality	2.54 (.67)	2.87 (.57)	2.77 (.77)
Coping			
Active	3.59 (.53)	3.60 (.64)	3.54 (.53)
Avoidant	$2.49\ (.72)_{a}$	$2.30\ (.79)_{a}$	$2.97\ (.64)_{b}$
Use of social relations	$2.70\ (.78)_{a,b}$	$2.28\ (.81)_{a}$	$3.01\ (.81)_{b}$

Note. Groups with different subscripts differ significantly at $p < .05$. OA = osteoarthritis; FMS = fibromyalgia syndrome.
[a]$n = 29$. [b]$n = 22$. [c]$n = 50$.

rated their general health as poorer than did each group of participants with OA (*p*s < .05). Group differences also emerged for the SF–36 PF subscale, $F(2, 98) = 5.75$, $p = .004$, reflecting that despite their generally poorer health, women with FMS reported that their level of physical functioning was similar to that of the OA nonsurgery group and better than that of the OA surgery group ($p < .05$).

Group Differences in Negative Social Ties and Vulnerability Factors

We next compared the FMS and OA groups on both level of negative social ties and stress vulnerability factors, including affect, pain coping, social support, and disposition. Analyses again yielded some key differences between groups, $F > 3.30$, $p < .05$. As displayed in Table 1, the FMS group scored lower on both the SF–36 MH and the PANAS Positive Affect subscales than did the other two groups (*p*s < .05). Thus, women with FMS experienced more emotional disturbance and lower levels of positive affect than did surgery and nonsurgery women with OA. Evaluation of pain-coping strategies revealed that the FMS sample also was significantly more likely to use avoidant coping when in pain than either of the OA samples (*p*s < .05). Women with FMS indicated that they were more likely to use social relations to cope with pain compared to nonsurgery women with OA ($p < .05$) but equally likely compared to the OA surgery group (see Table 1). Social network characteristics also varied by group, with participants with FMS reporting that they had fewer individuals in their social networks and more negative social ties than did surgery participants with OA (*p*s < .05). Reports of network size and negative ties were similar for FMS versus OA nonsurgery groups and for OA surgery versus nonsurgery groups. No differences emerged among groups for negative affect, $F(2, 96) = 1.61$, $p > .21$, active coping, or social support, $F(2, 98) = 2.01$, $p > .14$. With regard to personality attributes, groups achieved comparable scores for interpersonal sensitivity and emotionality, $F(2, 98) < 1.58$, $p > .21$.

Vulnerability Factors Related to Social Stress

To determine if affect, coping, and social support factors were related to the perception of negative social ties in participants with FMS and OA, we next conducted a series of simultaneous regression analyses predicting negative social stress. Neither affect measures nor active and avoidant pain-coping strategies were related to the perception of negative social stress, $\beta < .17$, $p = ns$. However, coping through social relations and perceived social support each predicted negative social stress, and these associations varied by diagnostic group, reflected in significant interaction terms. These findings are depicted in Table 2 and Figures 1 and 2. Subsequent regressions conducted separately by diagnostic group revealed that both perceived social support and use of social relationships to cope with pain

TABLE 2
Prediction of Negative Social Ties by Diagnostic Group and Either Perceived Support or Social Relations Coping for Study 1[a]

Variable	*Adjusted R^2*	β	*SE*
Model 1: Social relations coping	.18***		
Diagnosis Dummy 1		–.83***	.19
Diagnosis Dummy 2		.50***	.23
Coping		–.59***	.18
Diagnosis Dummy 1 × Coping		.63*	.26
Diagnosis Dummy 2 × Coping		.67*	.28
Model 2: Perceived social support	.39***		
Diagnosis Dummy 1		–.60***	.17
Diagnosis Dummy 2		–.27***	.18
Support		–.58***	.09
Diagnosis Dummy 1 × Support		.56**	.18
Diagnosis Dummy 2 × Support		.40*	.17

Note. All continous predictors were centered prior to inclusion in the analyses. Diagnosis Dummy 1 coded FMS = 0, OA Control = 0, OA Surgery = 1. Diagnosis Dummy 2 coded FMS = 0, OA Control = 1, OA Surgery = 0. Model 1, $F(5, 95) = 5.42$, $p < .0001$. Model 2, $F(5, 95) = 13.63$, $p < .0001$. OA = osteoarthritis; FMS = fibromyalgia syndrome.
[a]$N = 101$.

were negatively related to negative social ties among women with FMS (β = –.64, $t = –5.72$, $p < .0001$, and β = –.36, $t = –2.71$, $p < .009$, respectively). In contrast, in both groups of women with OA, interpersonal stress was unrelated to perceived support (β < –.33, $t < –1.56$, $p > .14$, for both) or social relations coping (β < .12, $t < .52$, $p > .61$, for both).

Study 1 Summary

The findings from Study 1 suggest that among women with chronic pain, those with FMS have fewer positive affective resources and are more likely to use ineffective, avoidant pain-coping strategies relative to those with OA. Furthermore, when compared with women with OA in comparable pain (i.e., those scheduled for surgery), women with FMS show some potential deficits in their social environments that may contribute to poorer adjustment. In particular, although women with FMS and OA in similar levels of pain report that they receive an equal amount of social support and are equally likely to turn to others to deal with their pain, patients with FMS also report that they have fewer individuals in their networks and more exposure to negative social interaction with these network members. Thus, women with FMS appear to be seeking help from a more confined cluster of individuals who apparently provide support but at the same time are more often a source of conflict. Moreover, these conflictual social ties were linked to lower perceived social support and less frequent use of support to cope with pain only among those with FMS. It seems, then, that the experience of negative social relationships may have limited the use of positive social attachments among women with FMS but did not appear to hamper the ability of women with OA to draw on their social resources for assistance.

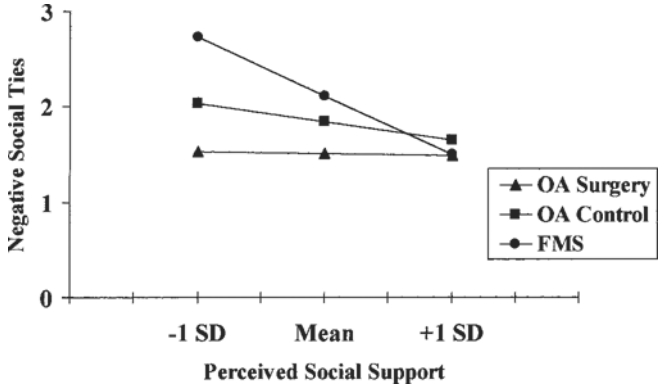

FIGURE 1 Relation between negative social stress and perceived social support for women with FMS and OA.

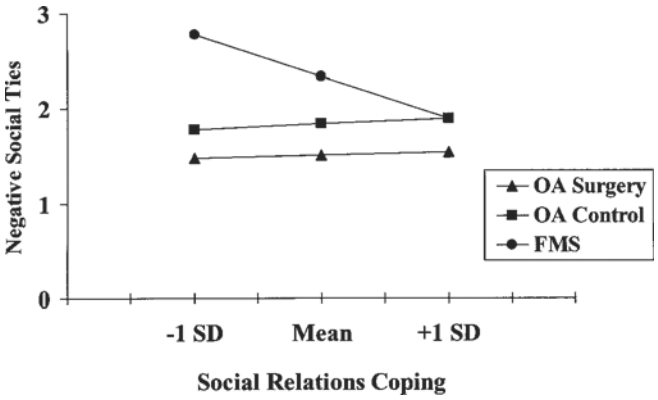

FIGURE 2 Relation between negative social stress and social relations coping for women with FMS and OA.

These group differences cannot be accounted for by differences in key personality dispositions, as the groups achieved similar scores on measures of emotionality and interpersonal sensitivity. Likewise, the deficits cannot be explained by greater pain experience among FMS relative to women with OA, because FMS and OA surgery groups reported comparable levels of pain but still demonstrated significant differences in multiple measures of adaptive functioning. The deficits apparent in women with FMS may mark their poorer adaptation to the stress of chronic illness, which may have implications for their ability to manage other sources of stress encountered in daily life, including interpersonal relationships. Although these findings are intriguing and point to the possibility that those with FMS are more socially and affectively vulnerable to stress than other chronic pain patients, the study is limited by its design in providing a strong test of our hypothesis. All data were collected cross-sectionally and through field assessments, and the study did not manipulate either vulnerability factors or social stress. Thus, we are unable to determine whether sampling differences account for the pattern of findings we obtained.

To further evaluate the extent to which women with FMS and OA differ in their vulnerability to interpersonal stress, we recruited a second sample of participants with FMS and OA, and we conducted an experiment in which we assessed participants' affect, pain, and physiological arousal before, during, and after discussing an interpersonal stressor. Given the prevalence of depressive features among chronic pain patients in general, and patients with FMS in particular, we were especially interested in examining how stress is experienced in the context of a negative affective state. To this end, we included a manipulation of negative affect prior to the stressor to determine to what extent a preexisting negative mood among those with chronic pain might represent a vulnerability that leaves individuals less able to respond to subsequent stress. Participants were randomly assigned within each diagnostic group to either a negative mood induction or a neutral mood control condition, and then they discussed a stressful event while affect, pain, fatigue, and physiological arousal were assessed.

STUDY 2

Method

Participants

The sample comprised 20 women with FMS (two of whom also had OA) and 21 age-matched women (within 3 years) with OA who were recruited from the local community through newspaper advertisements. Women were initially screened by phone to determine that they met the following eligibility criteria: (a) self-report of medically confirmed diagnosis of either OA only, or of FMS with or without OA; (b) no other chronic pain diagnosis or medical conditions; and (c) no use of medications with cardiovascular effects. The sample was composed entirely of Whites, with an average age of 55.08 years (SD = 9.50). Sixty-three percent of the participants were married, and 44% were employed. OA and FMS groups were similar in age and in marital and employment status (ps > .40).

Measures

Physiological measures. Pulse rate (PR), systolic blood pressure (SBP), and diastolic blood pressure (DBP) were measured with an Industrial and Biomedical Sensors Corporation (Waltham, MA) automated blood pressure monitor (IBS, Model SD–700A) through the use of a standard inflatable blood pressure cuff placed over the brachial artery on the participant's nondominant arm. The IBS assesses blood pressure and PR using the auscultatory method and is equipped to detect artifact caused by movement or poor cuff placement. Values of PR, SBP, and DBP were averaged within the rest, priming, stress, and recovery periods of the session to yield mean levels.

Pain, fatigue, and affect. Participant ratings of average pain were collected using a standard 101-point numeric rating scale ranging from 0 (*no pain*) to 100 (*pain as bad as it can be*). Participants were asked to "choose a number between 0 and 100 that best describes the average level of pain you have experienced over the past week due to your (FMS or arthritis)." In our previous work, we have documented significant correlations between the self-report of average pain and clinician global ratings of disease activity (40). A comparable item assessing level of fatigue was also included.

Pain threshold levels were obtained at five paired (right and left) tender points included in the American College of Rheumatology criteria for FMS and five paired control points using a standardized dolorimeter (Chatillon Instruments, Kew Gardens, NY) and measurement procedure (41). The dolorimeter pressures that evoked faint pain at each of the tender points were averaged to produce a mean pain threshold.

The 20-item PANAS, employed in Study 1, was also included in Study 2 with one modification. The PANAS was modified for this study to reflect the experience of affect at the present moment rather than during the preceding week.

Procedure

On arrival at the laboratory, women were provided with information about the study and asked to sign a consent form; they then completed questionnaires regarding demographic information and the occurrence of recent life events. Participants were then seated in a comfortable chair, fitted with the blood pressure cuff, and asked to relax for 10 min while listening to relaxing music. Throughout the baseline period and subsequent periods of the session, PR, SBP, and DBP were monitored every 2 min. On termination of the baseline period, women completed questionnaires assessing their mood, fatigue, and pain level. An experimenter then measured their pain threshold using the dolorimeter.

Next, participants were randomly assigned by diagnostic group to undergo one of two priming conditions: negative mood induction or resting control. In the negative mood condition, participants underwent a standard mood induction procedure (42), designed to create a low-level, ongoing experience of sad mood that would endure throughout the priming and stress periods. Participants were presented with a text that described in vivid detail a situation that is sad and were told to imagine themselves in that situation. In the resting control condition, participants were instructed to relax quietly for several minutes. The priming period lasted for 3 min, after which participants completed questionnaires regarding mood, fatigue, and pain levels.

Participants were than asked to discuss a conflict that they had recently experienced with an important person in their lives; this could include a family member, friend, physician, or acquaintance. They were instructed to select a conflict or difficultly that provoked strong feelings in them at the time and that tended to last or recur. The participants and the interviewer discussed this event for a 30-min period, during which the interviewer prompted participants to relate what precipitated the problem, how they felt at the time, what efforts and approaches they made to cope with the problem, and the current state of the problem. This format was designed to re-create the experience of the event as realistically as possible and to provide a stress stimulus that would provoke a stress response representative of

the participants' typical response. It follows a format used by other investigators to mimic daily interpersonal stress in a laboratory environment (43,44). At the conclusion of the stress period, mood, fatigue, pain level, and pain threshold were again assessed. Participants then relaxed for a 10-min recovery period, after which the final measures of mood, fatigue, and pain level were taken. Women were then debriefed, excused, and subsequently paid $20 for their participation.

Data Analytic Strategy

To determine whether group differences were evident prior to mood priming and stress, baseline values of physiological, pain, fatigue, and mood measures served as dependent measures in a series of 2 (FMS vs. OA) × 2 (mood vs. control condition) ANOVAs. Next, we examined responses to mood priming and stress through a series of 2 (FMS vs. OA) × 2 (mood priming vs. control) × 4 (period: baseline, priming, stress, recovery) repeated measures ANOVAs, with affect, fatigue, and cardiovascular levels serving as the dependent measures. Similar analyses were conducted for pain intensity but included baseline level as a covariate to adjust for any diagnostic group differences in baseline levels of pain. Post hoc comparisons among means were accomplished with Tukey's HSD.

Finally, to further explore the role of negative and positive affect as potential factors contributing to stress-related increases in pain, we conducted a series of hierarchical multiple regression analyses predicting pain during stress. In the first step, the predictors included a dummy variable for diagnosis (0 = OA, 1 = FMS), pain at baseline, and positive and negative affect during stress; in the second step, the predictor was the interaction between diagnosis and either negative or positive affect during stress.

Blood pressure and pain tolerance data were available for all 41 women. PR data were lost from 2 participants due to equipment failure, and mood, pain, and fatigue data were lost from 3 participants who failed to complete at least one questionnaire during the course of the session. Thus, analyses are based on a sample size ranging from 38 to 41 women.

Results

Baseline Comparisons

Evaluation of baseline values for mood, fatigue, and pain measures based on diagnosis and mood condition indicated that groups were similar in resting levels of positive and negative affect, degree of fatigue, and pain threshold threshold (*p*s > .06). However, a significant main effect for diagnosis, $F(1, 34) = 7.70$, $p = .009$, revealed that women with FMS reported experiencing greater pain intensity ($M = 4.65$, $SD = 2.08$) than did women with OA ($M = 2.71$, $SD = 1.79$). For all cardiovascular measures, no group differences emerged.

Effects of Mood Priming and Stress

Affect. Evaluation of affect scores indicated that levels of both negative and positive affect varied over the course of the session, both period effects, $F(3, 102) > 6.84$, $p < .0001$. Follow-up analyses indicated that the mood priming condition did not influence levels of positive affect, which decreased from baseline levels during the priming, stress, and recovery periods to a similar extent for all groups of women. As expected, the changes in levels of negative affect depended on mood condition, Period × Mood condition, $F(3, 102) = 9.03$, $p < .0001$. For all women in the mood priming condition, negative affect increased from baseline levels during priming and stress and returned to baseline levels during recovery. In contrast, for women without mood priming, negative affect remained unchanged from baseline level during priming, increased during the stress period, and returned to baseline levels during recovery. The magnitudes of the changes in positive and negative affect during the session were similar for women with FMS and OA, Diagnostic Group × Period interaction, $F(3, 103) < 1.0$, $p > .25$ (for both diagnostic groups).

Pain intensity, pain threshold, and fatigue. Analyses controlling for baseline pain level revealed that pain intensity varied during the session according to both diagnosis and mood condition, Diagnostic Group × Mood Condition × Period interaction, $F(2, 60) = 3.63$, $p < .05$. As shown in Figure 3, women with FMS and OA had comparable increases in pain during stress without priming, whereas women with FMS had larger increases in pain than did women with OA during stress in the mood-priming condition ($p < .05$). Moreover, during recovery, pain intensity levels decreased among the other three groups but remained elevated among women with FMS in the mood condition (*p*s < .05), suggesting that the stressor had prolonged effects on pain in this group. Fatigue also varied during the session, $F(3, 102) = 3.75$, $p = .02$, such that self-reported fatigue remained constant during baseline, priming, and stress, and then declined during recovery. Pain threshold, in contrast, did not change from baseline levels during stress, and no effects involving diagnostic group emerged for fatigue or pain threshold.

Cardiovascular measures. Results for cardiovascular measures indicated that the session elicited changes in SBP and

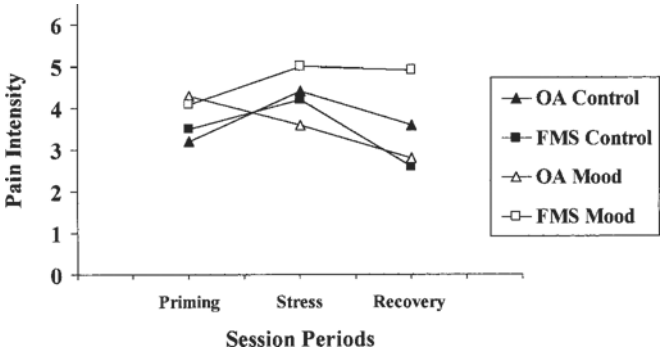

FIGURE 3 Pain intensity ratings, adjusted for baseline levels, during the Session × Mood condition and diagnosis.

DBP, $F(3, 111) = 21.23$, $p < .0001$, and PR, $F(3, 105) = 9.84$, $p < .0001$. Follow-up comparisons revealed that, regardless of mood priming condition, PR and blood pressure levels remained constant from baseline to the priming period, then increased during stress (ps < .05). During recovery, PR levels returned to baseline levels, but blood pressure remained elevated (ps < .05). The alterations in SBP during the session, however, varied depending on priming condition, Period × Mood, $F(3, 111) = 4.97$, $p < .003$. Subsequent examination of means revealed that the increase from baseline during stress was more pronounced among the participants without priming relative to the mood-priming group ($p < .05$). No effects involving diagnostic group emerged for SBP, DBP, or PR change during the session.

The findings, then, indicate that the mood priming and stress manipulations influenced affect, pain, and cardiovascular arousal as intended. Mood priming was associated with an increase in negative affect, and stress was associated with an increase in negative affect, pain, and cardiovascular arousal and with a decrease in positive affect among women in both the mood-priming and control conditions. Moreover, the impact of mood priming on pain during stress and recovery was more pronounced among FMS relative to women with OA.

The Association Between Pain and Affect During Stress

Results of multiple regression analyses predicting pain during stress, shown in Table 3, revealed that negative mood was strongly and positively related to pain ratings during stress. The lack of a significant Diagnostic Group × Negative Affect interaction (Step 2A in Table 3) indicates that this association held for women with both FMS and OA. In contrast, the Diagnostic Group × Positive Affect interaction was significant (Step 2B in Table 3), suggesting that the relation between positive affect and pain during stress varied by diagnosis. Subsequent regressions conducted separately by diagnostic group revealed that positive affect during stress was a stronger inverse predictor of pain among women with FMS compared to women with OA, independent of pain at baseline and negative affect during stress. As Figure 4 makes clear, pain was unrelated to positive mood during stress in women with OA but negatively related to positive mood in women with FMS in separate regressions by diagnosis ($\beta = .07$ vs. $-.30$, $p = .65$ and .03, for OA and FMS groups, respectively).

TABLE 3

Prediction of Pain During Acute Interpersonal Stress by Diagnostic Group and Mood for Study 2[a]

Variable	*R2*	β	*SE*
Step 1	.73**		
Diagnostic group		.24	.53
Rest pain		.71**	.13
Stress negative mood		.13**	.03
Stress positive mood		–.04	.03
Step 2a	.00		
Diagnostic Group × Stress Negative Mood		–.01	.07
Step 2b	.04*		
Diagnostic Group × Stress Positive Mood		–.11*	.05

Note. For diagnosis, 0 = OA, 1 = FMS. All continuous measures were centered prior to analysis. Step 1, $F(4, 36) = 4.84$, $p < .00001$. Step 2a, $F(5, 35) = 19.35$, $p < .00001$. Step 2b, $F(5, 35) = 23.10$, $p < .00001$. OA = osteoarthritis; FMS = fibromyalgia syndrome.

[a]$N = 41$.

*$p < .05$. **$p < .001$.

GENERAL DISCUSSION

Our goal in these investigations was to identify specific stress responses that may contribute to a lower quality of life in those whose chronic pain is due to FMS rather than to OA. Comparison of FMS with another chronic pain group allows us to begin to tease out whether FMS is associated with decrements beyond those that may be attributable to the experience of chronic pain per se. OA provides a optimal comparison group because it is the most prevalent form of chronic pain and therefore allows for greater generalizability to the general population of older women who are managing a chronic pain condition.

The pattern of findings does in fact point to an enhanced stress vulnerability among those with FMS. In Study 1, results suggested that women with FMS may be more susceptible than those with OA to the effects of negative social stress, in part because of deficits in coping strategies and positive affect and a tendency toward social disengagement. Although women with FMS and OA were generally similar in their reported use of social support and active coping strategies to deal with pain, women with FMS were more likely than both surgery and control women with OA to use avoidance coping strategies. These strategies include resignation, passivity, and social withdrawal in response to pain episodes, and they may be among the least effective forms of coping. In fact, avoidance coping has been related to more negative and less positive affect, and more bodily pain among individuals with both FMS and OA (14,45). This type of coping with pain and other symptoms may be a key feature of FMS that has important implications for long-term adaptation (1).

The differences in the interplay of negative and positive social resources across diagnostic groups were also noteworthy. Negative social stress was associated with lower perceived sup-

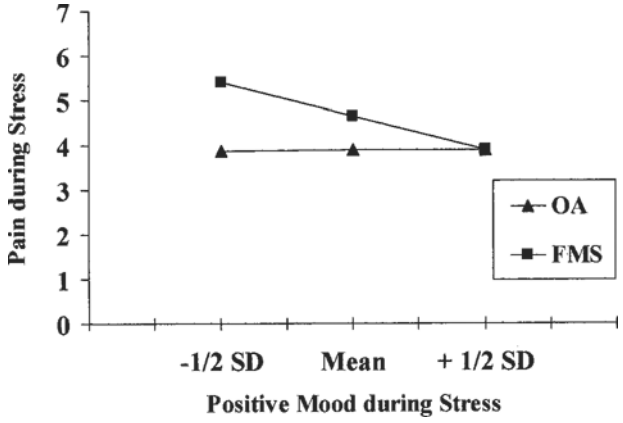

FIGURE 4 Relation between pain intensity and positive affect during stress for women with FMS and OA.

port and less social support coping with pain for women with FMS but not OA. Thus, positive and negative social ties appear more tightly interwoven in women with FMS. As a consequence, lower levels of perceived support may enhance the experience of social conflict among those with FMS, leaving them with fewer resources to cope with pain and other stressors. This vulnerability among women with FMS was apparent even when they were compared with the surgery women with OA, who were not only in comparable pain but also more physically disabled. Poorer physical functioning or the experience of greater pain, therefore, cannot explain the social vulnerability among women with FMS. Likewise, because women with FMS and OA had a similar level of education and were equally likely to be employed, their differences in negative interpersonal experiences are not likely due to greater financial dependence on their networks among those with FMS. In addition, participants with FMS and OA were similar in levels of interpersonal sensitivity and emotionality, suggesting that differences in at least these personality dispositions do not account for the findings. It would be useful to examine further the possible role of dispositional factors more thoroughly in future studies through the use of omnibus inventories that assess dimensions such as the "big five" personality attributes.

Women with FMS appear not only to experience more interpersonal stress than women with OA in comparable pain (reflected in Study 1 findings) but also to respond to such stress less adaptively than women with OA (reflected in Study 2 findings). The stress response differences between women with OA and those with FMS may emerge only under special conditions, however. Only when participants were primed to experience a negative mood prior to stress did women with FMS show greater elevations in pain during stress relative to their OA counterparts—pain elevations that persisted into the recovery period. It seems that a propensity among individuals with FMS to experience elevations in negative mood may heighten their experience of pain during stress. Although they should be considered tentative, these findings suggest that patients with FMS who are prone to high levels of negative affect may be especially susceptible to stress-related increases in the experience of pain that are sustained over time.

A second vulnerability demonstrated by participants with FMS in Study 2 was their inability to maintain affective boundaries between pain and positive emotion during stress. Although positive emotions declined during stress for both participants with FMS and OA, the decline was associated with increased pain only among women with FMS. Among those with OA, in contrast, positive affect and pain during stress were unrelated. Stress-related changes in negative affect did not differ for participants with FMS and OA. In both groups of women, negative affect increased during stress, and these increases were positively associated with pain perception. Recent data point to the ability to maintain positive affect during times of stress as an important factor contributing to ongoing adaptation to chronic illness, serving to decrease distress in chronic pain patients (46). Indeed, one line of recent research on the benefits of positive affect suggests that positive feelings may "loosen the hold" of negative affect on the mind and body, broadening an individual's response repertoire, and permitting the pursuit of a wider range of experiences (19,47). To the extent that individuals can cultivate and sustain positive emotions, even in the face of chronic pain and stress, they may experience more optimal functioning and an improved quality of life.

Interestingly, differences between participants with FMS and OA in Study 2 emerged only in measures of affect and perceived pain intensity, not in fatigue or in pain tolerance. Although fatigue may be a key symptom of FMS and one that distinguishes patients with FMS from other chronic pain patients, it does not appear to change in response to interpersonal stress, at least as evaluated here. Moreover, the lack of a difference between diagnostic groups in pain tolerance suggests that the enhanced stress-related increases in pain among those with FMS may be limited to pain perceptions.

These findings must be interpreted with some caution, in light of several methodological limitations of the investigations. First, although women with FMS reported pain levels equivalent to those of the Study 1 surgery women with OA, participants with FMS reported more pain than Study 1 control participants with OA and Study 2 participants with OA. We employed statistical methods to control for these group differences in pain level where appropriate, but we still could not equate the pain experience of the two groups. The pain associated with FMS is of unknown origin, highly variable, and often accompanied by fatigue and other symptoms. The differences between women with FMS and OA in the quality and predictability of pain and other symptoms may account in part for the observed differences in coping and use of social resources. Along this line, patients with OA have what is universally recognized as a medical disorder that often responds to interventions, including surgery. In contrast, patients with FMS often are stigmatized by the medical community as well as others in their social networks because their condition is so poorly understood and difficult to manage. It is possible that the experience of stigmatization, unpredictability, and uncontrollability, none of which we assessed in these studies, may be key factors underlying the affective and social vulnerability among those with FMS.

A second aspect that constrains interpretation of the data is the lack of assessment of time since diagnosis. Participants with FMS and OA were matched in age but may have been managing their illnesses for different periods of time. The apparent vulnerability evidenced by FMS relative to women with OA, therefore, may be attributable to differences in stage of the illness. Typically, FMS symptoms emerge in midlife, whereas OA symptoms emerge in the middle to late years of life (48,49). Thus, it is possible that although they were the same age, women with FMS may have been afflicted by their symptoms for a longer period of time than women with OA in these samples. As a result, those with FMS may have drained their social capital to a greater extent, resulting in their reports of a poorer quality social environment. A third limitation is the study designs. The use of cross-sectional data in Study 1 precluded making causal inferences, and the experimental manipulation in Study 2 was somewhat artificial. However, the convergence of the data from the two investigations strengthens our confidence in the findings.

Undoubtedly, the interplay between chronic pain, stress, affect, and social ties is complex, and delineation of the dynamic processes involved awaits additional, intensive longitudinal study. Nevertheless, the model that emerges from our work points to the importance of preserving the affective boundaries between pain and other negative emotional experiences, and social support and other positive emotional resources. Individuals who are able to sustain this affective differentiation may experience an enhanced quality of life and resilience in the face of chronic pain and other stressors. Although the data are not definitive, they suggest that the apparent vulnerability of women with FMS relative to women with OA may stem in part from an inability to maintain positive resources during times of pain and stress. Elaboration and application of strategies to preserve rewarding social relationships, sustain positive affect, and minimize negative affect despite the presence of stress and chronic pain may be essential to sustaining psychological well-being and physical functioning in those with FMS.

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