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Pain Catastrophizing, Pain Intensity, and Dyadic Adjustment Influence Patient and Partner Depression in Metastatic Breast Cancer

Hoda Badr, Ph.D.¹ and Megan J. Shen, Ph.D.²

¹Icahn School of Medicine at Mount Sinai

²Memorial Sloan Kettering Cancer Center

Abstract

Objective—Metastatic breast cancer can be challenging for couples given the significant pain and distress caused by the disease and its treatment. While the use of catastrophizing (e.g., ruminating, exaggerating) as a pain coping strategy has been associated with depression in breast cancer patients, little is known about the effects of pain intensity on this association. Moreover, even though social relationships are a fundamental resource for couples coping with cancer, no studies have examined whether the quality of the spousal relationship affects the association between catastrophizing and depression. This study prospectively examined these associations.

Methods—Couples (N=191) completed surveys at the start of treatment for metastatic breast cancer (baseline), and 3 and 6 months later.

Results—Multilevel models using the couple as the unit of analysis showed patients and partners (i.e., spouses or significant others) who had high levels (+1SD) of dyadic adjustment (DAS7) experienced fewer depressive symptoms than those who had low levels (−1SD) of dyadic adjustment ($p < .01$). Moreover, at low levels of dyadic adjustment, when patients engaged in high levels of catastrophizing and had high levels of pain, both patients and their partners reported significantly ($p = .002$) higher levels of depression than when patients engaged in high levels of catastrophizing but had low levels of pain.

Discussion—Findings showed that catastrophizing and pain exacerbate depression in couples experiencing marital distress. Programs that seek to alleviate pain and depressive symptoms in metastatic breast cancer may benefit from targeting both members of the couple, screening for marital distress, and teaching more adaptive pain coping strategies.

Introduction

Pain associated with advanced cancer has an estimated prevalence of 69 to 94% and is often caused by bone metastases or nerve compression from tumor growth [1, 2]. Although recent advances in pharmacology and adjuvant therapies have resulted in highly effective pain management strategies for people with cancer, the complete relief of pain is rare [3]. Because unrelieved pain increases the risk for mood disturbance [4, 5], psychosocial

interventions are recommended as part of standard care for cancer patients who are experiencing pain [6]. However, great variability exists in pain adaptation [7, 8]. Identifying individual difference variables that might mitigate or exacerbate mood symptoms (e.g., depression) could contribute greatly to the development of more effective psychosocial treatments for advanced cancer patients who experience pain.

Pain catastrophizing is a negative response style characterized by the tendency to ruminate about pain, exaggerate the threat value of pain, and adopt a helpless orientation to pain [9]. It is associated with negative patient outcomes including increased pain intensity [10, 11], heightened disability [12], and depression [13]. Even though catastrophizing is a mental process and is not immediately accessible to others, it is often accompanied by pain behaviors which can serve a communicative function to elicit support and assistance [14], and therefore occurs in a social context [15].

For patients who are married or in a committed relationship, their relationship with their partner (spouse or significant other) is often their primary coping resource [16, 17], and studies have shown that patients frequently rely on their partners to provide caregiving and support when they are experiencing pain [18, 19]. However, living with someone who engages in catastrophizing can be challenging. Keefe and colleagues [20] found that increased patient catastrophizing was associated with heightened levels of caregiver stress and postulated that this was because patients who catastrophized placed more emotional and practical demands on their partners than patients who did not catastrophize. Despite this, studies have yet to investigate how patient catastrophizing wears on the partner and affects partner depression over time. Given that researchers have called for greater partner involvement in psychosocial interventions to alleviate pain and suffering at the end of life [19], clarifying this association could help to identify couples who are at risk for psychological distress and who may stand to benefit the most from intervention.

Using a Diathesis-Stress Framework to Understand Associations between Catastrophizing and Depression in Couples Coping with Cancer

Banks and Kerns [21] posited that the comorbidity of depression and chronic pain can be conceptualized within a psychological-diathesis-stress framework. Based on this, individuals who have chronic pain and a psychological diathesis (e.g., maladaptive cognitions such as catastrophizing) develop depression when they are confronted with stressors that exceed their capacity to cope. Such stressors can vary from those related to the pain itself (e.g., pain intensity) to factors in the patient's social environment (e.g., experiencing non-validating medical responses or having a stressful relationship) [18, 21], and may modulate associations between catastrophizing and depression. For example, some researchers have conceptualized catastrophizing as a mode of responding to pain that prevents patients from disengaging their attention from pain stimuli and maintaining attention on other tasks [22-24] and studies in chronic pain have shown that catastrophizing is associated with helplessness and depressive symptoms [25-27]. Given this, it is possible that the relationship between catastrophizing and depression could be stronger for patients who are in more pain because they may feel more helpless in the face of pain [28].

Although the diathesis-stress framework was originally conceived to explain depressive symptomatology in patients, it can easily be extended to explain depressive symptoms in the patient's partner. Indeed, even though the intensity of the patient's pain is not necessarily directly observable to the partner, patient and partner reports of patient pain have been shown to be moderately correlated [38, 39], suggesting that partners do know when patients are in pain and have fairly accurate perceptions about the intensity of that pain. Moreover, research has shown that patient pain and suffering is a source of great distress for partners [40, 41] and that patient catastrophizing is significantly related to caregiver stress [42, 43]. Thus, it seems reasonable to expect that patient catastrophizing would also be associated with caregiver depression and that pain intensity could modify or affect this association. For example, if the patient was catastrophizing and in severe pain, that could exacerbate the partner's fears about the patient's condition or prognosis, increase the partner's sense of helplessness, and heighten his/her depression. However, if the patient was catastrophizing but not in a lot of pain, the patient's catastrophizing might not have as salient an effect on the partner in terms of contributing to his/her depression. Clearly, more research is needed to clarify these possible associations.

In addition to aspects of the pain condition itself, the diathesis-stress framework posits that social or relationship stressors may affect the association between catastrophizing and depression [18, 21]. Supporting this idea, research in chronic pain has shown that when patients are satisfied with their partners' responses to their pain, they are less likely to experience increases in negative affect due to catastrophizing [29]. While these findings support the idea that illness-specific perceptions of social relationships -- in this case, how the partner responds when the patient is in pain -- play a key role in patient adjustment, interpersonal models of coping and adjustment suggest that general features or perceptions of relationships such as dyadic adjustment could also play an important role in this process [30]. Spanier [31] defined dyadic adjustment as "...a process, the outcome of which is determined by the degree of: (1) troublesome dyadic differences; (2) interpersonal tensions; (3) dyadic satisfaction; (4) dyadic cohesion; and (5) consensus on matters of importance to dyadic functioning" (p. 17). Despite the fact that research in cancer has shown that dyadic adjustment is an important coping resource for both patients and their partners [16, 32] and that it is an aspect of the couple relationship that is responsive to psychosocial intervention [33], studies have yet to examine whether perceptions of dyadic adjustment influence associations between patient pain catastrophizing and patient and partner depression. Given that higher levels of dyadic adjustment are associated with better emotional adjustment in patients and their partners [34-36], dyadic adjustment may mitigate or lessen the effects of patient catastrophizing on patient depression. Likewise, in the context of a satisfactory relationship, partners may simply explain away the patient's catastrophizing, and as such, catastrophizing may not have the expected effect of exacerbating their depression. Although partial support for this idea comes from a recent study of lung cancer patients and their spouses that found that dyadic adjustment buffered partners from the effects of patient distress on their own distress [37], more research is needed to understand the possible role that dyadic adjustment plays in the context of pain catastrophizing.

To our knowledge, no studies have used the diathesis-stress framework to explain the comorbidity of pain and depression in the context of couples coping with cancer. While

research has shown that patients with cancer report comparable levels of pain intensity as non-malignant chronic pain patients [8], they also differ in a few key ways. Specifically, many cancer patients and their partners believe that the presence of pain signifies the progression of disease [44, 45]. In the context of metastatic cancer, the progression of disease may be interpreted as further deterioration of health and impending death. Indeed, research has shown that cancer patients think and worry more about pain, avoid activities to prevent the onset of pain, and generally report feeling more hopeless than patients with non-malignant chronic pain [8]. Although, research has shown that cancer patients perceive their social environment as more supportive and their significant others as more solicitous than chronic pain patients [8], many hide their pain in an effort to shield their partners from distress [45]. Research has also shown that the partners of cancer patients often overestimate their pain and this is associated with heightened levels of partner distress [46, 47]. Finally, research in chronic pain has shown that patients who report better functioning relationships experience less distress and less severe pain [48, 49] however, among cancer patients, pain has been associated with decrements in relationship functioning [47, 50, 51]. Given that pain intensity and social relationships are key components in the diathesis-stress framework, more work is needed to better understand their links with catastrophizing and depressive symptoms in the context of cancer.

For several reasons, metastatic breast cancer provides an excellent context to study associations between catastrophizing, pain, dyadic adjustment, and depressive symptoms. First, women with breast cancer are more likely to report pain relative to other cancers, and 34% of metastatic breast cancer patients report being in significant pain [52]. Second, one-third of women diagnosed with metastatic breast cancer experience significant levels of depression and depressive symptoms [53-56]. Third, even though metastatic breast cancer cannot be cured, it can be controlled for several years, making coping with pain and depression a significant quality of life concern. Finally, breast patients identify their partners as their most important source of practical and emotional support [57], their partners are often responsible for caregiving [19, 58], and dyadic adjustment has been shown to be an important coping resource in metastatic breast cancer [32, 59]. Given this, it may be useful to clarify the role that general perceptions of the spousal relationship play in patients' pain experience.

The Present Study

We conducted a prospective study of couples where the patient was initiating treatment for metastatic breast cancer. We hypothesized that: 1) higher levels of patient catastrophizing would be associated with greater depressed mood for both patients and their partners; and, 2) that pain intensity and dyadic adjustment would moderate this association. Specifically, we hypothesized that catastrophizing would be associated with greater depressed mood when patients and partners reported higher levels of pain intensity and lower levels of dyadic adjustment and that catastrophizing would be associated with less depressed mood when patients and partners reported lower levels of pain intensity and higher levels of dyadic adjustment.

Methods

Procedure

The current data are part of a larger longitudinal study of spousal relationships and pain in metastatic breast cancer. The study was approved by the Institutional Review Board of The University of Texas M D Anderson Cancer Center. A complete description of the study design, recruitment strategies, and preliminary results are presented elsewhere [17, 60]. Briefly, patients were identified through medical chart review and approached to participate during routine clinic visits. Patients were eligible if they: 1) were initiating treatment for metastatic breast cancer (any line of therapy); 2) had a physician-rated Eastern Cooperative Oncology Group (ECOG) [61] performance status score ≤ 2 (i.e., ambulatory and capable of all self-care but unable to perform any work activities); 3) rated their average pain as ≤ 1 on the Brief Pain Inventory [50] (BPI; where 0=no pain and 10=worst pain imaginable); 4) could speak and understand English; and 5) had a male partner (spouse or significant other) with whom they had lived for the past year. Patients and partners completed written surveys and returned them in individually sealed postage-paid envelopes. Follow-up surveys were mailed 3 and 6 months later, and participants received gift cards worth \$10 upon the return of each completed survey.

Measures

Pain intensity—Patients completed the 4-item pain severity subscale of the BPI [50] which asks for ratings of the patient's current (right now), worst, least, and average pain over the last seven days on an 11-point (0 = “no pain” to 10 = “pain as bad as you can imagine”) Likert-type scale. The scale has been used in both cancer [62] and chronic pain populations [63] [64]. Cronbach's alphas across assessments for patients ranged from .91 to .92.

Catastrophizing—Patients were asked to rate how often they engage in catastrophizing (e.g., “It's terrible and I feel it's never going to get any better”) when they feel pain using the 6-item catastrophizing subscale of the Coping Strategies Questionnaire (CSQ) [25] on a 7-point Likert-type scale (0 = “never do that” to 6 = “always do that”). Cronbach's alphas across assessments ranged from .82 to .84.

Dyadic adjustment—Patients and partners completed the 7-item, short version of the Dyadic Adjustment Scale (DAS-7), which measures relationship functioning and marital satisfaction [65]. This measure has been found to conserve, without loss of variance, the pattern of relations found between the longer, 32-item DAS and related constructs. Scores can range from 0 to 36; scores less than 21 indicate marital distress. Cronbach's alphas across assessments ranged from .84 to .87 for patients and from .89 to .91 for partners.

Depression—Patients and partners completed the well-validated 20-item Center for Epidemiological Studies Depression Scale (CES-D) [66], which assesses the frequency of affective symptoms such as hope, fear, and sadness over the past week. Responses range from 0 to 3 where 0 = rarely or none of the time (less than 1 day); 1 = some or a little of the time (1–2 days); 2 = occasionally or a moderate amount of the time (3–4 days); and 3 = most or all of the time (5–7 days). Scores range from 0 to 60, and scores ≥ 16 suggest

depressive symptomatology [67]. Individuals scoring at or above this level are considered to be in need of mental health services and further psychological evaluation. Cronbach's alphas across assessments ranged from .89 to .93 for patients and .90 to .93 for partners.

Demographic/medical variables—Patients and partners provided demographic information, including age, sex, race/ethnicity, marital status, length of relationship, number of children living at home, and occupational status. Patients were also asked questions about their disease, including time since initial cancer diagnosis, disease stage at time of initial cancer diagnosis, whether they had any comorbid conditions (and if so, what were they), and type of cancer treatment that they were currently undergoing. Disease stage at the time of study enrollment was confirmed by pathology reports and treatment type was verified by the medical record. In cases where there were discrepancies between patient's self-report of treatment and the medical record, they were reviewed and verified by the patient's treating oncologist.

Data Analysis Plan

To characterize the sample, descriptive statistics including means, standard deviations, ranges, and Pearson's correlations between study variables were calculated for patients and partners separately at each assessment time point. Paired correlations examined the associations at each time point between patients and partners. Paired t-tests were also conducted to examine differences between patient and partner scores on the major study variables at each assessment.

To test our hypotheses, a multilevel modeling approach was used. Multilevel models are well-suited to repeated measures designs like the present one because they can handle missing data due to sample attrition and maximize the utility of existing data [68]. In our analyses, data from dyad members were treated as nested scores within the same group (i.e., couple) [68]; and because we obtained some of our measurements from both individuals at three points in time, the over-time component of the data is crossed with individuals within dyads.

To illustrate our approach, consider a simple example in which we predict depression as a function of patient catastrophizing. Depression was measured at three time-points for patients and partners. Catastrophizing was measured at three time-points for patients only. The multilevel model we estimated treated both time and person as replications in coming up with the final equation that predicted both the patient's and partner's time-specific depression from the patient's time-specific catastrophizing.¹ Treating the data in this relatively complex multilevel format allowed us to: 1) model how patient catastrophizing affects both patient and partner outcomes, controlling for the non-independence of scores

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¹There are several types of analyses that are potentially possible for this type of data. [68, 69] The most obvious is a growth-curve model in which change in the outcome score over time is predicted by person-level and dyad-level variables. However, given that the key predictors in our analyses were also time-varying, growth-curve models were not well-suited in this case. Such analyses also require that systematic change occurs over time in the DV, and, perhaps surprisingly, this was not the case for this data set (see Table 2). A lagged analysis in which we examine the degree to which variables at time t-1 predict the outcomes as time t, controlling for those same predictors at time t is another possible model. Unfortunately, lagged analyses can be very difficult to estimate a) when the predictors at time t correlate strongly with the predictors at time t-1, and b) when there are relatively few lags. With only three lags of data, and strong lagged correlations, we were not able to estimate such a model.

within couples and over time; and 2) examine variables such as pain intensity and dyadic adjustment as moderators of effects.

Pearson correlations of the medical (i.e., number of comorbidities, length of time since initial diagnosis of breast cancer, BPI average pain at recruitment) and socio-demographic variables (i.e., age, length of relationship, number of children living at home) with the study outcomes were examined to determine potential covariates. We also examined whether there were significant differences in the study outcomes based on stage of initial cancer diagnosis (i.e., stage 4 vs. stages 1, 2, and 3). Only age, length of relationship, and time since diagnosis had *p*-values less than .05. Because age and length of relationship were strongly correlated, only age and time since diagnosis were included as covariates in our analyses.

To examine the over-time effects of catastrophizing on patient and partner depression, we ran a multilevel model that included as predictors age, time since diagnosis, patient catastrophizing, and patient pain intensity. To examine the over-time effects of pain catastrophizing, pain intensity, and dyadic adjustment we ran a single multilevel model that simultaneously tested the individual and combined effects of these variables on both patient and partner depression. We felt that such a model would better approximate what happens in real life compared to running separate models because pain catastrophizing and pain intensity occur at the patient level, dyadic adjustment occurs at the couple level, and the effects of catastrophizing, pain intensity and dyadic adjustment are likely not completely independent of one another when viewed in a couples context. Thus, our over-time model examined a person's (patients' and partners') depression scores (CES-D) as a function of: his/her age, length of time since the patient was diagnosed, the patient's scores on catastrophizing (CSQ), the patient's pain intensity (BPI), the person's dyadic adjustment score (DAS-7), the two-way interaction term patient catastrophizing $\times$ patient pain intensity, the two-way interaction term patient pain intensity $\times$ the person's dyadic adjustment, the two-way interaction term patient catastrophizing $\times$ the person's dyadic adjustment, and a three-way interaction term patient catastrophizing $\times$ patient pain intensity $\times$ the person's dyadic adjustment.²

In multilevel modeling terms, our models included both time varying and non-varying predictors. Specifically, pain catastrophizing, pain intensity, dyadic adjustment, and their interaction were time-varying (i.e., lower-level) predictors. Medical and demographic variables were time invariant predictors. All analyses were conducted using SAS Proc Mixed. The predictor variables were grand-mean centered across couples and time [68]. Error terms were allowed to auto-correlate because we defined the error structure as a lag 1 autoregressive structure [69, 70]. Finally, effect sizes were calculated using the formula $r = \sqrt{t^2 / (t^2 + df)}$ [71].

Results

Recruitment and Characteristics of the Baseline Sample

Research staff approached 367 female metastatic breast cancer patients and their male partners. Of these, 24 patients (6.5%) were ineligible (7 did not live with their partner; 11

had no pain; 2 did not speak English; and 6 could not provide informed consent). Of the 343 eligible patients remaining, 50 (14.6%) declined participation (4 said they were too distressed to participate and 46 said they were not interested). Comparisons were made between study participants and those who declined participation based on available data for age, ECOG performance status, race, average pain (BPI) at time of recruitment, and primary metastatic site. The only significant difference was for average pain $t(351) = -8.49, p=.001$. Specifically, patients who agreed to participate had more pain ($M=4.34, SD=3.02$) on average than those who declined participation ($M=1.44, SD=1.34$).

In 12 of the 293 eligible patients who agreed to participate, we were unable to contact the partner for consent. Couples who consented but did not return surveys within 2 weeks received reminder phone calls, letters, and a second set of mailed surveys. Still, 75 (27%) of the 281 couples who consented did not return their baseline surveys (passive refusal). African American, Hispanic, and Asian patients had a greater likelihood of passive refusal than white patients $\chi^2(3, 273) = 5.79, p=.02$. In 15 of the 206 remaining couples, only one person returned the survey (10 patients, 5 partners), resulting in 201 patients and 196 partners. In 191 couples, both the patient and partner returned the baseline survey. Demographic and medical characteristics of the baseline sample are presented in Table 1.

²The multilevel equations are somewhat complex because of the over-time dyadic nature of the data. In the models below, Y_{ijk} is an outcome score (e.g., depression) where i denotes person ($i = 1, 2$), j denotes couple ($j = 1 \dots n$), and k denotes time ($k = 1 \dots t$); $X1$ represents time with $X1 = 0$ for baseline, $X1 = 1$ for 3 months, and $X1 = 2$ for 6 months. For the other predictors in the model, $X2$ = Patient's Catastrophizing, $X3$ = BPI Pain Severity, and $X4$ = Dyadic Adjustment. The lower-level model predicting a person's depression would be:

$$\begin{aligned} Y_{ijk} = & b_{0j} + b_{1j}X1_k \\ & + b_{2j}X2_k \\ & + b_{3j}X3_k \\ & + b_{4j}X4_k \\ & + b_{2*3j}X2^*X3_k \\ & + b_{3*4j}X3^*X4_k + b_{2*4j}X2^*X4_k + b_{2*3*4j}X2^*X3^*X4_k + e_{1jk} + e_{2jk} \end{aligned}$$

In this model the variances of the time-specific error components were constrained to be the same across time but were allowed to differ for patients and their partners. Similarly, a single time-specific covariance between the two individuals' residuals was specified. The upper level models were:

$$\begin{aligned} b_{0j} = & a_0 + a_1(Age) + a_2(Time \text{ since } dx) + d_{1j} + d_{2j} \\ b_{1j} = & c_0 \\ b_{2j} = & f_0 \\ b_{4j} = & g_0 \\ b_{2*3j} = & h_0 \\ b_{3*4j} = & i_0 \\ b_{2*4j} = & j_0 \\ b_{2*3*4j} = & k_0 \end{aligned}$$

As was the case for the errors in the lower-level model, the variances associated with the lower-level intercepts (d_{1j} and d_{2j}) were allowed to differ for patients and their partners, and were allowed to correlate.

Ten patients who completed the baseline survey died or were referred to hospice before the 3-month assessment, so only 181 follow-up surveys were mailed. Of the 138 couples who returned the 3-month surveys, data from both partners was obtained from 122 couples (67% of the 181 mailed out). Before the 6-month survey was mailed, we learned that 8 additional patients died and 22 either dropped out or were lost to follow-up, resulting in a mail-out of 151 surveys. Six couples did not return the 6-month survey because the patient had died. Of the 126 couples (66% of the original 191 who completed baseline surveys) who returned the 6-month surveys, 110 couples (73% of the 151 couples who were mailed 6-month surveys) had complete data. Comparisons were made between patients who completed the study and those who did not based on age, ECOG performance status, race/ethnicity, dyadic adjustment, and distress. No significant differences were found.

Descriptive Results

Despite the fact that all the patients in this study had metastatic breast cancer, we did not directly assess whether their pain was directly related to their cancer and its treatment (e.g., tumor involvement, treatment-related neuropathy) or whether it was due to other chronic pain conditions. We did however ask patients whether they had any other comorbid health conditions. Although 64% (N=123) indicated that they had a comorbid health condition, only 7% (14) patients said they had a chronic pain condition (i.e., back pain, arthritis, headaches, carpal tunnel syndrome, shingles, and fibromyalgia); 6% (11) patients reported having diabetes, but did not specify whether they experienced any diabetic-related pain or neuropathy. The remainder of patients reported having conditions that are generally not associated with pain (e.g., hypothyroidism, high blood pressure, gastro-esophageal reflux disease, asthma, and allergies).

In terms of depression, 41% of patients and 36.4% of partners scored at or above the CES-D cutoff of 16, indicating that they had significant depressive symptoms warranting further psychological evaluation; in 18.5% of couples, both partners were at or above the cut-off. At 3 months, this percentage was slightly higher for patients (48.6%) and slightly lower for partners (30.8%); in 19.6% of couples, both partners were at or above the cut-off. At 6 months, 36.5% of patients and 36.5% of partners were above the cut-off (21.9% of couples). For patients, depression did not differ as a function of treatment type.

In terms of dyadic adjustment, 23% of patients and 23% of partners met the DAS-7 criteria for marital distress at baseline; in 10% of couples, both partners reported marital distress. At 3 months, this percentage was slightly higher (28% of patients and 25% of partners; 8% of couples). At 6 months, 21% of patients and 29% of partners had marital distress (6% of couples).

Table 2 shows the correlations between patients and partners on the major study variables at each assessment; correlations for partners are above the diagonal, correlations for patients are below the diagonal, and paired correlations (between the two partners' scores) are on the diagonal. Because catastrophizing and pain intensity were only measured for patients, there are no alphas, means, SDs, or correlations for partners on these measures. Of note, patients' and partners' depression and dyadic adjustment scores were significantly correlated at each assessment.

Table 2 also shows the means, SDs, and paired t-test results comparing each of the major study variables between patients and partners. At baseline, patients reported significantly better dyadic adjustment than their partners. However, dyadic adjustment scores were comparable at 3-month and 6-month follow-ups. Patients reported significantly more depression than their partners at the 3-month follow-up than their partners. At the baseline and 6-month assessments, there were no significant differences between patient and partner depression scores.

Multilevel Modeling Results

The three-way interaction between patient catastrophizing, patient pain intensity, and dyadic adjustment was significant (see Table 3). To test the simple slopes of the interaction, we used the procedures by Preacher, Curran, and Bauer [72], developed specifically for multilevel models. To break apart the three-way interaction, we examined the interactions between pain intensity and catastrophizing at high (+1 SD) and low (−1 SD) levels of dyadic adjustment. These findings are graphically depicted in Figure 1. As the figure shows, pain intensity influenced the association between catastrophizing and depression differently in couples who reported high (+1SD) levels of dyadic adjustment compared to those who reported low (−1SD) levels of dyadic adjustment. At high levels of dyadic adjustment, tests of the simple slopes showed that the general pattern of association between catastrophizing and depression was the same regardless of whether patients reported high (+1SD) levels of pain ($b=2.16$, $z=3.72$, $p=.0002$) or low (−1SD) levels of pain ($b=2.84$, $z=4.00$, $p=.00$) – namely, higher levels of catastrophizing were associated with higher levels depression for both patients and their partners. In contrast, at low levels of dyadic adjustment, the relationship between catastrophizing and depression was influenced by patient pain levels. Specifically, in the context of low (−1SD) pain, patient catastrophizing had a positive but non-significant association with depression ($b=.96$, $z=1.45$, $p=.15$); however, in the context of high (+1SD) pain, higher levels of catastrophizing were associated with higher levels of depression for both patients and their partners ($b=2.59$, $z=4.90$, $p=.00$). These results indicate that the negative relationship between patients' catastrophizing and patients' and partners' depression did not exist among couples in which both the patient had low levels of pain and the couple had low levels of dyadic adjustment. Couples who reported having higher levels of DAS, however, reported lower levels of depression overall than those who reported having lower levels of DAS ($p < .001$).

In order to further determine which points on simple slopes graph (Figure 1) were statistically significantly different, tests of the plotted points were conducted.³ Results showed that when patients engaged in high levels of catastrophizing and had high levels of pain, both patients and their partners reported significantly ($p=.002$) higher levels of depression ($M=25.0$) than when patients engaged in high levels of catastrophizing but had low levels of pain ($M=16.9$). This difference was not significant when patients engaged in low levels of catastrophizing.

Specifically, at high levels of catastrophizing, couples who had low levels of dyadic adjustment and high levels of pain ($M=25.0$) reported significantly higher levels of depression than couples who had high levels of dyadic adjustment at high levels of pain

³In order to test the difference between two points (e.g., depression levels among couples in which the patient is high in catastrophizing and pain and the couple is *high* in DAS vs. depression levels among couples in which the patient is high in catastrophizing and pain and the couple is *low* in DAS), we compared the two regression equations that led to these two points by subtracting one from the other. Then, we tested that result for significance using a delta-method standard error in a z-test. In this particular example, the regression equation is:

$$\hat{Y} = b_0 + b_1X + b_2Z + b_3W + b_4X*Z + b_5X*W + b_6Z*W + b_7X*Z*W$$

Where $\hat{Y}$ =depression (CES-D), X =catastrophizing, Z =marital adjustment (DAS), and W =pain.

In order to test for the difference between the two predicted points, we simply subtracted the equation for predicting depression among couples in which the patient is high in catastrophizing and pain and the couple is *high* in DAS from the equation for predicting depression levels among couples in which the patient is high in catastrophizing and pain and the couple is *low* in DAS. In short, we were comparing the equation at different points of DAS.

$$\begin{aligned}\hat{Y}_1 &= b_0 + b_1X + b_2Z_1 + b_3W + b_4X*Z_1 + b_5X*W + b_6Z_1*W + b_7X*Z_1*W \\ \hat{Y}_2 &= b_0 + b_1X + b_2Z_2 + b_3W + b_4X*Z_2 + b_5X*W + b_6Z_2*W + b_7X*Z_2*W\end{aligned}$$

Thus, the statistic (the numerator of the z ratio) is:

$$\begin{aligned}\hat{Y}_1 - \hat{Y}_2 &= (b_0 + b_1X + b_2Z_1 + b_3W + b_4X*Z_1 + b_5X*W + b_6Z_1*W + b_7X*Z_1*W) \\ &\quad - (b_0 + b_1X + b_2Z_2 + b_3W + b_4X*Z_2 + b_5X*W + b_6Z_2*W + b_7X*Z_2*W) \\ &= b_2(Z_1 - Z_2) + b_4X(Z_1 - Z_2) \\ &\quad + b_6W(Z_1 - Z_2) \\ &\quad + b_7XW(Z_1 - Z_2) \\ &= (b_2 + b_4X + b_6W + b_7XW)(Z_1 - Z_2)\end{aligned}$$

We had to calculate the denominator (standard error) of the equation in order to calculate the z-test. Ordinarily, we would use calculus and matrix algebra to derive the standard error as a complex function of the parameters b_1 , b_4 , b_6 , and b_7 and their asymptotic variances and covariances. However, because we centered X (catastrophizing) and W (pain) at 0 prior to computing product terms and running the analysis, the above equation reduces to the following:

$$(b_2 + b_4(0) + b_6(0) + b_7(0)(0))(Z_1 - Z_2) = b_2(Z_1 - Z_2)$$

The standard error of this statistic is:

$$\sqrt{\left[\text{var}(b_2) * (Z_1 - Z_2)^2 \right]} = SE(b_2) * (Z_1 - Z_2)$$

Therefore, the z-test for testing the differences of these two regression equations is:

$$z = b_2(Z_1 - Z_2) / SE(b_2) * (Z_1 - Z_2) =$$

The $(Z_1 - Z_2)$ terms are canceled (regardless of what Z_1 and Z_2 happen to equal), leaving the following formula:

$$z = b_2 / SE(b_2)$$

This formula is simply the test for the slope of Z , which is the t test for the slope of DAS. This is the formula we would utilize to test the difference between any two variations on the difference between X (catastrophizing), Z (DAS), and W (pain). Thus, the test for point differences is simply the t-test for the slope of DAS, which is:

$$t = -4.21, \quad p < .0001$$

catastrophizing, couples who had low dyadic adjustment and low levels of pain ($M=10.8$) reported significantly lower levels of depression than couples who had high levels of dyadic adjustment at high levels of pain ($M=20$) ($p < .0001$) and at low levels of pain ($M=20.0$) ($p < .0001$).

In addition to the significant three-way interaction described above, Table 3 shows that the lower order two-way interactions between catastrophizing and pain intensity and dyadic adjustment and pain intensity were not significant. However, significant ($p < .01$) main effects were found for pain catastrophizing, pain intensity, and dyadic adjustment.

Discussion

The results of this study underscore the complex interplay between catastrophizing and depression as they unfold over time in couples coping with metastatic breast cancer. As hypothesized, we found that patient catastrophizing was consistently associated with patient and partner depression over time. We also found that the effects of catastrophizing on patients' and partners' depression varied depending not only on patients' pain intensity but also patients' and partners' dyadic adjustment. These findings extend the diathesis-stress framework developed by Banks and Kerns [21] in chronic pain to a couples context in cancer by identifying when patient catastrophizing is most likely to exacerbate patient and partner depression (i.e., when the patient is in severe pain and patients and partners have low dyadic adjustment).

Contrary to our hypothesis, we found that when patients and partners reported higher than average levels of dyadic adjustment, higher levels of patient catastrophizing were associated with higher levels of depression, regardless of pain intensity. However, when patients and partners reported lower than average levels of dyadic adjustment, the effects of catastrophizing on depression depended to a greater degree on patient pain intensity. Notably, patients and partners reported the highest levels of depression when they had low levels of dyadic adjustment and patients reported high levels of pain intensity and pain catastrophizing. Taken together, these findings suggest that having a positive, supportive relationship (characterized by high dyadic adjustment) does not necessarily mitigate the effects of catastrophizing on depression, but having a poorly functioning relationship (characterized by low dyadic adjustment) could make things worse. One possible explanation for the lack of a buffering effect for dyadic adjustment could be that partners who have high levels of dyadic adjustment may be more "in tune" with what their spouses are feeling and thus more likely to be affected by the patient's catastrophizing, regardless of pain intensity, than those who are low in dyadic adjustment. Alternatively, those who are low in dyadic adjustment may rely more heavily on the cues of pain intensity in determining how distressed their partner is. More work is needed to develop a clearer understanding of these relationships.

Our findings are consistent with Baumeister's idea that "bad is stronger than good" [73] and empirical research in cancer showing that the negative aspects of close relationships have a stronger role than positive aspects in terms of their associations with psychological distress and well-being [74]. At the same time, our findings differ slightly from Holtzman and

Delongis [29] who found that illness-specific perceptions (i.e., patients' satisfaction with spouse responses to their pain) buffered chronic pain patients from the negative effects of catastrophizing on their well-being. Given that a broad range of social interactions besides dyadic adjustment have been shown to relate to patient and partner adjustment to cancer (e.g., communication patterns, social constraints, criticism) [16], future research may benefit from comparing positive and negative interactions as well as the relative effects of illness-specific versus general relationship perceptions on both patient and partner adjustment in the contexts of advanced cancer pain and non-malignant chronic pain.

Overall, our findings are consistent with a diathesis-stress framework and underscore the importance of taking into account aspects of the pain condition (i.e., pain intensity) as well as relationship (social) factors when examining the effects of patient catastrophizing on patient and partner depression. However, it is important to point out study limitations. First, all patients were female and all partners were male. Future studies should evaluate whether the findings can be replicated in a patient population with mixed genders. Second, our sample was overwhelmingly Caucasian, well-educated, and married or cohabiting for a lengthy period of time. It is possible that our findings would not generalize to minorities, less well-educated couples, or couples in less lengthy relationships. Third, we had considerable passive refusal rates and sample attrition. Because our sample comprised individuals initiating treatment for metastatic breast cancer, completing a lengthy survey may not have been a priority. Non-completion may have also been due to factors such as psychological and marital distress. Because we did not collect such data at recruitment, we cannot determine whether passive refusers were more or less distressed than study participants. A related issue is sample attrition. A total of 110 of the 191 couples who completed baseline surveys also completed the 3 and 6 month follow-ups (58%); however, 24 women died (13%), suggesting that only 29% dropped out, which is lower than drop-out rates in other prospective studies involving cancer patients and their spouses [75, 76]. Differences between study completers and non-completers were examined with regard to baseline physical symptoms, distress, and dyadic adjustment. Although no significant differences were found, those who dropped out may have experienced sharper declines over time. Fourth, we did not assess dyadic adjustment prior to the cancer diagnosis and we did not examine whether partners felt that the patient's catastrophizing was justified, based on the patient's pain or any other factor. Thus, we do not know if dyadic adjustment changed after diagnosis or if it remained stable and influenced the levels of depression (and in some cases the effect of catastrophizing on depression). Moreover, since our sample comprised late stage (terminal) breast cancer patients, it is possible that partners could have felt that the patient's catastrophizing was justified independent of pain. Finally, even though our findings suggest that pain intensity is important to consider in understanding the effects of catastrophizing on depression, we were unable to examine the effects of partner perceptions of the patient's pain on this association.

The present findings, if they are replicated with other populations, have clinical implications and provide potential targets for future intervention. Most participants had good dyadic adjustment at study entry but at least one partner met DAS criteria for marital distress in a third of the original 205 couples surveyed. These rates increased over time, suggesting that this may be an important area for intervention in metastatic breast cancer and that future

research should evaluate whether the efficacy of couples' interventions in advanced cancer may depend on couples' initial levels of dyadic adjustment. If this is the case, future programs that seek to alleviate pain and depressive symptoms in patients with metastatic breast cancer may benefit from targeting both members of the couple and screening for marital distress as these couples may stand to benefit most from intervention.

To date, only a handful of psychosocial interventions have been published that have targeted couples coping with advanced cancers [19, 77, 78], and none have focused exclusively on metastatic breast cancer. While it may seem that the functional impairment issues and caregiving demands experienced by this population might dampen their enthusiasm to participate in couple-based interventions, these published studies have shown that such programs are not only feasible and acceptable, but also effective in terms of improving patient and/or partner distress and marital adjustment. In an effort to move this research area forward, future programs should focus on enhancing the interactions between metastatic breast cancer patients and their partners to identify and clarify the ways that both members of the couple can adaptively cope with pain together and coordinate care and support. For example, interventions could teach partners to identify when and what type of support the patient needs when he/she is experiencing pain to decrease the likelihood of the patient engaging in maladaptive coping strategies. Teaching couples coping skills to deal with the specific impact of the patient's pain condition on their relationship and working to improve communication specifically about pain and pain management may also help to bolster intervention efficacy. Finally, going forward, it will be important to create interventions that take into consideration the fact that patients with advanced disease have greater symptom burden than patients with early stage disease and that their partners have greater caregiver responsibilities and demands on their time that may preclude them from participating in clinic or hospital based interventions. Home based interventions that utilize the telephone or emerging communication technologies (e.g., internet, mobile health) may not only facilitate the uptake and dissemination of couple-based interventions, but also prove to be more cost-effective.

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Figure 1. Results of multilevel analysis among (a) high dyadic adjustment (DAS-7) patients (+1 *SD*) and (b) low dyadic adjustment patients (−1 *SD*) regressing depression (CES-D) scores on patient reports of catastrophizing with pain intensity (BPI) as a moderator.

Table 1

Demographic and Medical Characteristics of Baseline Sample

	<u>Patients (N = 201)</u>	<u>Partners (N = 196)</u>
White (%)	185 (92.0)	182 (92.9)
Age (mean $\pm$ SD) (range) yrs	52.20 $\pm$ 10.5 (23–78)	54.40 $\pm$ 10.85 (24–79)
College 2 yrs (%)	141 (70.1)	147 (75.0)
Employment status (%)		
Full-time	50 (24.9)	131 (66.8)
Part-time	21 (10.40)	7 (3.6)
Unemployed	63 (31.3)	8 (4.1)
Retired	52 (25.9)	46 (23.5)
Unknown	15 (7.5)	4 (2.0)
Married (%)	199 (99.0)	
Years of marriage (range)	25.57 $\pm$ 13.02 (Range = 1–58 yrs)	
Stage at time of initial cancer diagnosis: (%)		
I	24 (11.9)	
II	51 (25.4)	
III	41 (20.4)	
IV	51 (25.4)	
Unknown	34 (16.9)	
Years since diagnosis (range)	5.43 $\pm$ 5.20 (5 wks–25.6 yrs)	
Primary metastatic site (%)		
Bone	113 (56.2)	
Lung	42 (20.9)	
Liver	38 (18.9)	
Brain	8 (4.0)	
Treatment (%)		
Chemotherapy	171 (85.1)	
Hormonal therapy	22 (10.9)	
Palliative radiation	8 (4.0)	

SD: standard deviation.

Table 2

Descriptive Results for Patients and Partners at Each Assessment

	Patients [^]				Partners [^]		t _f
	CSQ-C ^a	BPLS	DAS7	CES-D	Mean+SD	Range	
CSQ-C ^a							
Baseline	--	--	--	--	.97 ± 1.05	.00 – 4.57	--
3 months	--	--	--	--	.98 ± 1.08	.00 – 4.71	--
6 months	--	--	--	--	1.02 ± 1.15	.00 – 5.14	--
BPLS ^b							
Baseline	**	--	--	--	2.34 ± 1.98	.00 – 9.50	--
3 months	**	--	--	--	2.14 ± 1.96	.00 – 8.25	--
6 months	**	--	--	--	2.04 ± 2.05	.00 – 9.75	--
DAS7 ^c							
Baseline	-.06	-.10	.53	**	25.66 ± 6.21	9.00 – 36.00	24.80 ± 5.60 3.00 – 35.00 *
3 months	-.19 *	-.15	.57	**	24.92 ± 6.21	9.00 – 36.00	24.88 ± 6.13 1.00 – 36.00 --
6 months	-.28	-.35	.54	**	25.00 ± 6.13	7.00 – 36.00	24.45 ± 6.49 2.00 – 36.00 --
CES-D ^d							
Baseline	.53	.29	-.16 *	**	14.35 ± 9.53	.00 – 47.00	14.20 ± 9.97 .00 – 46.00 --
3 months	.52	.36	-.34	**	15.37 ± 9.56	.00 – 44.00	12.74 ± 9.45 .00 – 46.00 **
6 months	.63	.65**	-.47	**	14.29 ± 10.81	.00 – 46.00	14.70 ± 11.15 .00 – 53.00 --

Note: Catastrophizing and Pain Severity were only measured for patients, so there are no means, SDs, or correlations for partners on those variables. Patient correlations on lower diagonal, partner correlations on upper diagonal, and paired correlations are on the diagonal

* $p < .05$

** $p < .01$

[^] Mean scores did not significantly differ for patients or partners over time

[#] Paired t-tests examined differences in patient and partner scores at each assessment.

d Center for Epidemiological Studies Depression Scale (CES-D)
 d Short Form 7-item Dyadic Adjustment Scale Total Score
 d Patient's Brief Pain Inventory (BPI) Severity total score
 d Patient's Catastrophizing total score on the Coping Strategies Questionnaire

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Table 3

Over-time Effects of Pain Severity and Dyadic Adjustment on the Link between Patient Catastrophizing and Patient and Partner Depression

	B	SE	t	Effect size (r)
Intercept	14.14	.50		
Time	.10	.31	.33	
Age	-.06	.05	-1.46	
Time since diagnosis	-.11	.08	-1.29	
Patient catastrophizing	2.14	.37	5.70**	.29
Patient pain severity	.64	.20	3.14**	.16
Dyadic adjustment	-.27	.06	-4.21**	.18
Catastrophizing × pain severity	.12	.15	.79	
Pain severity × dyadic adjustment	-.03	.03	-.81	
Catastrophizing × dyadic adjustment	.06	.05	1.09	
Catastrophizing × pain severity × dyadic adjustment	-.04	.02	-2.62**	.12

Note. B = raw coefficient, SE = standard error; effect size $r = \sqrt{t^2 / (t^2 + df)}$,

* $p < .05$

** $p < .01$