# Catastrophizing Is Associated with Clinical Examination Findings, Activity Interference, and Health Care Use Among Patients with Temporomandibular Disorders

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***Aims:*** *To examine whether catastrophizing is associated with clinical examination findings, pain-related activity interference, and health care use among patients with pain related to temporomandibular disorders (TMD).* ***Methods:*** *Patients with TMD (n = 338; 87% female; mean age, 37 years) completed measures of pain, pain-related activity interference, health care use, and depression, and received a Research Diagnostic Criteria/Temporomandibular Disorders (RDC/TMD) clinical examination from an oral medicine specialist.* ***Results:*** *Catastrophizing was not significantly associated with the more objective clinical examination measures of maximum assisted jaw opening and jaw-joint sounds, but it was associated with the more subjective examination measures (unassisted opening without pain, extraoral muscle site palpation pain severity, joint site palpation pain severity) and with increased TMD-related activity interference and number of health care visits (*P *values for all < .01). Even after controlling for demographic variables, pain duration, and depression severity, catastrophizing remained significantly associated with extraoral muscle and joint site palpation pain severity and with activity interference and number of health care visits.* ***Conclusion:*** *TMD patients who catastrophize have higher scores on clinical examination measures reflecting more widely dispersed and severe pain upon palpation of TMD-related facial muscle and joint sites, as well as greater TMD-related activity interference and health care use. Clinicians should consider screening patients with moderate or greater TMD pain and activity interference for catastrophizing. Cognitive-behavioral interventions may help reduce pain, disability, and health care use of patients who catastrophize.*
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**Key words:** activity interference, catastrophizing, chronic pain, Reasearch Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD), temporomandibular disorders

Temporomandibular disorders (TMD) are a group of conditions characterized by signs and symptoms in the masticatory and related muscles and the temporomandibular joint (TMJ). Most commonly, these are pain in the preauricular area, TMJ, and/or masticatory muscles; limitations in vertical range of mandibular motion; and noises in the TMJ (crepitus, clicking) during mandibular function. Although TMD are the most frequent facial pain problems,[1] with an estimated prevalence of 10% to 12%,[2–4] the etiologies of the most familiar forms of TMD are poorly understood.[5,6] Patients with TMD share characteristics in common with patients who have other chronic pain conditions



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such as headache and back pain, including similar pain intensity levels and associated behavioral and psychological dysfunction,[7] tendency to have persistent and recurrent pain,[8] and refractoriness of pain to treatment.[9] Individuals with TMD differ considerably in levels of psychosocial dysfunction and pain-related disability,[10–12] and objective findings do not appear to explain these differences.[7,11] The importance of nonbiological factors in this condition is also suggested by findings that changes over time in physical measures of jaw function are not clearly related to course of pain.[13]

Depression and somatization are 2 nonbiologic factors that have been demonstrated as important in TMD symptoms.[13–16] Pain-related catastrophizing may be another potentially powerful nonbiologic influence on symptoms and functioning among patients with TMD, but, unlike depression and somatization, it has received relatively little attention in the orofacial pain literature. Pain-related catastrophizing may be defined as an excessive focus on pain, magnification of the threat associated with pain, and feelings of helplessness in controlling pain. Patients who catastrophize have thoughts such as "I can't stand this pain anymore" and "This pain is terrible" and tend to worry excessively about their symptoms. A substantial volume of research has demonstrated that pain-related catastrophizing is associated significantly with pain intensity, disability, and psychological distress among patients with a variety of other pain syndromes.[17] Catastrophizing has also been found to be associated with increased pain during dental hygiene treatment,[18,19] lower experimental pain threshold and tolerance,[20] and greater pain medication use.[21] Although catastrophizing is related to depression, there is evidence that it is associated with pain and dysfunction independent of depression.[17,22]

The sparse research that has been conducted on catastrophizing in samples of patients with TMD has yielded intriguing findings. In a study of women with TMD, catastrophizing was greater among those with chronic pain than among those with recent onset of pain.[23] Other studies found that catastrophizing was associated with patient-reported TMD symptom severity[12] and patient failure to respond to conservative therapy.[24] Furthermore, there is evidence that treatments for TMD that specifically target patients' dysfunctional cognitions enhance the positive effects of more generic dental and behavioral treatments.[9,25] In a previous study of patients with TMD,[26] the present authors found that catastrophizing was associated significantly with patient-reported pain-related activity interference, depression, and nonmasticatory jaw-activity limitations, even after controlling for age, gender, and pain intensity.

The primary objective of the present study was to examine whether catastrophizing is associated with clinical examination findings, pain-related activity interference, and health care use among patients with TMD. It was hypothesized that catastrophizing would not be associated significantly with the more objective biological examination measures (joint sounds heard by the examiner and maximum jaw opening with assistance from the examiner) but that catastrophizing would be related to measures dependent upon the patient's subjective responses (ie, responses more likely to be influenced by nonbiologic factors such as increased pain upon palpation of facial sites associated with TMD, decreased range of vertical jaw opening when asked to open as wide as possible without discomfort, and increased health care utilization for TMD). It was also hypothesized the findings of this study would replicate, in a different and larger patient sample, the authors' previous findings of significant and positive associations between catastrophizing and pain-related jaw-activity limitations and more general activity limitations. It was further hypothesized that catastrophizing would be associated with the outcome measures independently of depression.

In all analyses, the authors tested for gender differences in light of the evidence that gender is important in TMD, pain report, and catastrophizing. It is well-known that TMD are much more common in women.[27] Other studies have found that women tend to catastrophize more[17,22,28–30] and report more pain as compared with men.[31] Some research suggests that gender differences found in pain reports may be explained by differences in catastrophizing.[22,28] Finally, the authors examined whether associations between catastrophizing and the study outcome measures were maintained even after controlling for pain intensity, which could be associated with both catastrophizing and the outcome measures.

## Materials and Methods

### Participants and Procedures

For this study, the authors combined baseline data from 2 different studies, both of which enrolled participants from patients seeking evaluation and treatment at the University of Washington TMD clinic. Both studies were approved by the University of



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Washington institutional review board, and all participants provided written informed consent. In both studies, patients were typically approached during their first visit to the clinic (or in a few cases, a subsequent visit).

Participants in the first study enrolled in a randomized clinical trial (RCT) comparing usual care in the TMD clinic plus either a self-care manual or 4 cognitive-behavioral pain management training sessions. Study inclusion criteria were *(1)* age 18 years or older; *(2)* a Research Diagnostic Criteria/Temporomandibular Disorders (RDC/TMD) Axis I TMD pain diagnosis,[5] as determined by an oral medicine specialist based on a structured RDC/TMD clinical examination; *(3)* residence within a 2-hour drive of the TMD clinic; *(4)* facial pain for at least 3 months; *(5)* facial pain-related disability, as defined by a chronic pain grade[32] of II high (high pain and low disability), III (moderate disability), or IV (severe disability); and *(6)* ability to communicate in English. Study exclusion criteria were the need for further diagnostic evaluation, pending litigation or disability compensation for pain, current or prior participation in cognitive-behavioral therapy for pain, and major medical or psychiatric conditions that would interfere with ability to participate (eg, psychosis, clinical indications for surgical treatment, major medical illness, active suicidal ideation, current alcohol or other substance abuse). Of the 313 eligible patients approached during the period of enrollment for this report, 129 (41%) enrolled in the study and 184 (59%) declined to enroll. Study participants did not differ significantly from study refusers on any variable for which data were available for study refusers (gender, age, race, education, chronic pain grade, pain intensity, and pain-related activity interference; see Measures section for descriptions of these measures), as determined by *t* tests and chi-square tests.

Participants in the second study were patients at the same TMD clinic who enrolled in an RCT that compared 3 treatments: *(1)* usual treatment in the clinic; *(2)* a single educational session emphasizing self-care strategies plus telephone follow-up by a dental hygienist; and *(3)* the same educational session and telephone follow-up plus case management by a dental hygienist for patients with continued pain-related activity interference after 3 months. Study inclusion and exclusion criteria were similar to those of the first study except that patients with chronic pain grades of I (low pain and low pain-related disability) and II low (high pain and no disability) were also included, and patients were not excluded based on where they lived, pain duration, or participation in cognitive-behavioral therapy for pain. Of the 409 eligible patients approached, 272 (67%) enrolled in the study and 137 (33%) declined to enroll. Study participants did not differ from study refusers on any variable for which data were available for study refusers (gender, age, race, education, chronic pain grade, pain intensity, pain-related activity interference; see Measures section for descriptions of these measures), as determined by *t* tests and chi-square tests. The catastrophizing measure was added to the baseline assessment after the first 63 patients enrolled; therefore, data from 209 participants in this study were available for analysis for this report and combined with data from the 129 participants in the other study to create a total sample of 338 patients with TMD.

### Baseline Questionnaire Measures

The self-report data analyzed for this report came from baseline questionnaires completed by participants in both studies prior to beginning the RCT. The questionnaires included questions about sociodemographic variables (age, race/ethnicity, gender, marital status, education), and pain duration. The questionnaire also included the following measures of health care use, pain, pain-related activity interference, catastrophizing, and depressive symptoms.

**Health Care Use.** Patients were asked to report the number of health care visits they had made in the past 6 months for facial pain, excluding those to the University of Washington TMD Clinic, in each of 6 categories (dentist, medical doctor, naturopath/homeopath, chiropractor, physical therapist, and other). These numbers were summed to create a single measure of number of visits in the past 6 months.

**Pain Intensity and Activity Interference.** The Graded Chronic Pain Scale (GCPS)[32,33] was used to assess facial pain intensity and interference with normal daily activities. This measure has been validated and shown to have good psychometric properties in a large population survey and in large samples of primary care patients with pain.[32,33] Characteristic pain intensity was calculated by averaging 0-to-10 ratings of current facial pain and average and worst facial pain in the past month.[32–34] The pain-related activity interference score[33] was calculated by averaging 0-to-10 ratings of facial pain interference with daily activities, work/housework activities, and recreational/social activities in the past month. The characteristic pain intensity and pain-related activity interference



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scores have good internal consistency, test-retest reliability, and validity.[33,35] Jaw-activity limitations were assessed by the Mandibular Function Impairment Questionnaire (MFIQ),[36] a 17-item measure consisting of 2 subscales (masticatory and nonmasticatory jaw-use limitations) demonstrated to be sensitive to change with treatment for TMD.[37]

**Catastrophizing.** Catastrophizing was assessed by the 6-item Coping Strategies Questionnaire (CSQ)[38] catastrophizing scale. This scale has excellent internal consistency[38,39] and has been shown to be associated with various measures of functioning among patients with different pain conditions.[39–43]

**Depression.** Depressive symptom severity was assessed by the 13-item Depression scale of the Symptom Checklist-90 (SCL-90).[44] Construct validity for this scale has been demonstrated.[45]

### RDC/TMD Clinical Examination

At their first clinic visit, all study participants received a standardized RDC/TMD examination[5] conducted by an oral medicine facial pain specialist trained by a "gold standard examiner" responsible for training and calibrating examiners at the University of Washington and internationally. Training involved watching a training videotape, reviewing the written specifications concerning the RDC/TMD examination, using a postage scale for determining the correct amount of pressure to apply during palpations, practicing the examination on patients with and without TMD, and performing the examination on subjects trained to give standardized feedback. The RDC/TMD includes diagnostic algorithms for the most common TMD conditions and allows for multiple diagnoses. Axis I of the RDC/TMD includes the 3 most common TMD diagnostic categories: (I) myofascial pain disorders, with and without limitation in vertical range of mandibular motion; (II) disc displacement disorders, with and without reduction of the articular disc; and (III) arthralgia, arthritis, and arthrosis.

**RDC/TMD Examination Measures.** Two measures of vertical range of jaw motion were obtained by measuring the opening between the edges of the maxillary and mandibular central incisors in millimeters (corrected for overbite): unassisted (mandibular) opening without pain (open mouth as wide as possible without pain) and maximum assisted opening (moderate pressure to open the patient's mouth as wide as possible even if uncomfortable). The latter is useful in determining whether there is a limitation in opening due to physical causes such as articular fossa shape, arrangement of the mandibular condyle in the fossa, displaced or immovable articular disc, or muscle contraction. Jaw joint sounds (clicking, crepitus) on opening or closing were recorded and analyzed as any sounds versus none. Digital pressure was applied to sites presumed to be related to TMD pain. These bilateral sites include extraoral masticatory muscles (8 sites on each side of the face: posterior, middle, and anterior temporalis; origin, body, and insertion of the masseter; posterior mandibular region; submandibular region) and joint sites (lateral pole of the condyle and posterior attachment). Patients rated the severity of pain experienced during palpation of each site as none (0), mild (1), moderate (2), or severe (3). The 16 extraoral muscle pain severity ratings were averaged to create a measure reflecting extraoral masticatory muscle palpation pain severity and extent, and the 4 joint site pain severity ratings were averaged for a measure of joint site palpation pain severity and extent. Acceptable interrater reliability has been demonstrated for the vertical range of opening and palpation pain measures.[46]

### Statistical Analysis

Descriptive statistics were used to summarize the demographic and clinical characteristics of the study sample. Little information is available concerning gender differences in demographic and clinical characteristics among patients with TMD pain. Thus, for descriptive purposes, men and women were compared with respect to these variables using *t* tests (for normally distributed continuous measures), Mann-Whitney tests (for number of visits for facial pain, which showed a skewed distribution), and chi-square analyses (for categorical variables).

To examine the associations of catastrophizing with the clinical examination and patient self-report measures, linear regression analyses were performed for the continuous measures and logistic regression for the binary variable (joint sounds on examination). The authors controlled for patient gender, age, pain duration, and education in the models, because these patient characteristics could potentially affect catastrophizing or the outcome measures. Inclusion of gender is particularly important for the jaw-opening measures, because men have greater vertical range of motion in the jaw.[3] The authors also tested for a catastrophizing × gender interaction effect. To determine whether catastrophizing was associated with the outcome measures independently of depression, these multivariate regression analyses were repeated controlling for SCL-90 Depression scores. The regression



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**Table 1** Sample Demographic Characteristics

| Characteristic* | Total sample (n = 338) n (%) | Women (n = 293) n (%) | Men (n = 45) n (%) | $P^{\dagger}$ |
|---|---|---|---|---|
| Race | | | | .80 |
| White | 292 (88.8) | 252 (88.4) | 40 (90.9) | |
| Other | 37 (11.2) | 33 (11.6) | 4 (9.1) | |
| Marital status | | | | .31 |
| Married | 168 (50.6) | 146 (50.9) | 22 (48.9) | |
| Divorced, separated, widowed | 66 (19.9) | 60 (20.9) | 6 (13.3) | |
| Never married | 98 (29.5) | 81 (28.2) | 17 (37.8) | |
| Education | | | | .02 |
| High school or less | 76 (22.7) | 66 (22.8) | 10 (22.2) | |
| Some college or vocational/technical | 121 (36.1) | 112 (38.6) | 9 (20.0) | |
| College graduate | 63 (18.8) | 51 (17.6) | 12 (26.7) | |
| Graduate or professional school | 75 (22.4) | 61 (21.0) | 14 (31.1) | |

*Some frequencies sum to < 338 because data are missing.

†*P* values from chi-square or Fisher exact (race) tests comparing men and women. In the marital status category, married subjects were compared to other subjects. In the education category, those with some college or less were compared with those who had at least a college degree.

analyses were repeated a final time with baseline characteristic pain intensity added to the model with gender, age, education, pain duration, and catastrophizing. The authors wished to determine the effect of catastrophizing after adjusting for pain intensity, because pain intensity could be associated with catastrophizing, the other covariates, and the outcome measures.

Because pain duration and number of health care visits for facial pain had highly skewed distributions, a square root transformation of these variables was used in the regression analyses. Joint palpation pain and extraoral masticatory muscle palpation pain also had somewhat skewed distributions. Regression analyses were performed for these variables with both untransformed and square-root-transformed values, and the conclusions did not differ. The results for the untransformed values have been reported for greater ease in interpretation.

## Results

### Patient Characteristics

The mean age ± SD of the 338 patients was 37 years ± 12 (range, 18 to 70 years). Men averaged 36.7 ± 11.7 years; women averaged 37.6 ± 11.8 years ($P > .05$); 293 patients (87%) were female. Table 1 shows other demographic characteristics of the sample. Most were white (89%), 41% were educated through college or higher, and 51% were married. As compared with the female study participants, the men were more highly educated ($\chi_1^2 = 6.0$, $P = .02$), but there were no significant gender differences in race or marital status.

Almost 90% of the sample had a RDC/TMD Group I (myofascial pain) diagnosis—43% without a limitation in opening (Ia) and 46% with limited opening (Ib). Twenty-one percent had a diagnosis of disc displacement with reduction (IIa). Almost 10% had a diagnosis of disc displacement without reduction; 6% had with limited opening (IIb) and 4% had without limited opening (IIc). Fifty-three percent had a diagnosis of arthralgia (IIIa), and about 10% had degeneration of the TMJ (7% with osteoarthritis [IIIb] and 2% with osteoarthrosis [IIIc]). Comparisons of men and women revealed only 1 statistically significant difference: women were more likely to receive a diagnosis of myofascial pain with limited opening (49% versus 29%; $\chi^2 = 6.0$, $P = .01$). Because range of jaw opening is a factor in the algorithm for this diagnosis, this difference in diagnosis may be due to the smaller range of opening in women (Table 2a).[3]

Tables 2a and 2b show the clinical characteristics of this sample. There were several significant gender differences in addition to those on the range of jaw-opening measures. Male study participants reported significantly shorter duration of facial pain. Female participants reported significantly greater masticatory jaw-activity limitations ($P = .03$) and greater pain severity upon palpation



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**Table 2a** Means and SDs for Sample Clinical Characteristics

| Measure (possible range) | Total sample (n = 338) Mean (SD) | | Women (n = 293) Mean (SD) | | Men (n = 45) Mean (SD) | | P* |
|---|---|---|---|---|---|---|---|
| Self-report measures | | | | | | | |
| Characteristic pain intensity (0 to 10) | 6.0 | (2.0) | 6.0 | (2.0) | 5.8 | (2.0) | .46 |
| Pain-related activity interference (0 to 10) | 3.5 | (2.7) | 3.5 | (2.7) | 3.8 | (2.7) | .41 |
| Catastrophizing (0 to 6) | 1.7 | (1.3) | 1.7 | (1.3) | 2.0 | (1.4) | .13 |
| Depression (0 to 4) | 0.8 | (0.7) | 0.9 | (0.7) | 0.7 | (0.7) | .23 |
| Masticatory jaw-use disability (0 to 1) | 0.6 | (0.3) | 0.6 | (0.3) | 0.5 | (0.3) | .03 |
| Nonmasticatory jaw-use disability (0 to 1) | 0.3 | (0.2) | 0.3 | (0.2) | 0.3 | (0.2) | .20 |
| RDC/TMD measures | | | | | | | |
| Unassisted opening (mm) | 35.5 | (12.2) | 34.4 | (11.9) | 42.7 | (11.6) | < .001 |
| Maximum assisted opening (mm) | 47.4 | (9.7) | 46.8 | (9.7) | 51.5 | (8.6) | .004 |

*$t$ tests.

**Table 2b** Medians and Interquartile Ranges (IQRs) for Sample Clinical Characteristics

| Measure (possible range) | Total sample (n = 338) Median (IQR) | | Women (n = 293) Median (IQR) | | Men (n = 45) Median (IQR) | | P* |
|---|---|---|---|---|---|---|---|
| Self-report measures | | | | | | | |
| Pain duration (y) | 3.0 | (.9–11) | 4.0 | (1–12) | 2.0 | (.6–5) | .009 |
| Facial pain health care visits, past 6 months | 3.0 | (1–7) | 3.0 | (1–8) | 3.0 | (1–7) | .85 |
| RDC/TMD measures | | | | | | | |
| Joint palpation pain (0 to 3) | 0.5 | (0–1) | 0.5 | (0–1) | 0.3 | (0–.5) | .02 |
| Extraoral muscle palpation pain (0 to 3) | 0.5 | (.3–.9) | 0.5 | (.3–.9) | 0.4 | (.1–.9) | .07 |

*Mann-Whitney tests.

of joint sites ($P$ = .02). Women also reported more pain upon palpation of extraoral muscle sites, although this difference only approached statistical significance ($P$ = .07).

### Associations Between Catastrophizing and RDC/TMD Examination Findings

Table 3a summarizes the results of the 3 regression models for each RDC/TMD examination variable. As hypothesized, catastrophizing was not associated significantly with the 2 examination variables that were more objective: whether jaw-joint sounds were heard on examination and maximum jaw opening with assistance from the examiner. In contrast, and also as hypothesized, adjusting for the demographic variables and pain duration, catastrophizing was associated significantly with the more subjective examination variables: unassisted jaw opening without pain ($P$ = .005), extraoral muscle palpation pain ($P$ < .001), and joint site palpation pain ($P$ = .003).

In no case was the gender × catastrophizing interaction term statistically significant. Controlling for depression resulted in the association between catastrophizing and unassisted opening without pain being no longer statistically significant. However, even controlling for depression, catastrophizing remained significantly (although modestly) associated with the 2 palpation pain measures. After controlling for characteristic pain intensity, catastrophizing remained significantly associated with only 1 examination measure: catastrophizing explained an additional 3% of the variance ($sr^2$) in extraoral muscle palpation pain. Together, the demographic variables, pain duration, pain intensity, and catastrophizing explained 20% of the variance (model $R^2$) in this examination measure.

### Associations of Catastrophizing with Pain, Activity Limitations, and Health Care Use

Table 3b summarizes the results of the 3 regression models for the measures of TMD pain, pain-related activity limitations, and health care visits. Catastrophizing was associated significantly with each measure in the models, after demographics and pain duration were adjusted for. Catastrophizing uniquely explained only a modest amount



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**Table 3a** Association of Catastrophizing with Clinical Examination Findings

| | Joint sounds‡ | Maximum assisted opening | | | Unassisted opening | | | Extraoral muscle palpation pain | | | Joint palpation pain | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Model† | B | B | $sr^2$ | Model $R^2$ | B | $sr^2$ | Model $R^2$ | B | $sr^2$ | Model $R^2$ | B | $sr^2$ | Model $R^2$ |
| 1 | –.10 | –.79 | .01 | .07 | –1.45** | .02 | .09 | .15*** | .10 | .10 | .08** | .03 | .09 |
| 2 | –.06 | –.75 | .01 | .07 | –0.86 | .01 | .11 | .11*** | .04 | .17 | .07* | .01 | .11 |
| 3 | –.04 | .29 | .00 | .15 | .27 | .00 | .22 | .09*** | .03 | .20 | .01 | .00 | .18 |

*$P < .05$; **$P < .01$; ***$P \leq .001$.
†Model 1 = catastrophizing, age, gender, education; model 2 = model 1 + SCL-90 Depression; model 3 = model 1 + characteristic pain intensity.
‡Logistic regression; does not yield $sr^2$ and $R^2$ values.
B = unstandardized regression coefficient for catastrophizing; $sr^2$ = squared semi-partial correlation coefficient for catastrophizing.

**Table 3b** Association of Catastrophizing with TMD Pain, Activity Limitations, and Health Care Visits

| | Pain intensity | | | Masticatory jaw-use disability | | | Nonmasticatory jaw-use disability | | | Pain-related activity interference | | | Health care visits, past 6 months | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Model† | B | $sr^2$ | Model $R^2$ | B | $sr^2$ | Model $R^2$ | B | $sr^2$ | Model $R^2$ | B | $sr^2$ | Model $R^2$ | B | $sr^2$ | Model $R^2$ |
| 1 | .68*** | .18 | .26 | .03** | .02 | .06 | .06*** | .15 | .19 | 1.06*** | .25 | .31 | .44*** | .13 | .14 |
| 2 | .69*** | .14 | .27 | .03 | .01 | .07 | .04*** | .06 | .22 | .89*** | .13 | .32 | .35*** | .06 | .14 |
| 3 | NA | NA | NA | –.001 | .01 | .16 | .03*** | .04 | .36 | .63*** | .12 | .47 | .41*** | .10 | .14 |

**$P < .01$; ***$P \leq .001$.
†Model 1 = catastrophizing, age, gender, education; model 2 = model 1 + SCL-90 Depression; model 3 = model 1 + characteristic pain intensity.
B = unstandardized regression coefficient for catastrophizing; $sr^2$ = squared semi-partial correlation coefficient for catastrophizing; NA = not applicable.

of variance in masticatory jaw-activity limitations (2%), but accounted for substantial additional amounts of the variance in nonmasticatory jaw-activity limitations (15%), characteristic pain intensity (18%), and pain-related activity interference (25%). In no case was the gender × catastrophizing interaction term statistically significant. Even after controlling for depression, catastrophizing remained significantly associated with each measure and explained substantial additional proportions of the variance in characteristic pain intensity and pain-related activity interference. After controlling for characteristic pain intensity, catastrophizing was no longer associated significantly with masticatory activity limitations, but remained significantly associated with the other activity limitations measures and with number of health care visits for facial pain. In order to better understand the relationship between catastrophizing and health care use, patients were grouped into quartiles according to their catastrophizing scores, and their health care use was then compared. The median number of health care visits for facial pain in the past 6 months in these groups, from lowest to highest catastrophizing scores, was 2, 3, 4, and 6 visits (Kruskal-Wallis, $P < .001$).

## Discussion

The findings suggest that patient catastrophizing may play an important role in TMD pain problems, both as reported by patients and as assessed during a clinical examination. The results confirmed the authors' prediction that the association between catastrophizing and the clinical examination measures would increase as the potential influence of nonbiologic factors on the measure increased. Catastrophizing was not associated with the more objective examination measures (presence of jaw-joint sounds and maximum jaw opening with assistance from the examiner). In contrast, catastrophizing was associated with significantly more limited jaw opening when patients were asked to open as wide as possible without pain and with higher joint and extraoral muscle palpation pain scores, reflecting more widely dispersed, more severe pain.

The findings also confirmed the hypothesis that catastrophizing would be associated with TMD-related jaw-use limitations and activity interference. Although catastrophizing was not associated significantly with masticatory disability after controlling for depression or pain intensity, similar to



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findings in the authors' previous study of patients with TMD pain,[26] catastrophizing was associated significantly with pain interference with nonmasticatory jaw activities such as speaking, laughing, yawning, and kissing, as well as with more general activities, even after controlling for depression and for pain intensity. The association between catastrophizing and pain-related interference with daily work, housework, recreational, and social activities was substantial. Catastrophizing uniquely explained 12% of the variance in this measure even after controlling for demographic variables, pain duration, and pain intensity, and 13% of the variance after controlling for depression. Significant associations were previously found between catastrophizing and activity limitations among patients with moderate to high levels of TMD pain and activity interference.[26] These findings were replicated in the current study using a different measure of general activity interference in patients with a broad range of pain and interference levels.

A significant relationship was also found between catastrophizing and health care utilization for TMD. Patients in the highest quartile of catastrophizing scores reported on average 3 times the number of visits for TMD in the previous 6 months as compared with those in the lowest quartile. To the authors' knowledge, this is the first study of patients with any pain condition to examine the association between catastrophizing and number of health care visits. Whether interventions to reduce pain-related catastrophizing also reduce health care utilization could be an important area for future research.

The study results also have implications for the controversy over whether catastrophizing is simply a symptom of depression.[17,47,48] Even after controlling for depressive symptom severity, catastrophizing remained significantly associated with extraoral muscle and joint palpation pain scores, jaw activity limitations, pain-related activity interference, and health care use. Thus, the findings support the argument that catastrophizing is a construct that, although related to depression, is distinct from it.[17]

The significant associations between catastrophizing and TMD symptoms and associated problems point to the importance of assessing patient catastrophizing in TMD clinical and research settings. Previous findings that catastrophizing predicts patient failure to respond to conservative TMD therapy[24] and that treatments that specifically target dysfunctional patient cognitions enhance the positive effects of more generic dental and behavioral treatments for TMD[9,25] suggest that treatments that decrease catastrophizing are likely to have positive effects on clinical outcomes. Further support for this suggestion comes from the finding that catastrophizing is associated positively with examination measures reflecting the number of sites painful to palpation as well as palpation pain severity, given evidence that TMD patients with a greater number of painful palpation sites are more likely to have persistent pain over the next 5 years.[49] Clinicians may find it useful to assess catastrophizing in their patients with TMD by using 1 of the brief patient self-report measures available (eg, CSQ Catastrophizing Scale,[38] Pain Catastrophizing Scale[50]). Patients with high catastrophizing scores may benefit from referral to a psychologist trained in cognitive-behavioral therapy, an evidence-based treatment that helps patients learn to recognize and challenge dysfunctional thoughts as well as apply cognitive and behavioral pain management strategies.[51] RCTs are needed to determine whether cognitive-behavioral interventions aimed at reducing catastrophizing improve pain and disability outcomes and reduce health care utilization of TMD patients who tend to catastrophize.

Cause-effect relations cannot be determined from this study, and several explanations for the relationship between catastrophizing and the outcome measures are possible. However, it appears likely that catastrophizing results in increased attention to pain and perception of pain as threatening,[52] decreased ability to shift attention from pain,[53] and increased guarding and activity avoidance in response to pain. A functional magnetic resonance imaging study of individuals with fibromyalgia undergoing an experimental pain procedure found catastrophizing, independent of depression, to be associated with increased activity in areas of the brain related to anticipation of pain, attention to pain, emotional aspects of pain, and motor control; these findings support the hypothesis that catastrophizing influences pain perception through altering attention and anticipation and by heightening the emotional response to pain.

It is also possible that patients with a more painful TMD condition may have a greater tendency to focus on pain and perceive it as threatening (ie, to catastrophize). However, although inclusion of pain intensity in the regression models attenuated the associations of catastrophizing with unassisted opening and joint palpation pain, catastrophizing remained significantly associated with other examination and self-report measures, indicating that, for people with the same reported level of typical pain, those who catastrophize have greater disability and health care utilization.



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Gender differences in the relationships between catastrophizing and pain problems were not found, although the number of men in the sample was small. Women had a significantly smaller range of jaw vertical opening, higher joint palpation pain scores, and a tendency toward higher extraoral muscle palpation pain severity scores consistent with prior reports of gender differences in jaw opening[3] and pain ratings.[31] The only gender difference on the self-report measures was a higher level of masticatory jaw activity limitations in women.

In addition to the correlational design, other limitations of this study should be acknowledged. Further research is needed to confirm the authors' finding of a significant association between catastrophizing and self-reported health care use by using objective measures of health care use such as medical or administrative records. In addition, studies with other populations of individuals with TMD pain (eg, those not seeking treatment at a specialty clinic, those with different sociodemographic characteristics) are indicated to determine the generalizability of the present findings.

In summary, to the authors' knowledge, this is the only study that has examined the role of catastrophizing in TMD patient clinical examination measures and health care utilization. The findings of significant associations of catastrophizing with examination measures, activity interference, and health care use support the potential fruitfulness of further study of catastrophizing in TMD patients. The study findings also point to the potential benefits of assessing patients with moderate to severe TMD pain or TMD-related disability for catastrophizing and referring catastrophizers for cognitive-behavioral interventions.

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