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C. Ervin Davis, MS, PhD; John W. Stockstill, DDS, MS; William D. Stanley, DDS, MS; Qiang Wu, PhD

ABSTRACT

Background. Pain-related worry is distinct from, but related to, pain catastrophizing (PC) and anxiety. Worry and its relationship with other variables have been studied in people with chronic pain but not in people with chronic orofacial pain. The authors explored the prevalence of trait, general and pain-related worry and the association of worry with higher pain levels and other variables.

Methods. The authors assessed people who had a diagnosis of chronic orofacial pain by using nonpain-related trait worry, state anxiety, trait anxiety, PC and pain measures. The participants' answers to an open-ended question about what they were most worried about led to the identification of worry domains, including worry about pain.

Results. The authors found that worrying about pain was related significantly to worst and least pain levels, pain interference and pain duration, as well as moderated trait worry in predicting pain interference. Although trait worry was not correlated directly with pain, when moderated by PC, it made substantial contributions in predicting pain interference.

Conclusions. Participants with chronic orofacial pain reported experiencing substantial levels of trait worry, anxiety, PC and worry about pain that related to pain ratings directly and indirectly.

Practical Implications. Clinicians should assess pain-related worry in patients with chronic orofacial pain to understand the effects of worry on pain and functioning. Clinicians could treat these patients more effectively by helping them reduce their levels of pain-related worry and focusing on improved coping.

Key Words. Psychological adaptation; anxiety disorders; behavioral sciences; facial pain; myofascial pain; orofacial pain.

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Orofacial pain" refers to pain associated with the hard and soft tissues of the head, face and neck. In terms of prevalence, about 22 percent of the general population has experienced it.[1,2] The range of diagnoses includes disorders of muscular and joint origin, headache and neuropathic pain. Research results suggest that chronic pain disorders—including chronic orofacial pain—are characterized by a state of pain amplification and heightened psychological distress.[3] Somatization, negative affect or mood, and high levels of perceived stress also are important risk factors for chronic orofacial pain.[4] Worry, which is distinct from pain catastrophizing (PC), has been recognized as an important factor in patients with chronic pain.[5-10] Worry may be the patient's attempt to solve the chronic pain problem.[5-10] The author of a 2013 review highlighted treatment implications of PC for dental patients.[11] Other research results have demonstrated the importance of PC in patients with orofacial pain.[12-14] However, investigators have not studied worry and its possible relationships to PC and other variables in patients with chronic orofacial pain.

In general, the worry process represents a negative, affect-laden cognitive activity that may be uncontrollable.[15] It also may be an attempt by the patient to engage in mental problem solving for an issue for which the outcome is uncertain and possibly negative. Patients who perceive possible dangers in different ways from one another may worry to varying extents to rehearse possible unpleasant outcomes. They may engage in avoidance or escape rather than in effective coping strategies or problem solving.[16] People who have generalized anxiety disorder may worry continuously about many minor problems and have been characterized as having trait worry (the tendency to worry uncontrollably about many things much of the time).[17] Worry is a common feature of chronic pain, especially when the cause of the

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chronic pain is largely unknown, and patients may worry about the possible threats and consequences of their painful condition.[7] Eccleston and colleagues[9] said that patients experienced worry about chronic pain as being more difficult to dismiss, more distracting, more attention grabbing, more intrusive, more distressing and less pleasant than worrying about something other than pain. Worry also has been associated strongly with the unpleasant emotional aspects of pain, particularly PC, which is related to increased pain, sleep disturbances, pain interference (the extent to which pain interfered with daily activities), abnormal cortisol stress responses and treatment seeking in patients with orofacial pain.[12-14,18] However, worry as a pattern of thought and misdirected problem solving is distinct from PC, anxiety, and pain-related fear and avoidance.[10,19]

Worry about chronic pain has been conceptualized as a perseverance loop of misdirected problem solving concerning the possible causes and the negative consequences of pain.[5] Instead of being helpful, this type of worry can result in being hypervigilant about pain. Chronic pain also may be perceived as a persistent and unpleasant signal of threat—that is, a problem without an acceptable solution.[7] If patients experience relentless pain, they may develop maladaptive ways of coping. Such efforts are maintained by negative thinking, such as the tendency to catastrophize about pain and its consequences.[6,11,20] Investigators have not studied worry in patients with orofacial pain; however, patients with chronic irritable bowel syndrome who worried more also engaged in more catastrophic thinking, and by means of this cognitive process, they experienced more intense pain and suffering.[10] PC also mediated the relationship between worry and pain.[10] Therefore, worrying about more general concerns or about pain and its consequences may cause further psychological distress, leading to more specific catastrophizing. This chain of events can become a self-perpetuating threat, resulting in heightened vigilance and attention to pain, thereby increasing pain and suffering in general.[5,7,8,10]

On the basis of this model, we hypothesized that specific pain-related worry and a higher level of trait worry in patients with chronic orofacial pain would be associated directly or indirectly with a higher level of experienced pain. To examine this relationship, we assessed the prevalence and levels of self-reported pain-related worry, trait worry and pain in a clinical sample of patients with a diagnosis of chronic orofacial pain. We also examined the type and extent of worry these patients experienced, explored possible indirect relationships between worry and pain (such as those moderated by PC and anxiety) and explored interactions between trait worry and pain-specific worry. Having a better understanding of these relationships should improve the assessment of the psychosocial aspects of chronic orofacial pain and help guide and refine interventions.

METHODS

Participants. This study received approval from the institutional review board at the University of North Carolina at Chapel Hill, and we obtained informed consent from each patient. We recruited consecutive patients from the Orofacial Pain Clinic in the School of Dentistry at the University of North Carolina at Chapel Hill. Inclusion criteria involved having received a diagnosis of chronic orofacial pain lasting for more than three months and being 18 years or older. Exclusion criteria included the inability to speak or write in English fluently and decisional impairment. Fifty patients (46 women, four men) with a mean (standard deviation [SD]) age of 41.28 (14.44) years (age range, 18-80 years) participated in the study (Table 1). This sex ratio is typical in patients who seek care for orofacial pain.[21] Table 1 shows the participants' demographic information.

Measures. Participants completed five questionnaires: demographic information, pain and mental health information, the Penn State Worry Questionnaire (PSWQ), the State-Trait Anxiety Inventory (STAI) and the Pain Catastrophizing Scale (PCS). We also assessed worry domains, including worry domain pain (WDP) or pain-related worry, by asking the open-ended question "What is the thing you are most worried about?"

Demographics, pain, diagnosis and mental health information. We recorded the participants' demographic information (that is, age, sex and race or ethnicity). Participants rated pain intensity on a scale ranging from zero to 10 (in which zero indicated "no pain" and 10 indicated "the worst possible pain") for current pain, as well as for the average, worst and least pain experienced in the preceding week. Participants also rated pain interference with general activity or normal work routine on a scale ranging from zero to 10 (in which zero indicated no interference and 10 indicated extreme interference). We recorded the participants' pain durations, mental health histories and current medications. We made diagnoses of orofacial pain by using guidelines from the American Academy of Orofacial Pain and the Research Diagnostic Criteria for Temporomandibular Disorders[22] after a trained orofacial pain clinician took the participants' medical, dental and mental health histories, conducted a clinical examination and reviewed relevant investigations.[1]

Worry domain pain (WDP). We assessed pain-related worry or WDP on the basis of responses to the open-ended question "What is the thing you are most worried about?" For participants who said they worried about pain, we coded yes as 1 and no as zero. We reported but did not use other domains of worry in the data analysis.

ABBREVIATION KEY. **PC:** Pain catastrophizing. **PCS:** Pain Catastrophizing Scale. **PSWQ:** Penn State Worry Questionnaire. **STAI:** State-Trait Anxiety Inventory. **WDP:** Worry domain pain.

PSWQ. The PSWQ is a 16-item self-report questionnaire designed to measure the generality, intensity and uncontrollability of trait worry.[17] It is a measure of generalized trait worry and is not specific to pain or any particular worry domain or topic. Items are rated on a five-point scale in which 1 indicated not at all typical and 5 indicated very typical. Total scores can range from 16 to 80, with higher scores reflecting higher levels of trait worry. A cutoff score of 45 has high sensitivity (0.99) and high specificity (0.98) in discriminating between people who had received a diagnosis of generalized anxiety disorder and those who had not.[23] The developers of the PSWQ reported Cronbach α to be 0.93 and a significant correlation (0.64) with the percentage of time per day spent worrying.[17]

STAI. The STAI is a two-part, self-report questionnaire designed to measure state anxiety (the anxiety one feels at the present moment or about an event) and trait anxiety (the anxiety one feels generally over time and across different situations).[24] Each part of the questionnaire consists of 20 items that are similar in nature, but participants must answer items measuring state anxiety on the basis of how they feel "right now … at this moment," and they must answer items measuring trait anxiety on the basis of how they "generally feel." Items are rated on a four-point scale in which 1 indicates not at all and 4 indicates very much so. Scores on either scale may range from 20 to 80, with higher scores reflecting higher levels of anxiety. Scores of 40 or higher on either scale indicate substantial levels of anxiety. The developers reported Cronbach α to be 0.86 for the trait scale and 0.67 for the state scale, as well as a substantial correlation with the Taylor Manifest Anxiety Scale (0.80).[24]

TABLE 1

Demographics and summary statistics (N = 50).

VARIABLE	VALUE
Sex, No. (%)	
Female	46 (92)
Male	4 (8)
Race or Ethnicity, No. (%)	
Hispanic	2 (4)
Middle Eastern	1 (2)
Black	3 (6)
White	44 (88)
Psychiatric Disorder, No. (%)	
No	33 (66)
Yes	17 (34)
Used Pain Medication, No. (%)	
No	13 (26)
Yes	37 (74)
Worry Domain Pain, No. (%)	
No	31 (62)
Yes	19 (38)
Age, in Years, Mean (SD*)	41.3 (14.4)
State-Trait Anxiety Inventory Score, Mean (SD)	
State anxiety	38.3 (11.6)
Trait anxiety	40.1 (10.0)
Penn State Worry Questionnaire Score, Mean (SD)	50.8 (10.2)
PC Score,† Mean (SD)	
Rumination	5.2 (3.8)
Magnification	3.3 (2.7)
Helplessness	7.3 (6.1)
Total	15.7 (11.7)
Pain Rating, Mean (SD)	
Current (0-10)‡	4.5 (2.9)
Average in preceding week (0-10)‡	5.0 (2.5)
Worst in preceding week (0-10)‡	7.9 (2.1)
Least in preceding week (0-10)‡	2.1 (2.4)
Interference (0-10)§	4.8 (3.1)
Duration, in years	6.4 (6.8)

* SD: Standard deviation.
† PC: Pain catastrophizing.
‡ Pain ratings on 0-10 numerical scale.
§ Pain interference on 0-10 numerical scale.

PCS. The PCS is a 13-item scale used to measure catastrophic thinking about pain.[20] Participants are asked to reflect on past painful experiences and to indicate on a five-point scale (in which zero indicates not at all and four indicates all the time) the degree to which they experienced each of the 13 catastrophic thoughts or feelings during the pain episode. Examples of catastrophic thoughts and feelings about pain include feelings of not being able to go on; feeling it is terrible and thinking it will not get better or will get worse; feeling it is awful, overwhelming and uncontrollable; thinking about it continuously; and wondering whether something serious may happen. One item refers to worrying all the time about whether the pain will end. The PCS has been shown to be valid and reliable and to have good internal consistency (Cronbach α between 0.92 and 0.95).[6,20] A total score—the PC total—can be calculated by using all of the items on the PCS. Three subscales—PC rumination, PC magnification and PC helplessness—have shown satisfactory internal consistency (Cronbach α of 0.85, 0.75 and 0.86, respectively).[20,25] A PCS total score higher than 30 (75th percentile) is considered to be clinically relevant and can predict unemployment, disability and depression.[26]

TABLE 2

Worry domains identified from participants' responses to an open-ended question.*

WORRY DOMAIN	NO. (%)
Worry Domain Pain	19 (38)
Relationships	18 (36)
Work	17 (34)
Health	6 (12)
Education	6 (12)
Financial	2 (4)
Future	2 (4)
More Than One Response	17 (34)

* The open-ended question to assess pain-related worry or worry pain domain was "What is the thing you are most worried about?"

Statistical analysis. For demographic and summary statistics, we used number (percentage) for categorical variables and mean (SD) for quantitative variables. The summary statistics revealed insufficient variations in both sex and race or ethnicity, so we excluded them from further analysis. We investigated associations between the six pain scales (current pain, average pain, worst pain, least pain, pain interference and pain duration) and 11 possible predictors (PSWQ, WDP, age, psychiatric problem, used pain medication, STAI state, STAI trait, PC rumination, PC magnification, PC helplessness and PC total) by using Pearson correlations if the predictor was quantitative or by using two-sample *t* tests if the predictor was categorical. We used linear regressions to detect possible moderators for the PSWQ and WDP as predictors for the six pain scales. Each model had one of the pain scales as a dependent variable and one or both worry scales (the PSWQ, WDP) as a predictor, as well as another predictor and two-way interactions. For models with significant interaction effects ($P \leq .05$), we obtained parameter estimates. We excluded models without significant interaction effects ($P > .05$) from further analysis. We investigated associations among the PSWQ, WDP and other predictors and for possible multicolinearity effects in the linear regressions.

RESULTS

Sample characteristics. Fifty people participated in this study (Table 1). Thirty-five of the participants (70 percent) received a diagnosis of orofacial pain of muscular origin, arthralgic origin or both, and 15 participants (30 percent) had received a diagnosis of nonmuscular pain, arthralgic pain or both. Pain medications reportedly were taken by 37 participants (74 percent), which included any participants who took one or more pain medications. Twenty-six participants (52 percent) took nonopioid analgesics, eight (16 percent) took opioid analgesics, 14 (28 percent) took muscle relaxants, 10 (20 percent) took anticonvulsants, four (8 percent) took benzodiazepines, and four (8 percent) took tricyclic antidepressive agents (these percentages added up to more than 100 percent because many participants reported taking more than one medication). Seventeen participants (34 percent) had received a diagnosis of a psychiatric disorder, including depressive disorder (nine participants, 18 percent) and anxiety disorder (15 participants, 30 percent), and were taking medications (predominantly antidepressive agents and anxiolytics) for their mental health condition.

Pain-related variables. The pain-related variables were pain intensity and pain interference rated on a scale of zero to 10 and pain duration rated in years. Table 1 shows the pain ratings. Mean pain levels across all participants ranged from the least in the preceding week of 2.1 to the worst in the preceding week of 7.9, with current pain and average pain in the preceding week being 4.5 and 5.0, respectively (Table 1). Pain interference with general activity, normal work routine or both averaged 4.8. Mean duration of pain experienced was 6.4 years, with a range from less than one year to 30 years.

Levels of anxiety, trait worry and PC. The mean scores reported for state anxiety and trait anxiety were 38.3 and 40.1, respectively. The mean score for trait worry on the PSWQ was 50.8. For the PCS total, the mean score was 15.7, and the PCS subscale mean scores were 5.2 for rumination, 3.3 for magnification and 7.3 for helplessness (Table 1).

Pain-related and other worries. After we examined all of the responses, we categorized responses to the open-ended question "What is the thing you are most worried about?" into seven worry domains—WDP, relationships, work, health, education, financial and future (Table 2). Participants reported experiencing worry in the domains (from most to least) of WDP, relationships, work, health, education, financial and future. Seventeen participants reported experiencing worry in more than one domain.

Relationships among pain, anxiety, worry and PC. Table 3 shows relationships between pain variables (intensity, interference and duration) and other variables—state anxiety, trait anxiety, trait worry, WDP and PC. We observed significant differences for WDP (participants who reported experiencing worry about pain and participants who did not) in worst pain ($P = .004$), least pain ($P = .048$), pain interference ($P = .045$) and pain duration ($P = .005$), with participants who reported experiencing worry about pain reporting experiencing higher pain levels and pain interference and shorter duration (Table 3). The PCS had several associations with pain variables. The PCS total was associated significantly with worst pain level in the preceding week ($P < .01$), pain interference ($P < .01$) and least pain level in the preceding week ($P < .05$). The helplessness aspect of PC also correlated positively with the worst pain level in the preceding week

TABLE 3

Relationships between pain variables and other variables.*

PREDICTOR VARIABLE	PAIN SCALE					
	Current Pain (0-10), Mean	Average Pain (0-10), Mean	Worst Pain (0-10), Mean	Least Pain (0-10), Mean	Pain Interference (0-10), Mean	Pain Duration, Mean in Years
Penn State Worry Questionnaire Score, Bivariate Correlation (95 Percent CI†)	−0.066 (−0.34 to 0.22)	−0.117 (−0.38 to 0.17)	−0.024 (−0.30 to 0.26)	0.048 (−0.23 to 0.32)	0.066 (−0.22 to 0.34)	0.057 (−0.22 to 0.33)
Worry Domain Pain‡ (SD§)						
No	4.18 (2.79)	4.71 (2.57)	7.39 (2.18)¶#	1.57 (1.75)#**	4.04 (3.04)#**	8.54 (7.92)¶#
Yes	5.30 (2.81)	5.50 (2.42)	8.95 (1.36)¶#	3.10 (2.95)#**	5.85 (2.98)#**	3.45 (3.57)¶#
Age, Bivariate Correlation (95 Percent CI)	−0.021 (−0.30 to 0.26)	0.123 (−0.16 to 0.39)	0.162 (−0.12 to 0.42)	0.211 (−0.07 to 0.46)	0.073 (−0.21 to 0.34)	−0.109 (−0.38 to 0.17)
Psychiatric Disorder (SD)						
No	5.00 (2.89)	5.45 (2.61)#**	8.30 (1.94)	2.48 (2.69)	5.27 (3.27)	5.34 (6.18)
Yes	3.53 (2.62)	4.06 (2.01)#**	7.18 (2.27)	1.47 (1.55)	3.82 (2.53)	8.58 (7.58)
Use Pain Medication†† (SD)						
No	3.85 (3.48)	4.38 (2.84)	7.15 (2.54)	2.08 (2.78)	4.92 (3.64)	4.29 (4.03)
Yes	4.73 (2.63)	5.19 (2.37)	8.19 (1.90)	2.16 (2.29)	4.73 (2.93)	7.19 (7.42)
STAI‡‡ State Score, Bivariate Correlation (95 Percent CI)	0.139 (−0.14 to 0.40)	−0.001 (−0.28 to 0.28)	0.129 (−0.15 to 0.39)	0.235 (−0.05 to 0.48)	0.291 (0.01 to 0.53)#**	−0.185 (−0.44 to 0.10)
STAI Trait Score, Bivariate Correlation (95 Percent CI)	−0.010 (−0.29 to 0.27)	−0.071 (−0.34 to 0.21)	−0.054 (−0.32 to 0.23)	0.099 (−0.18 to 0.37)	0.194 (−0.09 to 0.45)	−0.207 (−0.46 to 0.07)
PC§§ Rumination Score, Bivariate Correlation (95 Percent CI)	-0.066 (−0.34 to 0.22)	−0.117 (−0.38 to 0.17)	0.391 (0.13 to 0.60)¶#	0.048 (−0.23 to 0.32)	0.358 (0.09 to 0.58)#**	0.057 (−0.22 to 0.33)
PC Magnification Score, Bivariate Correlation (95 Percent CI)	0.092 (−0.19 to 0.36)	0.136 (−0.15 to 0.40)	0.285 (0.01 to 0.52)#**	0.213 (−0.07 to 0.46)	0.224 (−0.06 to 0.47)	−0.200 (−0.45 to 0.08)
PC Helplessness Score, Bivariate Correlation (95 Percent CI)	0.182 (−0.10 to 0.44)	0.184 (−0.10 to 0.44)	0.376 (0.11 to 0.59)¶#	0.362 (0.09 to 0.58)¶#	0.404 (0.14 to 0.61)¶#	−0.266 (−0.51 to 0.01)
PC Total Score, Bivariate Correlation (95 Percent CI)	0.175 (−0.11 to 0.43)	0.193 (−0.09 to 0.45)	0.389 (0.12 to 0.60)¶#	0.324 (0.05 to 0.55)#**	0.379 (0.11 to 0.59)¶#	−0.264 (−0.51 to 0.02)

* Assessed by means of Pearson correlations when the other variable is quantitative or by means of two-sample *t* tests (when the other variable is categorical).
† CI: Confidence interval.
‡ Indicates whether patients reported pain-related worries.
§ SD: Standard deviation.
¶ Significantly different or significant correlations at $P < .01$.
# Significant mean differences, correlations and *P* values.
** Significantly different or significant correlations at $P < .05$.
†† Indicates the use of any and all pain medications.
‡‡ STAI: State-Trait Anxiety Inventory.
§§ PC: Pain catastrophizing.

($P = .005$), pain interference ($P < .05$) and the least pain level in the preceding week ($P < .01$). Scores on the PCS magnification and PC rumination subscales correlated positively with worst pain in the preceding week ($P < .05$ and $P < .01$), and PCS rumination scores also correlated positively with pain interference ($P < .05$). State anxiety correlated positively with pain interference ($P < .05$). Trait worry, anxiety and PC were not associated with pain duration. Neither trait worry nor trait anxiety was associated directly with any of the pain variables. The findings from further analysis of the subsample of 19 participants (38 percent) who reported WDP revealed a significant correlation between trait worry and pain interference ($P < .02$) but indicated no significant correlations between trait worry and pain intensity or duration (data not shown).

There were significant positive correlations between trait worry, state anxiety, trait anxiety and PC ($P < .01$). The highest correlations occurred between state anxiety and trait anxiety on the STAI ($P < .01$) and PCS subscales and total score on the PCS ($P < .01$). We observed more moderate correlations among anxiety, trait worry and PC ($P < .05$).

WDP. In addition to showing the direct effects between WDP and pain, the linear regressions indicated that PSWQ score was a moderator for predicting pain interference from WDP. The models also showed that "use pain medication" was a binary variable that

TABLE 4

Linear regressions of pain interference and current pain as dependent variables with worry domain pain and trait worry as predictors.

MODEL	ESTIMATE (STANDARD ERROR)*	*t* VALUE	*P* VALUE†
Pain Interference, $R^2 = 0.27$, $P = .003$			
WDP‡	12.402 (4.336)	2.86	.007
PSWQ§	0.151 (0.058)	2.6	.013
WDP × PSWQ¶	−0.283 (0.084)	−3.35	.002
Current Pain, $R^2 = 0.19$, $P = .024$			
WDP	0.024 (0.906)	0.03	.979
Use pain medication#	1.238 (1.282)	0.97	.339
WDP × use pain medication¶	−4.333 (1.720)	−2.52	.015

* Nonstandard regression coefficient (standard error of the estimate).
† Probability of the *t* value being different from zero in a two-tailed test.
‡ WDP: Worry domain pain (1 = yes, 0 = no).
§ PSWQ: Penn State Worry Questionnaire. This questionnaire was used to assess trait worry.
¶ Interaction between the two predictors.
# Use pain medication (1 = yes, 0 = no) indicates the use of any and all pain medications.

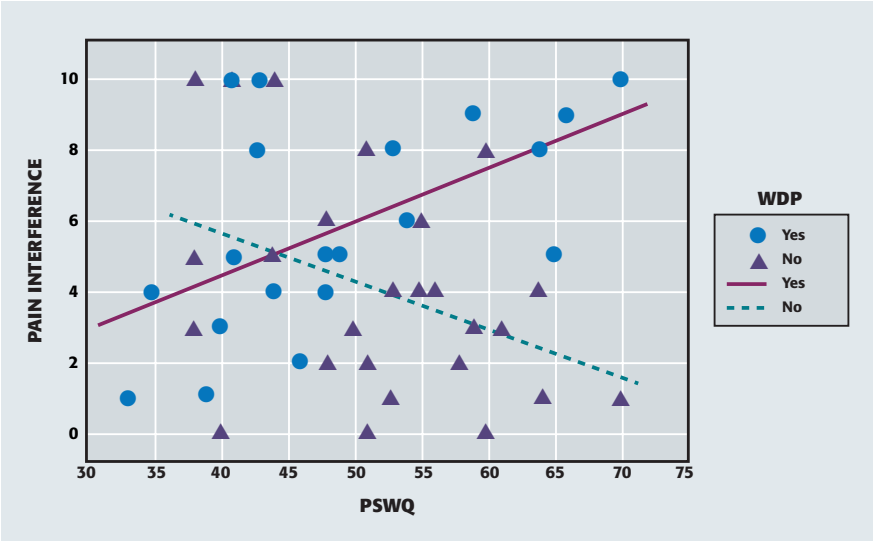

Figure. A plot of pain interference versus Penn State Worry Questionnaire (PSWQ) scores with shape and colors representing worry domain pain (WDP). This plot shows a moderation effect of WDP on the relationship between PSWQ scores and pain interference. Because WDP is dichotomous, the moderation effect is shown on the plot by using two regression lines. For participants who reported experiencing worry about pain, the moderation effect was positive and for participants who did not report experiencing worry about pain, it was negative.

indicated that the use of any and all pain medications was a moderator for predicting current pain level from the WDP. Table 4 provides a detailed summary of both of these models: pain interference and current pain. In the first linear regression, WDP ($P = .007$), PSWQ score ($P = .013$) and their interaction ($P = .002$) were significant in predicting pain interference. The figure shows that the relationship between PSWQ score and pain interference depends on WDP. For participants who reported experiencing worry about pain (WDP = yes), PSWQ score was related positively to pain interference, and for participants who did not report worry about pain (WDP = no), PSWQ score was related negatively to pain interference. In the second linear regression, the interaction between WDP and use of pain medication was significant in predicting current pain. For participants who did not use pain medication, there was a significant negative mean difference in current pain level between the participants who did not worry about pain and the ones who did. A small positive mean difference in current pain level was not statistically significant for participants who took pain medication. In addition, WDP was associated with the PCS rumination score (WDP = no: mean [SD], 4.14 [3.48] versus WDP = yes: mean [SD], 6.65 [3.80]; $P = .025$).

Trait worry according to the PSWQ. Although the PSWQ was not correlated directly with any individual pain scale (Table 3), when moderated by the PCS rumination, PCS helplessness or PCS total score, the PSWQ made significant contributions in predicting pain interference (linear regressions, $P = .005$). Table 5 shows a summary of the three models used to predict pain interference from trait worry and PC. In all three linear regressions in Table 5, PSWQ scores had significant negative slopes when the other predictors were at zero and positive interaction effects with the other predictors. These findings mean that when PSWQ score increased and the other predictors were held at zero, participants experienced less pain interference on average. These negative effects were undermined or even reversed when the other predictors increased. PSWQ score also was correlated with trait anxiety, PCS rumination score, PCS magnification score, PCS helplessness score, PCS total score and psychiatric disorder (data not shown).

DISCUSSION

Participants who reported experiencing pain-related worry also reported having a higher level of worst pain, least pain and pain interference and shorter pain duration than did participants who did not report pain-related worries. This finding supports the hypothesis that pain-related worry is related to a higher level of pain. In the linear regressions, pain-related worry was related significantly to pain interference and current pain. Although trait worry was not related directly to any of the pain variables, pain-related worry moderated the effect of trait worry on pain interference. For participants who reported experiencing pain-related worries, a higher level of trait worry was related to a higher level of pain interference, and for participants who did not report pain-related worry, higher levels of trait worry were related to lower levels of pain interference. The first finding was consistent with the hypothesis that pain-related worry is related to higher levels of pain. However, the unexpected decrease in the level of pain interference with increasing levels of trait worry for participants who did not report experiencing pain-related worry may be similar to the anxiety suppression effect seen in generalized anxiety disorder. In this disorder, participants who report experiencing higher levels of trait worry report experiencing less anxiety and may use generalized worry to distract themselves from emotionally distressing topics.[27] Participants with chronic orofacial pain also may distract themselves from pain by means of more generalized worrying. Further exploration of this finding is warranted. In addition, for participants not taking pain medication, pain-related worry related positively to current pain ratings, which could reflect an uncertainty about ability to control pain when not taking pain medications.

We also found substantial evidence for a moderating effect of PC on trait worry in predicting pain interference. In participants who reported experiencing high levels of PC, trait worry had a greater effect on pain interference than it did in patients who reported experiencing low levels of PC. Our conclusion was supported by the significant interactions of trait worry with PC rumination, helplessness and total in predicting pain interference in the linear regressions. This finding was consistent with results from a study of patients with osteoarthritis, in whom PC, even more than pain-related fears, was a significant independent predictor of pain intensity, disability and walking ability.[28] Our finding also may be consistent with results of previous research in which worry did not correlate with ratings of the sensory component of pain but did correlate with the more affective components such as PC.[8,10] Therefore, patients could view PC as a more directly pain-relevant indication of their psychological distress and cognitive process than are the more general indicators of anxiety and trait worry.

Results from other studies have suggested that PC may be an especially important predictor of pain and disability.[11,28,29] Some investigators have proposed that PC mediates the relationship between worry and pain ratings.[10,20] However, in our study, only PC was correlated with pain ratings, and trait worry was not, so a mediating relationship was not plausible. Thus, it appears that PC at least may moderate the relationship between trait worry and pain interference, which might reflect an emotional pathway whereby trait worry affects pain interference more when there is a higher level of PC, which may, in turn, lead to higher levels of interference with activities of living.

Our study had a few limitations. Some pain ratings may not have been predicted in our study's sample owing to the relatively small sample size. A larger sample may allow for better understanding of direct and indirect effects of worry on pain. The responses revealed that all participants reported experiencing at least one type or domain of worry, although only about one-third (38 percent) reported experiencing worries specifically related to pain, which also was the most frequently reported worry domain. Having only a subset of participants who reported experiencing worry about pain allowed us to

TABLE 5

Linear regressions of pain interference as a dependent variable with trait worry and pain catastrophizing as predictors.

MODEL	ESTIMATE (STANDARD ERROR)*	*t* VALUE	*P* VALUE†
Pain Interference ($R^2 = 0.25$, $P = .004$)			
PSWQ‡	−0.187 (0.074)	−2.53	.015
PC§ rumination	−1.101 (0.540)	−2.04	.047
PSWQ × PC rumination¶	0.028 (0.010)	2.69	.010
Pain Interference ($R^2 = 0.25$, $P = .004$)			
PSWQ	−0.135 (0.066)	−2.06	.045
PC helplessness	−0.532 (0.358)	−1.49	.144
PSWQ × PC helplessness¶	0.014 (0.006)	2.14	.038
Pain Interference ($R^2 = 0.24$, $P = .005$)			
PSWQ	−0.162 (0.070)	−2.32	.025
PC total	−0.298 (0.177)	−1.68	.099
PSWQ × PC total¶	0.008 (0.003)	2.36	.023

* Nonstandard regression coefficient (standard error of the estimate).
† Probability of the *t* value being different from zero in a two-tailed test.
‡ PSWQ: Penn State Worry Questionnaire. This questionnaire was used to assess trait worry.
§ PC: Pain catastrophizing.
¶ Interaction between the two predictors.

find an effect of pain-related worry on pain by contrasting participants who did worry about pain with participants who did not. The results of our study are consistent with those of a previous study in which investigators examined the prevalence of worry in patients with various chronic pain conditions.[9] In that study, patients revealed over a seven-day period that 57.3 percent of their worries were pain related, and 61.8 percent of patients reported experiencing more pain-related worries than nonpain-related worries. A thought sampling (a procedure in which participants are polled at intervals to report their current thoughts or worries) or other more detailed survey of pain-specific worry over time might reveal that a higher percentage of patients have pain-related worries. The STAI and the PSWQ are not specific to pain, unlike the PCS, which is specific to catastrophizing in relation to pain. Therefore, the STAI and the PSWQ may not be entirely relevant for measuring pain-specific anxiety and worry, as investigators pointed out in a previous article.[8] Using a more specific scale such as the Pain Anxiety Symptoms Scale (which is a 40-item self-report measure of fear and anxiety symptoms associated with pain[30,31]) might have led to a different degree of anxiety related to pain, worry and pain interference in the sample in our study. Development of a pain-specific worry instrument could be an important step forward in further understanding the clinical makeup of patients with chronic orofacial pain. Finally, the cross-sectional and correlational nature of our study did not lend itself to a thorough investigation of the fluctuating pattern and relationship of worry and pain over time.

Dentists should assess pain-related worry by means of a simple inquiry, ask about worrying in general and assess PC in patients with orofacial pain because these issues may lead to higher levels of pain and pain interference. One treatment implication for patients with chronic orofacial pain would be to use interventions aimed at identifying and helping patients with orofacial pain reduce catastrophizing and unproductive worrying about pain. Techniques used to control catastrophic thinking and anxiety[32] could be expanded to address pain-related worry. For example, instead of focusing on or worrying about determining the origin of chronic pain or finding a way to eliminate chronic pain, patients could learn to direct their efforts toward developing more effective ways to cope with pain. These might include distraction, self talk, living life to the fullest and continuing with activities despite pain. Advances in cognitive behavioral pain therapy—namely acceptance-based treatments—have addressed this aspect[33] and may provide the framework for future studies examining pain-coping strategies.

CONCLUSIONS

We found that 19 (38 percent) participants reported experiencing pain-related and trait worry and 33 (66 percent) participants reported experiencing trait worry on the PSWQ at levels higher than the cutoff of 45. Pain-related worry was related directly to increased pain but also moderated the effect of trait worry on pain. Trait worry also was moderated by catastrophizing in predicting pain. Patients may have an effect of worry on pain with high PC or may even use general worries to distract themselves from negative emotions. ■

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