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ORIGINAL REPORT

ASSOCIATION BETWEEN CATASTROPHIZING AND SELF-RATED PAIN AND DISABILITY IN PATIENTS WITH CHRONIC LOW BACK PAIN

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Background: **Catastrophizing plays an important role in models of pain chronicity, showing a consistent correlation with both pain intensity and disability. It is conceivable that these associations are mediated or confounded by other psychological attributes.**

Objective: **To examine the relative influence of catastrophizing and other psychological variables on pain and disability in patients with chronic low back pain.**

Methods: **Seventy-eight patients completed the Pain Catastrophizing Scale, Roland Morris Disability Questionnaire, Fear-Avoidance Beliefs Questionnaire (work/activity), Modified Somatic Perception Questionnaire, Modified Zung Depression Scale, and Pain Intensity scale.**

Results: **Catastrophizing was significantly correlated with both Pain intensity and Roland and Morris Disability, and with all other psychological variables (all $p < 0.001$). However, multiple regression analyses showed that Catastrophizing explained no significant variance in Pain intensity beyond that explained by the unique contributions of Modified Somatic Perception and Fear-Avoidance Beliefs (work) and explained no further variance in Disability beyond that explained by the unique contributions of Fear-Avoidance Beliefs (work) and Depression.**

Conclusion: **These findings are consistent with previous models proposing that negative psychological attributes are associated with greater perceptions of pain and disability. Nonetheless, our study indicates that measures of catastrophizing show notable measurement overlap in multivariate models.**

Key words: low back pain, chronic disease, self assessment, catastrophizing.

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INTRODUCTION

Pain catastrophizing is characterized by patients magnifying their feelings about painful situations and constantly thinking about these situations. It also involves feelings of helplessness and incorporates rumination about pain. It has been described as a cognitive style that involves the tendency to misinterpret and exaggerate the threat value of situations (1) or as an exaggerated negative mental set brought to bear during an actual or anticipated painful experience (2). Catastrophizing plays an important role in theoretical models of pain chronicity, showing a consistent correlation with both pain intensity and disability (3). Catastrophizing could be considered to serve as a coping strategy in terms of displaying distress to achieve attention or help from the social environment (4). However, other research on the construct of catastrophizing suggests that it is more a response to distress than a coping strategy (2) and, in terms of chronicity, it seems to worsen the situation and lead to an increased perception of pain and disability (2). Sullivan et al. (5) also describes catastrophizing as a cognitive determinant of the pain experience. Accordingly, in patients with chronic pain, depression and pain behaviour often improve when catastrophizing thoughts are diminished following treatment (6). One study on patients with chronic low back pain (cLBP) participating in a pain programme showed that changes in catastrophizing mediated the improvement in disability and pain intensity after treatment (7). However, it is also known that fear-avoidance and depression are important predictors of pain-intensity and disability (8–10) and there is contradictory opinion as to whether catastrophizing is a unique determinant of pain and disability or simply an expression of some of these other "negative" psychological constructs (5, 10, 11). In other words, it is not clear whether pain catastrophizing has a unique influence on pain and disability, once other variables such as negative mood, somatic hypervigilance or fear-avoidance beliefs have been accounted for. The question can only be addressed by the inclusion of all hypothetical predictors in one multivariate model. In managing patients with chronic pain, it is of great importance to understand the factors that determine their perceived pain and disability. Identification of the key determinants should then allow more focused assessment and treatment, and possibly also prevent the transition from acute to chronic pain (12).

The present study sought to further investigate the relative influence of catastrophizing and other psychological variables on pain and disability in patients with cLBP in a cross-sectional setting. Catastrophizing was measured using the German version of the Pain Catastrophizing Scale (PCS) (13), a 13-item self-administered questionnaire. We hypothesized that, in a multivariate model including demographic variables and various psychological variables, the PCS score would make a unique contribution to explaining the variance in pain and disability.

METHODS

Patients

Patients who were seeking care for their low back problem were recruited from the Department of Rheumatology and Institute of Physical Medicine of the authors' hospital. Inclusion criteria were: low back pain (LBP) for > 3 months with the diagnosis of either non-specific LBP or specific LBP such as disc disorders with and without radiculopathy, degenerative processes of the lumbar spine, spondylopathy and other lumbar pain problems in the ICD10 categories M40 – M80 (diseases of the musculoskeletal system and connective tissue injury) and the ability to read and understand German. Exclusion criteria were: inflammatory diseases, vertebral fractures and serious, immediately life-threatening diseases. Patients with only sciatica and no back pain were not included.

The study was approved by the local ethics committee.

Measures

The patients were asked to complete a questionnaire booklet, which contained the German version of the PCS (13) and a series of other questionnaires or questions that were expected to correlate with the PCS. From the literature, interrelationships were expected between the underlying constructs of pain-related catastrophizing and depression (14), fear of pain (8), emotional distress (14) and pain intensity and subjective disability (2). To cover these constructs the following questionnaires were selected for inclusion in the questionnaire booklet:

- the *Pain Catastrophizing Scale (PCS)*, a self-administered questionnaire comprising 13 items that assess the extent of the patient's catastrophizing thoughts and behaviours (14). There are 3 subscales: *helplessness, magnification* and *rumination.* The total score (PCStot) is computed by summation of all items, and ranges from 0 to 52. Both the original English version (14) and the cross-culturally adapted German version of the PCS (13) have been shown to be valid and reliable;
- the *ZUNG self-rating depression scale (ZUNG)*, which is a screening instrument to assess depression. It comprises 20 questions, such as "I get tired for no reason", "I am hopeful about the future". Each item is answered using an adjectival scale with 4 response categories, ranging from "not at all all/little of the time" (score 0) to "most of the time" (score 3).The total score (sum score for all 20 items) ranges from 0 to 60 points (15, 16);
- the *Modified Somatic Perception Questionnaire (MSPQ)*, to assess heightened somatic awareness or anxiety (16, 17). This is a 13-item instrument with questions about the occurrence in the last week of various vegetative symptoms such as nausea, sweating, or feeling faint. Each item is answered using an adjectival scale with 4 response categories ranging from "not at all" (0 points) to "could not have been worse" (3 points). The total score (sum score of all 13 items) ranges from 0 to 39;
- the *Fear-Avoidance Beliefs Questionnaire (FABQ)*, with subscales to measure fear-avoidance beliefs in relation to work (7 items in the work-subscale *FABQw* (total score, 0–42)) and in relation to physical activity (4 items in the Fear-Avoidance activity scale *FABQa* (total score, 0–24)) (18). Sample items include: "my pain was caused by physical activity" (FABQa) and "my work might harm my back" (FABQw). Each item is answered using a 7-point Likert scale, with response categories ranging from "completely disagree" (0 points) to completely agree (6 points);
- the *Roland and Morris Questionnaire (RM)*, consisting of 24 items that measure disability in everyday activities due to LBP, with items such as "I stay at home most of the time because of my back" (score ranges from 0 to 24 points) (19). This 24-item questionnaire was cross-culturally adapted for the German language (20) with a slight modification, to include yes/no categories for each item (rather than just "tick if applicable" in the original English version);
- *0–10 graphic rating scales (GRS)* to assess the intensity in the last week of the average low back pain (PAIN) (21–23), and leg pain (PAINL) and to measure the current back-problem related pain (i.e. back and/or leg) (PAINc).

Statistics

Descriptive statistics were firstly calculated to examine the distribution of the data; where the data were normally distributed parametric statistics (means and standard deviations (SD)) were used; otherwise, non-parametric statistics are reported (medians and interquartile ranges (IQR)).

The Pearson correlation coefficient was used to quantify the relationships between the scores for Pain Catastrophizing (total score), Fear-Avoidance Beliefs (physical activity), Fear-Avoidance Beliefs (work), Roland Morris Disability, Modified Somatic Perceptions, Depression and Pain Intensity (see Table III). Multiple linear regression analyses were used to quantify which of the scores explained unique variance in the dependent variables. In such models, the independent variables are typically called predictor variables in the regression model despite the cross-sectional nature of the study design. Hence, 2 multiple linear regression models were built: one with Pain Intensity as the dependent variable and the other with Disability as the dependent variable. All the potential predictor variables (i.e. independent variables) were introduced into the multiple regression analyses simultaneously, using the enter method. To test the stability of our models, we did subgroup analyses, using (where appropriate) the median value of the variable of interest as a cut-off to dichotomize the group. Significance was accepted at $p < 0.05$ (two-tailed).

RESULTS

Of 104 eligible patients, 78 (77.3%) agreed to participate and signed the informed consent form. The patients' characteristics, their work status and mean questionnaire scores are shown in

Table I. *Characteristics of the 78 patients and scores of the psychological variables*

	n	Mean (SD)
Age, years	78	50 (17)
Gender, female/male	52/26	
Duration of pain history since first pain episode (months)	78	53.5 (63.9)
Work status		
At work: full-time	16	
Only partially at work because of LBP	13	
Sick leave because of LBP	17	
Unpaid work (household)	5	
Disability pension	4	
Retired*	20	
Data not available	3	
PCStot	77	19.2 (10.3)
FABQa	75	12.0 (6.4)
FABQw	73	19.4 (11.8)
ZUNG	77	20.0 (10.7)
MSPQ	78	10.4 (6.0)
RM	77	11.6 (5.5)
PAIN	77	5.3 (2.3)
PAINL	68	4.6 (2.7)
PAINc	77	4.6 (2.5)

*Retired on age grounds (> 65 years).

LBP: low back pain; PCStot: total score of the Pain Catastrophizing Scale; FABQa: activity scale of the Fear-Avoidance Beliefs questionnaire; FABQw: work scale of the Fear-Avoidance Beliefs questionnaire; ZUNG: self-rating Depression Scale; MSPQ: Modified Somatic Perception questionnaire; RM: Roland and Morris questionnaire; PAIN: intensity of the average low back Pain; PAINL: average leg pain; PAINc: current back and leg pain; SD: standard deviation. See text for details of maximum possible score range for each instrument.

Table II. *Diagnoses of the patients (n = 78)*

ICD 10-Code	Diagnosis	*n*
M 54.5	Low back pain	49
M 51.1	Lumbar intervertebral disc disorders with radiculopathy	13
M54.8	Other dorsalgia	4
M 48.0.6	Spinal stenosis	4
M 51.2	Other specified intervertebral disc displacement	2
M 47.8.7	Spondylosis, lumbosacral region	2
M 43.1.6	Spondylolisthesis	1
M 43.9.0	Deforming dorsopathy	1
M 48.9.6	Spondylopathy, unspecified	1
M 79.8	Specified soft tissue disorders	1

Table III. *Correlations between the various psychological scores, Pain and Disability, as measured with bivariate Pearson correlation coefficients (n = 73–77)*

	PCStot	FABQa	FABQw	Zung	MSPQ	RM	PAIN
PCStot							
FABQa	0.49						
FABQw	0.59	0.60					
ZUNG	0.54	0.30	0.55				
MSPQ	0.60	0.28	0.56	0.61			
RM	0.54	0.52	0.70	0.57	0.55		
PAIN	0.43	0.23	0.55	0.49	0.60	0.51	

FABQa: activity scale of the Fear-Avoidance Beliefs questionnaire; FABQw: work scale of the Fear-Avoidance Beliefs questionnaire; MSPQ: Modified Somatic Perception questionnaire; PAIN: intensity of the average low back Pain; PCStot: total score of the Pain Catastrophizing Scale; RM: Roland and Morris questionnaire; ZUNG: self-rating Depression Scale. All $p < 0.05$.

Table I and their diagnoses in Table II. Twenty-six of the 78 patients had additional musculoskeletal disorders in locations other than the lumbar region (e.g. neck pain). Thirty-seven of the 78 patients had 1–3 co-morbid conditions and 5 had 4–8. Four of the 78 patients were diagnosed by the allocating physician as depressed. The patients who were employed (paid work) had a median (IQR) ability to work of 50% (0/100%). All patients were seeking care for their low back problem and in most cases were receiving a combination of medication, physiotherapy and/or reconditioning exercises, or were taking part in an interdisciplinary pain programme. Thirteen of the patients were hospitalized. The PCS revealed a moderate level of catastrophizing, with a mean (SD) score of 19.2 (10.3). As a group, the patients showed moderately severe back pain complaints (5.3, on a 0–10 scale) and moderate disability (11.6, on the 0–24 Roland Morris scale). All subjects had LBP, and most of them (87.1%) also had referred pain in the leg. The 13% without leg pain had 21–53% lower scores in all the questionnaires than patients with leg pain. Pain Catastrophizing showed a moderate but significant ($p < 0.001$) correlation with both Pain (0.43) and Disability (0.54); significant correlations of between 0.23 and 0.70 were also found between all the other variables (Table III).

Multiple regression analyses showed that age, gender, Pain Catastrophizing, Fear-Avoidance Beliefs about activity, Fear-Avoidance Beliefs about work, Depression and Modified Somatic Perception explained 42% of the variance in Pain, but only Fear-Avoidance Beliefs about work and Modified Somatic Perception had significant regression coefficients and hence made a unique significant contribution to the model. Pain Catastrophizing did not contribute significantly to the final model (Table IV). Fifty-nine percent of the variance in disability was explained by age, gender, Pain, Pain Catastrophizing, Fear-Avoidance Beliefs about activity, Fear-Avoidance Beliefs about work, Depression and Modified Somatic Perception, but again only some variables (Fear-Avoidance Beliefs about work, Depression) made a significant unique contribution; the regression coefficient for Pain Catastrophizing was not significant (Table V). We examined whether the overall results would change when, in turn, persons with minimal pain (< 3/10) (24) and patients who were clinically depressed were excluded or after running the regression analysis for only the patients with leg pain in addition to their back pain, and only the patients with co-morbidities. These exclusions made virtually no difference to the final regression models reported (results not shown). Comparing the models for patients with a short pain history duration (< 31 months) and those with a long pain history (> 31 months) (dichotomized on the basis of the median) revealed slightly different results in terms of the

Table IV. *Multiple regression with intensity of the average low back Pain (PAIN) as dependent variable (n = 72)*

Model	Unstandardized regression coefficients (B)	Standardized regression coefficients (Beta)	Significance *p*-value	95% lower confidence limit of B	Upper confidence limit of B
(Constant)	0.675		0.567	–1.668	3.018
PCStot	–0.003	–0.013	0.918	–0.061	0.055
FABQa	–0.046	–0.123	0.318	–0.137	0.045
FABQw	0.078	0.396	0.006*	0.023	0.134
ZUNG	0.031	0.138	0.257	–0.023	0.084
MSPQ	0.138	0.353	0.007*	0.038	0.237
Age	0.015	0.104	0.270	–0.012	0.042
Gender†	0.582	0.121	0.212	–0.339	1.504

*Significance $p < 0.008$.

†Female = 1, Male = 0.

R-squared = 0.48, R-squared adjusted = 0.42, $p = 0.000$.

Age, Gender, PCStot, FABQa, FABQw, ZUNG and MSPQ simultaneously entered into the model.

FABQa: activity scale of the Fear-Avoidance Beliefs questionnaire; FABQw: work scale of the Fear-Avoidance Beliefs questionnaire; MSPQ: Modified Somatic Perception questionnaire; PCStot: total score of the Pain Catastrophizing Scale; ZUNG: self-rating Depression Scale.

Table V. *Multiple regression with Disability (RM) as dependent variable (n = 72)*

Model	Unstandardized regression coefficients (B)	Standardized regression coefficients (Beta)	Significance *p*-value	95% lower confidence limit of B	Upper confidence limit of B
(Constant)	–3.646		0.126	–8.340	1.048
PAIN	0.076	0.032	0.761	–0.419	0.571
PCStot	0.031	0.058	0.593	–0.085	0.147
FABQa	0.120	0.136	0.195	–0.063	0.303
FABQw	0.190	0.403	0.002*	0.072	0.307
ZUNG	0.127	0.241	0.022*	0.019	0.235
MSPQ	0.129	0.138	0.226	–0.082	0.339
Age	0.047	0.139	0.085	–0.007	0.101
Gender†	1.698	0.148	0.074	–0.167	3.563

*Significance $p < 0.025$.
†Female=1, Male=0.
R-squared=0.64, R-squared adjusted=0.59, $p=0.000$.
Age, Gender, Pain, PCStot, FABQa, FABQw, ZUNG and MSPQ simultaneously entered into the model.
FABQa: activity scale of the Fear-Avoidance Beliefs questionnaire; FABQw: work scale of the Fear-Avoidance Beliefs questionnaire; MSPQ: Modified Somatic Perception questionnaire; PAIN: intensity of the average low back Pain; PCStot: total score of the Pain Catastrophizing Scale; RM: Roland and Morris questionnaire; ZUNG: self-rating Depression Scale.

significance of the individual predictors, but pain catastrophizing still did not make any significant unique contribution in either model. Because of the moderately high correlations between the questionnaires, we analysed the collinearity diagnostics by looking at the tolerance values. Tolerance values are the inverse of the variance inflation factor (VIF); values below 0.1 suggest possible collinearity, and values less than 0.01 confirm collinearity. In our model, collinearity diagnostics revealed acceptable tolerance values between 0.4 and 0.9, and hence the possibility of collinearity was disregarded. The residuals plots of both models showed normal distributions of the residuals and confirmed that the model was reliable. In the model with Disability as the dependent variable we originally found 2 standard residuals with values of –3.1 and 2.6, when checking for outliers using case-wise diagnostics. Because the patient with the standard residual of –3.1 had often corrected his own answers and left questions unanswered in the questionnaire, we decided to exclude this case from the final model presented (25). Exclusion of this case had made only negligible changes to the final model. The results are shown with exclusion of the case with the poorly completed questionnaires.

DISCUSSION

Main findings

The present study sought to quantify the extent to which Catastrophizing and other psychological variables explained the variance in self-reported pain and disability in patients with cLBP. Pain Catastrophizing was significantly correlated with Pain and Disability, but in multiple regression analyses it failed to make a significant contribution to their explained variance. The various psychological variables showed significant correlations with each other and with Pain Catastrophizing, confirming the findings of previous studies (9, 26, 27). In comparison with other similar studies of patients with cLBP our sample had: a 2–7-point lower Catastrophizing Score (1, 28); a 1–4-point lower Disability Score (10, 29, 30); a 2 and 6-point lower score for the Fear-Avoidance Beliefs about Activity and Work, respectively (10); twice as great a score for the Modified Somatic Perception questionnaire (12) and similar scores for Depression (12) and Pain (7, 10, 29, 30).

Considerations regarding the statistical procedures

Due to the contradictory results in the literature regarding the influence on pain and disability of pain catastrophizing, we entered all variables simultaneously into the multiple linear regression model, which gave all the variables investigated the same chance of contributing to the model. This differed from other studies in which a hierarchical model was used and which provides the variables entered first with a greater chance of attaining significance (5, 10, 11, 30). Gender and age were included as independent variables in all models, in order to obviate the need for subgroup analyses for these factors.

Unique predictors of Disability and Pain

In our regression model with Disability as the dependent variable, Fear-Avoidance Beliefs about work and Depression were the most powerful unique predictors; in the model with pain, Fear-Avoidance Beliefs about work and Modified Somatic Perception made a significant unique contribution. Some studies have reported pain intensity to be a significant determinant of disability (31). However, in our study, Pain made no significant unique contribution to explaining the variance in Disability. We suspect that this was because of the stronger correlations between Fear-Avoidance Beliefs (work) and Disability (r=0.70), and between Fear-Avoidance Beliefs (work) and Pain (r=0.55), than between Pain and Disability (r=0.51); because of this, Pain did not achieve significance in the multivariate model when Fear-Avoidance Beliefs was entered too. Other studies have similarly shown only a negligible influence of pain intensity on disability (26, 32).

Pain Catastrophizing was not a unique predictor of either Pain or Disability in the present cross-sectional study. This finding concurs with a number of cross-sectional and inter-

ventional studies of patients with cLBP (10, 11, 30, 31), as does our finding that overlap occurs between closely-related constructs (e.g. catastrophizing, negative affectivity, anxiety and depression (2, 11) in terms of their ability to explain the variance in pain intensity. Some other studies *did* find an influence of pain catastrophizing on pain or disability, but they did not measure fear-avoidance, depression or somatic hypervigilance and could therefore not control for these related but potentially stronger predictors (5, 33). In one study that had employed factor analysis, a mixed factor that included catastrophizing (labelled "psychological distress") explained some variance in disability; however, the unique variance accounted for by catastrophizing alone was not determined (31). In 2 studies Catastrophizing predicted pain or disability in multivariate analysis; one of these concerned the prediction of disability one year after baseline assessment in acute/subacute patients (12, 30). However, being in the transition phase from acute to chronic, these patients had a greater potential to change, which compared with patients with long-standing chronic pain might result in different relationships between catastrophizing and outcome. Indeed, some studies on cLBP patients have reported that catastrophizing is a precursor or mediator of pain-related fear, fear-avoidance or depression (6, 7, 34, 35), and there is some evidence (10, 31, 34) that fear-avoidance and depression (9) are, in turn, predictors of disability/reduced function and of the transition from acute/subacute to chronic pain (34). Nonetheless, the latter issue is not uncontested, and some studies have shown that there is no or only a negligible association between fear-avoidance beliefs and a poor outcome in terms of disability (29, 36, 37). Subtle differences between all the aforementioned studies in terms of their design and the independent variables included in their respective models may explain the seemingly discordant findings between them. One generally consistent finding in almost all of the studies, however, is that when fear-avoidance beliefs are included in the multivariate model this appears to lessen the relative influence of catastrophizing *per se*. Vlaeyen & Linton (34) offer a possible explanation of the role of catastrophizing in the fear-avoidance model: patients with negative affectivity perceive a painful experience as threatening, and catastrophizing thoughts emerge. This leads to pain-related fear and to avoidance behaviour. The development of hypervigilant somatic perceptions, depression and disability are all possible consequences. Finally, this may increase the pain experience, causing a vicious circle to develop (34). If this model were to apply, and catastrophizing were indeed to have an influence in the development of chronic pain, then the identification of catastrophic cognitions should not only take place when the pain is already chronic, but also early on to prevent the development of fear-avoidance, depression and, consequently, disability (34).

Limitations

Certain limitations must be considered in interpreting the results of the current study. Whilst the findings are consistent with many previous studies and conform to plausible and appealing hypotheses put forward in the literature, the cross-sectional nature of the study does not permit conclusions to be drawn in relation to any mediating or causal effects. The sample size of 78 patients was not very large; however, we included the recommended number of at least 9 subjects per variable for multivariate analysis (38). Finally, the mean catastrophizing score for our sample was not very high, and in terms of generalizability the results are strictly-speaking only applicable to patients with cLBP attending tertiary care with moderately severe pain and disability.

In conclusion, pain catastrophizing and pain-related fear-avoidance behaviour, heightened somatic awareness and depression are inter-correlated and are all associated with greater perceptions of pain and disability. However, in multivariate analysis with various psychological variables – and notably, with the inclusion of fear-avoidance beliefs – catastrophizing did not significantly explain any unique variance in pain or disability. The results of this cross-sectional study hence bring into question whether, in the clinical environment, the measurement of pain catastrophizing in addition to fear-avoidance beliefs really provides any additional information for the management of patients with cLBP.

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