Catastrophic Thinking And Symptom Perception In Asthma: Validation Of A Questionnaire

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Citation

Abstract
Within the field of pain--especially chronic pain--the influence of catastrophic thinking on vigilance, fear/avoidance and the long-term evolution of the clinical state has been identified. Catastrophic thinking may appear to be of similar influence within the field of asthma.

We adapted the Pain Catastrophizing Scale (PCS; Sullivan et al., 1995) to the situation of asthma, including a scale assessing catastrophic thinking during an exacerbation (exacerbation scale) and a scale assessing catastrophic thinking in general, when patients are not experiencing an exacerbation (general scale). We administered the Catastrophizing about Asthma Scale (CAS) to 94 patients with asthma.

Principal component analysis revealed two factors that were identical to the two scales. Based on statistical considerations, three items were removed from the exacerbation scale. Internal consistency of the revised CAS was high (Gronbach’s alpha = .93), test-retest reliability was excellent (r = .94), and the CAS showed good construct validity.

INTRODUCTION
A large proportion of asthma patients reports an amount of subjective complaints that is inconsistent with the physiological abnormalities of their airways. Kendrick et al., reported that 60% of patients treated in general practice was inadequate in assessing the state of their airways.

A variety of explanations, both physiological and psychological, has been put forward: Effects of age, gender, airway reactivity, duration of the disease, fluctuations in the state of lungs and airways, the degree of airway inflammation, the speed of constriction, the localization of the reactivity, and recently also possible asthma-specific deficits in brain structures involved in symptom perception have been reported. Attempts to explain the discrepancy between (subjective) symptom reports and (objective) airway pathology by psychological factors have been less successful. There is no specific “asthma personality” and there is no relationship between personality and the perception of dyspnea either. Patients who suffered a near-fatal asthma attack showed high levels of denial, however, Steiner et al., suggested that those patients do not simply deny specific symptoms, but use a general repressive defense mechanism, leading them to notice physical
sensations (symptoms) but not to report them (see also 7).

There is a correlation between depression/anxiety and reporting of asthma symptoms and emotional status is a determinant of clinical dyspnea scores. On the other hand, there appeared to be no correlation between depression/anxiety and objective measurements of asthma severity. Similarly, patients with asthma with comorbid panic disorder reported significantly higher levels of perceived breathlessness during induced bronchoconstriction, although their mean fall in lung function was similar to that of asthmatic patients without panic disorder. 10

Asthma-related symptom reports increased with an increase in negative affectivity (NA; a general tendency to experience negative emotions, but also including characteristics such as introversion, negative self-image, and dwelling on failures and shortcomings) and a decrease in peak flow, suggesting that both NA and changes in peak flow predict symptoms, but NA seemed to have the greater influence. 11, 12, 13 Research within our group in both patients with asthma and healthy participants consistently found that persons with a high level of NA report more symptoms than persons low in NA, in daily life as well as in the laboratory, without showing corresponding physiological differences. 12, 14, 15, 16, 17 We also found that patients admitted to hospital with medically unexplained dyspnea reported more intense dyspnea and anxiety than patients with an established organic cause for their dyspnea. Finally, high-NA persons are less accurate in perceiving respiratory symptoms than low-NA persons, especially in distressing situations. 19, 20

Because NA is a very broad concept, covering a whole range of negative emotions, it is possible that a more specific component of NA is responsible for the observed effects on symptom reporting and illness behavior in asthma. In the pain literature, the role of catastrophic thinking about pain has been firmly established: patients who have a lot of catastrophic thoughts about their pain report more pain, more intense pain, more disability from their pain, and more interference with their daily activities and other life domains. 21 Catastrophic thinking may be of value for symptom perception in asthma too: Similarities between pain and dyspnea have recently been described. 23 Carr, Lehrer, and Hochron 24 suggested that negative emotions associated with poor disease management may be more determined by the tendency to have catastrophic thoughts than by objective pulmonary function. Furthermore, the first reports on the role of catastrophic thinking in asthma have been published 25, 26. However, no disease-specific instrument to measure catastrophic thinking in asthma exists.

Therefore, it would be interesting to have a measure of catastrophic thinking about asthma, in order to be able to further investigate its role in symptom reporting in asthma.

METHODS

PARTICIPANTS

The Catastrophizing about Asthma Scale (CAS) was completed by 94 patients with asthma (48 males and 46 females, mean age = 30.06 years, SD = 11.13) who participated in several studies of our group over the course of three years. According to GINA guidelines, 10 patients had intermittent asthma, 32 had mild persistent asthma, and 22 had moderate persistent asthma. For the remaining 31 patients we could not determine asthma severity because we had insufficient access to their medical records. Because these patients were required to have stabilized asthma to enter the study (i.e., no asthma exacerbation during 6 weeks prior to participation), our study group probably consisted of patients with mild-to-moderate asthma. Because some patients participated in more than one study, we had data on 18 patients who completed the questionnaire twice with one week between the first and second completion; 17 patients completed the questionnaire again after five months; and 15 patients completed the questionnaire again after 8 months.

Figure 1

Table 1: CAS scores, PANAS scores, ASC scores: mean total and subscale scores (and standard deviations), for the total study sample and according to asthma severity.

<table>
<thead>
<tr>
<th>Scale</th>
<th>Total sample (N = 94)</th>
<th>Intermittent asthma (n = 10)</th>
<th>Mild persistent asthma (n = 32)</th>
<th>Moderate persistent asthma (n = 22)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAS total score</td>
<td>32.46 (17.76)</td>
<td>22.44 (11.03)</td>
<td>10.04 (9.14)</td>
<td>11.55 (18.96)</td>
</tr>
<tr>
<td>CAS (catastrophization)</td>
<td>18.61 (7.56)</td>
<td>11.26 (5.12)</td>
<td>6.26 (2.26)</td>
<td>8.94 (11.72)</td>
</tr>
<tr>
<td>CAS (general)</td>
<td>13.84 (5.25)</td>
<td>10.21 (4.05)</td>
<td>4.42 (2.34)</td>
<td>2.59 (5.77)</td>
</tr>
<tr>
<td>PANAS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive Affectivity (PA)</td>
<td>31.25 (5.43)</td>
<td>21.46 (9.24)</td>
<td>14.4 (6.26)</td>
<td>11.55 (5.81)</td>
</tr>
<tr>
<td>Negative Affectivity (NA)</td>
<td>18.44 (7.56)</td>
<td>10.58 (4.05)</td>
<td>6.26 (2.26)</td>
<td>8.48 (5.77)</td>
</tr>
<tr>
<td>ASC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obstruction</td>
<td>92.76 (25.26)</td>
<td>98.88 (16.09)</td>
<td>98.04 (21.46)</td>
<td>102.3 (23.37)</td>
</tr>
<tr>
<td>Dyspnea</td>
<td>14.20 (5.43)</td>
<td>14.11 (4.22)</td>
<td>12.56 (5.22)</td>
<td>16.1 (5.91)</td>
</tr>
<tr>
<td>Anxiety</td>
<td>19.68 (6.05)</td>
<td>19.11 (6.17)</td>
<td>17.29 (8.17)</td>
<td>18.6 (8.0)</td>
</tr>
<tr>
<td>Insomnia</td>
<td>15.93 (5.80)</td>
<td>15.47 (5.47)</td>
<td>13.89 (4.79)</td>
<td>16.7 (7.16)</td>
</tr>
<tr>
<td>Fatigue</td>
<td>20.78 (6.03)</td>
<td>20.71 (6.26)</td>
<td>19.63 (6.26)</td>
<td>21.37 (6.65)</td>
</tr>
<tr>
<td>Hyperventilation</td>
<td>19.4 (3.97)</td>
<td>19.71 (5.87)</td>
<td>19.59 (3.74)</td>
<td>16.9 (2.9)</td>
</tr>
</tbody>
</table>

Note: Due to incomplete data, 7 n = 74, 8 n = 67, 9 n = 27, 10 n = 10.
QUESTIONNAIRES

We adapted the Pain Catastrophizing Scale (PCS-DV), a 13-item self-report measure for use in clinical and non-clinical pain populations, in patients with pain and pain-free individuals, and in people with acute and chronic pain. In the PCS-DV, participants reflect on past painful experiences and indicate the degree to which they experience a number of thoughts or feelings when experiencing pain. As such, the PCS refers to one aspect of coping with a chronic and possibly deteriorating disease. A large impact of catastrophic thinking on pain patients' quality of life has been established. Moreover, the PCS taps typical aspects of thinking about chronic diseases, aspects that are applicable to most chronic diseases. In addition, the questionnaire showed to be valid and highly reliable (Pearson's r = .92) and a good internal consistency was found (Cronbach's alpha between .85 and .91). For those reasons, we chose not to develop a new questionnaire starting from a large item pool, but to adapt the PCS for asthma.

We adapted each item of the PCS so that it was applicable to asthma. This was done at first by replacing the word 'pain' by the words 'asthma attack', and we changed the wordings of the items to obtain a meaningful sentence, resulting in a 13-item scale measuring catastrophic thinking about asthma during an asthma exacerbation ('exacerbation' scale). Next, we replaced 'asthma attack' by 'asthma' to obtain a scale measuring catastrophic thinking about asthma in general, when participants had no exacerbation ('general' scale). Two items were deleted because they referred explicitly to the situation of an asthma exacerbation and could not be rephrased into a 'general' form ("there is nothing I can do to make my asthma less intense" and "I keep asking myself whether my asthma will pass off"). Participants had to rate "to which extent the thoughts and feelings expressed in the items were applicable to themselves" on a scale from 0 ('not at all') to 4 ('certainly'; Complete instructions in English are included in the appendix). The rating scale was printed on top of the page, above the items. All scores were labelled verbally ('not at all'; 'slightly'; 'to some extent'; 'to a great extent'; and 'certainly'). On top of the 'exacerbation' scale, we inserted the sentence “During an asthma attack...” On top of the 'general' scale, we inserted "In general, when I do not have an attack...” The final questionnaire contained two scales and 24 items. Means and standard deviations of the CAS for the total sample and for each asthma severity group are presented in Table 1.

We used also the validated Dutch translation of the Asthma Symptom Checklist (ASC) to assess the subjective symptomatology of patients with asthma. The ASC is a 36-item checklist, consisting of 6 subscales: symptoms of airway obstruction (5 items), dyspnea (3 items), fatigue (6 items), symptoms of hyperventilation (6 items), anxiety (8 items) and irritability (6 items) (2 additional items did not load on any of these factors in factor analyses and are therefore not scored). Internal consistency for five of the six subscales is high (Cronbach's : 0.93, 0.88, 0.86, 0.87, 0.92) and acceptable for symptoms of hyperventilation (Cronbach's : 0.76). Patients rate how frequently they experience each of the symptoms during an asthma exacerbation. Ratings range from 1 (never) to 5 (always).

In addition, we administered the validated Dutch version of the PANAS (Positive and Negative Affect Schedule) to measure positive and negative affect as a disposition (trait). Participants have to rate the degree to which 10 positive and 10 negative adjectives are applicable to themselves. End points are very little or not at all (scored 1) and very much (scored 5), resulting in a total score between 10 and 50 per scale.

ANALYSIS

The structure of the CAS was explored by Principal Component Analysis (PCA) followed by Varimax rotation. The reliability of the (sub)scale(s) was estimated by calculating item-total correlations and internal consistency (Cronbach's ). We checked test-retest reliability by calculating Spearman correlations for the total CAS and subscale scores over different completions for those patients who completed the CAS on more than one occasion. Finally, we correlated the CAS-scores with the data from the Asthma Symptom Checklist and PANAS to check construct validity.
RESULTS
PRINCIPAL COMPONENT ANALYSIS OF THE CAS

Findings from the PCA are summarized in Table 2. We chose a two-factor solution based on the scree test and the interpretability of the results. As can be seen in Table 2, in the unrotated solution all items loaded negatively on the first factor, whereas the second factor differentiated between the two scales: The items from the 'exacerbation' scale loaded positively on the second factor, the items from the 'general' scale loaded negatively. Eigenvalues were 9.41 and 3.55, respectively, accounting for 39.20 and 14.79% of the variance, respectively (data not shown in tables).

Items 3, 7, and 12 showed aberrant loadings: item 3 loaded negatively on the second factor—suggesting it was conceptually closer to the 'general' scale; items 7 and 12 had very low—though positive—loadings on the second factor.

Varimax rotation revealed two factors that converged with the two scales from the CAS: the items from the 'general' scale all loaded positively > .60 on the first factor (Eigenvalue = 7.03) and < .30 on the second factor; the items from the 'exacerbation' scale loaded positively > .60 on the second factor (Eigenvalue = 5.93) and < .30 on the first factor, except for item 3 (loading .52 on the first factor), and items 7 and 12 (loading low on both factors).

ITEM ANALYSIS AND INTERNAL CONSISTENCY OF THE CAS
Cronbach’s ? and the item-total correlations per scale and for the CAS as a whole are presented in Table 3. Cronbach’s ? for the 'exacerbation' scale, the ‘general’ scale and for the CAS as a whole were .90, .92 and .93, respectively. Item-total correlations ranged from .60 to .77 for the general scale and from .44 to .69 for the CAS as a whole. For the 'exacerbation' scale, the item-total correlations ranged from .40 to .76, with items 3, 7, and 12 scoring <.45. Because all the other items except one scored >.60, items 3, 7, and 12 were questionable, in accordance with the results from the PCA.

REVISED 'EXACERBATION' SCALE
Based on these results, we decided to delete items 3, 7, and 12 from the 'exacerbation' scale. As can be seen from Table 2, the factor structure stayed the same, with little differences in factor loadings. The proportion of explained variance was higher, though: 41.06 and 16.83%, respectively (Eigenvalues...
= 8.63 and 3.54, respectively). Similarly, Cronbach’s $\alpha$ for the scale increased slightly to .91.

**TEST-RETEST RELIABILITY**

Correlations between CAS-scores completed on different occasions are shown in Table 4, for the total score and subscale scores. Test-retest reliability after one week was excellent with all correlations $> .90$ (all p's < .005). Even after 8 months, correlations were $> .85$ (all p's < .005). Test-retest reliability after 5 months was more variable, especially for the ’general’ scale ($r = .49$, n.s.), but still acceptable for the ’exacerbation’ scale and the total CAS score ($r = .67$ and .59, p < .005 and .05, respectively).

**VALIDITY OF THE CAS**

72 patients had less than two missing items on the ASC, all patients completed the PANAS. We calculated correlations between the total CAS scores and subscale scores on the one hand and PANAS scores and ASC total score and subscale scores on the other hand (Table 5). Because of the high number of correlations and the increased risk of Type-I error, we looked only at correlations higher than .25. We observed considerable correlations between the ‘exacerbation’ scale on the one hand and the ASC total score and anxiety, irritability and fatigue subscales on the other hand ($r = .48; .68; .33;$ and .37 respectively). In addition, the correlation with the NA-scale was .32. No correlation between the ’general’ scale and ASC or PANAS scores was $> .25$. For the total CAS score, this resulted in a correlation with the total ASC score of .39; a correlation with the anxiety scale of .54 and a correlation with the ASC fatigue subscale of .30. The total CAS score correlated .29 with the NA-scale.

**DISCUSSION**

The present study investigated a questionnaire designed to measure ‘catastrophic thinking about asthma’. We adapted the Pain Catastrophizing Scale (PCS28,29) to be applicable to asthma and invited asthma patients participating in studies from our research group to complete the questionnaire.

PCA on the original and the revised scales revealed a two-factor solution. The unrotated solution revealed one factor on which all the items loaded, indicating that the questionnaire measures one and the same construct; whereas the second factor differentiated between the two scales. The Varimax rotated solution revealed one factor for each scale.

Despite some items having quite low item-total correlations, internal consistency of the scales was high, replicating Cronbach’s alpha values that have been reported for the PCS. The item-total correlations suggested that three items be deleted from the ‘exacerbation’ scale, which was consistent with the results from PCA. Deleting these three items from the ‘exacerbation’ scale did not change the PCA results, nor did the results of the item analysis change substantially.

Test-retest reliability after one week was excellent and as high as the reliability of the PCS. Over a period of several months, results are more variable: Reliability after 5 months was less than after 8 months, a pattern of results that was most pronounced for the ‘general’ scale. Because test-retest reliability was calculated on a limited number of data points, it is possible that this caused the results. On the other hand, it is possible that, over the course of several months, some subjects experienced a change in their condition, leading to an increase or decrease in current concerns about asthma. This, in turn, may have influenced their thinking about asthma ‘in general’, whereas their concern about asthma...
exacerbations was less influenced by it. This means that there might be an effect of asthma severity on catastrophic thinking about asthma. Future research investigating catastrophic thinking in asthma therefore needs to control for disease severity.

In addition, we calculated test-retest reliability for the revised scale based on the data from the original scale. Because the deleted items may have had an influence on the answers on the other items of the scale, test-retest reliability needs to be examined again for the revised questionnaire.

The scores of the ‘exacerbation’ scale were positively correlated with subjective symptom reports. This means that patients, who report a high amount of catastrophic thinking during an exacerbation, also report to experience a range of symptoms more frequently during an asthma exacerbation. We observed the highest correlation with the anxiety subscale of the ASC. This is not surprising: catastrophic thoughts probably elicit anxious feelings. The other correlations we observed were with the irritability and fatigue subscale. What is interesting about these results, is that there were no correlations between catastrophizing on the one hand and the obstruction, dyspnea, or hyperventilation subscale on the other hand. So, none of the ‘respiration-related’ subscales was correlated with catastrophizing. The former scales (anxiety, irritability and fatigue) have been shown to be more related to emotional factors of the asthma experience than to respiratory factors (i.e., obstruction of the airways and difficulties breathing), suggesting that catastrophizing plays a role somewhere along the path from emotion to symptoms. An alternative explanation could be that patients with more severe asthma have more complaints and have more reasons to be worried about their condition. In that case, the higher catastrophizing scores are the consequence of the severity of the disease. Because we are dealing with correlational data, we can not determine the direction of the effect. Nevertheless, we would expect patients with more severe asthma to report more symptoms on every scale of the ASC, especially on those scales referring to airway pathology. We found the opposite pattern of results, suggesting a link from catastrophizing to symptom reporting.

Because the present study used a relatively small sample size, further studies with larger samples are needed to confirm our results and consolidate the psychometrics of the CAS. As we already mentioned, this needs to control for patients’ disease characteristics. Furthermore, to investigate the concept and possible role of catastrophizing in symptom reporting in asthma, the CAS could be added to studies using respiratory challenges (e.g., respiratory loads, bronchial provocation tests) or diary studies investigating the relationship between lung function and symptom reports. Considering that we found a differentiation between the effects on respiratory symptoms versus emotional symptoms, it will be interesting to include this in future research also.

Finally, we found a moderate correlation between catastrophizing and NA, suggesting that catastrophizing has considerable overlap with the concept of NA, but at the same time is sufficiently different to warrant further investigation. A more specific factor to elucidate some of the path from NA to symptoms could help to pinpoint more specific processes. Within the field of pain—especially chronic pain—the influence of catastrophic thinking on vigilance, fear/avoidance and the long-term evolution of the condition has been identified. Because of the similarities between pain and dyspnea, catastrophic thinking may appear to be of similar influence within the field of asthma.

**APPENDIX: INSTRUCTIONS FOR THE CAS**

Patients with asthma experience all sorts of complaints during an attack and in daily life. Some of those complaints interfere with daily activities to a large extent, other are tolerable. In addition, every asthma attack elicits thoughts and feelings.

We are interested in the thoughts and feelings that you experience during an asthma attack. The lists on the following page contain thirteen items describing various thoughts and feelings possibly related to asthma. Try to indicate to what extent these thoughts and feelings are applicable to you. In order to do that, use the following scale:

0 = not at all 1 = slightly 2 = to some extent 3 = to a great extent 4 = certainly

**References**

5. Rocco PL, Barboni E, Balestrieri M. Psychiatric
symptoms and psychological profile of patients with near fatal asthma: absence of positive findings. Psychother Psychosom 1998;67:105-8.
36. PCA is a commonly used data reduction technique and is related to factor analysis. Mathematically, the computation of factors in PCA basically consists of diagonalizing a symmetric matrix. The result is a new set of variables (principal components) that are linear combinations of the original variables and are uncorrelated. The new variables thus are smaller in number, and yet account for the inherent variation of the data to the maximum possible extent. In fact, in this way, a new space (factor space) is generated onto which the cases and the variables can be projected and classified into categories.
37. Varimax rotation is aimed at maximizing the variances of the squared normalized factor loadings across variables for each factor. This is equivalent to maximizing the variances in the columns of the matrix of the squared normalized factor loadings. This is the rotational method that is most commonly used in PCA.
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