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Characteristics and consequences of the co-occurrence between social anxiety and pain-related fear in chronic pain patients receiving multimodal pain rehabilitation treatment

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HIGHLIGHTS

- There is a subgroup with comorbid social anxiety in the studied pain population.
- Central factors stated by the shared vulnerability model are found in this group.
- This group has higher symptomatology compared to other subgroups.
- This group has unchanged clinically high levels of symptoms posttreatment.

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ABSTRACT

Background and aims: Chronic pain problems are related to specific pain related fears and maladaptive pain-coping but also commonly co-occur with other anxiety problems. Shared emotional vulnerability factors may explain this comorbidity and may influence treatment outcome. Indeed, pain patients going through multimodal pain treatment are a heterogeneous group and treatment results vary. One understudied anxiety disorder co-occurring with pain is social anxiety. This may be relevant as many pain-related challenges are situated in social contexts. The aim of this study is to investigate the occurrence of subgroups with differential patterns of social anxiety and pain related fear in a sample of chronic pain patients who receive multimodal pain treatment. The aim is also to study the characteristics of these potential subgroups and the consequences of different patterns of social anxiety and pain related fear.
Methods: 180 patients with chronic musculoskeletal pain answered questionnaires before and after a multimodal pain treatment in a hospital rehabilitation setting in middle Sweden. A cluster analysis using pre-treatment scores on the Social Phobia Screening Questionnaire and the Tampa Scale of Kinesiophobia was performed. Subgroups were thereafter validated and compared on impairment due to social anxiety, pain catastrophizing, anxiety, and depression. Moreover, subgroups were described and compared on vulnerability factors (anxiety sensitivity, negative affect) and outcome factors (pain intensity, pain interference, and return to work self-efficacy).
Results: Four distinct clusters emerged: (1) low scores, (2) pain-related fear only, (3) social concern only, and (4) high social anxiety and pain-related fear. Patients high on social anxiety and pain-related fear had significantly higher levels of anxiety sensitivity, negative affect, and higher general emotional symptomatology. They also had remaining problems posttreatment.
Conclusions: A subgroup of patients with clinical levels of social anxiety has suboptimal rehabilitation results, with residual emotional problems and high levels of emotional vulnerability.
Implications: These patients may be in need of additional treatment efforts that are not being met today. To prevent insufficient treatment results and prolonged work disability, these patients need to be detected during screening and may benefit from pain treatment that takes their emotional problems into account.

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1. Introduction

Problems with adaptation to chronic pain have been linked to psychological factors such as pain-related fear, avoidance behaviours, and other maladaptive pain-coping strategies [1]. Besides fears specific to pain and its consequences, other psychological problems such as anxiety disorders are overrepresented in chronic pain patients [2–4]. An important question is how to understand this comorbidity.

The 'shared vulnerability model' proposes that underlying factors such as vulnerabilities (e.g. negative affect, anxiety sensitivity), triggers (e.g. traumatic life events), and cognitive behavioural factors (e.g. hypervigilance, catastrophizing, avoidance) may explain this comorbidity [5]. However, evidence supporting this model is mainly based on pain populations with comorbid posttraumatic stress. Studies are needed that investigate the propositions of this model in pain populations with other comorbid anxiety problems.

One potentially important disorder to investigate is social anxiety disorder as the prevalence in chronic pain populations is increased and disorder specific problems may be amplified. The prevalence of social anxiety in pain populations is 11–36% compared to 0.5–15% in the general population [6,7]. Pain patients may feel shame about not being able to function on the same level as before pain onset [8,9]. This may lead to or exacerbate problems central to social anxiety, such as the fear of being judged, self-criticism or avoidance of social situations [10–14]. Also, existing social anxiety may make it harder to deal with chronic pain. For example, socially anxious pain patients may find it challenging to express their needs, especially when talking to authority figures like doctors or bosses [15,16]. This increased prevalence and the symptom overlap could partly be explained by shared underlying factors. To the best of our knowledge, no study has evaluated the association between social anxiety and chronic pain problems in relation to underlying vulnerability factors and interpersonal consequences.

Two important underlying factors that may explain comorbidity are trait negative affect and anxiety sensitivity. Patients high on these factors may be vulnerable to experiencing stressors more intensely. They may also have more problems regulating emotions triggered by pain and social situations. Indeed, anxiety sensitivity and negative affect have been shown to be elevated in chronic pain as well as comorbid anxiety and pain [5,17,18]. These factors may have treatment implications and are therefore important to study in relation to the comorbidity between chronic pain and social anxiety.

In general, multimodal pain rehabilitation treatments have been shown to be moderately effective in improving outcome when compared to other treatments [19], but group results may hide improvements of varying significance. Several studies have highlighted the existence of subgroups of pain patients with different psychological characteristics and varying progress during treatment [20–24]. It is therefore important to map variations in treatment progress while taking into consideration the existence of subgroups, and to do so on the basis of a theoretical model. This has, to our knowledge, not been done concerning social anxiety. We aim to study the occurrence of subgroups with different patterns of pain related fear (used as a proxy for maladaptive pain-coping) and social anxiety in a sample of chronic pain patients who receive multimodal pain treatment. We use the shared vulnerability model [5] as a theoretical framework and focus on studying variations in anxiety sensitivity and negative affect, as well as treatment outcome.

2. Methods

2.1. Design

This study uses a prospective design with two measurement points, pre and posttreatment in a sample of chronic musculoskeletal pain patients receiving multimodal rehabilitation.

2.2. Procedure

This study used data from a longitudinal project studying the comorbidity between pain and social anxiety in chronic pain patients receiving care at a university hospital based pain rehabilitation clinic in middle Sweden (the Social Anxiety and Pain project, SAP). Data collection was conducted from 2011 to 2014 and new patients were consecutively asked to participate. Participation was voluntary, making the sample self-selected. Participation consisted of answering a battery of self-report measures at four time points during the rehabilitation process: at first visit to the rehabilitation physician (A), before treatment (B), after treatment completion (C), and at 1 year follow up (D). The data collected specifically for this project was supplemented with data collected as part of regular clinical routine [the Swedish Quality Registry for Pain Rehabilitation, SQRP, 25]. During this time period, the clinic had 955 new patients visiting of which approximately 535 went on to receive rehabilitation treatment and 385 chose to answer self-report measures at one or more of the four time points. This study used measures from two time points B and, which 180 patients chose to answer.

Participants provided written informed consent. Data collection was handled by trained health-care providers at the clinic while independent researchers analyzed the data. The Regional Ethical Board reviewed and approved the study.

2.3. Participants

Participants ($N = 180$; 82% female; 90% born in Sweden; 36% with a university education, 49% with an upper secondary school education, 13% with only compulsory school education) were included for analyses given that they had complete data on the variables used for the cluster analysis pretreatment and had filled out posttreatment measurements. All patients suffered from chronic musculoskeletal pain with chronicity defined as lasting longer than 3 months. The average duration of pain-problems was 13.2 years since first pain episode (range: 2–46, sd: 9.3). Most (77%) had generalized pain, defined as pain in more than six areas (divided up in left and right side of the body). More specified areas of pain varied, so that the second most common area of pain (head–neck) was shared by only 3 participants (1.67%). Age ranged from 21 to 70 ($M_{age} = 45.58$; sd = 10.81). Of the patients indicating employment status before treatment, 42% reported that they did not work. The level of education in this sample is fairly representative for the Swedish population (45% upper secondary school, 34% university degree) [26]. To analyze our sample's representativeness we have compared it to a larger study ($N = 4069$) using data from the Swedish Quality Registry for Pain rehabilitation collected between 2005 and 2008 at a different, but comparable, Swedish pain rehabilitation clinic offering multimodal secondary pain rehabilitation to chronic pain patients [27]. Concerning areas of pain, these patients report pain in, on average, 14 areas (sd = 8), which indicates that generalized pain is also common in this sample. No differences were found concerning age between our sample and this sample ($M = 46$, sd = 14, $t(4452) = .57$, $p = .57$), but a χ^2-analysis shows that our sample contained significantly more women (82% compared

to 69%, $\chi^2(1, n = 4249) = 14.21$, $p = .001$). The average duration of pain is reported as 8.1 years (sd = 8.3), which is significantly shorter than the 13 years reported by our sample ($t(4247) = 8.02$, $p = .0001$). Concerning employment they report that 32% of their sample is working, compared to 45% of our sample reporting that they did not work. No information is available concerning country of birth. To summarize, our sample contains more women, has a longer pain duration and seems to be more likely to work when compared to a larger study from a different Swedish pain rehabilitation clinic.

2.4. Measures

Validated Swedish translations were used for all measures.

2.4.1. Measures used for subgrouping

2.4.1.1. Pain-related fear. Pain-related fear was understood as a proxy for maladaptive pain coping and assessed with the Tampa Scale of Kinesiophobia [TSK, 28]. The TSK contains 17 items (e.g. 'I wouldn't have this much pain if there weren't something potentially dangerous going on in my body') with scores ranging from 1 ('don't agree at all') to 4 ('agree completely'). Total scores range from 17 to 68. For the purpose of benchmarking the clusters, scores over 35 indicate problematic pain-related fear [29,30]. The TSK has been shown to be reliable and valid [29,31]. Internal consistency in the present study was good ($\alpha = .82$).

2.4.1.2. Social anxiety. Social anxiety was assessed with the first part of the Social Phobia Screening Questionnaire [SPSQ, 6] which asks participants to rate the degree of distress they would experience in 14 social situations (e.g. 'Maintaining a conversation with someone unfamiliar'). Each situation was rated on a scale ranging from 0 ('not distressing at all') to 4 ('extremely distressing'). Total scores range from 0 to 48. The SPSQ converges well with other measurements of social anxiety and shows good internal consistency [6]. For the purpose of benchmarking the clusters, norm data for the social distress scale is $M = 20.7$ (sd = 8.9) for the general population (Furmark, personal communication, February 19th, 2014) and $M = 30.4$ (sd = 8.7) for a clinical sample with social anxiety [32]. Internal consistency in the present study was excellent ($\alpha = .93$).

2.4.2. Measures used to validate subgroups

2.4.2.1. Pain catastrophizing. Pain catastrophizing was assessed with the Pain Catastrophizing Scale [PCS, 33]. It includes 13 items (e.g. 'I worry all the time about whether the pain will end') rated on a scale from 0 ('Not at all') to 4 ('All the time'). Total scores range from 0 to 52. For the purpose of benchmarking the clusters scores over 24 indicated an increased risk for future chronic low back pain and disability in a population-based cohort [30]. The scale has been validated and has shown good reliability [34]. Internal consistency in the present study was excellent ($\alpha = .92$).

2.4.2.2. Social impairment. Impairment due to social anxiety was assessed with the subsection of the Social Phobia Screening Questionnaire [SPSQ, 6] which asks participants to rate to which degree social distress leads to impairment in three areas of life: work/studies, social activities and leisure time, answered with 'yes' (=1) or 'no' (=0). The percentage of individuals indicating impairment in >1 area was compared between clusters. This subscale adds additional information of theoretical and clinical importance as it equals the G-criterion in the DSM system [35]. This is clinically important as patients who have difficulties in many different social situations, and thus high scores on the scale used to measure social anxiety, would not be diagnosed with social anxiety according to the DSM system without fulfilling the G-criterion. These patients may not show up in clinical practice as their difficulties do not lead to subjective suffering. On the other hand, some patients may have problems with few social situations and thus score low, but still experience considerable impairment in their daily functioning. From a theoretical viewpoint this information is important as it gives us the possibility to assess our operationalization of social anxiety as we are not simply interested in the number of social situations people find problematic, but if these perceived difficulties translate into clinically relevant impairment.

2.4.2.3. Anxiety and depression. Symptoms of anxiety and depression were assessed with the Hospital Anxiety and Depression scale [HAD, 36]. The HAD scale consists of 7 questions for anxiety (e.g. 'I feel tense or wound up') and 7 for depression (e.g. 'I still enjoy the things I used to enjoy') scored on a 4-point scale ranging from 0 to 3 points. Total scores on each subscale range from 0 to 21. For the purpose of benchmarking the clusters, scores over 10 have shown to indicate problems on a clinical level [36]. The questionnaire has been shown to have good internal consistency with α ranging from .68 to .93 (mean = .83) for the anxiety scale and α ranging from .67 to .90 (mean = .82) for the depression scale [37]. The depression scale converges upon other measures of depression [38]. Internal consistency in the present study was good, with $\alpha = .87$ for anxiety and $\alpha = .86$ for depression.

2.4.3. Vulnerability measures

2.4.3.1. Anxiety sensitivity. Anxiety sensitivity was assessed with the Anxiety Sensitivity Index [ASI, 39]. The ASI measures fear of anxiety-related symptoms and its somatic, psychological, and social consequences. It contains 16 items scored on a 5-point scale ranging from 0 to 4, adding up to between 0 and 64 points (e.g. 'It is important to me not to seem nervous'). In a norm sample women on average scored 20.5 (sd = 10.2) while men scored 15.4 (sd = 8.1), which can be compared to a sample with anxiety disorders where women on average scored 23.9 while men scored 25.8 (no standard deviations were reported) [39]. The scale has been shown to be reliable and to have good internal consistency [40]. Internal consistency in the present study was excellent ($\alpha = .91$).

2.4.3.2. Negative affect. Negative affect was assessed with the negative affect subscale of the short version of the Positive and Negative Affect Schedule [PANAS, 41,42]. Participants are asked to indicate how they usually feel, thus capturing 'trait' rather than 'state' affect. The short PANAS consists of 10 words describing feelings (e.g. 'nervous', 'alert'), of which five describe negative affect. Scores for each item range from 1 ('very slightly or not at all') to 5 ('extremely') adding up to 5–25 points. It has been validated and is considered a reliable measure with good internal consistency ($\alpha = .87$ for NA) [42,43]. The internal consistency for the present study was good, with $\alpha = .86$ for NA.

2.4.4. Outcome measures

2.4.4.1. Pain severity and interference with daily life. Pain severity and interference with daily life were assessed with the first part of the Multidimensional Pain Inventory [MPI, 44]. The MPI asks about chronic pain problems and their consequences. This study used the subscales 'pain severity' (two items, e.g. 'Rate the level of your pain at the present moment') and 'interference with daily life' (11 items, e.g. 'In general, how much does your pain interfere with your day-to-day activities?') [following 45]. Mean scores were used and total scores range from 0 to 6. In a pain-population mean scores of 3.73 (pain severity) and 3.74 (pain interference) were recorded [44]. One item on the interference scale, which asked for enjoyment at work, was left out for participants indicating that they did not work. These subscales have been shown to be both valid and reliable [45,46]. Internal consistency in the present study was good, with $\alpha = .82$ for pain severity and $\alpha = .89$ for pain interference.

2.4.4.2. Efficacy to communicate work related needs. The belief of being able to communicate accommodation needs at work was measured with seven items from the Return To Work Self-Efficacy Scale, rated on a scale ranging from 1 ('not at all confident') to 10 ('completely confident') [RTWSE, 47]. The items analyzed in this study were all four items of the communicating-needs-to-others subscale and three out of eight items from the modifying-job-demands subscale, which also load on the communication-of-needs subscale [47]. Patients are asked: 'How confident are you that you could. . .' and an example-item is 'Suggest to your supervisor ways to change your work to reduce discomfort'. The full version of RTWSE has been evaluated and is considered valid and reliable with a high internal consistency ($\alpha = .81$ for the communicating-needs-to-other subscale and $\alpha = .92$ for the modifying-job-demand subscale) [47]. In the present study, the seven items were summarized and analyzed together as one scale, which had excellent internal consistency ($\alpha = .94$).

2.5. Statistical analysis

The IBM Statistical Package for Social Sciences version 22 was used for analyses. To isolate subgroups with differential profiles we used a cluster analytical approach with standardized scores on the TSK and the social distress scale of the SPSQ (the 14 social situations) as variates. This method provides the opportunity to study the comorbidity of symptoms that some individuals may experience in relation to the characteristics of hypothetical subgroups that have singular or no symptoms. First, a hierarchical cluster analysis was performed, using Wards method with squared Euclidian distances. We selected a cluster solution that explained at least 67% of the total error sums of squares to ensure satisfactory homogenous clusters [48]. The hierarchical cluster analysis was followed by a K-means cluster analysis using the hierarchical cluster solution centre points as a starting point [following 49]. This allows cluster members to change clusters if a move results in a reduction of the total error sums of squares, resulting in higher within cluster homogeneity. To validate the cluster solution the subgroups were thereafter compared on impairment due to social anxiety (SPSQ impairment subscale), pain catastrophizing (PCS), general anxiety, and depression (HAD). Pre- and posttreatment scores were compared separately using χ^2-test of independence and one-way ANOVAs. Finally, the resulting subgroups were described and compared before and after treatment on negative affect (PANAS), anxiety sensitivity (ASI), pain intensity and pain interference (MPI), and return to work self-efficacy (RTWSE) using repeated measures and one-way ANOVAs. Games-Howell post hoc analyses were performed where significant differences were found. For categorical variables, χ^2-tests were performed and standardized residuals were compared when differences were found. As multiple comparisons were used, a Bonferroni correction was done to decrease the risk for type-1 errors and significance was set at $p \leq .01$ for all statistical analyses.

3. Results

3.1. Subgroup analysis on social anxiety and pain-related fear

The cluster analysis procedure performed on pretreatment social anxiety and pain related fear resulted in a 4-cluster solution explaining >68% of the variance. As can be seen in Fig. 1, there was a cluster with relatively low scores on both social anxiety and pain-related fear (low scores cluster 'LS'), a cluster with relatively high scores on pain-related fear only (pain related fear only cluster 'PF'), a cluster with somewhat higher scores on social anxiety only (social concern cluster 'SC'), and a cluster with relatively high scores on both social anxiety and pain related fear (pain related fear and social anxiety cluster 'PF-SA').

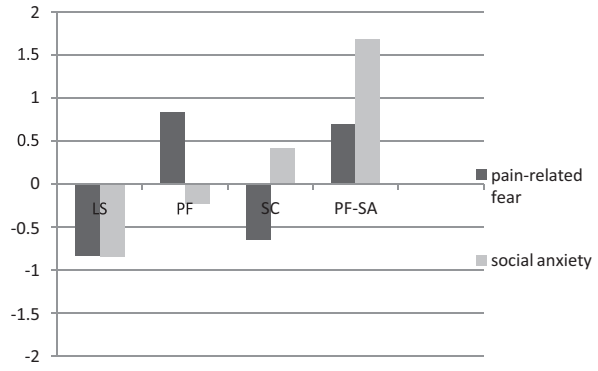

Fig. 1. Standardized scores on social anxiety and pain-related fear for each cluster.

The PF-SA cluster had a mean score of 32.5 (sd = 8.2) on the SPSQ, which is in the range of the benchmark clinical sample with social anxiety. On the TSK, both the PF-SA cluster ($M = 43.7$, sd = 6.5) and the PF cluster ($M = 44.9$, sd = 6.2) had scores exceeding the benchmark of 35 for problematic pain related fear. As can be seen in Table 1, χ^2 tests for independence showed a significant difference between clusters on gender ($\chi^2(3, n = 180) = 14.32$, $p < .005$, phi = .28) and education ($\chi^2(9, n = 180) = 36.47$, $p < .001$, phi = .45) with the PF cluster including a higher proportion of men, the LS cluster including a higher proportion of university educated and the PF-SA including a higher proportion of individuals with only compulsory education. Also, the LS cluster had a significantly longer pain duration compared to the PF cluster ($F(3, 171) = 2.93$, $p < .05$). There were no differences between the clusters on age, birth place, pain localization or pretreatment employment status.

3.2. Validation of the subgroups

To validate the cluster solution, the subgroups were compared on impairment due to social anxiety, pain catastrophizing, general anxiety, and depression. An overview of pre- and posttreatment descriptives is presented in Table 2. At pretreatment, a χ^2-test for independence showed a significant association between clusters and impairment due to social anxiety ($\chi^2(9, n = 176) = 67.5$, $p = .001$, phi = .62). Patients in the PF-SA cluster included a higher proportion of individuals who indicated that they experienced impairment while patients in the LS and PF clusters included a lower proportion. These differences were retained posttreatment ($\chi^2(9, n = 124) = 33.2$, $p = .001$, phi = .52). There were significant differences between the clusters on pain catastrophizing ($F(3, 174) = 17.40$, $p < .001$). The PF-SA cluster scored significantly higher on the PCS than all other clusters with scores well over the benchmark of 24. The PF cluster scored significantly higher than the LS cluster and scores in this cluster were around the benchmark of 24. At posttreatment, even though the overall analysis was significant ($F(3, 107) = 3.00$, $p < .05$), post hoc analyses did not show any differences between clusters on the PCS. On pretreatment as well as posttreatment anxiety, there were significant differences between the clusters ($F(3, 170) = 10.98$; $p < .001$ respectively $F(3, 149) = 9.66$; $p < .001$). Specifically, the PF-SA cluster had significantly higher anxiety scores than the LS and PF clusters at pretreatment. At posttreatment, the PF-SA cluster scored significantly higher than the LS cluster. There were also pretreatment and posttreatment differences on depression ($F(3, 170) = 7.98$; $p < .001$ respectively $F(3, 149) = 3.95$; $p < .01$). The PF-SA cluster scored significantly higher than the LS cluster at both pretreatment and posttreatment. In fact, the PF-SA cluster scored on a level indicating clinical anxiety both

Table 1
Demographic variables.

	LS cluster	PF cluster	SC cluster	PF-SA cluster	Total sample
N (% of total)	63 (35)	53 (29)	34 (19)	30 (17)	180
Gender (% men)	9[b]	34[a]	9[b]	17[b]	18
Age (*M* (sd))	46.1 (11.2)	46.2 (9.8)	45.4 (9.6)	45.7 (10.5)	45.9 (10.3)
Education (%)					
University	59[a]	23[b]	29[b]	17[b]	36
High-school	35	59	59	50	49
Lower-level	5[b]	13[b]	12[b]	33[a]	13
Born in Sweden (%)	91	87	97	87	90
Pain-duration (years (sd))	15.2 (10.7)	10.7 (7.0)	14.8 (10.6)	11.5 (6.8)	13.2 (9.3)
Generalized pain (%)	71	79	77	83	77
Unemployed (%)	34.9	47.2	38.2	53.3	42.2

LS, low-scores cluster; PF, cluster with high scores on pain-related fear only; SC, cluster with elevated scores on social anxiety; PF-SA, cluster with high scores on both social anxiety and pain-related fear. Different superscripts (a, b) indicate significant differences between the cluster.

Table 2
Validation of the clusters.

	LS cluster	PF cluster	SC cluster	PF-SA cluster	Total sample
Anxiety (HAD (0–21)) *M* (sd)					
Pre	6.5 (4.2)[b]	9.1 (4.7)[b]	9.4 (4.9)[a,b]	12.4 (5.1)[a]	8.8 (5.0)
Post	6.2 (3.8)[b]	7.7 (4.3)[a,b]	7.8 (3.4)[a,b]	11.2 (4.0)[a]	7.8 (4.2)
Depression (HAD (0–21)) *M* (sd)					
Pre	6.9 (3.9)[b]	9.4 (4.4)[a,b]	9.1 (4.3)[a,b]	11.2 (4.7)[a]	8.7 (4.5)
Post	6.2 (4.2)[b]	7.7 (3.6)[a,b]	8.4 (4.1)[a,b]	9.3 (5.0)[a]	7.6 (4.3)
Pain catastrophizing (PCS (0–52)) *M* (sd)					
Pre	16.8 (9.0)[c]	23.7 (10.5)[b]	21.9 (9.3)[b,c]	32.1 (10.0)[a]	22.4 (11.0)
Post	19.2 (9.4)[b]	20.8 (10.1)[b]	20.4 (8.6)[b]	28.7 (12.0)[a]	20.9 (10.0)
Impairment due to social anxiety (SPSQ) (%)					
Pre	3[c]	25[c]	36[b]	71[a]	27
Post	9[b]	22[b]	31[b]	69[a]	25

LS, low-scores cluster; PF, cluster with high scores on pain-related fear only; SC, cluster with elevated scores on social anxiety; PF-SA, cluster with high scores on both social anxiety and pain-related fear. Different superscripts (a, b, c) indicate significant differences between the clusters.

pre- and posttreatment as well as clinical depression pretreatment. Overall, the results validated the cluster solution based on the SPSQ distress scale and the TSK and indicate that the cluster with comorbidity (PF-SA) displays clinical levels of anxiety, depression, social anxiety, and pain-related fear.

3.3. Differences between clusters on vulnerability factors

Table 3 shows an overview of pre- and posttreatment descriptives on anxiety sensitivity and negative affect. In addition, Fig. 2 visualizes how the clusters scored in comparison to each other on these variables. This figure also visualizes differences between the clusters on outcome variables. There were significant pretreatment as well as posttreatment differences between clusters on anxiety sensitivity ($F(3, 175) = 20.43$; $p < .001$ respectively $F(3, 110) = 10.78$; $p < .001$), and on negative affect ($F(3, 175) = 14.10$; $p < .001$ respectively $F(3, 109) = 8.62$; $p < .001$). Specifically, the PF-SA cluster had significantly higher scores compared to the LS and the SC cluster on anxiety sensitivity and negative affect at pre- as well as posttreatment. In addition, the PF cluster had significantly higher anxiety sensitivity scores than the LS cluster at pretreatment. The Mixed between-within subject ANOVA showed that there were no overall changes nor any significant interactions. This indicates that the PF-SA cluster has significantly higher anxiety sensitivity and negative affect and that scores do not change during multimodal treatment.

3.4. Differences between clusters on outcome variables

Table 4 displays descriptives for the clusters on outcome variables at pre and posttreatment.

While there were significant improvements for the total sample on pain intensity ($F(1, 144) = 19.27$; $p < .01$) and on pain interference ($F(1, 147) = 25.29$; $p < .01$), there was no significant difference between the clusters on the degree of change. The pre- and posttreatment score differences between the clusters on pain intensity and pain interference were small and did not reach Bonferroni-corrected significance. There were significant differences between

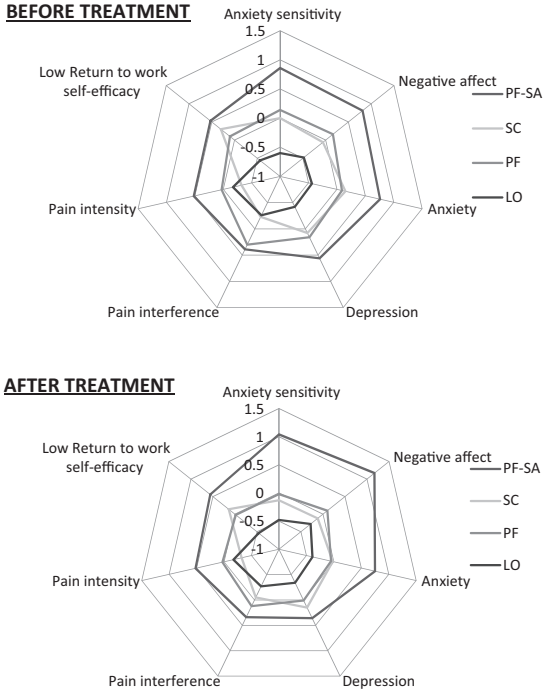

Fig. 2. Radar graphs showing the four clusters' *z*-scores before and after treatment and thus the differences in patterns of symptomatology for clusters. Scores further out from the centre indicate more problems.

Table 3
Description and comparison of clusters on vulnerability factors.

	LS cluster	PF cluster	SC cluster	PF-SA cluster	Total sample
Anxiety sensitivity (ASI (0–64)) *M* (sd)					
Pre	8.5 (5.8)[c]	16.3 (11.2)[a,b]	14.8 (9.7)[b,c]	23.8 (9.4)[a]	14.6 (10.4)
Post	9.9 (6.4)[cb]	14.7 (11.4)[a,b]	13.6 (8.2)[b]	25.7 (10.3)[a]	13.8 (9.9)
Negative affect (PANAS (5–25)) *M* (sd)					
Pre	8.9 (3.4)[b]	11.9 (4.7)[a,b]	10.9 (3.7)[b]	14.9 (5.5)[a]	11.2 (4.7)
Post	9.6 (3.4)[b]	11.4 (4.9)[a,b]	10.4 (3.6)[b]	16.5 (6.0)[a]	11.0 (4.7)

LS, low-scores cluster; PF, cluster with high scores on pain-related fear only; SC, cluster with elated scores on social anxiety; PF-SA, cluster with high scores on both social anxiety and pain-related fear. Different superscripts (a, b, c) indicate significant differences between the clusters.

Table 4
Description and comparison of clusters on outcome variables.

	LS cluster	PF cluster	SC cluster	PF-SA cluster	Total sample
Pain intensity (MPI (0–6)) *M* (sd)					
Pre	4.0 (.9)	4.2 (1.0)	3.9 (1.1)	4.7 (1.1)	4.2 (1.0)
Post	3.8 (1.1)	4.0 (1.2)	3.9 (.9)	4.0 (1.1)	3.9 (1.1)
Pain interference (MPI (0–6)) *M* (sd)					
Pre	4.2 (1.2)	4.8 (.8)	4.3 (1.1)	4.8 (.8)	4.5 (1.0)
Post	3.9 (1.1)	4.3 (.9)	4.1 (1.0)	4.5 (.8)	4.2 (1.0)
Efficacy to communicate needs (RTWSE (7–70)) *M* (sd)					
Pre	53.2 (13.8)[b]	40.9 (18.1)[b]	37.2 (17.5)[b]	33.1 (19.4)[a]	43.3 (18.4)
Post	52.5 (12.5)[b]	43.2 (16.1)[b]	40.4 (19.7)[b]	33.1 (21.2)[a]	44.5 (17.7)

LS, low-scores cluster; PF, cluster with high scores on pain-related fear only; SC, cluster with elated scores on social anxiety; PF-SA, cluster with high scores on both social anxiety and pain-related fear. Different superscripts (a, b) indicate significant differences between the clusters with Games-Howell posttest.

the clusters on their efficacy to communicate work related needs at pretreatment ($F(3, 167) = 12.10$; $p < .001$) as well as posttreatment ($F(3, 115) = 6.38$; $p < .001$). The PF-SA cluster had significantly lower efficacy to communicate needs compared to the other clusters.

4. Discussion

The purpose of this study was to explore the role of social anxiety in chronic pain by studying the occurrence of subgroups with different patterns of pain-related fear (used as a proxy for maladaptive pain coping) and social anxiety in a sample of chronic pain patients receiving multimodal pain treatment. This is important since maladaptive pain coping in combination with emotional problems has been shown to lead to worse treatment outcome [see for example 20, 24]. We argue that social anxiety may be particularly significant to study as situations relevant for pain often have a social aspect. Our starting point was the shared vulnerability model and we studied the relationship between vulnerability factors and comorbidity between social anxiety and pain-related fear. The results of our study showed that patients could be meaningfully clustered in four subgroups with different patterns of social anxiety and pain-related fear, including a subgroup with comorbid social anxiety and more specific pain-related fears, comprising 17% of the sample. While information on formal diagnoses with social anxiety disorder or any other psychiatric disorder is lacking, the level of social anxiety in this subgroup is comparable with that of a clinical sample with social anxiety disorder [32] and exceeds the benchmark of problematic levels of pain-related fear [30]. The significance of emotional problems was confirmed by this subgroups' clinical levels of anxiety, depressive symptoms, and pain catastrophizing. This highlights the existence of a substantial subgroup that warrants further investigation.

Our study also aimed to investigate the characteristics of these subgroups and the consequences of different patterns of social anxiety and pain-related fear. The study shows that the subgroup with high levels of both social anxiety and pain-related fear had significantly higher levels of anxiety sensitivity and negative affect. This confirms the premises of the shared vulnerability model and provides further evidence of the relevance these factors have in understanding the comorbidity between anxiety and pain problems [17,18].

While, on a general level and irrespective of cluster, the sample improved from pre- to posttreatment on pain intensity, pain interference, pain catastrophizing, and depression, there were no significant changes across treatment on anxiety sensitivity and negative affect or on return to work self-efficacy. While statistically significant, improvements were generally small, which is in line with other research on multimodal pain rehabilitation [19]. This raises an important question of whether the improvements are of clinical relevance. On pain intensity our sample as a whole, as well as the separate clusters, are still on levels seen in clinical samples posttreatment [44]. However, it is important to remember that pain intensity is not the main target for treatment in multimodal pain treatments. On pain interference, a change of .6 on the interference subscale of the MPI has been suggested as clinically meaningful [21]. None of our clusters, nor the sample as a whole, reaches this benchmark and posttreatment scores are comparable to clinical pain samples [44]. Regarding depression, only the PF-SA cluster has scores on a clinical level pretreatment and changes to subclinical scores posttreatment. Changing anxiety sensitivity and negative affect is not a main treatment target and it is therefore not surprising that these factors were not changed, even though some treatments have been able to show positive effects on anxiety sensitivity (for a review see [51]). We want to highlight the fact that all clusters change fairly parallel to each other, which is illustrated in Fig. 2. Most of the clusters are on subclinical levels on the emotional symptoms and vulnerability factors before treatment and have therefore no need for change. This is different for the PF-SA cluster. For this cluster, vulnerability factors, as well as levels of anxiety were left on an unchanged clinically high level. Moreover, low efficacy to communicate work related needs have been negatively correlated to return to work [47], indicating a poor prognosis for this subgroup.

The high level of anxiety sensitivity and negative affect in this subgroup underscores the potential role of these factors as underlying vulnerability factors. The results of this study stress the importance of overall emotional reactivity, beyond the well-known role of pain-specific fears, in understanding a subgroup of pain patients' problems. Even though the subgroup with pain related

fear only and the comorbid subgroup scored similarly on pain-related fear, the comorbid group stood out as having much broader emotional problems and worse outcome. Interestingly, there were no significant differences between clusters on pain intensity and pain interference. Thus, the comorbid group's emotional symptomatology cannot be explained by the severity of the pain itself. In line with other studies, we therefore propose that shared vulnerability factors and overall high emotionality, rather than pain severity, are of importance for understanding the negative outcome of patients with pain coping problems such as pain-related fear and comorbid (social) anxiety. Vulnerability factors like anxiety sensitivity and trait negative affect may be important to consider in clinical practice and warrant further research.

There are several paths for future research with potential relevance for clinical practice. Qualitative studies of people's experience with comorbid social anxiety and chronic pain could elucidate how social anxiety influences the perception of an acute pain episode and how the difficulties in communicating needs are experienced. It could also clarify if chronic pain influences how people function in and think about social situations. Moreover, given the sub optimal treatment results of the comorbid PF-SA subgroup, it seems important to develop and test a psychological pain treatment specifically for this group. This could be done by combining existing psychological treatments for pain and social anxiety. Alternatively, treatments targeting underlying transdiagnostic factors, such as the Unified Protocol could be tested in the context of chronic pain and social anxiety [53]. The Unified protocol uses CBT techniques and focuses on emotional reactions and their consequences. The treatment is mainly developed for anxiety disorders and unipolar depression, but is believed to work for disorders where emotion may play a crucial role, which may include pain-problems.

This study has several limitations. First, it should be noted that this study relies on self-report measures. This may have influenced results as it is based on people's potentially inaccurate memory and perception. However, the measurements used have been properly validated and have good reliability and construct validity, which minimizes the risk for bias. Second, the vulnerability factors were assessed concurrently and we do not know whether people in the comorbid group scored high on negative affect and anxiety sensitivity before they developed social anxiety and pain. The use of the term 'vulnerability factor' is therefore theoretical, based on the previous literature. Third, some important information, like actual return to work after treatment, is missing due to the fact that patients do not work during treatment, including the time for filling in posttreatment measurements. Moreover, consecutive patients were invited to participate on a voluntary basis, which possibly jeopardized the representativeness of the sample. Our sample differed on gender, pain duration and work status when compared to another study with a sample from a comparable pain rehabilitation clinic [17]. A different gender ratio may have changed the ratio of our clusters since we also had more men in the PF cluster when compared to the LS and SA clusters. In our study pain duration was not related to the severity of pain- or emotional problems (see Table 1), so this difference has most likely no severe influence on the representativeness of our sample. The differences in work status may be explained by how the information was retrieved. Participants may have reported to be working when they were getting employment training while on sick-leave. These differences have to be considered when interpreting the results, but it should be kept in mind that patients in our sample are actual clinical patients. Both our sample and the sample used for comparison contained chronic pain patients where generalized pain was common. Also, our PF-SA cluster with high emotionality contained 17% of the sample, which is the same amount of patients with high emotional problems (depression and general anxiety) detected in [17]. Fourth, while the sample size is sufficient for cluster analysis, a larger sample size would have given the opportunity to replicate the cluster analysis using a split sample method. On the other hand, there are several studies confirming the existence of subgroups that differ in pain coping and emotional reactivity [20,54]. Fifth, it would have been preferable to have more measures covering the variables mentioned in the shared vulnerability model. Especially maintaining variables of importance, such as cognitive and behavioural avoidance and worry, could have given added validity to the results of this study. Future studies investigating the co-occurrence of social anxiety and chronic pain problems should include a focus on both shared vulnerability and maintaining factors.

Despite the limitations, the study adds important information and has several strengths. Using a cluster analysis made important subgroups visible and enabled us to highlight a clinically relevant and understudied subgroup with additional emotional problems and needs that are important to consider in clinical praxis. The prospective design with pre- and posttreatment measurements allowed us to follow this group over time and get important information on treatment results.

5. Conclusions

The results of this study show that patients high on both social anxiety and pain-related fear have more general emotional problems and higher scores on proposed vulnerability factors, highlighting the importance of emotional factors for the development and management of chronic pain. These patients are also more likely to have residual problems after pain rehabilitation treatment, possibly indicating a worse prognosis.

6. Implications

Patients high on both pain related fear and social anxiety need to be detected during screening and may benefit from a pain treatment that takes their emotional problems into account and focuses on their overall functioning. This may achieve better treatment results and prevent prolonged work disability and ill health.

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Conflict of interest

None.

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