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Thilo O. Kromer, Judith M. Sieben, Rob A. de Bie, Caroline H.G. Bastiaenen

Background. Little information exists about the role of fear-avoidance beliefs and catastrophizing in subacromial pain syndrome.

Objective. The purpose of this study was to investigate the associations among pain, catastrophizing, fear, and disability and the contribution of fear-avoidance beliefs to disability at baseline and at 3-month follow-up.

Design. A cross-sectional and longitudinal analysis was conducted.

Methods. Baseline demographic and clinical data, including fear-avoidance beliefs and catastrophizing, of 90 patients were assessed for this analysis. Disability was measured with the Shoulder Pain and Disability Index at baseline and at 3-month follow-up. First, bivariate and partial correlations were calculated among pain, fear-avoidance beliefs, catastrophizing, and disability, based on the fear-avoidance model. Second, the contribution of fear-avoidance beliefs to disability at baseline and at 3-month follow-up was examined with hierarchical regression analyses.

Results. Correlations between clinical variables and disability were largely in line with the fear-avoidance model. Regression analyses identified a significant contribution of fear-avoidance beliefs to baseline disability but not to disability at 3 months.

Limitations. Patients with subacromial pain syndrome were studied; therefore, the results should be transferred with caution to other diagnoses. A modified version of the Fear-Avoidance Beliefs Questionnaire was used, which was not validated for this patient group.

Conclusions. Fear-avoidance beliefs contribute significantly to baseline disability but not to disability change scores after 3-month follow-up. Duration of complaints and baseline disability were the main factors influencing disability change scores. Although the results help to improve understanding of the role of fear-avoidance beliefs, further studies are needed to fully understand the influence of psychological and clinical factors on the development of disability in patients with subacromial shoulder pain.

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With an incidence of 9.5 per 1,000 patients, shoulder complaints are among the most common musculoskeletal complaints presented to primary caregivers.[1] Many patients with shoulder complaints show clinical signs of subacromial pain syndrome (SPS),[1,2] which leads to pain and functional restrictions, especially with overhead activities, and often persists far beyond expected tissue recovery times.[3,4] In addition to biomechanical deficits in strength or coordination of the rotator cuff[5,6] and other shoulder girdle muscles,[7] stability,[8,9] and posture,[10] fear-avoidance beliefs and catastrophizing also appear to negatively influence functioning and recovery.[11,12]

Although well investigated in patients with low back pain (LBP), the role of fear-avoidance beliefs and catastrophizing in the development of chronic pain and disability in shoulder disorders and especially in SPS is still unclear. In LBP, the fear-avoidance model (FAM)[13] explains why acute LBP becomes chronic in a minority of patients and describes 2 possible pathways. In the adaptive pathway, labeled "confrontation," patients interpret pain as nonthreatening and are likely to maintain their activities of daily living (ADL) despite pain, which facilitates spontaneous recovery. In the maladaptive pathway, labeled "avoidance," pain is interpreted as a threat, initiating a vicious circle of catastrophizing, pain-related fear, hypervigilance, and avoidance behavior. Consecutively, the maladaptive pathway leads to chronic pain, disuse, increased pain sensitivity, psychological distress, and ongoing disability. The FAM is widely accepted in chronic LBP. However, a study by Sieben et al[14] investigating patients with acute or subacute LBP showed stronger correlations between pain and disability than between pain-related fear and disability. In a cohort of 174 patients with acute LBP, Sieben et al[15] found that pain intensity was a stronger predictor for chronic disability compared with fear-avoidance beliefs. This finding is supported by results of studies by van der Windt et al,[16] who could not identify fear-avoidance beliefs as a prognostic factor for a negative outcome in acute LBP, and by Gheldof et al[17] and Wideman and Sullivan,[18] who prospectively identified unique relationships between fear-avoidance beliefs and long-term work disability and between catastrophizing and long-term pain intensity. These contradictory results suggest different underlying mechanisms for patients with acute and chronic LBP.

The role of fear-avoidance beliefs also has been investigated in musculoskeletal disorders other than LBP. Hart et al[19] found similar results for fear-avoidance beliefs in acute stages of upper and lower extremity disorders, neck pain, and LBP, indicating that fear-avoidance beliefs are not specific to LBP but also are present in other musculoskeletal complaints. Other studies have shown a negative influence of fear-avoidance beliefs on recovery times in patients with musculoskeletal pain,[20] patients with neck pain,[21,22] patients who had undergone knee anterior cruciate ligament rehabilitation,[23] patients with knee osteoarthritis,[24] and patients with patellofemoral pain.[25]

Associations between clinical and psychological characteristics and disability also have been shown in patients with shoulder pain.[26,27] Clinical characteristics appear to have the strongest influence on disability in both subacute and chronic complaints,[16,28–31] but study results are contradictory, and no data exist specifically for patients with SPS.

The Bottom Line

What do we already know about this topic?

Fear-avoidance beliefs seem to negatively influence shoulder disability. However, there is scarce evidence about the influence of fear-avoidance beliefs on specific shoulder pathologies and there is little information about their impact on treatment outcome in patients with subacromial shoulder pain.

What new information does this study offer?

The study results show that fear-avoidance beliefs contributed to baseline disability levels but do not influence treatment outcome. Treatment outcome was influenced instead by duration of complaints and baseline disability levels.

If you're a patient, a family member, or a caregiver, what might these findings mean for you?

Patients with shoulder pain are advised to visit a health care provider soon to prevent a prolonged and cumbersome rehabilitation. The clinician might then be able to quickly initiate treatment and provide more individualized prognosis and patient education.

Because complaints in the shoulder region summarized under the term "shoulder pain" are diverse in their impact on functional ability of the patient, it is important to investigate the influence of psychological factors separately in each of the different diagnoses, with about 70% to 80% of patients with SPS representing the largest subgroup.[1] We hypothesize that fear-avoidance beliefs and catastrophizing are important contributors to disability in patients with SPS. Therefore, this study investigated the relationships between disability and pain, fear-avoidance beliefs, and catastrophizing at baseline and tested whether associations among these variables are in line with the FAM. It further analyzed to what degree fear-avoidance beliefs and catastrophizing contribute to the variance of disability at baseline and at 3-month follow-up in patients with SPS.

Method

Participants

Data were gathered from patients with SPS who gave their informed consent to participate in a randomized controlled trial investigating the effects of 2 different physical therapy interventions in this patient group in general practice. Inclusion criteria set for this trial were: (1) age between 18 and 75 years; (2) symptoms for at least 4 weeks; (3) main complaints in the glenohumeral joint region or the proximal segments of the arm; (4) presence of one of the following signs indicating SPS: Neer impingement sign, Hawkins-Kennedy impingement test, or painful arc with active abduction or flexion; and (5) pain during one of the following resistance tests: external rotation, internal rotation, abduction, or flexion.

Exclusion criteria were: (1) average 24-hour pain of 8/10 or more on a visual numeric rating scale (VNRS); (2) primary scapulothoracic dysfunction due to paresis; (3) diagnosed instability or previous history of dislocation; (4) frozen shoulder; (5) more than one-third restriction of elevation compared with the unaffected side; (6) substantial shoulder weakness or loss of active shoulder function; (7) shoulder surgery on the involved side in the previous 12 months; (8) reproduction of symptoms with active or passive cervical movements; (9) neurological involvement with sensory or muscular deficits; (10) inflammatory joint disease (eg, rheumatoid arthritis); (11) diabetes mellitus; (12) intake of psychotherapeutic drugs; (13) compensation claims; and (14) inability to understand written or spoken German.

Of 188 patients who were assessed for eligibility, 55 did not fulfill the eligibility criteria, and 33 refused participation. Ten patients were not included due to other reasons (3 moved, 4 did not get a prescription for physical therapy, and 3 could not fulfill the treatment schedule). Thus, 90 participants were included in the trial and randomly assigned to either an intervention group (n=46) or a control group (n=44). Participants of both groups had supervised stretching and strengthening exercises for the shoulder, shoulder girdle, and thoracic spine. In addition, the intervention group received examination-based manual mobilization techniques for the shoulder complex and the cervical spine, individualized education about the pathology, and instructions for the most provocative ADLs to reduce pain events during the day. Both groups had 10 treatment sessions within 5 weeks. Afterward, all participants continued their exercises at home for another 7 weeks. A detailed description of the inclusion process, applied treatments, and primary analyses are available in the published study protocol[32] and the published trial results.[33]

Measures

Baseline assessment comprised collection of demographic data, including age and sex, and clinical data, including the overall duration of shoulder complaints, the episodic character of complaints during the previous 12 months, sick leave, and sports hours per week. Functional status was measured at baseline and 3 months after the application of the physical therapy interventions.

Assessment of fear-avoidance beliefs. A validated questionnaire used to measure fear avoidance is the Fear-Avoidance Beliefs Questionnaire (FABQ), a 16-item questionnaire developed by Waddell et al.[34] The German version[35] shows good psychometric properties and, therefore, was used in this study. This questionnaire was initially designed in patients with LBP but recently also has been used to measure fear-avoidance beliefs in other musculoskeletal disorders. The FABQ comprises 2 subscales, one for physical activity (FABQ-PA) and one for work activities (FABQ-W). Because our focus was on shoulder function and not on work loss, we used only the FABQ-PA subscale in this study. All 4 items of this scale are scored on a 7-point Likert scale (0=strongly disagree, 6=strongly agree). The total FABQ-PA score is calculated by adding the scores of the single items, with higher scores reflecting a higher level of fear-avoidance beliefs. To adapt the FABQ-PA to our patient group, the word "back" was replaced by the word "shoulder." This modification was previously made in other studies investigating anatomic areas other than the low back.[26,36]

Assessment of catastrophizing. Catastrophizing was measured using the Pain Catastrophizing Scale (PCS), a multidimensional, reliable, and valid 13-item measurement tool with a strong association to pain

Table 1.
Demographic and Clinical Data (N=90)[a]

Measure	Median (IQR)	$\bar{X}$ (SD)
Sex (female), % (n)	51.1 (46)	
Age (y)	51.0 (18.3)	51.8 (11.2)
Duration of complaints (wk)	38 (114)	104.8 (152.6)
Pain score (VNRS)	5 (2)	5.1 (1.8)
SPADI total score	37.6 (24.4)	40.4 (17.0)
SPADI pain subscale score	45 (26)	48.7 (18.0)
SPADI-F score at baseline	28.9 (30.1)	32.2 (18.9)
SPADI-F change score at 3 mo[b]	17.3 (25.1)	18.8 (18.5)
FABQ physical activity subscale score	16 (7)	14.6 (4.9)
FABQ work subscale score	12 (20)	12.1 (9.9)
PCS total score	9 (11)	11.4 (8.5)
Sports (hours per week), % (n)		
0–2	37.8 (34)	
3–5	62.2 (56)	
Days of sick leave		0.5 (2.7)

[a] IQR=interquartile range, SPADI=Shoulder Pain and Disability Index, SPADI-F=Shoulder Pain and Disability Index function subscale, VNRS=visual numeric rating scale, FABQ=Fear-Avoidance Beliefs Questionnaire, PCS=Pain Catastrophizing Scale.
[b] n=88.

and disability.[37–40] The PCS has been validated for the German population.[41] For this study, the total score was calculated by adding the ratings for each item, with higher scores representing higher levels of catastrophizing.

Assessment of pain. Average weekly pain intensity was assessed using an 11-point VNRS, a recommended core outcome measure in the assessment of pain.[42] Zero points on the left end of the scale was defined as "no pain at all," and 10 points on the right end of the scale was defined as "as much pain as I can imagine (worst pain I can imagine)."

Assessment of disability. The Shoulder Pain and Disability Index (SPADI) is a shoulder-specific, self-report questionnaire measuring pain and disability in patients with shoulder pain of musculoskeletal origin.[43] It contains 5 items assessing pain and 8 items assessing shoulder function. Each item is scored on a 100-mm visual analog scale, with the right end defined as "worst pain imaginable/so difficult required help" and the left end defined as "no pain/no difficulty." The SPADI has been validated for use in the German population[44] and has been shown to be valid and highly responsive in assessing shoulder pain and function.[43,45] In this study, only the SPADI subscale for function (SPADI-F) was used to obtain a pure score for disabled function and to prevent an overlap between the 2 concepts of pain measured with the VNRS and the SPADI total score, as the latter includes the pain subscale, which was highly correlated with the SPADI-F (r=.7). The SPADI-F score ranges from 0 to 100, with higher scores reflecting higher disability levels. Participants were measured at baseline and after 3 months. A change score was created by subtracting the 3-month follow-up scores from the baseline scores.

Data Analysis

Participant characteristics. Descriptive statistics were generated for the total group, and data were analyzed for distribution. Normality of data was tested with the Kolmogorov-Smirnov test. Possible differences in baseline characteristics between participants with subacute pain (≥4 weeks and ≤3 months) and those with chronic pain (>3 months) were assessed, as most of the measurements taken can be influenced by symptom duration as a possible confounder.

First aim: associations among FAM variables at baseline. Bivariate correlations (Pearson r for normally distributed data, Spearman rho for non-normally distributed data) were calculated between baseline data for disability and pain, fear-avoidance beliefs, and catastrophizing. In a second step, partial correlations were calculated, with every correlation between 2 of the variables being adjusted for a third variable to examine its mediating effect.

Second aim: contribution of fear-avoidance beliefs and catastrophizing to disability at baseline and at 3-month follow-up. In order to determine the contribution of fear-avoidance beliefs and catastrophizing to the variance of disability, 2 separate hierarchical linear regressions were performed using the SPADI-F baseline score and the SPADI-F change score after 3 months as the dependent variables. Demographic and clinical factors that could be associated with disability scores were identified from the literature and used as possible independent variables for multivariable regression analyses. Furthermore, variable selection was preceded by checking for multicollinearity by calculating correlation coefficients among the independent variables. In case of correlated variables (r≥.5), the most easily obtainable variable in

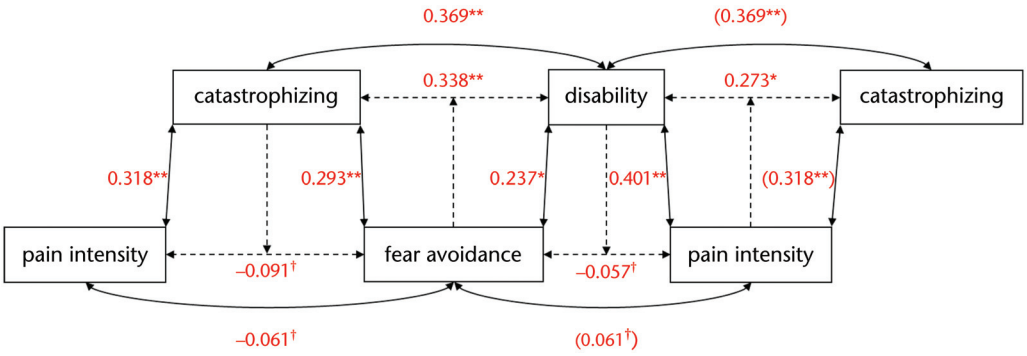

Figure.
Baseline associations and mediation among pain, fear-avoidance beliefs, catastrophizing, and disability. Solid arrows represent Spearman rho; dashed arrows represent partial correlations. *$P<.05$, **$P<.01$ (.001), †nonsignificant.

clinical practice was chosen for further analysis.

In each model, sex and age were included in a first step to control for these potentially influencing factors; they were then kept in the model throughout the following analyses even if insignificant. In a second step, clinical baseline variables, and in a third step, psychological baseline variables, were entered into the model to assess their contribution to the model's variance. In each step, variables with the lowest predictive value were removed sequentially until all remaining predictors were significantly associated with the dependent variable or until R^2 was reduced significantly by removing the next variable from the model (stepwise backward strategy). All statistical tests were 2-sided, and statistical significance was determined with an alpha level of .05 unless reported otherwise. Regression coefficients and beta coefficients were calculated for all variables in each of the final models.

Assuming that 15 participants are needed to include one independent variable,[46] we can include a maximum of 6 variables in the final model with sufficient statistical power. Data analysis was performed using IBM SPSS version 19.0 (IBM Corp, Armonk, New York).

Results

Complete baseline data were available for all patients included in the study (N=90), and follow-up data for the SPADI-F at 3 months were available for 88 patients. Demographic and clinical data are displayed in Table 1. At baseline, 17 participants (15.3%) had symptoms for 3 months or less ($\overline{X}$=9.9, SD=2.6) and 73 participants (84.7%) had symptoms for more than 3 months ($\overline{X}$=126.9, SD=161.8). However, no significant difference could be found between these groups regarding age, sex, baseline scores for disability, pain, fear-avoidance beliefs, or catastrophizing. Except for all SPADI scores and age, data were non-normally distributed and skewed to the lower end of the scales, as expected because of the defined eligibility criteria set up for this trial. Median scores and interquartile ranges (IQRs) for the psychological measures were relatively low, even in the chronic patient group (FABQ-PA: median=16, IQR=7; PCS: median=9, IQR=12).

In the model based on the FAM, disability showed significant correlations with pain, catastrophizing, and fear-avoidance beliefs. Correlations between pain and catastrophizing and between catastrophizing and fear-avoidance beliefs were significant and, therefore, in line with the FAM. However, partial correlations, calculated by adjusting the bivariate correlation between 2 variables for a third variable (dashed arrows in the Figure), indicated that pain and catastrophizing are independently associated with disability and that their association is not significantly mediated by a third variable.

For assessing the influence of psychological factors on baseline disability and on 3-month disability change scores in a hierarchical regression model, we identified 6

Table 2.
Contentwise Structured Blocks for Regression Analysis[a]

Step 1	Step 2	Step 3
Demographic Factors	**Clinical Factors**	**Psychological Factors**
Age Sex	Duration of complaints Pain intensity SPADI-F score at baseline	PCS score FABQ-PA score

[a] SPADI-F=Shoulder Pain and Disability Index function subscale, PCS=Pain Catastrophizing Scale, FABQ-F=Fear-Avoidance Beliefs Questionnaire physical activity subscale.

Table 3.
Steps of the Hierarchical Regression Analysis[a]

Step	Variables in Model	Variables Removed	R^2	R^2 Adjusted	R^2 Change	*F* Change	Significant *F* Change	Beta	Beta Significance	Beta 95% CI	VIF
1	Block 1:		.149	.130	.149	7.64	.001				
	Age							0.184	.076	−0.03, 0.65	1.07
	Sex							0.391	.001	7.03, 22.29	1.07
2	Blocks 1 and 2:		.281	.247	.131	7.76	.001				
	Age							0.101	.310	−0.16, 0.50	1.15
	Sex							0.324	.001	4.96, 19.38	1.11
	Duration of complaints							0.004	.970	−0.02, 0.02	1.08
	Pain at baseline							0.373	.001	1.93, 6.02	1.11
3		Duration of complaints									
4	Blocks 1 and 2:		.281	.256	.131	15.69	.001				
	Age							0.101	.299	−0.15, 0.49	1.12
	Sex							0.324	.001	4.99, 19.33	1.11
	Pain at baseline							0.374	.001	1.98, 5.98	1.06
5	Blocks 1, 2, and 3:		.370	.333	.090	5.98	.004				
	Age							0.230	.026	0.05, 0.72	1.37
	Sex							0.322	.001	4.94, 19.23	1.24
	Pain at baseline							0.296	.003	1.01, 5.21	1.26
	FABQ-PA score							0.287	.006	0.32, 1.89	1.40
	PCS score							0.090	.403	−0.27, 0.67	1.52

[a] Dependent variable: Shoulder Pain and Disability Index functional subscale (SPADI-F) score at baseline. 95% CI=95% confidence interval, VIF=variance inflation factor, FABQ-PA=Fear-Avoidance Beliefs Questionnaire physical activity subscale, PCS=Pain Catastrophizing Scale.

independent variables for analysis: (1) duration of complaints at baseline, (2) pain intensity, (3) disability,[11,16,28,30,31,47–51] (4) age,[52,53] (5) sex,[54] and (6) pain-related fear and catastrophizing.[11,12,28,51] These variables were categorized for analysis as shown in Table 2. Of these variables, sex, FABQ-PA, PCS, duration of complaints, baseline disability, and pain intensity were significantly correlated with either baseline disability or disability change scores after 3 months and were included in the analysis.

Regression Model 1 With Baseline Disability (SPADI-F Score at Baseline) as the Dependent Variable

As shown in Table 2, categories of independent variables were entered stepwise into the model, and variables with the lowest predictive value were then sequentially removed, as described in the "Method" section. Age and sex entered in step 1 explained 14.9% of the variance in SPADI-F scores. At the end of step 2, the total variance explained by the model as a whole (including age, sex, and pain intensity) was 28.1%. The total variance explained by the model as a whole at the end of step 3 (including age, sex, pain intensity, FABQ-PA scores, and PCS scores) was 37%. Pain intensity explained an additional 13.1% and the psychological variables an additional 9% of the variance in SPADI-F scores. Pain and SPADI-F scores had similar beta values. These results and the modeling process are displayed in Table 3.

Regression Model 2 With Disability at 3 Months (SPADI-F Change Score) as the Dependent Variable

The same statistical analysis was done as in model 1, except that the SPADI-F baseline score was added to the independent clinical factors. Age and sex entered in step 1 explained 10.3% of the variance in SPADI-F change scores. At the end of step 2, the total variance explained by the model as a whole (including age, sex, duration of complaints, and SPADI-F baseline score) was 46.8%. The total variance explained by the model as a whole at the end of step 3 (including age, sex, duration of complaints, SPADI-F baseline score, PCS score, and FABQ-PA score) was 47.7%. From these variables, only the SPADI-F baseline score (β=0.600,

Table 4.
Steps of the Hierarchical Regression Analysis[a]

Step	Variables in Model	Variables Removed	R^2	R^2 Adjusted	R^2 Change	*F* Change	Significant *F* Change	Beta	Beta Significance	Beta 95% CI	VIF
1	Block 1:		.103	.081	.103	4.86	.010				
	Age							0.087	.420	−0.21, 0.49	1.08
	Sex							0.333	.002	−4.43, 20.03	1.08
2	Blocks 1 and 2:		.473	.441	.371	19.23	.001				
	Age							0.036	.676	−0.22, 0.34	1.18
	Sex							0.114	.209	−2.39, 10.73	1.25
	Duration of complaints							−0.333	.000	−0.06, −0.02	1.09
	Pain at baseline							0.082	.375	−1.05, 2.76	1.32
	SPADI-F score at baseline							0.554	.001	0.36, 0.73	1.40
3		Pain									
4	Blocks 1 and 2:		.468	.442	.366	28.52	.001				
	Age							−0.044	.604	−0.21, 0.35	1.16
	Sex							−0.114	.205	−2.34, 10.75	1.25
	Duration of complaints							−0.320	.001	−0.06, −0.02	1.05
	SPADI-F score at baseline							0.588	.001	0.41, 0.75	1.18
5	Blocks 1, 2, and 3:		.477	.439	.009	0.72	.491				
	Age							0.000	.999	−0.32, 0.32	1.48
	Sex							0.081	.396	−3.94, 9.86	1.38
	Duration of complaints							−0.324	.001	−0.06, −0.02	1.07
	SPADI-F score at baseline							0.600	.001	0.40, 0.78	1.45
	FABQ-PA score							−0.102	.305	−1.14, −0.36	1.51
	PCS score							0.083	.381	−0.23, 0.59	1.40

[a] Dependent variable: Shoulder Pain and Disability Index functional subscale (SPADI-F) change score after 3 months. 95% CI=95% confidence interval, VIF=variance inflation factor, FABQ-PA=Fear-Avoidance Beliefs Questionnaire physical activity subscale, PCS=Pain Catastrophizing Scale.

P=.001) and duration of complaints (β=−0.324, P=.001) contributed significantly to the model's variance. These results and the modeling process are displayed in Table 4.

Discussion

Our first aim was to cross-sectionally analyze associations between disability and pain, fear-avoidance beliefs, and catastrophizing. Disability was strongly associated with pain and with catastrophizing. Neither of the associations lost significance when corrected for a third variable, indicating that there were no mediating effects. Only the association between catastrophizing and disability lost significance moderately when corrected for pain, but it remained significant. Findings of this first analysis are, to a large extent, in line with the original FAM, as there were significant associations between the included variables and disability. Differences with the FAM are the strong and direct association between pain and disability and the lack of mediating effects. Similar to findings in patients with acute LBP,[14] the apparent strong association between pain and disability found in this analysis indicates that, in our sample (including patients with chronic complaints), pain intensity was more important as a direct cause for disability than initially suggested by Vlaeyen and Linton,[13] based on data collected in patients with chronic LBP.

The lack of mediating effects indicates that variables in the model are independently associated instead of following a consecutive order as described in the FAM. However, they still appear to be related. Perhaps "consecutive order effects," showing as mediation, can only be found in patients who go through the fear-avoidance cycle for the first few times. In our cross-sectional analysis, the range of durations of complaints was quite broad (Tab. 1). A few patients had complaints for only a few weeks going through the fear-avoidance cycle for the first time;

others had a much longer history of shoulder complaints and were thus more experienced. However, even a longitudinal approach may not solve this issue. In more experienced patients, it can be assumed that all factors are measurable at the same time. Our sample consisted of patients of whom we can presume the latter to be the case.

Our second aim was to analyze the contribution of psychological variables to the variance of disability at baseline and to the disability change score at 3 months after controlling for other relevant demographic and clinical factors. Similar to the associations tested before, the final model for baseline disability confirmed the significant contribution of baseline pain intensity and fear-avoidance beliefs to the model, with pain intensity still being a stronger contributor explaining disability than fear-avoidance beliefs. Catastrophizing no longer contributed to the model after correcting for demographic and clinical variables in steps 1 and 2, which could have been due to overlapping constructs of catastrophizing and fear-avoidance beliefs. Parr et al[55] found similar results after inducing muscle injury to the shoulder in a healthy sample, with pain as the most important factor predicting disability, followed by kinesiophobia. The important contribution of pain to baseline disability may indicate that pain is dominantly of nociceptive origin at that stage, even in patients with longer durations of symptoms still functioning as a warning sign in order to protect injured body structures.

However, the regression model for the disability change score after 3 months clearly identified duration of complaints and baseline disability as the only significant variables. The positive beta value for the SPADI-F at baseline indicates that higher baseline disability levels are associated with higher change scores at 3 months; the negative beta value for duration of complaints indicates that a longer duration and thus a more chronic presentation are associated with lower change scores at 3 months. Similar results were found in a systematic review by Chester et al,[56] who identified these 2 factors as the only prognostic factors consistently associated with outcome. The insignificant contribution of the psychological variables was surprising and contradictory to our baseline analysis. Participants who stayed the same or even deteriorated in their SPADI-PA scores after 3 months (n=12) had similar FABQ-PA scores at baseline compared with the rest of the group ($\overline{X}$=13.2, SD=5.2, versus $\overline{X}$=14.7, SD=4.8; P=.32). These findings also may explain why interventions focusing on psychological factors did not result in improved outcomes compared with usual care in a study by De Bruijn et al.[51] To explain these results, it may be hypothesized that patients experience SPS as less threatening than, for example, back pain. In contrast to back pain, SPS is located more in the periphery of the body than in its center, leading to different body sensations and consequently to different thoughts and emotions.

Furthermore, patients with SPS can possibly compensate for some of the provocative movements with the healthy side and thus selectively control or avoid painful movements to a certain degree as an adaptive strategy. This strategy may have led to a shoulder-specific disability on the affected side (a temporary and partial limitation of function) but, on the other hand, enabled them to stay at work and to continue other activities. This strategy can further explain the relatively low ratings on the FABQ-PA and the PCS and the small number of sick days in this sample. The insignificant influence of fear-avoidance beliefs is in line with results from Sindhu et al,[57] who could identify an influence of elevated baseline fear levels on disability change scores in only 2 out of 8 diagnostic subgroups of shoulder complaints. The significant contribution of fear-avoidance beliefs (and the insignificant contribution of catastrophizing) to baseline disability became clear only when correcting for other factors included in our analysis. However, fear-avoidance beliefs had no influence on disability change scores at 3 months. Based on these results, we clearly can question the importance of fear-avoidance beliefs at baseline as prognostic factors for outcome in this patient group. Looking at it the other way round, we also can question the benefit of interventions specifically targeting these psychological components for patients with SPS. The applied physical therapy interventions in the original trial focused mainly on physical aspects and did not specifically address fear-avoidance beliefs or catastrophizing or informed patients about these factors.

Implications for Further Research

To obtain further insight and to support or refute the results from this study, fear-avoidance beliefs should be standardly assessed, as they were significantly associated with baseline disability, and their development over time and their influence on treatment outcome should be investigated in future SPS studies. Other psychological factors also may play a role in prognosis and need to be considered in further analyses, although some of them are still unknown. However, reflection is necessary regarding how to address important clinical factors such as duration of complaints and baseline disability scores when planning an intervention to improve prognosis.

Methodological Considerations

This study had several limitations that need to be considered when interpreting the results. We investigated patients with SPS, a diagnostic subgroup of shoulder disorders. The results, therefore, should be transferred with caution to other shoulder diagnoses or clinical populations. We further used a modified version of the FABQ-PA, which was not validated for this patient group.

Because we investigated the influence of baseline data on disability and did not measure fear-avoidance beliefs and catastrophizing at 3 months, it was not possible for us to analyze the development of fear-avoidance beliefs and catastrophizing over time and their scores after 3 months. However, we had a good sample size and a homogeneous sample due to clearly defined and reproducible eligibility criteria. We used a validated shoulder-specific outcome measure (SPADI-F) and conducted a sound statistical analysis including clinical and psychological factors often mentioned in literature. Thus, the results of this study help to better understand the contribution of these factors to pain and disability in patients with SPS.

In conclusion, this study analyzed the role of fear-avoidance beliefs and catastrophizing in patients with SPS at baseline and after 3 months. Our results suggest that the different constructs included in the FAM appear to affect the patient coincidently and not necessarily in a clear consecutive order. In patients with SPS, fear-avoidance beliefs measured at baseline appear to be significantly associated with baseline disability but not with disability change scores after 3 months. Therefore, the prognostic value of this factor must be questioned. Further studies are needed to improve the understanding of the contribution of fear-avoidance beliefs to treatment success, to the development of chronic pain states, and to long-term disability in patients with SPS, in addition to prognostically important factors such as duration of complaints or baseline disability levels.

All authors provided concept/idea/research design. Dr Kromer and Dr Bastiaenen provided writing, data collection and analysis, and project management. Dr Sieben, Dr de Bie, and Dr Bastiaenen provided consultation (including review of the manuscript before submission).

Ethical approval was granted by the Ethics Committee of the Ludwig Maximilian University, Munich, Germany (Project No. 018-10).

The trial is registered at Current Controlled Trials (ISRCTN86900354).

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