Research Report

Influence of Fear-Avoidance Beliefs on Functional Status Outcomes for People With Musculoskeletal Conditions of the Shoulder

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Background. The influence of elevated fear-avoidance beliefs on change in functional status is unclear.

Objective. The purpose of this study was to determine the influence of fear-avoidance on recovery of functional status during rehabilitation for people with shoulder impairments.

Design. A retrospective longitudinal cohort study was conducted.

Methods. Data were collected from 3,362 people with musculoskeletal conditions of the shoulder receiving rehabilitation. At intake and discharge, upper-extremity function was measured using the shoulder Computerized Adaptive Test. Pain intensity was measured using an 11-point numerical rating scale. Completion rate at discharge was 57% for function and 47% for pain intensity. A single-item screen was used to classify patients into groups with low versus elevated fear-avoidance beliefs at intake. A general linear model (GLM) was used to describe how change in function is affected by fear avoidance in 8 disease categories. This study also accounted for within-clinic correlation and controlled for other important predictors of functional change in functional status, including various demographic and health-related variables. The parameters of the GLM and their standard errors were estimated with the weighted generalized estimating equations method.

Results. Functional change was predicted by the interaction between fear and disease categories. On further examination of 8 disease categories using GLM adjusted for other confounders, improvement in function was greater for the low fear group than for the elevated fear group among people with muscle, tendon, and soft tissue disorders (Δ=1.37, P<.01) and those with osteopathies, chondropathies, and acquired musculoskeletal deformities (Δ=5.52, P<.02). These differences were below the minimal detectable change.

Limitations. Information was not available on whether therapists used information on level of fear to implement treatment plans.

Conclusions. The influence of fear-avoidance beliefs on change in functional status varies among specific shoulder impairments.

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Every year, 4 million people receive medical care for musculoskeletal conditions of the shoulder,[1,2] resulting in direct health care costs of an estimated 7 billion dollars.[3] Pain is the most common symptom associated with these conditions.[1,2] Many times, shoulder pain is associated with repetitive motions at work or during participation in athletics.[4–7] Among people with musculoskeletal conditions, fear-avoidance beliefs related to pain are prevalent and have been associated with greater disability and functional limitations.[8,9] Among individuals with fewer fear-avoidance beliefs, fear usually dissipates as the condition resolves. However, elevated fear-avoidance beliefs can be maladaptive, leading to chronic pain, disability, and reduced function.[10–15] Chronic pain and disability result from elevated fear, as described by the fear-avoidance model (FAM).[10,14,16,17] According to this model, some individuals consider a painful stimulus as negative, and avoid or postpone the presentation of an event that is considered painful.[18] Also, these individuals are hypervigilant toward painful stimuli, paying less attention to other tasks. Over a long period of time, hypervigilance and avoidance of physical activity lead to deconditioning of the musculoskeletal and cardiovascular systems, which, in turn, results in the development of chronic pain and disability.[10]

Conflicting evidence exists regarding the influence of fear-avoidance beliefs on treatment outcomes. Study findings range from poor to improved treatment outcomes among people with elevated fear. In support of the FAM, an increasing number of studies are reporting that elevated fear-avoidance beliefs adversely affect outcomes of treatment. For example, studies indicate that outcomes of lumbar surgery are poorer when patients report elevated levels of fear before surgery,[19] as well as after surgery.[20] Rehabilitation outcomes also are worse when fear is elevated at intake in people with low back pain.[21,22] In contrast to these findings and clinical intuition, some studies have shown no effect of elevated fear on treatment outcomes. For example, Pincus et al[24] conducted a systematic review examining the effect of fear-avoidance beliefs on treatment outcomes among people with low back pain. Based on findings from 9 studies, these researchers concluded that little evidence exists to link fear-avoidance beliefs with poor treatment outcomes.[23] Furthermore, other studies have shown greater improvement among people with elevated fear. For instance, elevated fear due to shoulder pain at intake was associated with a larger reduction in pain at 3-month and 12-month follow-ups, as well as a greater reduction in functional disability at a 3-month follow-up, in a general practice setting.[24] Likewise, elevated fear was associated with better physical therapy outcomes among people with upper-extremity musculoskeletal conditions[25] and people with low back pain.[26] In these studies, the associations between fear and treatment outcomes were mediated by the relationship among pain, disability, and fear. In other words, people with elevated fear reported more pain and disability despite having a greater change in function.

Additional research into the phenomenon of elevated fear associated with reduced pain and greater func-

The Bottom Line

What do we already know about this topic?

Fear-avoidance beliefs related to pain are prevalent among people with musculoskeletal conditions, and these beliefs have been associated with greater disability and functional limitations. However, it is not known how pain-related fear-avoidance beliefs affect the outcome of rehabilitation in people with shoulder impairments.

What new information does this study offer?

Elevated fear-avoidance beliefs were associated with poorer improvement in functional status from intake to discharge among people in the following 2 shoulder disease categories: (1) muscle, tendon, and soft-tissue disorders, and (2) osteopathies, chondropathies, and acquired musculoskeletal deformities.

If you're a patient, what might these findings mean for you?

The data from this study suggests that if you have a condition in 1 of the 2 disease categories above, your physical therapist may be able to improve your treatment outcomes by assessing for the presence of fear-avoidance beliefs and helping you manage those beliefs.

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tional gains requires a more detailed analysis of the association between fear and function. Conflicting findings regarding effects of fear-avoidance beliefs on treatment outcomes might be because studies have accounted for different confounding variables in their analysis. For instance, den Boer et al[19] found that preoperative levels of fear resulted in poorer outcomes of surgery after controlling for preoperative disability and pain intensity, age, sex, educational level, duration of complaints, neurological deficits, and intake of analgesics. In contrast, George and Stryker[25] found a greater improvement in function among people with elevated fear after accounting for differences in anatomical region and controlling for effect of differences in clinics. Consequently, there is a need to systematically examine how the effect of fear changes from before to after accounting for various confounding variables.

In addition, there is a need to determine the association between fear and function in specific disease categories. Previous studies have not only grouped different shoulder conditions together, but also have grouped shoulder conditions with neck and upper arm conditions.[25,28] Moreover, it is uncertain how fear influences different regions of the body. For example, George and Stryker[25] reported that fear-avoidance beliefs similarly affect 4 different anatomical regions of the body: cervical spine, lumbar spine, upper extremity, and lower extremity. In contrast, Feleus et al[27] reported that fear of movement occurred more with shoulder impairment than neck or arm injury. This study's findings, coupled with the large incidence of painful musculoskeletal disorders of the shoulder, indicate that varying responses to pain and levels of fear of pain in different shoulder conditions might be an important focus for future research.

The purposes of the current study were: (1) to determine the effect of fear-related cognitions on functional recovery with and without accounting for various confounding variables and (2) to determine the influence of fear-related cognitions on recovery of functional status during rehabilitation across different diagnostic categories of shoulder impairments. This study builds on previous work in that it accounts for differences between 8 disease categories—(1) arthropathies; (2) muscle, tendon, and soft tissue disorders; (3) osteopathies, chondropathies, and acquired musculoskeletal deformities; (4) fractures; (5) sprains and strains, (6) postsurgical, (7) "other," and (8) condition not reported—and other factors associated with change in function. We hypothesized that patients' fear-avoidance beliefs at intake would be predictive of the changes in function after accounting for other factors associated with functional status outcomes.

Method

Setting and Participants

We conducted a secondary analysis of data prospectively collected from people with musculoskeletal conditions of the shoulder who attended outpatient rehabilitation clinics throughout the United States. The data were collected using the Patient Inquiry system, a patient evaluation tool provided to clinics by Focus On Therapeutic Outcomes (FOTO), Inc (Knoxville, Tennessee).[28–30] FOTO is a medical rehabilitation database management company that partners with clinics to provide outcome measures and data management services. The FOTO outcomes database includes standardized assessments of function, along with instruments that collect information on demographic characteristics, patient history, physical functioning, pain, psychosocial constructs such as fear avoidance, and characteristics of health care providers and organizations.[31–33] For the present study, the FOTO database was reduced to include 3,362 patients who received outpatient rehabilitation for shoulder conditions between 2008 and 2010 in 35 different clinics. We selected the time frame of 2008 to 2010, as we sought to determine the association between fear avoidance and recovery of shoulder functional status in the context of currently used rehabilitation strategies. Patient data were not included from clinics contributing fewer than 20 patients to the FOTO database. We assumed that smaller clinics might not have an established protocol for patients with specific conditions of the shoulder. Therefore, we excluded smaller clinics to reduce the heterogeneity attributed by their data (Appendix).

People seeking rehabilitation for shoulder impairments provided demographic information (eg, age, sex, exercise history) before their initial clinical evaluation. During clinical evaluation at admission (intake) and at the end of rehabilitation (discharge), patients' upper-extremity functional status and pain intensity were assessed. Additionally, fear-avoidance beliefs were evaluated at intake. Clinical staff entered necessary medical information at intake, such as diagnosis codes based on the *International Classification of Diseases, Ninth Revision* (ICD-9).[34] The ICD-9 codes have been found to have variable interrater reliability (55%–98% agreement) and poor to moderate validity, with 40% to 74% agreement between coders and the gold standard.[35–37] Moreover, ICD-9 codes lack sufficient specificity values (0.30–0.81), even though they have high sensitivity values (0.81).[36]

Assessments

The shoulder Computerized Adaptive Test (CAT) was used to measure upper-extremity function at 2 time points: intake and discharge. The shoulder CAT estimates reliable, valid, sensitive, and responsive measures of functional status for individuals with shoulder impairments.[28,38–40] Specifically, the shoulder CAT is a self-report assessment of a person's ability to perform daily tasks using the affected arm.[41] It consists of a 37-item bank administered using a computer algorithm.[28,39] The computer algorithm selects items at the functional level of a person; thus, patients complete only those items that provide the greatest amount of information about their functional status.[42] Each item is rated on a 5-point scale ranging from 1 ("I can't do this") to 5 ("no difficulty"). The final functional status score represents a point estimate of functional status of a person on a linear 0 to 100 scale, with higher scores indicating higher functioning. Clinically meaningful change for shoulder CAT is 23 or more points for an intake score of 0 to 43, 10 or more points for an intake score of 44 to 52, 5 or more points for and intake score of 53 to 60, and 2 or more points for an intake score of 61 to 100.[40]

A numerical rating scale (NRS) was used for reporting shoulder pain intensity at intake and discharge. The NRS is a commonly used measure of pain intensity.[43] The NRS has well-established psychometric properties; it is valid[43–46] and sensitive to changes in pain intensity.[47–49] The NRS used by FOTO consists of an 11-point scale, with its anchors being 0 (no pain) and 10 (worst possible pain). A reduction of 1 point on the NRS is considered as a minimal clinically important improvement (MCII) in pain intensity.[50] Clinic staff asked patients to rate their current pain intensity by indicating a number from a list of integers displayed horizontally in ascending order.

A single-item screening method was used to classify patients into groups with low versus elevated fear-avoidance beliefs at intake. This screening item was selected from the Fear-Avoidance Beliefs Questionnaire physical activities scale (FABQ-PA), which consists of 16 items describing the association between pain and physical activities.[51] A single item—"I should not do physical activities that (might) make my pain worse"—was identified using item response theory (IRT) methods and receiver operating characteristic analyses. This item was found to be effective in distinguishing between elevated fear and low fear. That is, this item has a sensitivity value of 0.82, a specificity value of 0.98, and an area under the receiver operating characteristic curve of 0.94.[51] The item was scored on a 5-point scale ranging from 0 to 4, where 0 means "completely disagree," 2 means "unsure," and 4 means "completely agree." Responses of 2 to 4 were classified as *elevated fear*, and responses of 0 and 1 were classified as *low fear*.[51]

Data Analysis

We divided our sample into 2 groups based on level of fear-avoidance beliefs at intake (ie, low versus elevated fear) using the IRT-based single item. In addition, the patients were divided into 3 groups based on duration of condition (acute=less than 22 days, subacute=22–90 days, and chronic=greater than 90 days),[52] into 3 groups based on age (18–44 years, 45–64 years, and 65 years and older),[53] and into 8 disease categories based on their ICD-9 codes (Tab. 1). Change in functional status was calculated by subtracting the shoulder CAT score at intake from the shoulder CAT score at discharge (shoulder CAT at discharge − shoulder CAT at intake). Thus, a positive functional status change score indicated an improvement in function from intake to discharge. Differences in mean functional status change scores between the 2 fear-avoidance belief groups were calculated by subtracting the change score for the elevated fear group from the change score for the low fear group. A negative difference in means indicated greater functional improvement in the elevated fear group, and a positive difference in means indicated greater functional improvement in the low fear group. Likewise, change scores for pain intensity were calculated by subtracting pain intensity at intake from pain intensity at discharge, with a positive change score indicating an increase in pain (pain intensity at discharge − pain intensity at intake).

All individuals included in our sample (N=3,362) reported their functional status and pain scores at intake. At discharge, however, only 1,946 people reported functional status, 1,538 reported pain intensity, and 1,519 reported both functional status and pain intensity. A logistic regression analysis was used to determine whether a relationship existed between the incompletion rate (ie, not having a functional status or pain intensity score at discharge) and demographic characteristics measured at intake. This logistic regression allowed us to estimate dropout probabilities and calculate weights[54,55] to account for any imbalances in demographic characteristics between those who had only intake data and those who had both intake and discharge data. This procedure was designed to reduce the effect of missing data by providing weighted demographics of the population at discharge that had similar demographic characteristics as the unweighted intake data.

Using inverse probability weights generated from the logistic regression model, we estimated the parameters of a general linear model (GLM) and their standard errors with the weighted generalized estimating equations.[56] This model determined how change in function is affected by fear-avoidance beliefs, as well as by interactions of fear with other demographic variables (age groups,

Table 1.

Demographic and Health-Related Characteristics of Patients With Shoulder Impairments Who Had Low Versus Elevated Fear-Avoidance Beliefs[a]

Characteristics[b]	Elevated Fear-Avoidance Beliefs (n=766)		Low Fear-Avoidance Beliefs (n=2,596)		All (N=3,362)	
	$\bar{X}$ or n	SD or %	$\bar{X}$ or n	SD or %	$\bar{X}$ or n	SD or %
Age (y)	54.2	16.4	54	15.6	54.1	15.8
Sex						
Male	342	44.6	1,192	45.9	1,534	45.6
Female	424	55.4	1,404	54.1	1,828	54.4
Region of clinic						
Middle Atlantic	192	25.1	501	19.3	693	20.6
Mountain	126	16.4	507	19.5	633	18.8
North Central	355	46.3	1,282	49.4	1,637	48.7
Pacific	10	1.3	26	1.0	36	1.1
South Atlantic	22	2.9	77	3.0	99	2.9
South Central	61	8.0	203	7.8	264	7.9
Duration of condition						
Acute (0–21 days)	180	23.5	467	18.0	647	19.2
Subacute (22–90 days)	239	31.2	836	32.2	1,075	32.0
Chronic (≥91 days)	347	45.3	1,293	49.8	1,640	48.8
Disease categories						
Arthropathies (ICD-9 codes 714.41–719.81)	63	8.2	273	10.5	336	10.0
Muscle, tendon, and soft tissue disorders (ICD-9 codes 726–729.5)	412	53.8	1,485	57.2	1,897	56.4
Osteopathies, chondropathies and acquired musculoskeletal deformities (ICD-9 code 731.1)	3	0.4	30	1.2	33	1.0
Fractures (ICD-9 codes 810.03–812.2)	12	1.6	37	1.4	49	1.5
Sprains and strains (ICD-9 codes 840.0–840.972)	66	8.6	175	6.7	241	7.2
Postsurgical (CPT codes 23000–23929)	117	15.3	268	10.3	385	11.5
Other musculoskeletal conditions (ICD-9 codes 353, 714.41–719.81, 831–831.11, 923, 953.4)[c]	79	10.3	263	10.1	342	10.2
Not reported	14	1.8	65	2.5	79	2.3
Functional status score on shoulder Computerized Adaptive Test						
Intake (0–100)	46.4	15.3	51.7	13.9	50.5	14.4
Discharge (0–100)	66.9	15.5	69.1	14.5	68.6	14.8
Change (discharge − intake)	20.9	19.0	17.6	16.8	18.3	17.4
Pain intensity score on numerical rating scale						
Intake (0–10)	5.8	2.4	5.3	2.4	5.4	2.4
Discharge (0–10)	3.2	2.5	2.8	2.2	2.9	2.3
Change (discharge − intake)	−2.4	2.9	−2.5	2.7	−2.5	2.7

[a] ICD-9=*International Classification of Diseases, Ninth Edition*; CPT=Current Procedural Terminology.
[b] Significance for differences between low versus elevated fear groups for various characteristics has not been calculated, as such significance will not be adjusted for random effects (clinics) and missing data and any reference to it will be misleading.
[c] The category of "Other musculoskeletal conditions" was created by combining dislocations (n=22, ICD-9 code 831), contusions (n=7, ICD-9 code 923), peripheral nerve disorders (n=6, ICD-9 codes 353 and 953.4), and not otherwise classified musculoskeletal conditions (n=41) due to their very small sample size.

sex) and health-related variables (disease category, duration of condition, function at intake, pain intensity at intake, change in pain intensity). Possible within-clinic correlation was accounted for by including in the model an exchangeable working correlation matrix. All interactions were tested for significance. Fear significantly interacted only with disease categories. A separate GLM was used to calculate estimates unadjusted for other confounders (but adjusted for within-clinic correlation) to determine the effect of fear on change in function as expressed in each disease category by including only fear and disease category as independent variables. These unadjusted estimates represented mean differences in functional status change score between low and elevated fear groups (low fear group − elevated fear group) after controlling for subject effects and missing data at discharge. Furthermore, contrast statements were used to test the significance and to assess the effect of fear on change in function separately for each disease category.

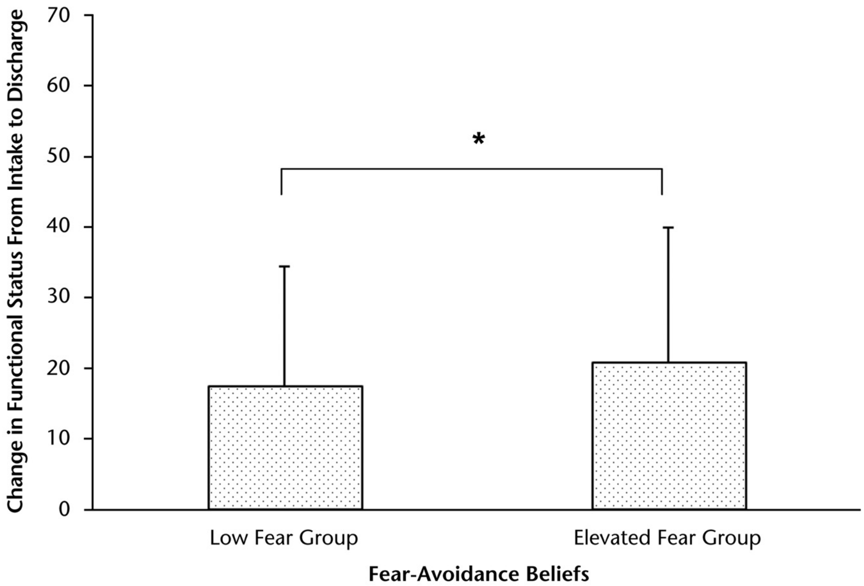

Figure 1.
Bar graph representing functional status change score (shoulder Computerized Adaptive Test [CAT] functional status score at discharge – shoulder CAT functional status score at intake) for people with low versus elevated fear-avoidance beliefs, without accounting for differences in subject effects, missing data, disease categories, clinics, and other confounding variables (asterisk indicates significance at alpha level of ≤.05).

Finally, we fitted a GLM adjusted for other significant predictors of change in function. In this GLM, the effect of fear on change in function for each disease category was included in the set of predictors as the variable of primary research interest. The adjusted estimates represented mean differences in functional status change score between low and elevated fear groups (low fear group − elevated fear group), while accounting for within-clinic correlation and for the effect of possible confounders. The confounders (ie, other significant predictors of change in function) that we controlled for included both pain intensity at intake and change in pain intensity from intake to discharge. These 2 pain intensity scores were included because both provide different information about change in functional status. Change in function was likely to be predicted by pain intensity at intake (eg, higher pain at intake resulting in smaller change in function). However, pain at intake does not indicate how pain intensity changes with treatment. A greater change in pain intensity was likely to be associated with a greater change in function.

In addition to the confounders, we controlled for subject effects and missing data at discharge. We identified significant predictors with the forward stepwise variable selection procedure. The level of fear, disease categories, and their interactions were always kept in the model. All main effects and 2-way interactions were tested for significance. The significance of continuous variables was explored through their linear and quadratic effects. For categorical variables, categories with small cell counts (less than 10) were combined with adjacent categories or by creating other meaningful groupings. Ordinal variables (duration of condition and age group) were treated as continuous, and their linear effect was analyzed. The data analysis for this article was generated using the SAS software, version 9.2 of the SAS System for Unix (SAS Institute Inc, Cary, North Carolina). We declared findings significant when their *P* values were less than .05.

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Results

For our sample of 3,362 participants, the mean age was 54.1 years (SD=15.8, range=18–92). Women made up more than half of the sample (n=1,828, 54%). Almost half of

Table 2.
Results of Wald Statistics for Type 3 General Linear Model (GLM) Model With Functional Status Change Score as the Dependent Variable[a]

Source[b]	df	$\chi^{2,c}$	P
Intake shoulder CAT score	1	190.92	<.001
Square of intake shoulder CAT score	1	41.87	<.001
Intake pain intensity score	1	94.91	<.001
Pain observed	1	59.67	<.001
Pain change observed	1	263.77	<.001
Age group	2	13.74	.001
Duration of condition	2	14.31	<.001
Disease category × fear	15	152.85	<.001
Intake shoulder CAT score × pain observed	1	10.72	.001
Pain observed × age group	2	18.02	<.001
Pain change observed × age group	2	15.81	<.001

[a] Only significant terms are reported.
[b] CAT=Computerized Adaptive Test, pain observed=pain intensity change score was missing (ie, 0) vs pain intensity change score was reported (ie, 1), pain change observed=(pain intensity change score) × (pain observed), age group=18–44 years vs 45–64 years vs 65 years and older, duration of condition=acute (0–21 days) vs subacute (22–90 days) vs chronic (≥91 days), fear=low vs elevated fear-avoidance beliefs.
[c] Inference of GLM regression parameters was performed using the Wald test statistic where the estimated parameter was compared with a chi-square distribution. The null hypothesis was no significant effect on change in function for a continuous variable and no significant difference in change in function between groups for a categorical variable.

the participants were classified as having chronic symptoms (>90 days from date of onset) (n=1,640, 49%), a third were classified as having subacute symptoms (22–90 days from date of onset) (n=1,075, 32%), and one fifth were classified as having acute symptoms (<22 days from date of onset) (n=647, 19%). Of the participants with medical or surgical codes (n=3,283, 98%), the most common diagnoses were associated with soft tissue disorders (ICD-9 codes 725–729, 56%). More than a tenth (12%) of the participants had postsurgical conditions such as repair of rotator cuff (Current Procedural Terminology [CPT] codes 23000–23929) (Tab. 1). Overall, almost three fourths (72%) of the participants reported no past surgical history, with 22% reporting 1 past surgery and 5% reporting 2 or more surgeries. A third (36%) of the participants reported exercising at least 3 times a week, followed by 39% who reported seldom or never exercising, and 26% reported exercising 1 to 2 times a week. Almost a third (31%) of the participants had 2 or 3 comorbidities, a quarter (25%) reported having none, another quarter (25%) reported having 1 comorbidity, and a fifth (19%) reported having 4 or more functional comorbidities.

Elevated fear-avoidance beliefs at intake were observed among more than a fifth of participants (n=766, 23%). The age and sex distributions were similar for the low fear group and the elevated fear group (Tab. 1). Both groups had 27% in the age range of 18 to 44 years, 45% in the age range of 45 of 64 years, and 28% in the age range of 65 years and older. However, differences existed between the low and elevated fear groups in terms of some health-related characteristics and not for

Table 3.
Results of General Linear Model Unadjusted for and Adjusted for Other Confounders to Determine Differences in Functional Status Change Scores Between Low Fear Group and Elevated Fear Group for 8 Disease Categories

	Unadjusted Difference in Functional Status Change Score			Adjusted Difference in Functional Status Change Score		
Disease Category	Estimate (Δ)	Standard Error	P	Estimate (Δ)	Standard Error	P
Arthropathies	−2.48	2.37	.29	0.37	2.41	.87
Muscle, tendon, and soft tissue disorders	−0.15	1.04	.88	1.37	0.57	.01[a]
Osteopathies, chondropathies, and acquired musculoskeletal deformities	4.42	2.84	.12	5.52	2.51	.02[a]
Fractures	−18.33	4.95	<.01[a]	1.93	3.04	.52
Sprains and strains	−5.29	4.26	.21	−3.73	2.81	.18
Postsurgical	−2.15	1.82	.23	0.80	1.52	.59
Other musculoskeletal conditions	−14.70	4.57	<.01[a]	−6.66	5.29	.21
Not reported	−2.69	2.04	.18	−1.48	1.60	.36

[a] Significant at alpha level of .05.

others. Both groups had similar distributions of diseases. For example, muscle, tendon, and soft tissue disorders formed the most common category of disorders in both groups, with 54% in the elevated fear group and 57% in the low fear group. Other musculoskeletal conditions formed the second largest category of diseases in both fear groups (10%). Pain intensity at intake was higher by 0.5 point for the elevated fear group (5.8) compared with the low fear group (5.3). In addition, pain intensity at discharge was half a point higher for the elevated fear group (3.2) compared with the low fear group (2.8). For both fear groups, the average reduction in pain intensity was greater than the 1 point MCII for the NRS (Tab. 1). Functional status at intake was 6 points higher for the low fear group (52 points) compared with the elevated fear group (46 points). Likewise, functional status at discharge was 2 points higher for the low fear group (69 points) compared with the elevated fear group (67 points; Tab. 1). In contrast, the improvement in function from intake to discharge was greater by 4 points for the elevated fear group (21 points) compared with the low fear group (17.6 points; Tab. 1, Fig. 1).

In the logistic regression analysis that we used to estimate dropout probabilities and calculate weights, 5 variables were significant: age group ($P<.0001$), pain intensity at intake ($P<.0001$), function at intake ($P=.0473$), disease category ($P=.0053$), and region where the clinic was located ($P<.0001$). Thus, these 5 variables were directly used for calculation of the GLM weights. The GLM identified that the effect of fear-avoidance beliefs on improvement in function varied among disease categories ($\chi^2=153$, $P<.001$; Tab. 2). On further examination of unadjusted estimates (ie, mean differences between the low fear group and the elevated fear group) while accounting for patient differences and missing data but unadjusted for possible confounders, the GLM revealed that improvement in function was greater for the elevated fear group than for the low fear group among people with fractures ($\Delta=-18.3$, $P\leq.0002$) and people with other musculoskeletal conditions ($\Delta=-14.7$, $P\leq.0013$). However, improvement in function was not different between the elevated and low fear groups among people with arthropathies; muscle, tendon, and soft tissue disorders; osteopathies, chondropathies, and acquired musculoskeletal deformities; sprains and strains; and postsurgical conditions, as well as among people whose condition was not reported (Tab. 3, Fig. 2).

In addition to the interaction between fear-avoidance beliefs and disease category, change in function was predicted by functional status at intake (linear and quadratic effects), pain intensity at intake, change in pain intensity, pain intensity reported versus not reported, age group, and duration of condition, as well as the clinic itself (Tab. 2). The effect of these significant predictors on change in function was controlled by calculating adjusted estimates for mean differences between low and elevated fear groups for the 8 disease categories (Tab. 3, Fig. 3). After adjustment (ie, extended examination of the 8 disease categories using adjusted GLM analysis), we found that improvement in function was greater for the low fear group than for elevated fear group among people with muscle, tendon, and soft tissue disorders ($\Delta=1.37$, $P\leq.01$) and among people with osteopathies, chondropathies, and acquired musculoskeletal deformities ($\Delta=5.52$, $P\leq.02$) (Tab. 3, Fig. 3). In contrast, improvement in function was not different between the elevated and low fear groups among people with arthropathies ($\Delta=0.37$, $P=.87$), fractures ($\Delta=1.93$, $P=.52$), sprains and strains ($\Delta=-3.73$, $P=.18$), postsurgical conditions ($\Delta=0.80$, $P=.59$), other musculoskeletal conditions ($\Delta=-6.66$, $P=.20$), and condition not reported ($\Delta=-1.48$, $P=.35$) (Tab. 3, Fig. 3). The data presented in Table 3 were used to make simple *post hoc* power calculations and to determine minimal detectable change (MDC) at 80% power. Using asymptomatic normality of regression coefficients and observed standard errors, we estimated values of regression coefficients we can detect at 80% power. For muscle, tendon, and soft tissue disorders, the observed difference was 1.37, whereas the minimal detectable difference at 80% power (ie, MDC) is 1.56. If the difference is actually 1.37, the hypothesis of no difference is rejected in 67% of cases (ie, an asymptotic power or 67%). For osteopathies, chondropathies, and acquired musculoskeletal deformities, the observed difference was 5.52, whereas the detectible difference at 80% power (ie, MDC) is 7.03. The power is 59% if the difference is 5.52.

Discussion

The findings of the present study revealed a small but significant effect of elevated fear-avoidance beliefs. This effect was associated with poorer recovery in upper-extremity function with rehabilitation in only 2 out of 8 disease categories—(1) muscle, tendon, and soft tissue disorders and (2) osteopathies, chondropathies, and acquired musculoskeletal deformities—and the asymptotic *post hoc* power associated with these changes was 67% and 59%, respectively. For the 2 disease categories, the functional change difference between elevated and low fear groups was less than the MDC at 80% power. This effect of fear-avoidance beliefs existed after accounting for several variables that influence change in function, including patient

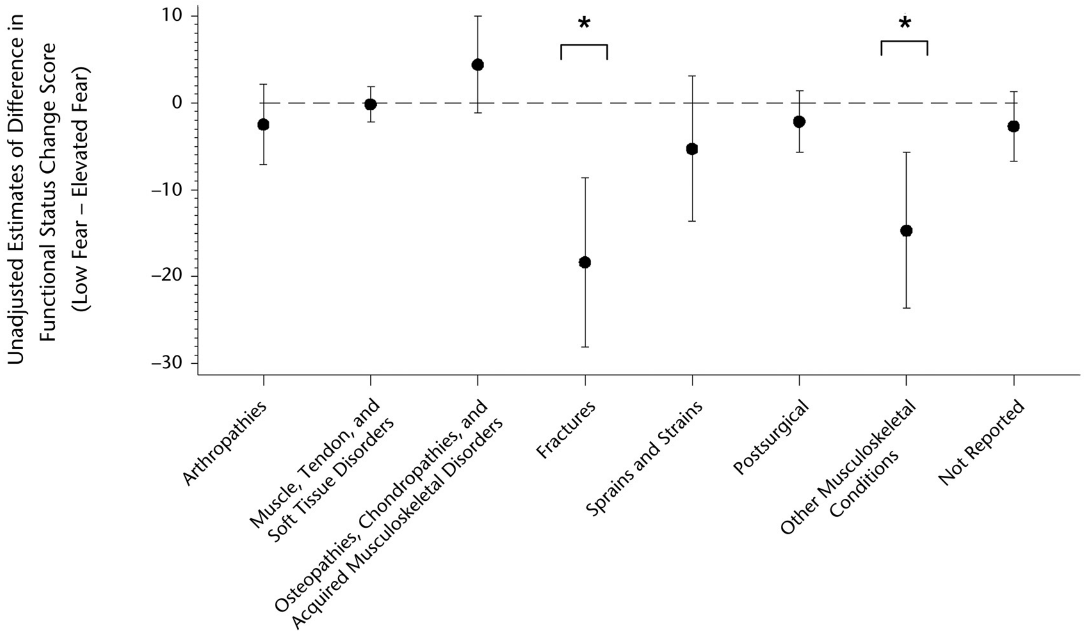

Figure 2.
Average values with 95% confidence intervals for unadjusted estimates of mean differences between low versus elevated fear groups (low fear – elevated fear) on functional status change score (shoulder Computerized Adaptive Test [CAT] functional status score at discharge – shoulder CAT functional status score at intake) among 8 shoulder disease categories (asterisk indicates significance at alpha level of ≤.05). The category "Other musculoskeletal conditions" was created by combining dislocations (n=22), contusions (n=7), peripheral nerve disorders (n=6), and not otherwise classified musculoskeletal conditions (n=41) due to their very small sample size. Dashed line at zero indicates no difference between low and elevated fear groups on change in function. Average and 95% confidence interval of unadjusted estimates lying below zero indicate that change in function was greater for the elevated fear group than for the low fear group. Similarly, average and 95% confidence interval of unadjusted estimates lying above zero indicate change in function was greater for the low fear group than for the elevated fear group.

differences, missing data, clinic location, upper-extremity function at intake, change in pain intensity from intake to discharge, duration of condition, age of the patient, and disease category of the patient. Findings of the present study are similar to conclusions drawn from previous studies investigating individuals' responses to chronic low back pain.[25,26] George and colleagues[25,26] found diminished rehabilitation outcomes for low back pain among individuals with elevated fear. Among people with acute low back pain, greater fear-avoidance beliefs about work at baseline were significantly associated with greater levels of disability at the 6-month follow-up.[21] These differences in improvement in function provide evidence for the FAM.[10,14,16,17] According to the FAM, elevated fear results in escape and avoidance of tasks that are anticipated to be painful. Avoidance combined with being hypervigilant toward painful stimuli results in deconditioning of muscles over time. This deconditioning leads to greater disability[10] and poorer treatment outcomes.[19–22]

We found differences in the influence of fear-avoidance beliefs on change in function between GLM regression analyses unadjusted for confounders and those adjusted or confounders. With the unadjusted analysis, we found that change in function was greater in the elevated fear group than in the low fear group (Fig. 1). This difference can be explained on the basis of higher functional status scores for the low fear group ($\overline{X}$=51, SD=13) compared with the elevated fear group ($\overline{X}$=46, SD=15) at intake (t=8.61, $P<.001$; Tab. 1). Higher functional status scores at intake suggest that the low fear group is likely to change less with rehabilitation. However, in terms of being able to generalize to real-world situations where functional improvement is affected by multiple factors, our findings suggest the unadjusted analysis is inadequate. This inadequacy results from the fact that it does not account for factors besides fear that influence change in functional status.

In addition, the unadjusted analysis revealed an interaction between fear and disease categories for predicting change in function. On further examination of this interaction, without adjusting for other important

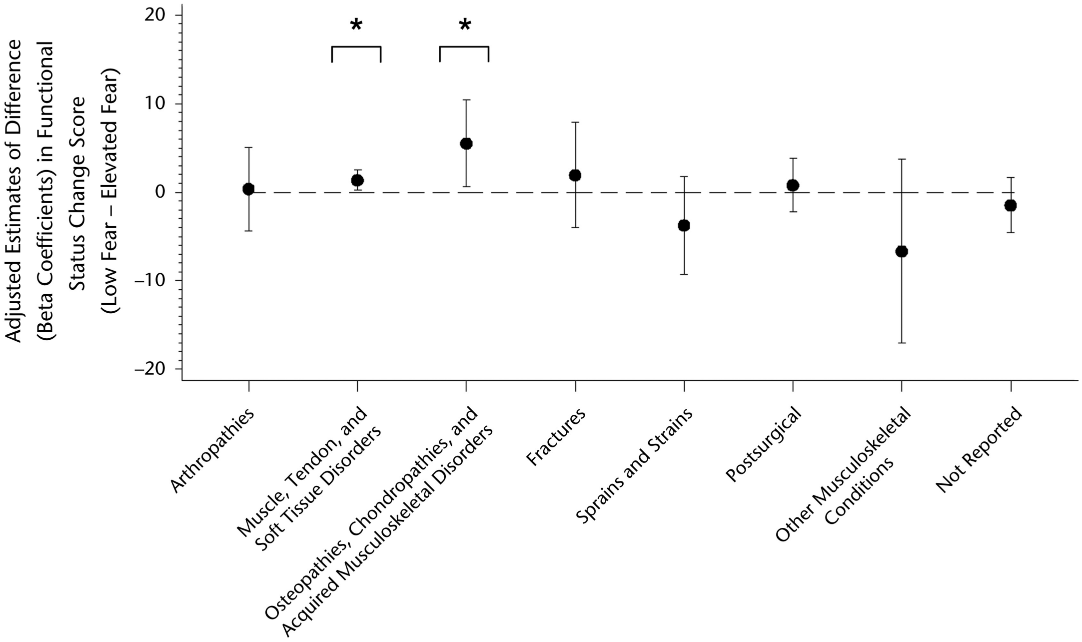

Figure 3.
Average values with 95% confidence intervals for adjusted estimates of mean differences between low and elevated fear groups (low fear – elevated fear) on functional status change score (shoulder Computerized Adaptive Test [CAT] functional status score at discharge – shoulder CAT functional status score at intake) among 8 shoulder disease categories (asterisk indicates significance at alpha level of ≤.05). The category "Other musculoskeletal conditions" was created by combining dislocations (n=22), contusions (n=7), peripheral nerve disorders (n=6), and not otherwise classified musculoskeletal conditions (n=41) due to their very small sample size. Dashed line at zero indicates no difference between low and elevated fear groups on change in function. Average and 95% confidence interval of adjusted estimates lying below zero indicate that change in function was greater for the elevated fear group than for the low fear group. Similarly, average and 95% confidence interval of adjusted estimates lying above zero indicate change in function was greater for the low fear group than for the elevated fear group.

covariates, fear was found to be a predictor for change in function among individuals with fractures and those with other diseases (Fig. 2). People with fractures and other diseases were found to show greater improvement in function when they had elevated fear at baseline. This finding is similar to that of George and Stryker,[25] whose repeated-measures analysis of variance test revealed that people receiving physical therapy for musculoskeletal conditions in 4 different regions showed greater improvement in function when experiencing elevated fear at intake. However, the influence of fear on function for people with fractures and people in other disease categories changed to not significant after adjusting for other covariates. This change in influence of fear may be due to the effect of pain intensity on function. For example, we might imagine that a bone fracture commonly results in high levels of pain intensity. As the fracture heals, pain usually reduces and function improves, irrespective of whether fear is low or elevated. Indeed, our multivariate analysis revealed that for people with fractures, change in function was predicted by change in pain intensity but not by fear-avoidance beliefs (Tab. 2, Fig. 3). Our findings also suggest that there is a need to reexamine findings of some of the earlier studies. For example, greater improvement in function among people with elevated fear, as reported by George and Stryker,[25] could be different if they would have accounted for other demographic and health-related characteristics in their analysis.

After adjusting for significant covariates, we found that out of 8 different disease categories, the influence of elevated fear on functional recovery existed only in 2 categories: (1) muscle, tendon, and soft tissue disorders and (2) osteopathies, chondropathies, and acquired musculoskeletal deformities. Additionally, we found that elevated fear-avoidance beliefs did not result in lower functional status outcomes among individuals in 6 of the 8 disease categories. These categories were: (1) arthropathies, (2) fractures, (3) sprains and strains, (4) postsurgical conditions, (5) other shoulder conditions, and (6) conditions not reported. To our knowledge, this is the first study to report diagnosis-related differences in fear-avoidance beliefs among people with musculoskeletal conditions of the shoulder. George et al[15] found similar diagnosis-related differences between individuals with cervical spine pain and those with lumbar spine pain. Although we found statistically significant differences, it is not clear whether the difference in functional recovery was clinically meaningful between the low fear group and the elevated fear group for muscle tendon and soft tissue disorders, as well as for osteopathies, chondropathies, and acquired musculoskeletal deformities. For the 2 groups with significant differences, the asymptotic *post hoc* power of these changes in regression parameters was 67% and 59%, respectively. Also, the observed difference between low and elevated fear groups was less than the *post hoc* calculation of MDC at 80% power. However, these *post hoc* power calculations only describe power properties of our analyses; they do not change the statistical inference, which is based solely on *P* values less than .05. In addition, some regression coefficients had higher standard errors than others, which could prevent us from showing significance due to lower power. Future clinical trials need to be conducted to determine the clinical significance of this difference between low and elevated fear groups.

One possible explanation for a weaker relationship between fear and change in function in the 6 disease categories is that patients may perceive the potential for pain with physical activity to be greater when pain results from muscle, tendon, and soft tissue disorders, as well as from osteopathies, chondropathies, and acquired musculoskeletal deformities. Some conditions included in these categories are rotator cuff tears, muscle impingement, chondral defects, and other bone problems. Health care professionals may convey a different message to patients in these 2 categories compared with patients with diagnoses in other categories where fear is not a predictor of change in function. For example, among people with sprains and strains, a rehabilitation professional may be confident of recovery in a short duration of time and may convey a reassuring message to the patient. Subsequently, patients may view their condition as temporary, which may lessen the amount of fear they feel. This reduced fear of pain related to activity may result in a more confrontational response to the pain, and thus the potential for greater functional recovery.[15] In contrast, with a rotator cuff tear, a therapist may convey that rehabilitation may not be successful, and the patient may eventually need surgery if the symptoms do not improve. Such a message of more delayed recovery may support the maintenance of fear-avoidance beliefs, which, in turn, may hinder functional recovery. We could have been more certain of this explanation if we would have measured attitudes of health care professionals toward different medical conditions.

An alternative explanation for differences in disease categories may be that interventions implemented by therapists may be more concentrated on reducing the effects of fear among the 6 disease categories that did not show differences between low and elevated fear groups. However, this differential effect is less likely because clinicians generally are not aware of patient fear-avoidance beliefs.[57,58] Furthermore, we cannot be certain about the effect of intervention because we do not know what intervention was implemented. Therefore, we have no information on the effectiveness of any interventions on reducing fear-avoidance beliefs.

Our findings are similar to those found among other musculoskeletal conditions where the association between fear-avoidance and functional status is significant, yet small.[15,59,60] Overall, fear-avoidance is not one of the most important predictors of functional outcomes. However, fear-avoidance was found to be an important predictor for some people but not for others, as indicated by differences among diagnostic groups of shoulder conditions. Consequently, use of diagnostic categories may allow us to identify subgroups of individuals who benefit the most from targeted treatment for fear avoidance.

The present study has 2 important clinical implications. First, it is important to assess fear-avoidance beliefs related to pain among people with shoulder conditions. Second, people with shoulder conditions may benefit from targeted treatment for fear avoidance, especially when diagnosed with a muscle, tendon, or a soft tissue disorder, or osteopathy, chondropathy, or an acquired musculoskeletal deformity.

Limitations

This study had several limitations. First, this study was a retrospective review of cohort data sets where the potential for patient selection bias was strong. In this case, we created disease categories based on data from patients whose health care providers had voluntarily elected to enter ICD-9 diagnostic codes into the system. Moreover, we were unable to confirm the diagnosis recorded by the clinician or the methods by which a clinician selected an individual diagnostic label. Previous studies have shown ICD-9 codes to have variable interrater reliability, poor to moderate validity,[35–37] and insufficient specificity values.[36] Consequently, the findings of our study could be biased because of the accuracy of the assigned ICD-9 codes.

Second, we do not know the rehabilitation protocol followed in treatment of the patients with shoulder conditions making up our sample. Specifically, we do not know whether therapists used patient information on elevated fear to implement interventions to reduce fear. Our study findings could be greatly influenced if some therapists implemented interventions to reduce fear and others did not implement such interventions. Finally, our findings may be influenced by other factors that were not controlled for in this analysis. Accounting for these variables in the statistical analysis could potentially change the findings of our multivariate analysis. For example, it might be important to include characteristics of treating health care professionals, including their training (specialist versus generalist) and their attitudes toward prognosis of the condition that they treated. Future studies collecting information from therapists on treatment provided to patients would be beneficial. Additionally, information on other possible predictor variables might be collected and included in the model. Finally, information on how patients were classified and details of their disease course could help clarify the extent of variability within groups and perhaps eliminate some of this variability.

Conclusions

Elevated fear-avoidance beliefs were found to be associated with poorer functional status in only 2 out of 8 disease categories: (1) muscle, tendon, and soft tissue disorders and (2) osteopathies, chondropathies, and acquired musculoskeletal deformities. This effect of fear-avoidance beliefs on improvement in function is dependent on covariates included in the analysis. We accounted for differences in clinics, age groups, sex, function and pain intensity at intake, duration of condition, and missing data. Among the 2 disease categories, our data suggest rehabilitation professionals should assess for and manage fear-avoidance beliefs to improve treatment outcomes. There is a need to investigate effectiveness of rehabilitative treatments when individuals with shoulder impairments experience elevated fear-avoidance beliefs.

Dr Sindhu, Dr Lehman, and Dr Tarima provided concept/idea/research design. Dr Sindhu, Dr Lehman, Dr Bishop, and Mr Klein provided writing. Dr Hart provided data collection and participants. Dr Sindhu, Dr Lehman, Dr Tarima, Dr Bishop, Mr Klein, Mr Shivakoti, and Dr Wang provided data analysis. Dr Tarima, Dr Hart, and Mr Shivakoti provided consultation (including review of manuscript before submission). The authors thank Focus On Therapeutic Outcomes, Inc (Knoxville, Tennessee) for providing data for this research project.

At the time of this study, Dr Wang and Dr Hart were employees of Focus On Therapeutic Outcomes, Inc (Knoxville, Tennessee).

This study was reviewed and approved by the institutional review boards for the protection of human subjects at the University of Wisconsin–Milwaukee and FOTO, Inc.

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Appendix.

Flow Diagram Used for Selecting Study Participants