Systematic Review

Depression and Anxiety Are Associated With Worse Subjective and Functional Baseline Scores in Patients With Frozen Shoulder Contracture Syndrome: A Systematic Review

Fabrizio Brindisino, P.T., O.M.P.T., M.Sc., Elena Silvestri, P.T., B.Sc., Chiara Gallo, P.T., M.Sc., Davide Venturin, P.T., O.M.P.T., Giovanni Di Giacomo, M.D., Annalise M. Peebles, M.D., Matthew T. Provencher, M.D., and Tiziano Innocenti, P.T., O.M.P.T., M.Sc.

Purpose: To investigate whether psychological factors, such as avoidance behavior, fear, pain catastrophization, kinesiophobia, anxiety, depression, optimism, and expectation are associated with different subjective and functional baseline scores in patients with frozen shoulder contracture syndrome (FSCS). **Methods:** Searches were conducted in MEDLINE, Cochrane Library (CENTRAL Database), PEDro, Pubpsych, and PsychNET.APA without restrictions applied to language, date, or status of publication. Two authors reviewed study titles, abstract, and full text based on the following inclusion criteria: adult population ($\geq$ 30 $<$ 70 years old) with FSCS. **Results:** Seven hundred and seventy-six records were included by the search strategies. After title final screening, 6 studies were included for the qualitative synthesis. Psychological features investigated were anxiety, depression, pain-related fear, pain catastrophizing, and pain self-efficacy; reported outcomes included pain, function, disability, quality of life, and range of motion. Data suggest that anxiety and depression impact self-assessed function, pain, and quality of life. There is no consensus on the correlation between psychological variables and range of motion. Associations were suggested between pain-related fear, pain-related beliefs, and pain-related behavior and perceived arm function; pain-related conditions showed no significant correlation with range of motion and with perceived stiffness at baseline. **Conclusion:** Scores traditionally thought to assess physical dimensions like shoulder pain, disability, and function seem to be influenced by psychological variables. In FSCS patients, depression and anxiety were associated with increased pain perception and decreased function and quality of life at baseline. Moreover, pain-related fear and catastrophizing seem to be associated with perceived arm function.

Introduction

Frozen shoulder contracture syndrome (FSCS)[1] is a musculoskeletal pathology characterized by insidious onset, shoulder pain, intense night pain, limitation in range of motion, pain during movements, disturbing sleep, and disability.[1-3] Despite the lack of a clear etiology, FSCS has a prevalence of 2-5% in the general population,[2,3] and it occurs more frequently in people

Department of Medicine and Health Science "Vincenzo Tiberio", University of Molise, Campobasso, Italy (F.B.); Fisiopoint, Roma, Italy (E.S., C.G.); Kiné Physiotherapy Department, Treviso Italy (D.V.); Department of Orthopaedic and Trauma Surgery, Concordia Hospital for Special Surgery, Rome, Italy (G.D.G.); Steadman Philippon Research Institute, Vail, Colorado, U.S.A. (A.M.P.); Steadman Clinic and Steadman Philippon Research Institute, Vail, Colorado, U.S.A. (M.T.P.); Department of Health Sciences, Faculty of Science, Vrije Universiteit Amsterdam, Amsterdam Movement Sciences, The Netherlands (T.I); and GIMBE Foundation, Bologna, Italy (T.I.).

The authors report the following potential conflicts of interest or sources of funding: M.T.P. reports personal fees from Arthrex, United States, Joint Surface Foundation, SLACK, Inc., and Arthrosurface during the conduct of the study. He is an editorial or governing board member of Arthroscopy, Knee, Orthopedics, *and SLACK, Inc., and is a an editorial or governing board member of AANA, AAOS, AOSSM, ASES, ISAKOS, the San Diego Shoulder Institute, and the Society of Military Orthopaedic Surgeons. Full ICMJE author disclosure forms are available for this article online, as supplementary material.*

Received January 12, 2022; revised manuscript received February 26, 2022; accepted April 1, 2022.

Address correspondence to Fabrizio Brindisino, P.T., M.Sc., O.M.P.T., Via della Libertà, 14, 73023 Lizzanello (Le), Italy. E-mail: fabrizio.brindisino@unimol.it

2666-061X/228

https://doi.org/10.1016/j.asmr.2022.04.001

who suffer from diabetes, thyroid disease,[1,3-7] autoimmune disease,[3,5] and Dupuytren's contracture.[4,5,8] Moreover, it seems that the occurrence of FSCS is higher in patients with sedentary jobs with physically low activity,[9] that women seem to be slightly more predisposed to develop FSCS than men,[5,8] that the prevalence is higher in the age range between 50 and 59,[4] and the incidence increases with age.[9]

Recovery from FSCS remains controversial in the literature. FSCS is sometimes reported as self-limiting pathology, or that need of care[10,11] and the time for symptoms resolution ranged from few months to two years.[10,12,13] Moreover, although some patients report complete symptom resolution, others report residual range of motion impairments and pain.[10,14] Despite reports of a three-phased evolution of the disease (freezing, frozen, and thawing), there exists no strong evidence supporting this kind of subclassification[10] in terms of prognostic or diagnostic value.[15]

In shoulder pathologies different from FSCS, the impact of psychological factors and baseline self-assessment evaluation in pain, disability, and function is well documented;[16-18] however, little is known about the association between psychological factors and the main patient-reported outcome measures (PROMs) in FSCS patients.

The association between psychological factors and patients self-assessment demands further investigation, as psychological factors play an important role in mediating objective pathophysiology and patients' subjective experience of pain and disability,[19,20] greater self-perceived pain, and self-perceived function in patients with musculoskeletal pathologies.[19,21,22]

The purpose of this systematic review is to investigate whether psychological factors, such as avoidance behavior, fear, pain catastrophization, kinesiophobia, anxiety, depression, optimism, and expectation are associated with different subjective and functional baseline scores in patients with FSCS. We hypothesized that higher levels of psychological features will be associated with clinically different baseline scores assessing pain disability, function, and quality of life in patients with FSCS.

Materials and Methods

Data Sources and Searches

This systematic review was conducted according to the Manual of Evidence and synthesis of JBI 2020,[23] and the protocol was registered in PROSPERO (CRD420 21250212). The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) statement[24] was used for the reporting. The research was conducted in the following databases: MEDLINE, Cochrane Library (CENTRAL database), Pubpsych, PsychNET.APA, and PEDro. In efforts to extract additional relevant articles, a reference list of identified articles was also reviewed with other noncommercially operated databases (gray literature sources as Google Scholar, conference proceedings, as theses).

Searches were conducted for all studies published until to 31st of July 2021 without restriction of language, data, or status of publication were applied. Additionally, the authors did not apply restrictions to study design in efforts to maximize the inclusion of reviewed literature that examines psychological factors in multiple capacities, which may provide prevalent information to the review (e.g., cross-sectional studies; surveys; cohort studies; and observational, epidemiological, and descriptive studies).[23]

Furthermore, a manual cross-referencing was performed on the reference lists of included articles, and experts in the field were asked for further manuscripts of interest for both search strategies. A combination of medical subject heading terms and text words were used to create search strategies for each database to include all potentially eligible studies (Appendix Table 1). Population, Exposition, Outcomes (PEO) strategy is described in Appendix Table 2.

Study selection criteria

Population

Studies were included if participants met the following criteria: adult population ($\geq$30 $<$70 years old) with FSCS. Studies were excluded if they encompassed patients with secondary frozen shoulder, patient with shoulder fractures during the last year, patients with rotator cuff repair during the last year, patients with shoulder surgery procedure during the last year, patients with shoulder dislocation during the last year, patients with serious specific shoulder disorders (i.e., tumor, infection), or patients with psychiatric diagnosed disorders.

Condition

Two authors evaluated all retrieved studies that analyzed the association between psychological factors and baseline scores in patients with FSCS. Psychological factors variables, including fear, avoidance behavior, catastrophization, anxiety, hypervigilance, depression and depressive disorder, expectation motivation, kinesiophobia, and optimism, were included.

Context

The association between psychological factors and baseline subjective and functional scores in groups of patients with FSCS was compared.

Setting

The setting was primary and secondary care.

Types of Publications and Study Design

The authors did not apply restrictions to study design in efforts to maximize the inclusion of reviewed

literature that examines psychological factors in multiple capacities, which may provide prevalent information to the review (e.g., cross-sectional studies; surveys; cohort studies; and observational, epidemiological, descriptive studies).[23]

Data Extraction

A single search strategy was used to conduct the systematic review (Appendix Table 1). Search results from consulted databases were exported to EndNote v.X9 (Clarivate Analytics, Philadelphia, PA). Duplicates were removed and Rayyan QCRI online software[25] were used for the study selection process. Two authors independently screened the extracted literature by title, abstract, and full-text review, according to the inclusion/exclusion criteria. Disagreements at any stage of the study selection process were resolved by a third author consultation. When data of interest were not reported in the full text, original investigators were contacted to retrieve missing data. To ensure relevant literature had not been missed, a list of the identified articles was shared with the third author to examine the reference lists of the eligible studies and to perform a manual citation search. Moreover, four experts in the field were contacted to suggest articles of interest that could have been missed from the prior search strategies. The following data were extracted from the included literature: general study information (first author, study design, and publication year); patient's characteristics and selection criteria, psychological factors considered, characteristics of intervention and control groups, follow-up periods, outcome measures, and main results (Table 1). The extraction form was filled in by two authors alternately with mutual check on each entry. Disagreements were resolved by either consensus or consultation with a third review author. The results of the studies were analyzed by the first author and were summarized in a qualitative synthesis. A second researcher was involved in case of doubt.

Quality Assessment of Studies Included

Two authors independently assessed the quality in included studies (C.G. and F.B.) using a modified version of the Downs and Black score.[26] Any disagreement over the quality assessment was resolved through discussion with a third author (E.S.).

Strategy for Data Synthesis and Analysis

Studies were grouped per exposition of interest (psychological factors). The potential sources of heterogeneity were assessed through subgroup analyses of the studies' populations, outcome measures, psychological factors assessment modalities, statistical methods used, and study design. Meta-analysis was not performed because of the heterogeneity of the data (clinical heterogeneity). Because a quantitative pooled summary could not be performed, a descriptive qualitative analysis (the most relevant summary measure with a precision estimate) for each psychological factor was provided. Moreover, data imputed or calculated (i.e., standard deviations calculated from standard errors, *P* values, confidence intervals, and imputed from graphs), were reported in the extraction form. Authors used a priori defined decision rules to select data from included studies, aiming to prevent selective inclusion of data, as previously stated in the Protocol.

Results

Study Selection

Overall, the search strategies retrieved 776 articles. No additional records were identified through other sources and expert on field inquiry and 14 duplicates were found. Two blinded authors (C.G. and E.S.) independently screened all articles retrieved for title and abstract. A total of 751 articles were excluded. The remaining 11 articles were independently screened by the same researchers for full text, and 5 additional articles were further excluded (Appendix Table 3).[27-31] A total of 6 articles were included in the final review.[32-37] A PRISMA flowchart of the selection process can be viewed in Fig 1.

Data Extraction

Two authors checked each other's choices of extracted studies, as previously specified in Methods section (Table 1). Disagreements were resolved by consulting a third author. Missing data from one included study[33] were reached by contacting the corresponding authors of the article.

Quality Assessment

Studies were assessed using a modified version of the Downs and Black score[26] by two independent authors (C.G. and E.S.) (Table 2). A clear description of the aims (item 1), the main outcome to be measured (item 2), the patients characteristics (item 3), the principal confounders (item 4), and the main findings (item 5) were provided in all included studies; moreover, the main outcome measures used were accurate (item 13). In the majority of the studies, the authors were unable to determine whether groups of different intervention came from the same population (item 14).

All but one[30] study reported estimates of the random variability for the main outcome (item 6). In all but two[30,31] studies, actual probability statistical values were not reported for the main outcomes (item 7), and appropriate statistical tests to assess the main outcomes were not used (item 12).

For a majority of the included studies, the reviewers were unable to determine whether the included

Table 1. Characteristics of the Studies Included

Author, Year, Study Design	Participants (n), Inclusion/exclusion criteria	Psychological Factors Investigated	Group of Intervention (GI) Group of Control (GC)	Outcome Measures, Units, Time of Follow-Up
Bagheri et al., 2016 Cross-sectional study Level of evidence: IV	$n = 120$ (mean age 52 y; 37 men, 83 woman) **Inclusion criteria:** • Idiopathic FS phase-II • Shoulder pain <3 months **Exclusion criteria:** • History of rotator cuff tear • Previous shoulder surgery or fracture • Psychosis	Anxiety; depression	//	DASH score, VAS score, SF-36 (PCS component), SF-36 (MCS component), HAQ, HDQ, at baseline
De Baets et al., 2020 Cross-sectional study Level of evidence: IV	$n = 85$ (mean age 55.2 y; 26 men, 59 woman) **Inclusion criteria:** • unilateral FSCS • passive ROM restriction ≥25% in at least 2 directions compared to the unaffected side • ER≥50% compared to the unaffected side. • Pain and restricted ROM ≥ 2 months • gradual onset of pain and stiffness. • be able to fill in questionnaires in Dutch. **Exclusion criteria:** • surgery procedure for FS • systemic or neurological disease	Pain-related fear, pain catastrophizing, pain self-efficacy	//	DASH questionnaire, TSK, PCS*, PSEQ, NPRS at baseline
Ding et al., 2014 Cross-sectional study Level of evidence: IV	$n = 254$ (mean age: 52.16 ± 6.16 y; 46 men, 78 woman) **Inclusion criteria:** • Insidious onset and last ≥3 months • night pain • tenderness around the joint capsule • ER restriction • normal radiographic or just a little joint fluid in magnetic resonance imaging. **Exclusion criteria**: • concomitant disorders that could influence disease activity or psychological status • secondary FS, trauma, arthritis • the relapse of FS or both shoulders affected • cervical spondylosis	Anxiety; depression	**GI**: $n = 124$ FSCS **GC:** $n = 130$ healthy people	VAS, sleep disturbances, SST, SPADI, ROM, HAQ, HADS-D, HADS-A at baseline
Ebrahimzadeh et al., 2019 Cross-sectional study Level of evidence: IV	$n = 120$ (mean age 52 SD 17 y; 37 men, 83 women) **Inclusion criteria**: • FSCS • phase II FS • shoulder pain ≥ 3 months **Exclusion criteria**: • history of psychosis	Anxiety; depression	//	VAS, DASH, HADS-D, HADS-A at baseline

(continued)

Table 1. Continued

Author, Year, Study Design	Participants (n), Inclusion/exclusion criteria	Psychological Factors Investigated	Group of Intervention (GI) Group of Control (GC)	Outcome Measures, Units, Time of Follow-Up
	• diagnosed rotator cuff tear • previous shoulder surgery or fracture			
Toprak et al., 2018 Cross-sectional study Level of evidence: IV	n = 148 (25-65 years old) **Inclusion criteria:** • Age range 25−65 y • insidious onset of pain and stiffness with a clinical reduction in ROM, principally ER reduction >50% no radiological abnormalities • presence of pain **Exclusion criteria:** • history of shoulder surgery or trauma • other shoulder pathology • history of psychiatric disorders • local corticosteroid injection or any physiotherapy intervention to the affected shoulder within the last 6 months • cerebrovascular accident affecting the shoulder • concomitant disorders unwillingness to participate in the study	Anxiety; depression	**GI**: n = 76 FSCS patients (mean age 59.32 ± SD 13.91 y; 21 men, 55 women) **GC**: n=72 healthy patients (mean age 58.50 ± SD 8.74 y; 18 men, 54 women)	VAS, BDI, BAI, WHO-QoL bref, PSQI
De Baets et al., 2020 Prognostic study Level of evidence: IV	n = 20 (mean age 56 ± 8 y, 6 men, 14 women) **Inclusion criteria:** • Adults with unilateral, FSCS • passive ROM restriction≥25% in minimum 2 directions • unaffected shoulder • ER restriction of at least 50% • pain and restricted ROM last≥2 months • A gradual onset of the perceived pain and stiffness • Be able to fill in questionnaires in Dutch **Exclusion criteria:** • Previous surgical procedure for FS • Partial/full thickness rotator cuff tear seen on magnetic resonance arthrogarphy • Systemic, neurological, or psychiatric disease	Pain-related fear, pain catastrophizing	patients were treated with Ultrasound-guided intra-articular corticosteroid injections (80 mg Depomedrol and 6 cc Lidocaine HCl 1%) via posterior at baseline, 6 and 12 weeks; patient education (manual), joint mobilizations, mobility and stretching exercises, home-management training, and neuromuscular training	**Outcome measures:** DASH, GH ABD and ER ROM (goniometry), NRS-stiffness, NRS-pain, TSK, PCS*, CHL thickness, IGR perimeter **Follow-up: baseline and** 4 months

ABD, abduction; BAI, Beck Anxiety Inventory; BDI, Beck Depression Inventory; CHL, coraco-humeral ligament; DASH, Disability of the Arm, Shoulder and Hand; ER, external rotation; FS, frozen shoulder; FSCS, Frozen Shoulder Contracture Syndrome; GH, glenohumeral; HADS-A, Hamilton Anxiety and depression Scale-Anxiety; HADS-D, Hamilton Anxiety and depression Scale-Depression; HAQ, Hamilton Anxiety Questionnaire; HDQ, Hamilton Depression Questionnnaire; IGR, inferior glenohumeral recess perimeter; IR, internal rotation; MCS, Mental Component Summary; NPRS, Numeric Pain Rating Scale; NRS, Numeric Rating Scale; PCS, Physical Component Summary; PCS*, Pain Catastrophyzing Scale; PSEQ, Pain Self-Efficacy Questionnaire; PSQI, Pittsburgh Sleep Quality Index; ROM, range of movement; SF-36, Health Survey Short Form, 36 question; SPADI, Shoulder Pain and Disability Index; SST, Simple Shouder Test; TSK, Tampa Scale of Kinesiophobia; VAS, visual analog scale; WHO-QoL bref, World Health Organization Quality of Life Scale short form; Y, years.

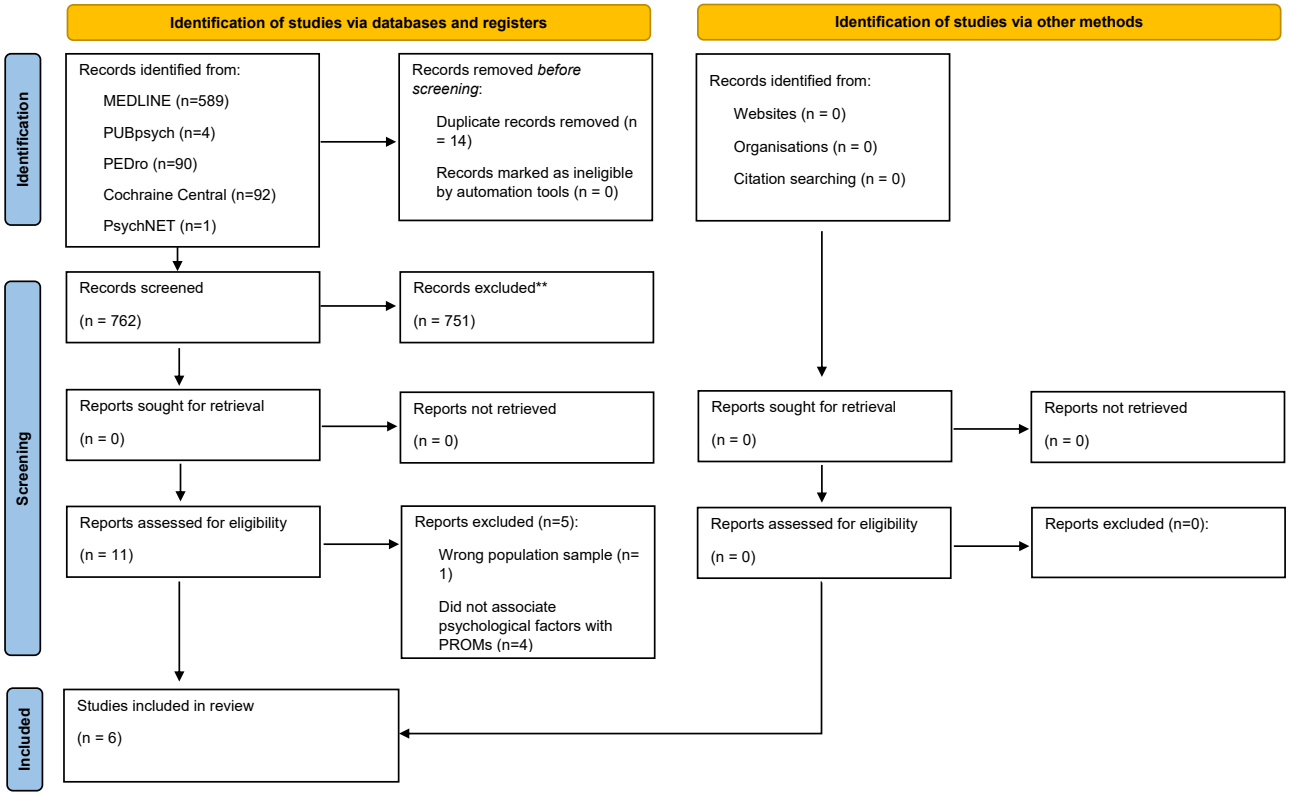

Fig 1. PRISMA flowchart.

subjects were representative of the entire population from which they were recruited (item 14).

Description of Included Studies

Overall, 545 patients with FSCS were included. Psychological features most investigated were anxiety and depression;[32,35-37] however, included studies also assessed pain-related fear, pain catastrophizing, and pain self-efficacy.[33,34] No other psychological factors were investigated.

Depression

Four studies investigated the correlation between depression and patient baseline scores in FSCS patients.[32,35-37] In multivariable analysis between depression (assessed with HDQ) and pain perception (assessed with VAS), the authors determined that depression was significantly correlated with patient VAS scores (partial $R^2 = .0039$, Beta = .06, $P = .044$, SE .027 95% CI: 0.002-0.109); furthermore, HDQ scores showed a significantly strong correlated (partial $R^2 = 0.36$, Beta = −.98, SE .13, 95% CI −1.2 − −0.72; $P < .001$) with the MCS of SF-36 scores.[32] Ding et al. found that FSCS patients reported both a significantly higher Hamilton Anxiety and depression Scale-Depression (HADS-D) score (6.42) and higher depression score (HADS-D >9) (28.2%) than the healthy control (HADS-D: 5.23, $P = .006$; HADS-D >9: 16.9%; $P = .036$).[35]

In multivariable analysis, DASH score (partial $R^2 = 0.089$, Beta = .107; SE .034, 95% CI: 0.039 to 0.17; $P = .002$), education (partial $R^2 = 0.12$, Beta = −1.46; SE .39, 95% CI: −2.22 to −0.69; $P < .001$), and internal rotation (partial $R^2 = 0.042$, Beta = −.99 SE 0.47, 95% CI: −1.93 to −0.052; $P = .039$) correlated with severity of depression symptoms.[36] In Toprak et al.'s cross-sectional study, there was no statistically significant difference between FSCS patients and healthy control groups in terms of the Beck Depression Inventory (BDI) at baseline (14.63 SD 9.60 vs 11.53 SD 10.85, respectively; $P = .06$).[37] Further detailed results of these correlations were shown in Table 3.

Anxiety

Four studies investigated the correlation between anxiety and baseline scores in patients with FSCS.[32,35-37] In multivariable analysis, anxiety was strongly correlated (partial $R^2 = 0.11$, Beta = .98; $P = .001$, SE .28, 95% CI: 0.43-1.5) with change in function assessed with DASH score.[32] Ding et al. reported that FSCS patients showed significantly higher Hamilton Anxiety and depression Scale-Anxiety (HADS-A) scores than healthy control (mean: 6.16, SD 3.62 and mean: 4.90, SD 3.05, respectively; $P = .003$) and significant high risk for anxiety (HADS-A >9) than healthy control (24.2% and 13.8%, respectively; $P = .035$).[35] Moreover, in multivariable analysis, DASH

Table 2. Quality Assessment of Included Studies

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
Bagheri et al., 2016	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	U	N	N
De Baets et al., 2020	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	U	Y	N
Ding et al., 2014	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	N
Ebrahimzadeh et al., 2019	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	U	Y	N
Toprak et al., 2018	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	N
De Baets et al., 2020	Y	Y	Y	Y	Y	N	Y	N	N	N	N	Y	Y	U	Y	N

N, no; U, unable to determine; Y, yes.

Q1: Is the hypothesis/aim/objective of the study clearly described?

Q2: Are the main outcomes to be measured clearly described in the Introduction or Methods section?

Q3: Are the characteristics of the patients included in the study clearly described?

Q4: Are the distributions of principal confounders in each group of subjects to be compared clearly described?

Q5: Are the main findings of the study clearly described?

Q6: Does the study provide estimates of the random variability in the data for the main outcomes?

Q7: Have actual probability values been reported (e.g., .035 rather than <.05) for the main outcomes except where the probability value is <.001?

Q8: Were the subjects asked to participate in the study representative of the entire population from which they were recruited?

Q9: Were those subjects who were prepared to participate representative of the entire population from which they were recruited?

Q10: Was an attempt made to blind those measuring the main outcomes of the intervention?

Q11: If any of the results of the study were based on data dredging, was this made clear?

Q12: Were the statistical tests used to assess the main outcomes appropriate?

Q13: Were the main outcome measures used accurate (valid and reliable)?

Q14: Were the patients in different intervention groups (trials and cohort studies) or were the cases and controls (case-control studies) recruited from the same population?

Q15: Were study subjects in different intervention groups (trials and cohort studies) or were the cases and controls (case-control studies) recruited over the same period of time?

Q16: Was the sample size calculation done a priori?

score was correlated with severity of anxiety (partial $R^2 = 0.15$, Beta = .12, SE .029, 95% CI: 0.065 to 0.18; $P < .001$) symptoms.[36] In the cross-sectional study of Toprak et al., FSCS patients showed a significantly stronger correlation with the Beck Anxiety Inventory (BAI) than healthy control subjects at baseline (18.45, SD 13.51 vs 11.97, SD 10.22, respectively; $P = .001$) . Further detailed results of these correlations are shown in Table 3.

Pain-Related Beliefs

Two studies by De Baets et al. investigated the correlation between pain-related beliefs and subjective and functional baseline scores in FSCS patients[33,34] (Table 4). The authors found that pain-related beliefs in patients with FSCS explained some of the variance in perceived arm function, including Tampa Scale of Kinesiophobia (TSK) (standardized Beta = .23; $P = .01$) and Pain Self-Efficacy Questionnaire (PSEQ) (standardized Beta = −.5; $P < .0001$), as well as pain intensity (standardized Beta = .29; $P < .0005$).[33]

Discussion

The results of this systematic review suggest that depression and anxiety are associated with increased pain perception and decreased function and quality of life at baseline. Moreover, pain beliefs, such as pain-related fear and catastrophizing, seem to be associated with worse perceived arm function, but not with pain intensity and range of motion (ROM) at baseline.

There were numerous strengths of this systematic review: a prespecified protocol was previously registered on PROSPERO to guaranteed clarity and transparency of the research and the article was structured with rigorous methodology following appropriate guidelines. Moreover, the current guidelines for reporting a systematic review (PRISMA checklist 2020) and specific review tools to assess the risk of bias were used. Additionally, no language, date of publication, or study design restrictions were applied in this research aiming to reach a broad body of literature for exploring the topics of interest. However, the included risk of bias of studies illustrated that samples size was not calculated a priori and that outcome measurements were not blinded. Additionally, the reviewers were unable to determine whether the included literature's patient population in different intervention groups were recruited from similar populations of interest.

While association between shoulder pathologies and psychological factors represents a topic widely discussed,[38-43] there is a paucity of literature that thoroughly examines the relationship between subjective and functional baseline scores and psychological distress in FSCS. To the authors' knowledge, this is the first systematic review that investigated this topic.

On the basis of the findings from this review, scores traditionally thought to assess physical dimensions like

Table 3. Synopses of Correlation Between Anxiety and Depression and Patient-Reported Outcome Measures

	HDQ	HAQ	HADS-D	HADS-D > 9	HADS-A	HADS-A > 9	HADS-D	HADS-D > 8	HADS-A	HADS-A > 8	BDI	BAI
VAS	$R = 0.21$, $P = .024$		$R = 0.482$ $P < .005$	$P = .002$	$R = 0.382$ $P < .05$	$P = .000$	$P = .011$	$R = 0.21$ $P = .02$				
DASH	$R = 0.38$, $P < .001$	$R = 0.32$, $P < .001$					$P > .001$	$R = 0.37$ $P < .001$	$P = .006$			
MCS	$R = 0.60$, $P = .021$	$R = -0.51$, $P < .001$										
SST			$R = -0.491$ $P < .005$	$P = .001$	$R = -0.366$ $P < .05$	$P = .001$						
SPADI			$R = 0.475$ $P < .005$	$P = .000$	$R = 0.400$ $P < .05$	$P = .013$						
HAQ			$R = 0.505$ $P < .005$	$P = .002$	$R = -.396$ $P < .05$	$P = .001$						
HADS-A			$R = 0.741$ $P < .005$									
HADS-D					$R = 0.741$ $P < .05$							
Sleep Disturbance			R = .319 $P < .005$	p= 0.012	$R = 0.322$ $P < .05$	$P = .026$						
ER ROM			$P > .005$		$P > .005$		$P > .001$	$R = -0.37$ $P < .001$		$R = -0.29$ $P = .002$		
IR ROM			$P > .005$		$P > .005$		$P > .001$	$R = -0.35$ $P < .001$		$R = -0.36$ $P < .001$		
EL ROM								R = −0.3 $P < .001$		$R = -0.29$ $P = .002$		
ABD ROM								$R = -0.3$ $P = .001$		$R = 0.29$ $P < .001$		
Education							$P = .013$	R = −0.3 $P < .001$				
WHO-QoL											$R = -0.267$ $P < .05$	$R = -0.266$ $P < .05$
FSCS Stages											P > 0.05	P > 0.05
BDI												$R = 0.296$ $P < .01$
	Bagheri et al., 2016			Ding et al., 2014				Ebrahimzadeh et al., 2019			Toprak et al., 2019	

ABD, abduction; ABD ROM, range of motion in abduction; BAI, Beck Anxiety Inventory; BDI, Beck Depression Inventory; CHL, coraco-humeral ligament; DASH, Disability of the Arm, Shoulder and Hand; ER, external rotation; EL ROM, range of motion in elevation; ER ROM, range of motion in external rotation; FS, frozen shoulder; FSCS, Frozen Shoulder Contracture Syndrome; GH, glenohumeral; HADS-A, Hamilton Anxiety and depression Scale-Anxiety; HADS-D, Hamilton Anxiety and depression Scale-Depression; HAQ, Hamilton Anxiety Questionnaire; HDQ, Hamilton Depression Questionnnaire; IGR, Inferior Gleno-Humeral Recess perimeter; IR, internal rotation; IR ROM, range of motion in internal rotation; MCS, Mental Component Summary; NPRS, Numeric Pain Rating Scale; NRS, Numeric Rating Scale; PCS, Physical Component Summary; PCS*, Pain Catastrophyzing Scale; PSEQ, Pain Self-Efficacy Questionnaire; PSQI, Pittsburgh Sleep Quality Index; ROM, range of movement; SF-36, Health Survey Short Form, 36 question; SPADI, Shoulder Pain and Disability Index; SST, Simple Shouder Test; TSK, Tampa Scale of Kinesiophobia; VAS, visual analog scale; WHO-QoL bref, World Health Organization Quality of Life Scale short form; Y, years.

Table 4. Synopses of Correlations Between Pain Related Beliefs and Patient-Reported Outcome Measures

	Pain-Related Fear	Pain Self-Efficacy	PCS	PSEQ	TSK	PCS	TSK
Perceived arm function	R= 0.51 $P < .0001$	$R = -.69$ $P < .0001$	$R = 0.45$ $P < .0001$			$P = .66$	$P = .88$
DASH						$R = 0.59$ $P = .006$	
TSK			$R = 0.55$ $P < .001$	$R = -0.46$ $P < .001$		$R = 0.2732$ $P = .24$	
PSEQ			$R = -.58$ $P < .001$		$R = -0.46$ $P > .001$		
PCS				$R = -0.58$ $P < .001$	$R = 0.55$ $P > .001$		
ER ROM						$P = .90$	$P = .77$
ABD ROM						$P = .91$	$P = .17$
PAIN at rest						$R = 0.2615$ $P = .26$	$R = 0.0265$ $P = .91$
PAIN at night						$R = 0.3104$ $P = .18$	$R = 0.0324$ $P = .89$
PAIN during activities						$R = 0.2243$ $P = .34$	$R = -0.3256$ $P = .16$
		De Baets et al., 2020				De Bates et al., 2020	

ABD ROM, range of motion in abduction; DASH, Disability of the Arm, Shoulder and Hand; ER ROM, Range of Motion in External Rotation; PCS, pain catastrophizing scale; PSEQ, Pain Self-Efficacy Questionnaire; TSK, Tampa Scale of Kinesiophobia.

shoulder pain, disability, and function seem to be influenced by psychological variables. This is in agreement with previous studies that showed how commonly used shoulder patient-reported outcome measures (PROMs) depend heavily on psychological variables.[17,18,44] Moreover, this systematic review suggests an important and perhaps underappreciated negative association between psychological factors and baseline scores on multiple PROMs that rely exclusively on patient self-assessment of pain and function (i.e., VAS for pain and DASH). Contrarily, other PROMs such as the Constant-Murley score, which bases 65% of its score on physical examination findings, did not correlate significantly with measures of psychological dimension.[16,17]

In clinical practice, the principal assessment for FSCS is range of motion (ROM) measurement;[45] however, in addition, PROMs have become increasingly important for patients' comprehensive assessments,[46] as clinician-based outcome instruments do not reflect patients' psychological distress.[47] Therefore, as illustrated from the current review, efforts should be made to select and to better interpret shoulder patient-based outcome instruments properly.

Knowledge about psychological distress on shoulder pathology should emphasize the importance of rehabilitation that should be catered not only toward physical management but also on psychological care to optimize patients outcomes: in this case, rehabilitation of FSCS patients could be directed not only to peripheral structures for gaining ROM and decreasing pain, but also to psychological aspects through a bio-psycho-social approach.[48-51]

In light of the findings from this review, clinicians should also consider the clinical assessment of FSCS patients. In addition to the biological aspects of pathology (i.e., the intensity of pain and the amount of the ROM restriction), a deeper assessment of psychological factors, such as anxiety, depression, and pain could be appropriate for early recognition management of these aspects that impact patients' conditions (i.e., seems that some symptoms such as pain, discomfort, and mental components of quality of life are more impacted by depression, while anxiety and pain beliefs have a greater impact on upper limb disability).[35] In fact, patients with depression and anxiety may see themselves as being more disabled than might be expected on the basis of objective findings and, thus, might not be capable of adapting to and managing painful upper extremity problem;[17] moreover, depression and anxiety could also impair adherence to prescribed therapy and response to treatment.[52]

A myriad of available treatment options for patients with FSCS were reported in the current review; however, findings suggest that the best rehabilitation choices encompassed corticosteroid injection, manual therapy techniques, stretching, and exercises.[53-55] However, not all FSCS patients had a complete recovery; some still experienced pain, functional disability, ROM deficiency, or both.[12,56] Presently, it has been shown that rehabilitation does not change the presence of pain-related fear and catastrophization in FSCS patients,[34] even if a decrease of score values is observed at 4 months. This is likely because current rehabilitation approaches are not fully directed to the psychological aspects of the pathology and, considering the results of

this systematic review, an implemented and comprehensive physical therapy treatment approach could be advocated.

Overall, the current review suggests that FSCS patients that reported anxiety and depression were more prone to show higher pain perception, lower function, and quality of life than healthy patients; however, it cannot be confirmed if these psychological aspects were present before the onset of the FSCS, or following FSCS diagnosis. In other words, this systematic review cannot answer the question of whether individuals who are depressed and anxious are more prone to develop FSCS.

The existence of personality traits that facilitate the onset of FSCS was a theme discussed in the included literature,[28-31] but the results were variable; accordingly, the hypothesis of a specific "frozen shoulder personality" was not substantiated. Moreover, authors in this article believe that the intrinsic characters of the FSCS (i.e., subdoluous and criptogenetic onset, and high pain, high disability in middle-aged working subjects) could be factors that increase the probability to develop psychological complaints as a consequence of pathology. Notably, the long period of recovery in a group of people who were usually active, the inability to use the arm normally due to pain and stiffness that affect even very fundamental activities of daily living, as well as sport and hobbies, could be psychologically disruptive.[57]

Moreover, the presence of anxiety and depression seem to be a trigger point for sleep disorders,[35] that could, in a vicious circle, increase physical and psychological fatigue. Sleep disturbances seem to be present at two different times for different causes: quality of sleep seems to be impaired due to pain in the first phase (generally characterized by intense pain and mild restriction of movement), while from the third month onward, sleep disturbance seems to be more strictly correlated with anxiety and depression, and mainly affect patients who habitually suffer from shoulder pain for 3 months or longer, negatively affecting the quality of life.[37,58,59] Sleep deprivation wore participants psychologically down, even though they self-declare as "resilient". The nature of the pain was such that they worried about what could be the cause,[57] enhancing catastrophization and pain-related beliefs that decrease the perceived arm function and increase disability in FSCS patients.[33,34] Notably, pain-related beliefs were in negative correlation with self-efficacy, that, in turn was directly correlated with better physical functioning, lower level of pain, and disability[39,60] in people with chronic musculoskeletal pain.

Jones et al.[57] estimated that patients experienced delay in receiving a definitive diagnosis of FSCS: for example, an average of 2 months elapsed from the onset of symptoms to the first medical consultation and that an average of 4.1 months elapsed from the first consultation to the definitive clinical diagnosis. The delay in diagnosis, especially in the early period when the ROM restrictions were not evident, with the increasing of pain-related disability and decreasing quality of life, as soon as the uncertainty about the recovery, could contribute to the development of anxiety and depression, as well as the length of recovery, described as up to 30 months.[56]

Anxiety and depression, the struggle of living, and dealing with FSCS was compounded, in some cases, by a lack of awareness on the part of clinicians and, foremost, a failure to properly and timely diagnose the condition. In fact, diagnosis presented a challenge among nonspecialist (i.e., not upgraded about shoulder disorders management) clinicians, and sometimes, lack of diagnosis or misdiagnosis led to diverse consequences among patients; for example, anxiety, depression, unanswered questions, uncertainty and/or contradictory advice to the treatment options and the potential risks and benefits of different treatments approach.[57] Some clinicians opted for a wait-and-see approach, and most prescribed analgesics without a precise diagnosis. The ineffectiveness of this approach could generate distrust in the patients, and the gaps of awareness of the particular characteristics of the pathology could bring the patients in a situation of psychological fragility.[57]

Notably, patient education is a milestone for clinicians that manage musculoskeletal diseases,[61,62] and pain neuroscience education was shown to be effective for the reduction of pain and the improvement in knowledge about pain, for improving function and lowering disability, and reducing psychosocial factors in adults with musculoskeletal pain.[61] Moreover, studies showed that this approach can enhance pain reconceptualization, which seems to be an important process to facilitate patients' ability to cope with their condition.[61] The results of this study highlights the importance of clinicians managing FSCS through patient education, as neuroscience education in these kinds of patients could reduce the impact of pain-related beliefs on self-efficacy and function.[63]

Clinicians involved in FSCS patients' rehabilitation should investigate the presence of psychological features. Moreover, the prognostic value of psychological features must be investigated: improving knowledge about this aspects could direct clinicians to include other therapeutic strategies and to gain further expertise in psychological management, because these factors can be positively managed by physiotherapeutic approaches.[64] Moreover, FSCS patients could be oriented to a multiprofessional pattern of care, implementing current care administration strategies.

Other psychological factors (i.e., expectation, fear, or optimism) should be investigated in future studies that aim to understand their own prognostic value.

Research into understanding the potential causative role of psychological distress in the FSCS development should be structured with the aim to identify people at risk, and the additional value of a psychosocial oriented therapeutic approach should be evaluated.

Limitations

Some limitations did exist in the current review. This review explored psychological factors in a specific pathological population: this limits the generalizability of our results, but at the same time increases the value of these results in a specific FSCS patient population. An additional limitation of the studies that was reflected by our review is that not all psychological factors were equally explored and that the level of evidence of the analyzed studies was low. Search strategies, even if comprehensive and based on the Population, Intervention, Comparison, Outcomes (PICO) approach, may have missed some studies of interest, and some psychological factors (e.g., helplessness, pessimism, and acceptance of illness) were not investigated.

Conclusion

Scores traditionally thought to assess physical dimensions like shoulder pain, disability, and function seem to be influenced by psychological variables. In FSCS patients, depression and anxiety were associated with increased pain perception and decreased function and quality of life at baseline. Moreover, pain-related fear and catastrophizing seem to be associated with perceived arm function.

Acknowledgments

Authors kindly thank Professor Liesbet de Baets for sharing the raw data of her manuscript.

References

1. Lewis J. Frozen shoulder contracture syndrome—Aetiology, diagnosis and management. *Man Ther* 2015;20:2-9.
2. Ryan V, Brown H, Minns Lowe CJ, Lewis JS. The pathophysiology associated with primary (idiopathic) frozen shoulder: A systematic review. *BMC Musculoskelet Disord* 2016;17:340.
3. Akbar M, McLean M, Garcia-Melchor E, et al. Fibroblast activation and inflammation in frozen shoulder. *PLos One* 2019;14:e0215301.
4. Kingston K, Curry EJ, Galvin JW, Li X. Shoulder adhesive capsulitis: Epidemiology and predictors of surgery. *J Shoulder Elbow Surg* 2018;27:1437-1443.
5. Le HV, Lee SJ, Nazarian A, Rodriguez EK. Adhesive capsulitis of the shoulder: review of pathophysiology and current clinical treatments. *Shoulder Elbow* 2017;9:75-84.
6. Redler LH, Dennis ER. Treatment of adhesive capsulitis of the shoulder. *J Am Acad Orthop Surg* 2019;27:e544-e554.
7. Wang K, Ho V, Hunter-Smith DJ, Beh PS, Smith KM, Weber AB. Risk factors in idiopathic adhesive capsulitis: A case control study. *J Shoulder Elbow Surg* 2013;22:e24-e29.
8. Page MJ, Green S, Kramer S, et al. Manual therapy and exercise for adhesive capsulitis (frozen shoulder) (Cochrane review) [with consumer summary]. *Cochrane Database of Systematic Reviews* 2014;8:2014.
9. Mertens MG, Meert L, Struyf F, Schwank A, Meeus M. Exercise therapy is effective for improvement in range of motion, function and pain in patients with frozen shoulder: A systematic review and meta-analysis. *Arch of Phys Med Rehabil* 2022;103:998-1012.e14.
10. Abrassart S, Kolo F, Piotton S, et al. 'Frozen shoulder' is ill-defined. How can it be described better? *EFORT Open Rev* 2020;5:273-279.
11. Eljabu W, Klinger HM, von Knoch M. The natural history of rotator cuff tears: A systematic review. *Arch Orthop Trauma Surg* 2015;135:1055-1061.
12. Wong CK, Levine WN, Deo K, et al. Natural history of frozen shoulder: Fact or fiction? A systematic review. *Physiotherapy* 2017;103:40-47.
13. Kim DH, Kim YS, Kim BS, Sung DH, Song KS, Cho CH. Is frozen shoulder completely resolved at 2 years after the onset of disease? *J Orthop Sci* 2020;25:224-228.
14. Shaffer B, Tibone JE, Kerlan RK. Frozen shoulder. A long-term follow-up. *J Bone Joint Surg Am* 1992;74:738-746.
15. Kelley MJ, Shaffer MA, Kuhn JE, et al. Shoulder pain and mobility deficits: Adhesive capsulitis. *J Orthop Sports Phys Ther* 2013;43:A1-A31.
16. Potter MQ, Wylie JD, Greis PE, Burks RT, Tashjian RZ. Psychological distress negatively affects self-assessment of shoulder function in patients with rotator cuff tears. *Clin Orthop Relat Res* 2014;472:3926-3932.
17. Roh YH, Noh JH, Oh JH, Baek GH, Gong HS. To what degree do shoulder outcome instruments reflect patients' psychologic distress? *Clin Orthop Relat Res* 2012;470:3470-3477.
18. Cho CH, Seo HJ, Bae KC, Lee KJ, Hwang I, Warner JJ. The impact of depression and anxiety on self-assessed pain, disability, and quality of life in patients scheduled for rotator cuff repair. *J Shoulder Elbow Surg* 2013;22:1160-1166.
19. Vranceanu AM, Barsky A, Ring D. Psychosocial aspects of disabling musculoskeletal pain. *J Bone Joint Surg Am* 2009;91:2014-2018.
20. Han H-S, Lee J-Y, Kang S-B, Chang CB. The relationship between the presence of depressive symptoms and the severity of self-reported knee pain in the middle aged and elderly. *Knee Surg Sports Traumatol Arthrosc* 2016;24:1634-1642.
21. Roh YH, Lee BK, Noh JH, Oh JH, Gong HS, Baek GH. Effect of depressive symptoms on perceived disability in patients with chronic shoulder pain. *Arch Orthop Traum Surg Archiv* 2012;132:1251-1257.
22. Lindenhovius AL, Buijze GA, Kloen P, Ring DC. Correspondence between perceived disability and objective physical impairment after elbow trauma. *J Bone Joint Surg Am* 2008;90:2090-2097.
23. Munn Z, Moola S, Lisy K, Riitan D, Tufanaru C. Chapter 5: Systematic reviews of prevalence and incidence. In: Aromataris E, Munn Z, eds. JBI Manual for Evidence Synthesis. *JBI* 2020. Available from, https://synthesismanual.jbi.global; doi:https://doi.org/10.46658/JBIMES-20-01.

24. Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71.
25. Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan-a web and mobile app for systematic reviews. *Syst Rev* 2016;5:210.
26. Chiarotto A, Clijsen R, Fernandez-de-Las-Penas C, Barbero M. Prevalence of myofascial trigger points in spinal disorders: A systematic review and meta-snalysis. *Arch Phys Med Rehabil* 2016;97:316-337.
27. Lorenz TH, Musser MJ. Life stress, emotions and painful stiff shoulder. *Annals Int Med* 1952;37:1232-1244.
28. Chiaramonte R, Bonfiglio M. A significant relationship between personality traits and adhesive capsulitis. 2020;66:166-173.
29. Debeer P, Franssens F, Roosen I, Dankaerts W, Claes L. Frozen shoulder and the Big Five personality traits. *J Shoulder Elbow Surg* 2014;23:221-226.
30. Wright V, Haq AM. Periarthritis of the shoulder. I. Aetiological considerations with particular reference to personality factors. *Annals Rheum Dis* 1976;35:213-219.
31. Fleming A, Dodman S, Beer TC, Crown S. Personality in frozen shoulder. *Annals Rheum Dis* 1975;35:456-457.
32. Bagheri F, Ebrahimzadeh MH, Moradi A, Bidgoli HF. Factors associated with pain, disability and quality of life in patients suffering from frozen shoulder. *Arch Bone Joint Surg* 2016;4:243-247.
33. De Baets L, Matheve T, Traxler J, Vlaeyen J, Timmermans A. Pain-related beliefs are associated with arm function in persons with frozen shoulder. *Shoulder Elbow* 2020;12:432-440.
34. De Baets L, Matheve T, Dierickx C, Bijnens E, Jans D, Timmermans A. Are clinical outcomes of frozen shoulder linked to pain, structural factors or pain-related cognitions? An explorative cohort study. *Musculoskelet Sci Pract* 2020;50:102270.
35. Ding H, Tang Y, Xue Y, et al. A report on the prevalence of depression and anxiety in patients with frozen shoulder and their relations to disease status. *Psychol Health Med* 2014;19:730-737.
36. Ebrahimzadeh MH, Moradi A, Bidgoli HF, Zarei B. The relationship between depression or anxiety symptoms and objective and subjective symptoms of patients with frozen shoulder. *Int J Prevent Med* 2019;10:38.
37. Toprak M, Erden M. Sleep quality, pain, anxiety, depression and quality of life in patients with frozen shoulder. *J Back Musculoskel Rehab* 2019;32:287-291.
38. Martinez-Calderon J, Struyf F, Meeus M, Luque-Suarez A. The association between pain beliefs and pain intensity and/or disability in people with shoulder pain: A systematic review. *Musculoskelet Sci Pract* 2018;37:29-57.
39. Martinez-Calderon J, Meeus M, Struyf F, Miguel Morales-Asencio J, Gijon-Nogueron G, Luque-Suarez A. The role of psychological factors in the perpetuation of pain intensity and disability in people with chronic shoulder pain: A systematic review. *BMJ Open* 2018;8:e020703.
40. Martinez-Calderon J, Meeus M, Struyf F, et al. Psychological factors are associated with local and generalized pressure pain hypersensitivity, pain intensity, and function in people with chronic shoulder pain: A cross-sectional study. *Musculoskelet Sci Pract* 2019;44:102064.
41. Kennedy P, Joshi R, Dhawan A. The effect of psychosocial factors on outcomes in patients with rotator cuff tears: A systematic review. *Arthroscopy* 2019;35:2698-2706.
42. Coronado RA, Seitz AL, Pelote E, Archer KR, Jain NB. Are psychosocial factors associated with patient-reported outcome measures in patients with rotator cuff tears? A systematic review. *Clin Orthop Relat Res* 2018;476:810-829.
43. Wong WK, Li MY, Yung PS, Leong HT. The effect of psychological factors on pain, function and quality of life in patients with rotator cuff tendinopathy: A systematic review. *Musculoskelet Sci Pract* 2020;47:102173.
44. Ring D, Kadzielski J, Malhotra L, Lee SG, Jupiter JB. Psychological factors associated with idiopathic arm pain. *J Bone Joint Surg Am* 2005;87:374-380.
45. Hanchard N, Goodchild L, Thompson J, et al. Evidence-based clinical guidelines for the diagnosis, assessment and physiotherapy management of contracted (frozen) shoulder. 2012;98:117-120.
46. Tesio L. Functional assessment in rehabilitative medicine: Principles and methods. *Eura Medicophys* 2007;43:515-523.
47. Coulter A. Measuring what matters to patients. *BMJ* 2017;356:j816.
48. Tseli E, LoMartire R, Vixner L, Grooten WJA, Gerdle B, Äng BO. What is the effectiveness of different duration interdisciplinary treatment programs in patients with chronic pain? A large-scale longitudinal register study. *J Clin Med* 2020;9:1-17.
49. Babatunde OO, Jordan JL, Van der Windt DA, Hill JC, Foster NE, Protheroe J. Effective treatment options for musculoskeletal pain in primary care: A systematic overview of current evidence. *PloS One* 2017;12:e0178621.
50. Leon Mateos L. Psychosocial aspects of rheumatic and musculoskeletal diseases. *Reumatol Clin (Engl Ed)* 2020;16:1-2. Aspectos psicosociales de las enfermedades reumáticas y musculoesqueléticas.
51. Hush JM, Cameron K, Mackey M. Patient satisfaction with musculoskeletal physical therapy care: A systematic review. *Phys Ther* 2011;91:25-36.
52. Turk DC, Rudy TE. Neglected topics in the treatment of chronic pain patients—Relapse, noncompliance, and adherence enhancement. *Pain* 1991;44:5-28.
53. Sharma SP, Bærheim A, Moe-Nilssen R, Kvåle A. Adhesive capsulitis of the shoulder, treatment with corticosteroid, corticosteroid with distension or treatment-as-usual; A randomised controlled trial in primary care. *BMC Musculoskel Dis* 2016;17:232.
54. Challoumas D, Biddle M, McLean M, Millar NL. Comparison of treatments for frozen shoulder: A systematic review and meta-analysis. *JAMA Netw Open* 2020;3:e2029581.
55. Lowe CM, Barrett E, McCreesh K, De Búrca N, Lewis J. Clinical effectiveness of non-surgical interventions for primary frozen shoulder: A systematic review. *J Rehabil Med* 2019;51:539-556.
56. Robinson CM, Seah KT, Chee YH, Hindle P, Murray IR. Frozen shoulder. *J Bone Joint Surg Brit Vol* 2012;94:1-9.
57. Jones S, Hanchard N, Hamilton S, Rangan A. A qualitative study of patients' perceptions and priorities when living with primary frozen shoulder. *BMJ Open* 2013;3:e003452.

58. Cho CH, Jung SW, Park JY, Song KS, Yu KI. Is shoulder pain for three months or longer correlated with depression, anxiety, and sleep disturbance? *J Shoulder Elbow Surg* 2013;22:222-228.
59. Mulligan EP, Brunette M, Shirley Z, Khazzam M. Sleep quality and nocturnal pain in patients with shoulder disorders. *J Shoulder Elbow Surg* 2015;24:1452-1457.
60. Martinez-Calderon J, Zamora-Campos C, Navarro-Ledesma S, Luque-Suarez A. The role of self-efficacy on the prognosis of chronic musculoskeletal pain: A systematic review. *J Pain* 2018;19:10-34.
61. Watson JA, Ryan CG, Cooper L, et al. Pain neuroscience education for adults with chronic musculoskeletal pain: A mixed-methods systematic review and meta-analysis. *J Pain* 2019;20:1140.e1-1140.e22.
62. Louw A, Zimney K, Puentedura EJ, Diener I. The efficacy of pain neuroscience education on musculoskeletal pain: A systematic review of the literature. *Physiother Theory Pract* 2016;32:332-355.
63. Sawyer EE, McDevitt AW, Louw A, Puentedura EJ, Mintken PE. Use of pain neuroscience education, tactile discrimination, and graded motor imagery in an individual with frozen shoulder. *J Orthop Sports Phys Ther* 2018;48:174-184.
64. Silva Guerrero AV, Maujean A, Campbell L, Sterling M. A systematic review and meta-analysis of the effectiveness of psychological interventions delivered by physiotherapists on pain, disability and psychological outcomes in musculoskeletal pain conditions. *Clin J Pain* 2018;34:838-857.

Appendix Table 1. Search Strategies for Databases

Source	Search Terms
MEDLINE (589 results)	(((((((frozen shoulder) OR (Adhesive Capsulitis of the Shoulder)) OR (Bursitis[MeSH Terms])) OR (Capsulit*)) OR (Shoulder Adhesive Capsulitis)) OR (Stiff shoulder)) OR (adhesive capsulitis)) OR (Frozen shoulder contracture syndrome)) OR (Frozen Shoulder[MeSH Terms]) AND ((((((((((((((((((((psychosocial) OR (psychosocial factors)) OR (psychological)) OR (psychology[MeSH Terms])) OR (fear[MeSH Terms])) OR (avoid*)) OR (avoidance behaviour)) OR (avoidance learning[MeSH Terms])) OR (Avoidance Behavior)) OR (Avoidance Behaviors)) OR (catastrophization[MeSH Terms])) OR (catastroph*)) OR (Catastrophizing)) OR (Pain Catastrophizing)) OR (anxiety[MeSH Terms])) OR (hypervigilance)) OR (depression[MeSH Terms])) OR (depressive disorder[MeSH Terms])) OR (expectation[MeSH Terms])) OR (motivation[MeSH Terms])) OR (Expectations)) OR (Kinesiophobia)) OR (optimism)
Cochrane Library (CENTRAL database) (92 results)	(“Frozen shoulder” OR “Adhesive Capsulitis of the shoulder" OR "stiff shoulder" OR "frozen shoulder contracture syndrome" OR bursitis OR capsulitis OR “shoulder adhesive capsulitis” OR “adhesive capsulitis”) AND (psychosocial OR “psychosocial factors” OR psychological OR psychology OR fear OR avoiding OR avoid OR avoided OR “avoidance behaviour” OR “Avoidance Behavior” OR catastrophization OR Catastrophizing PR “Pain Catastrophizing” OR Anxiety OR hypervigilance depression OR “depressive disorder” OR expectation OR motivation OR Expectations OR Kinesiophobia OR optimism)
PEDro Database (90 results)	Title and abstract: “Frozen Shoulder”
PubPSYCH (4 results)	Title and abstract: “Frozen Shoulder”
PsychNET.APA (1 result)	Title and abstract: “Frozen Shoulder”

Appendix Table 2. Population, Exposition, Outcomes (PEO) Strategy

MEDLINE	
POPULATION	Frozen Shoulder [MeSH Terms]
	Frozen shoulder contracture syndrome
	Adhesive capsulitis
	Stiff shoulder
	Shoulder Adhesive Capsulitis
	Capsulit*
	Bursitis [MeSH Terms]
	Adhesive Capsulitis of the Shoulder
EXPOSITION	psychosocial
	psychosocial factors
	psychological
	psychology [MeSH Terms]
	fear [MeSH Terms]
	avoid*
	avoidance behaviour
	avoidance learning [MeSH Terms]
	Avoidance Behavior
	Avoidance Behaviors catastrophization [MeSH Terms]
	catastroph*
	Catastrophizing
	Pain Catastrophizing anxiety [MeSH Terms]
	hypervigilance
	depression [MeSH Terms]
	depressive disorder [MeSH Terms]
	expectation [MeSH Terms]
	motivation [MeSH Terms]
	Expectations
	Kinesiophobia optimism
OUTCOME	Disability
	Pain
	Health-related quality of life
	Return to work
	Return to recovery

Appendix Table 3. Reasons for Full Text Exclusion

	Authors (Year)	Title	Study Design	Reason for Exclusion
1.	Lorenz et al. (1952)	Life stress, emotions and painful stiff shoulder	Cross-sectional study	Wrong population sample
2.	Chiaramonte et al. (2019)	A significant relationship between personality traits and adhesive capsulitis	Prospective study	Did not investigate association between psychological factors and PROMs
3.	Debeer et al. (2014)	Frozen shoulder and the Big Five personality traits	Cross-sectional study	Did not investigate association between psychological factors and PROMs
4.	Fleming et al. (1976)	Personality in frozen shoulder	Cross sectional study	Did not investigate association between psychological factors and PROMs
5.	Wright et al. (1976)	Periarthritis of the shoulder. I. Aetiological considerations with particular reference to personality factors	Cross sectional study	Did not investigate association between psychological factors and PROMs

PROMS, patient-reported outcome measures.