Do Psychological Factors Affect Outcomes in Musculoskeletal Shoulder Disorders? A Systematic Review

Ali Sheikhzadeh (as54@nyu.edu)
New York University Medical Center: NYU Langone Health https://orcid.org/0000-0001-7000-8866
Maria M. Wertli
Bern University Hospital
Shira Schecter Weiner
NYU Langone Orthopedic
Eva Rasmussen-Barr
Karolinks Institute
Sherri Weiser
NYU Langone Orthopedics

Research article

Keywords: conservative intervention, surgical intervention, modifiable psychological factors, treatment outcome, predictors

Posted Date: November 23rd, 2020

DOI: https://doi.org/10.21203/rs.3.rs-104798/v1

Abstract

Background

The aim is to systematically analyse the evidence for the effect of modifiable psychological factors (MPF), those that can be changed with intervention, on outcome, for patients with musculoskeletal shoulder disorders undergoing conservative or surgical treatment.

Methods

This is a systematic literature review. We searched five databases for longitudinal studies investigating the influence of MPF on the prognosis of patients with musculoskeletal shoulder disorders undergoing conservative or surgical treatment. We assigned each MPF identified in the included references to one of six constructs and categorized all constructs into three domains. We then evaluated each construct for its predictive value of at least one outcome, and all outcomes reported were considered. Evidence was classified into three categories: evidence for, inconclusive evidence, and evidence against each construct.

Results

Of 1140 publications, 35 publications based on 33 studies were included (intervention type: 15 surgical; 18 conservative). Outcomes reported included pain, disability/function, perceived recovery, physical and mental health, and work status. Six modifiable psychological constructs were explored including self-efficacy, expectation of recovery, catastrophizing, avoidant coping, depression, and anxiety. The majority of the evidence suggested the prognostic value of all constructs except self-efficacy for patients managed surgically. In patients undergoing conservative intervention the evidence was inconclusive or against the prognostic value of MPF on outcomes.

Conclusions

Five constructs were found to be predictive of outcome for surgically managed patients. This suggests that implementing the biopsychosocial approach to patients with musculoskeletal shoulder disorders managed surgically may be advantageous. The same was not observed for conservative care. The importance of other MPF on outcome requires further investigation.

Introduction

Background

Shoulder conditions are the third most common musculoskeletal complaint (1, 2). Only fifty percent of patients with a new episode of shoulder pain experience complete recovery within six months and pain persists in 40% for more than one year (3). In those who seek care, there is limited understanding of how to identify patients who may or may not respond to interventions (4). Therefore, we need to understand barriers to and facilitators of recovery in patients with shoulder pain.

To improve treatment outcomes for shoulder complaints, modifiable factors that influence the prognosis need to be identified. The focus of this review is on psychological factors. Modifiable psychological factors (MPF) are common responses to pain that may impact recovery, and may respond to treatment. Exploring the relationship between MPF and outcomes is valuable, because if MPF are effectively managed then outcomes may improve. Modifiable psychological factors are different than change-resistant psychological traits and psychopathologies which were not considered in this review. While all barriers to recovery may be relevant to the development of a treatment plan, those that are more easily modifiable may be remediated, thereby facilitating recovery. Some MPF such as pain beliefs, pain affect and pain coping strategies have previously been recognized as barriers to and facilitators of recovery in other musculoskeletal conditions (1, 2, 5–8). Maladaptive beliefs about pain, negative affective reactions and poor coping are indicators of psychological distress. They have been found to adversely influence both the short and long-term outcomes of conservative and surgical treatments in patients with spine, hip and knee conditions (9–12). Psychological distress has been associated with increased pain and health care utilization, as well as poor physical function and work outcomes (13). Likewise, self-efficacy and positive expectation of recovery are coping resources that have been associated with better functional and work outcomes in patients with musculoskeletal disorders (7, 8). There is compelling evidence to monitor and address MPF in patients with spine pain as part of routine clinical care (14, 15). However, despite their important role in spine and other musculoskeletal conditions, to date there is equivocal evidence to support the importance of MPF in shoulder pain (8, 16, 17, 18, 19, 20). As such, these factors typically are not part of routine clinical evaluation for patients with shoulder problems and are often overlooked in clinical treatment of the shoulder (21, 22).

Kendall and Burton propose that in the absence of red flags suggestive of an emergent medical situation, all musculoskeletal conditions that limit activity may be treated like low back pain (23). This treatment would include advice for self-care, education on expectation of a good recovery and instruction to continue with usual activity as tolerated. Therefore, it is reasonable to expect that in the treatment of shoulder disorders, the role of psychological factors may be comparable to the role they play in spine pain.

Recent reviews explored psychological factors in various patient groups, such as those receiving conservative and surgical care (16), conservatively managed patients only (17, 18), patients with shoulder and elbow tendinopathy (19) or shoulder tendinopathy(24) only, patients undergoing arthroplasty(25) and patients with various etiologies associated with chronic shoulder pain(8). This makes it difficult to compare the conclusions. In addition, the methodology of these reviews was limited to studies with a reported follow-up of at least 6 weeks (8), outcome measures restricted to pain and disability (8, 16, 20), nonspecific identification of psychological factors(25) or a single predefined psychological domain such as beliefs (20). Therefore, because of the heterogeneity of these studies (8) along with methodological variability, the current reviews provide a limited perspective on the relationship between MPF and outcomes in patients with musculoskeletal shoulder disorders (MSD).

The aim of this literature review was to systematically summarize the current evidence on the importance of MPF on outcome in those studies addressing surgical intervention and those addressing conservative intervention for patients with MSD. Unlike previous systematic reviews that focused on some MPF and did not subcategorize studies based on intervention, our aim was to capture studies on all MPF in surgical and conservative studies to better identify those MPF that predict outcomes in this population. This review included all phases of shoulder disorders (acute, subacute, chronic) and all MPF referenced in the reviewed studies, in order to gain important insights regarding the relationship between MPF and shoulder pain.

Methods

This systematic review followed the recommendation of the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement (26).

Search Strategy

The framework to determine the research questions, search strategy and criteria for inclusion was defined by the authors by consulting the relevant literature on modifiable psychological factors. We searched five databases, without any language and date range limits, in September 2019: MEDLINE (EBSCOhost), CINAHL (EBSCOhost), Cochrane Library, Embase (Elsevier), and PsycInfo (EBSCOhost), seeking literature for all psychological factors found to be associated with shoulder pain, and focused on those associated with the response to pain and considered to be modifiable (27).

The search was conducted with the help of a research librarian (MG). Two detailed search strategies are depicted in Appendix 1. To ensure the completeness of the literature search, bibliographies of included studies and review articles related to the research question were examined by one reviewer (MW), and relevant references were considered for full-text review (inclusion and exclusion criteria applied).

Data Collection and Abstraction

Two reviewers (MW and ERB) screened all references independently by title and abstract. Disagreements were discussed and resolved by consensus or by third-party arbitration (SSW). References with insufficient information in the title or abstract to assess eligibility, were included in the full text review. All full texts were then appraised by both reviewers independently (MW and ERB) for inclusion or exclusion. Alternative researchers with specific language proficiencies were used for non-English language references, with no language restrictions. In the case of several publications for the same cohort without change in outcome or follow-up duration, the most recent publication was chosen and missing information from the previous publication was added. Systematized criteria were defined to extract specific variables from each reference and were followed by each reviewer. All information needed to describe the study population and methodology was collected: study setting, study design, number of patients, age, proportion of women, intervention, and follow-up duration. In addition, the methods of assessment and information on the type of analysis of the prognostic, predictive or mediating factors were extracted. The inclusion/exclusion criteria guided this process.

Inclusion and Exclusion Criteria

Included were all longitudinal studies (cohort studies, randomized controlled trials (RCT), and registries) investigating patients with shoulder complaints undergoing conservative or surgical treatment. Studies were eligible when they included the influence of MPF on the prognosis or treatment outcome. Excluded were non-treatment based experimental studies, cross-sectional studies, case series, epidemiological studies, and studies on patients younger than 18 years of age. Studies of personality traits and psychiatric conditions were excluded.

Assessment of Study Quality

A quality rating was assigned based on the risk of bias, using the Scottish Intercollegiate Guidelines Network (SIGN) methodology checklist for cohort studies and randomized clinical trials and the overall quality was rated as high, moderate, or low (28).. The ratings were as follows: high quality (++), most (≥ 60%) of the criteria fulfilled; moderate quality (+), some criteria fulfilled (< 60%); and low quality (–), few or no criteria fulfilled. Two reviewers (MW and EBR) assessed each reference. Any discrepancies were resolved by another member of the research team (SSW). High and moderate quality studies were included in this review.

Definition of Terms

For the purpose of this study, MPF are defined as those factors that may be expected to change with appropriate therapeutic intervention and are therefore states rather than traits. We utilized a framework of psychological domains (14) and modifiable constructs extracted from the included studies (Table 1) in order to synthesize the findings.

The term prognostic factor is used to describe a MPF that influences or predicts the course or outcome of a shoulder disorder. The prognostic value of a psychological factor is based on the reported results and conclusions of the primary studies. No predefined outcomes were identified for this review. Study outcome was extracted from each included reference based on the reported measure of assessment.

We classified studies based on patients' duration of pain as subacute (< 12 weeks), chronic (> 12 weeks) or a mixed duration of shoulder complaints as described in the original studies.

Classification of evidence

All included studies were grouped based on the MPF addressed, time from onset and clinical intervention (conservative, surgical). We evaluated each construct based on the number of studies that reported it as a predictor of at least one outcome or not a predictor of any outcome. Outcomes were purposefully not predefined, as our objective was to identify all outcomes that have been included in studies on MPF in patients with MSD. If the number of

studies with results showing that a construct was predictive of outcome was greater than the number of studies showing it was not predictive, we considered the construct predictive. If the opposite was true, then we considered the construct to not be a predictor of outcome. In those cases where an equal number of studies found evidence for and against the predictive value of the construct, the evidence was found inconclusive. Based on these criteria, the evidence was classified into three categories: Category 1) Evidence for – a majority of the studies found the construct to be a predictor of outcome; Category 2) Inconclusive evidence – An equal number of studies found evidence for and against the predictive value of the construct, Category 3) Evidence against-a majority of studies did not find the construct to be a predictor of outcome.

Results

Study selection

A total of 1,515 publications were identified through database searches and 42 references through hand searches of relevant literature (Fig. 1). After excluding duplications, 1140 abstract were screened, and 121 full-text articles assessed for eligibility. After excluding 86 publications, 35 publications based on 33 patient data sets were included for data extraction and analysis, hereafter referred to as 35 studies. The main reasons for exclusion were mixed patient populations without reporting specific results for subjects with shoulder complains (n = 31) and studies that did not assess MPF (n = 26, Fig. 1)

Baseline Characteristics

Of the 35 included studies, three were randomized clinical trials. There were 18 studies on conservative intervention and 17 on surgical intervention. Follow-up duration ranged from end-of-treatment to 12 months. The studies represented a broad spectrum of shoulder diagnoses, representative of a typical clinical population (Table 2).

Study quality

Risk of bias in 35 studies was assessed using the SIGN method (Appendix 2A). In all tables, high-quality studies included in this manuscript (Appendix 2A) are indicated by bold typeface. Seventeen cohort studies were rated as high quality and 14 studies rated as moderate quality. Two randomized clinical trial was rated as high quality and two were rated as moderate. Overall, 17 (49%) of included studies were rated as high quality, 12 studies related to conservative care, and 5 studies related to surgical intervention. Most studies did not provide a formal sample size calculation. Five (28%) of the conservative studies reported a required sample size and met the requirement. Four (23%) surgical studies reported a required sample size; three studies met the required sample size, and one study did not (150 instead of 360 patients).

Study Outcomes and Measures

Various outcomes were noted in the reviewed literature and included those related to pain, disability/function, perceived recovery, physical and mental health, and work status. The most common outcomes noted in the reviewed literature were pain (15 (43%) publications), disability/function (19 (54%) publications), combined pain and disability/function (15 (43%) publications). Outcome measures most commonly utilized in the reviewed studies included the Visual Analog Scale (VAS) for pain (8 (23%) publications), the Disabilities of the Arm, Shoulder and Hand (DASH and QuickDASH) measuring function (7 (20%) publications), and the Shoulder Pain and Disability Index (SPADI) (10 (26%) publications). All outcome measures are listed in Table 3.

Clinical intervention

Conservative intervention: Among the 18 studies on conservative intervention, four addressed patients with subacute MSD, four addressed patients with chronic MSD and ten did not specify time from onset or presented a mixed population. All six MPF were investigated (Table 4).

Surgical intervention

Among the 17 studies on surgical intervention, one addressed patients with subacute MSD, two addressed patients with chronic MSD, and fourteen studies did not specify time from onset or presented a mixed population. Five of six MPF were addressed. There were no studies investigating the construct of self-efficacy for surgical cases, Table 4.

Modifiable psychological domains and constructs

In this sample, the domains of “coping” and “affect” were most investigated, 14 (40%) publications and 25 (71%) publications respectively, and the domain of “beliefs” was least investigated, 8 (23%) publications (Tables 3 and 4). Of the six predefined constructs, depression (Domain: Affect) was the most studied construct, 24 (69%) publications, and self-efficacy (Domain: Beliefs), the least studied, one publication. For surgical care, we found evidence for catastrophizing, avoidant coping, depression, anxiety, and expectation of recovery as predictors of outcome. For conservative care, we found inconclusive evidence or evidence against the prognostic value of these constructs as predictors of outcome. The following provides details of the prognostic value of each MPF in patients with shoulder problems managed conservatively or surgically.

Domain: Coping

Catastrophizing: Catastrophizing as a predictor of outcome was explored in ten publications (five surgical, five conservative). In seven publications (five (100%) surgical [two high quality], two (40%) conservative [two high quality]) catastrophizing predicted at least one outcome. Therefore, based on this review,

catastrophizing in surgical cases fell into Category 1, evidence for, while for conservative cases it was Category 3, evidence against.

Avoidant coping/Fear avoidance: Avoidant coping as a predictor of outcome was explored in eleven publications (five surgical, six conservative). In seven publications (four (80%) surgical [three high quality], three (50%) conservative [two high quality]) avoidant coping/fear avoidance predicted at least one outcome. Therefore, based on this review, avoidant coping/fear avoidance in surgical cases fell into Category 1, evidence for, while for conservative cases it was Category 2, inconclusive.

Domain: Affect

Depression: Depression as a predictor of outcome was explored in 24 publications (12 surgical, 12 conservative). In 11 publications (seven (58%) surgical [three high quality], four (33%) conservative [three high quality]) depression predicted at least one outcome. Therefore, based on this review, evidence for depression in surgical cases fell into Category 1, evidence for, while for conservative cases it was Category 3, evidence against.

Anxiety: Anxiety as a predictor of outcome was explored in 12 publications (six surgical, six conservative). In five publications (four (67%) surgical [two high quality], one (17%) conservative [one high quality]) anxiety predicted at least one outcome. Therefore, based on this review, evidence for anxiety as a predictor in surgical cases fell into Category 1, evidence for, while for conservative cases it was Category 3, evidence against.

Domain: Beliefs

Self-efficacy: Self-efficacy as a predictor of outcome was explored in only one publication (one conservative [one high quality]). Based on this publication evidence for self-efficacy as a predictor in conservative cases fell into Category 3, evidence against.

Expectation of recovery: Expectation of recovery as a predictor of outcome was explored in seven publications (two surgical, five conservative). In four publications (two (100%) surgical [one high quality], two (40%) conservative [two high quality]) expectation of recovery predicted at least one outcome. Therefore, based on this review, evidence for expectation of recovery as a predictor in surgical cases fell into Category 1, evidence for, while for conservative cases it was Category 3, evidence against.

Discussion

This review aimed to explore the relationship between MPF and outcomes in patients with shoulder disorders and found that psychological factors may be barriers and facilitators to recovery for patients with shoulder pain managed surgically. Compared to previous reviews (8, 16–20) this review provides a more comprehensive examination of the topic in several ways. We included studies of both conservative and surgical intervention, short and long time from onset, and applied no language restrictions in our search. Therefore, we were able to gain a broad perspective of the literature from which this topic could be explored. Also, our specific focus on factors that are modifiable makes our results clinically relevant to health care providers. Interventions to address MPF have been developed and have been shown to affect outcomes in other pain conditions such as back and neck pain, and may thus be modified for patients with shoulders disorders as well (29).

Categorizing studies by type of intervention proved useful in elucidating the importance of MPF on outcome in this population. Based on our findings, evidence for the predictive value of psychological constructs on outcome was noted for people with shoulder disorders managed surgically while evidence against most constructs as predictors was noted for those undergoing conservative treatment. The exception was the construct of fear avoidance, for which there were conflicting results in conservative treatment. Anxiety, expectation of recovery, depression, and avoidant coping style were shown to predict outcome in high quality surgical studies, while catastrophizing was shown to predict outcome in moderate quality surgical studies.

Another aim of this review was to explore the influence of time from onset on the relationship between MPF and outcome. Time from onset of shoulder pain was not defined in 14 of the surgical studies (82%) and nine of the conservative studies (50%) included in this review. When interpreting the findings, it is important to recognize that typically surgical intervention occurs during the chronic phase, after failed conservative management during the subacute phases (30). Therefore, it may be reasonable to infer that the majority of patients undergoing surgical intervention likely had chronic MSD. One incidental finding was found for those patients receiving surgical care. Less than 20% of the surgical studies reported time from onset. In those that did, a relationship between MPF and outcome was found for patients with chronic, but not subacute, MSD.

In the case of conservative intervention, it is difficult to draw definitive conclusions. This is because among those studies that did report time from onset for conservative intervention, the findings were either inconclusive or against the predictive value of MPF on outcome. Although this study aimed to explore the influence of time from onset on MPF and outcomes, the findings are inconclusive for conservative intervention. However, the findings from the surgical studies suggest that this is an important topic for further investigation.

Previous systematic reviews attempting to explore the impact of psychological factors on outcome in patients with shoulder conditions drew from a limited pool of studies, many of which are of low quality or lack important methodological details, such as time from onset (8, 16–20). Also, they focused on only surgical interventions or focused on psychological constructs, without defining those that are modifiable, and without distinguishing between surgical and conservative cases. For this reason, the importance of psychological factors on outcome in subgroups of patients with MSD was inconclusive. In this study all constructs were explored for their prognostic value on outcome based on type of intervention, and when possible, time from onset. By approaching the question in this way, we were able to identify the relative importance of MPF on outcome based on approach to intervention.

The implications of this review suggest that MPF are important considerations for those patients with shoulder pain who are managed surgically. Our findings show that there is evidence for the predictive value of expectation of recovery, catastrophizing, avoidant coping style, depression, and anxiety in patients receiving surgically intervention. However, there were conflicting results about the impact of fear avoidance on outcome in patients with chronic shoulder

disorders receiving conservative intervention. These results may inform clinical care including the inclusion of assessment and management of the MPF identified in this review, in patients with shoulder disorders managed surgically. Furthermore, other psychological responses to pain, such as anger, have been studied in other musculoskeletal conditions, yet are not addressed in the shoulder literature (31). All relevant psychological factors that are potentially modifiable should be addressed in future studies.

To gain deeper insight into how to explore the role of psychological factors as predictors of outcome, it is possible to look to the spine literature. Compared to the shoulder, an extensive literature base drives clinical management of psychological factors associated with low back pain. Consistent evidence supports the role of these psychological factors on prognosis (15) and the relationship with outcome for patients with low back pain (32, 33). However, there are limitations in generalizing the findings to other musculoskeletal disorders such as shoulder pain. The overall relationship of LBP with physical functioning and MPF has been described. It is unclear if the same relationship may exist for musculoskeletal conditions involving the extremities. For this reason, MPF need to be investigated for each patient population, based on specific musculoskeletal diagnoses and time from onset, to best understand the relationship with outcome. Another consideration is the relationship between psychological factors and the natural history/tissue healing associated with various musculoskeletal conditions. For instance, in patients with low back pain, fear of pain is a strong predictor of outcome (32, 33). The concept that pain does not equal damage, an important message to patients with spinal pain, may not be relevant for patients with shoulder conditions. Furthermore, while studies on back pain may inform the methodologies and research questions for shoulder pain populations, researchers must be prudent in recognizing the limitations of transposing these ideas. For example, many of the tools used to measure psychological constructs have not been validated for shoulder complaints (18). Future studies should focus on developing shoulder-specific instruments.

Limitations

Many included studies were small and may not have sufficient power to capture a clinically relevant influence of subgroups. None of the included studies investigated all predefined constructs and therefore the full impact of these variables cannot be completely described. Furthermore, some psychological constructs are complex, such as catastrophizing, which may be considered a belief or a coping strategy. For example, two studies that used the Pain Coping Scale designated catastrophizing as a coping strategy (34, 35). Yet most studies used the Pain Coping Scale to assess the impact of beliefs on expectation of outcome (36–40). In this review, catastrophizing was assigned to the coping domain. However, future studies need to investigate the difference between beliefs and coping strategies and their impact on treatment outcome. The limitations of our review reflect the lack of a strong literature base, including the heterogeneity of study populations, which precluded the possibility of a meta-analysis. Future studies need to address these methodological shortcomings.

Conclusions

Based on this review, expectation of recovery, catastrophizing, avoidant coping style, depression, and anxiety were the MPF most predictive of outcome in surgically managed patients with shoulder complaints. This provides sufficient evidence to suggest that implementing a biopsychosocial care paradigm to this population may be advantageous and requires investigation. Evidence against most constructs as predictors was noted for those undergoing conservative treatment, with the exception of fear avoidance, for which there were conflicting results. Future investigations that carefully define fear avoidance as a coping style or affective response may shed light on this. Because MPF have been shown to be important in the progression of other conservatively managed musculoskeletal disorders, such as low back and neck disorders, it was surprising that the same was not found for the shoulder. However, future high-quality comparative investigations and those assessing understudied constructs may shed more light on the prognostic value of MPF on outcome in this population. There is clearly a place for the study of psychological factors associated with shoulder disorders. Further investigation of all psychological factors may provide deeper insight into understanding patients with shoulder MSD, and best approaches to clinical management.

Abbreviations

DASH Disabilities of the Arm, Shoulder and Hand

MPF Modifiable psychological factors

MSD Musculoskeletal shoulder disorders

PRISMA Preferred Reporting Items for Systematic Reviews and Meta-analyses

RCT Randomized controlled trials

SIGN Scottish Intercollegiate Guidelines Network

SPADI Shoulder Pain and Disability Index

VAS Visual Analog Scale

Declarations

- Ethics approval and consent to participate: Not applicable.
- Consent for publication; Not applicable.
- Availability of data and materials: Not applicable. All data are available in public domains.
- Competing interests: The authors report no conflicts of interest.

- Funding: The authors did not receive any funding for this project.
- Authors' contributions: AS, WMW, SSW, EB participated in review abstracts and reading articles and discussion to resolve any concerns in classification of articles by another member of the research team. SW, Psychologist, review selective papers to assist with appropriateness of psychological instruments used in studies. All authors participated in writing and editing of manuscripts.
- Acknowledgements: Not applicable.
- Authors' information (optional)

References

1. Greving K, Dorrestijn O, Winters JC, Groenhof F, van der Meer K, Stevens M, et al. Incidence, prevalence, and consultation rates of shoulder complaints in general practice. Scand J Rheumatol. 2012;41(2):150–5.
2. Macfarlane GJ, Beasley M, Smith BH, Jones GT, Macfarlane TV. Can large surveys conducted on highly selected populations provide valid information on the epidemiology of common health conditions? An analysis of UK Biobank data on musculoskeletal pain. Br J Pain. 2015;9(4):203–12.
3. Kuijpers T, van der Windt DA, van der Heijden GJ, Bouter LM. Systematic review of prognostic cohort studies on shoulder disorders. Pain. 2004;109(3):420–31.
4. Chester R, Jerosch-Herold C, Lewis J, Shepstone L. Psychological factors are associated with the outcome of physiotherapy for people with shoulder pain: a multicentre longitudinal cohort study. British Journal Of Sports Medicine. 2016.
5. GBD 2015 DALYs and. Collaborators HALE. Global, regional, and national disability-adjusted life-years (DALYs) for 315 diseases and injuries and healthy life expectancy (HALE), 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet. 2016;388(10053):1603–58.
6. Luime JJ, Koes BW, Hendriksen IJ, Burdorf A, Verhagen AP, Miedema HS, et al. Prevalence and incidence of shoulder pain in the general population; a systematic review. Scand J Rheumatol. 2004;33(2):73–81.
7. Wertli MM, Held U, Lis A, Campello M, Weiser S. Both positive and negative beliefs are important in patients with spine pain: findings from the Occupational and Industrial Orthopaedic Center registry. Spine J. 2018;18(8):1463–74.
8. 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(4):e020703.
9. Bletterman AN, de Geest-Vrolijk ME, Vriezekolk JE, Nijhuis-van der Sanden MW, van Meeteren NL, Hoogeboom TJ. Preoperative psychosocial factors predicting patient's functional recovery after total knee or total hip arthroplasty: a systematic review. Clin Rehabil. 2018;32(4):512–25.
10. Khatib Y, Madan A, Naylor JM, Harris IA. Do Psychological Factors Predict Poor Outcome in Patients Undergoing TKA? A Systematic Review. Clin Orthop Relat Res. 2015;473(8):2630–8.
11. Vissers MM, Bussmann JB, Verhaar JAN, Busschbach JJV, Bierma-Zeinstra SMA, Reijman M. Psychological Factors Affecting the Outcome of Total Hip and Knee Arthroplasty: A Systematic Review. Semin Arthritis Rheum. 2012;41(4):576–88.
12. Wertli MM, Held U, Lis A, Campello M, Weiser S. Both positive and negative beliefs are important in patients with spine pain: findings from the oioc registry. The Spine Journal. 2017.
13. Gorge M, Ziehm J, Farin E. Health-care utilization of patients with chronic back pain before and after rehabilitation. BMC Health Serv Res. 2017;17(1):812.
14. National Health Committee. New Zealand Acute Low back pain Guide. 2004.
15. Nicholas MK, Linton SJ, Watson PJ, Main CJ. Early identification and management of psychological risk factors ("yellow flags") in patients with low back pain: a reappraisal. Phys Ther. 2011;91(5):737–53.
16. De Baets L, Matheve T, Meeus M, Struyf F, Timmermans A. The influence of cognitions, emotions and behavioral factors on treatment outcomes in musculoskeletal shoulder pain: a systematic review. Clin Rehabil. 2019;33(6):980–91.
17. Kooijman MK, Barten DJ, Swinkels IC, Kuijpers T, de Bakker D, Koes BW, et al. Pain intensity, neck pain and longer duration of complaints predict poorer outcome in patients with shoulder pain–a systematic review. BMC Musculoskelet Disord. 2015;16:288.
18. Struyf F, Geraets J, Noten S, Meeus M, Nijs J. A Multivariable Prediction Model for the Chronification of Non-traumatic Shoulder Pain: A Systematic Review. Pain Physician. 2016;19(2):1–10.
19. Mallows A, Debenham J, Walker T, Littlewood C. Association of psychological variables and outcome in tendinopathy: a systematic review. Br J Sports Med. 2017;51(9):743–8.
20. 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. Musculoskel Sci Prac. 2018;37:29–57.
21. Rodeghero JR, Cleland JA, Mintken PE, Cook CE. Risk stratification of patients with shoulder pain seen in physical therapy practice. J Eval Clin Pract. 2017;23(2):257–63.
22. Ristori D, Miele S, Rossettini G, Monaldi E, Arceri D, Testa M. Towards an integrated clinical framework for patient with shoulder pain. Arch Physiother. 2018;8:7.
23. Burton AK, Kendall NA, Pearce BG, Birrell LN, Bainbridge LC. Management of work-relevant upper limb disorders: a review. Occup Med (Lond). 2009;59(1):44–52.
24. 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.

25. Vajapey SP, Cvetanovich GL, Bishop JY, Neviaser AS. Psychosocial factors affecting outcomes after shoulder arthroplasty: a systematic review. J Shoulder Elbow Surg. 2020;29(5):e175-e84.
26. Moher D, Liberati A, Tetzlaff J, Altman DG, Group P. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. Bmj. 2009;339:b2535.
27. Urwin M, Symmons D, Allison T, Brammah T, Busby H, Roxby M, et al. Estimating the burden of musculoskeletal disorders in the community: the comparative prevalence of symptoms at different anatomical sites, and the relation to social deprivation. Ann Rheum Dis. 1998;57(11):649–55.
28. Scotish Intercollegiate Guidelines Network (SIGN). Methodology Checklist for Cohort Studies and Randomized Controlled Trials Edinburgh Scotish Intercollegiate Guidelines Network (SIGN); 2012 [updated 2012. Available from: http://www.sign.ac.uk/methodology/checklists.html.
29. Knoerl R, Lavoie Smith EM, Weisberg J. Chronic Pain and Cognitive Behavioral Therapy: An Integrative Review. West J Nurs Res. 2016;38(5):596–628.
30. Gagnier JJ, Robbins C, Bedi A, Carpenter JE, Miller BS. Establishing minimally important differences for the American Shoulder and Elbow Surgeons score and the Western Ontario Rotator Cuff Index in patients with full-thickness rotator cuff tears. J Shoulder Elbow Surg. 2018;27(5):e160-e6.
31. Nisenzon AN, George SZ, Beneciuk JM, Wandner LD, Torres C, Robinson ME. The Role of Anger in Psychosocial Subgrouping for Patients With Low Back Pain. Clin J Pain. 2014;30(6):501–9.
32. Wertli MM, Rasmussen-Barr E, Held U, Weiser S, Bachmann LM, Brunner F. Fear-avoidance beliefs-a moderator of treatment efficacy in patients with low back pain: a systematic review. The spine journal: official journal of the North American Spine Society. 2014;14(11):2658–78.
33. Wertli MM, Rasmussen-Barr E, Weiser S, Bachmann LM, Brunner F. The role of fear avoidance beliefs as a prognostic factor for outcome in patients with nonspecific low back pain: a systematic review. The spine journal: official journal of the North American Spine Society. 2014;14(5):816–36. e4.
34. Kuijpers T, Van Der Windt DAWM, Boeke AJP, Twisk JWR, Vergouwe Y, Bouter LM, et al. Clinical prediction rules for the prognosis of shoulder pain in general practice. Pain. 2006;120(3):276–85.
35. Van Der Windt DAWM, Kuijpers T, Jellema P, Van Der Heijden GJMG, Bouter LM. Do psychological factors predict outcome in both low-back pain and shoulder pain? Ann Rheum Dis. 2007;66(3):313–9.
36. George SZ, Wallace MR, Wright TW, Moser MW, Greenfield WH 3rd, Sack BK, et al. Evidence for a biopsychosocial influence on shoulder pain: pain catastrophizing and catechol-O-methyltransferase (COMT) diplotype predict clinical pain ratings. Pain. 2008;136(1–2):53–61.
37. George SZ, Wallace MR, Wu SS, Moser MW, Wright TW, Farmer KW, et al. Biopsychosocial influence on shoulder pain: Risk subgroups translated across preclinical and clinical prospective cohorts. Pain. 2015;156(1):148–56.
38. George SZ, Wu SS, Wallace MR, Moser MW, Wright TW, Farmer KW, et al. Biopsychosocial Influence on Shoulder Pain: Influence of Genetic and Psychological Combinations on Twelve-Month Postoperative Pain and Disability Outcomes. Arthritis Care Research. 2016;68(11):1671–80.
39. Reilingh ML, Kuijpers T, Tanja-Harfterkamp AM, van der Windt DA. Course and prognosis of shoulder symptoms in general practice. Rheumatology. 2008;47(5):724–30.
40. Valencia C, Fillingim RB, Bishop M, Wu SS, Wright TW, Moser M, et al. Investigation of central pain processing in postoperative shoulder pain and disability. Clin J Pain. 2014;30(9):775–86.
41. Berk SN, Moore ME, Resnick JH. Psychosocial factors as mediators of acupuncture therapy. J Consult Clin Psychol. 1977;45(4):612–9.
42. Ekeberg OM, Bautz-Holter E, Juel NG, Engebretsen K, Kvalheim S, Brox JI. Clinical, socio-demographic and radiological predictors of short-term outcome in rotator cuff disease. BMC Musculoskelet Disord. 2010;11:239.
43. Engebretsen K, Grotle M, Bautz-Holter E, Ekeberg OM, Brox JI. Predictors of shoulder pain and disability index (SPADI) and work status after 1 year in patients with subacromial shoulder pain. BMC Musculoskelet Disord. 2010;11:218.
44. Geraets JJX, Goossens MEJ, de Groot IJM, de Bruijn CPC, de Bie RA, Dinant G, et al. Effectiveness of a graded exercise therapy program for patients with chronic shoulder complaints. Australian Journal of Physiotherapy. 2005;51(2):87–94.
45. Karel Y, Verhagen AP, Thoomes-de Graaf M, Duijn E, van den Borne MPJ, Beumer A, et al. Development of a Prognostic Model for Patients With Shoulder Complaints in Physical Therapist Practice. Phys Ther. 2017;97(1):72–80.
46. Kennedy CA, Haines T, Beaton DE. Eight predictive factors associated with response patterns during physiotherapy for soft tissue shoulder disorders were identified. J Clin Epidemiol. 2006;59(5):485–96.
47. Kromer TO. Influence of fear-avoidance beliefs on disability in patients with subacromial shoulder pain in primary care: a secondary analysis. Physical therapy. 2014;94(12):1775–84.
48. Kvalvaag E, Roe C, Engebretsen KB, Soberg HL, Juel NG, Bautz-Holter E, et al. One year results of a randomized controlled trial on radial Extracorporeal Shock Wave Treatment, with predictors of pain, disability and return to work in patients with subacromial pain syndrome. Eur J Phys Rehabil Med. 2018;54(3):341–50.
49. Laslett M, Steele M, Hing W, McNair P, Cadogan A. Shoulder pain in primary care–part 2: predictors of clinical outcome to 12 months. J Rehabil Med. 2015;47(1):66–71.
50. O'Malley KJ, Roddey TS, Gartsman GM, Cook KF. Outcome expectancies, functional outcomes, and expectancy fulfillment for patients with shoulder problems. Med Care. 2004;42(2):139–46.
51. Ryall C, Coggon D, Peveler R, Poole J, Palmer KT. A prospective cohort study of arm pain in primary care and physiotherapy - Prognostic determinants. Rheumatology. 2007;46(3):508–15.
52. Sindhu BS, Lehman LA, Tarima S, Bishop MD, Hart DL, Klein MR, et al. Influence of fear-avoidance beliefs on functional status outcomes for people with musculoskeletal conditions of the shoulder. Phys Ther. 2012;92(8):992–1005.

53. Smedbraten K, Oiestad BE, Roe Y. Emotional distress was associated with persistent shoulder pain after physiotherapy: a prospective cohort study. Bmc Musculoskeletal Disorders. 2018;19.
54. Wolfensberger A, Vuistiner P, Konzelmann M, Plomb-Holmes C, Léger B, Luthi F. Clinician and Patient-reported Outcomes Are Associated With Psychological Factors in Patients With Chronic Shoulder Pain. Clin Orthop Relat Res. 2016;474(9):2030–9.
55. Cho C-H, Song K-S, Hwang I, Warner J, Warner JJP. Does Rotator Cuff Repair Improve Psychologic Status and Quality of Life in Patients With Rotator Cuff Tear? Clinical Orthopaedics Related Research. 2015;473(11):3494–500.
56. Dambreville A, Blay M, Carles M, Hovorka I, Boileau P. Can the postoperative pain level be predicted preoperatively? Revue de Chirurgie Orthopedique et Reparatrice de l'Appareil Moteur. 2007;93(6):541–5.
57. Dekker AP, Salar O, Karuppiah SV, Bayley E, Kurian J. Anxiety and depression predict poor outcomes in arthroscopic subacromial decompression. J Shoulder Elbow Surg. 2016;25(6):873–80.
58. Henn RF 3rd, Kang L, Tashjian RZ, Green A. Patients' preoperative expectations predict the outcome of rotator cuff repair. J Bone Joint Surg Am. 2007;89(9):1913–9.
59. Jain NB, Ayers GD, Fan R, Kuhn JE, Baumgarten KM, Matzkin E, et al. Predictors of pain and functional outcomes after operative treatment for rotator cuff tears. J Shoulder Elbow Surg. 2018;27(8):1393–400.
60. Koorevaar RCT, Kleinlugtenbelt YV, Landman EBM, van 't Riet E, Bulstra SK. Psychological symptoms and the MCID of the DASH score in shoulder surgery. Journal of Orthopaedic Surgery and Research. 2018;13.
61. Koorevaar RC, van 't Riet E, Gerritsen MJ, Madden K, Bulstra SK. The Influence of Preoperative and Postoperative Psychological Symptoms on Clinical Outcome after Shoulder Surgery: A Prospective Longitudinal Cohort Study. PLoS One. 2016;11(11):e0166555.
62. Oh JH, Yoon JP, Kim JY, Kim SH. Effect of expectations and concerns in rotator cuff disorders and correlations with preoperative patient characteristics. J Shoulder Elbow Surg. 2012;21(6):715–21.
63. Potter MQ, Wylie JD, Granger EK, Greis PE, Burks RT, Tashjian RZ. One-year Patient-reported Outcomes After Arthroscopic Rotator Cuff Repair Do Not Correlate With Mild to Moderate Psychological Distress. Clin Orthop Relat Res. 2015;473(11):3501–10.
64. Ravindra A, Barlow JD, Jones GL, Bishop JY. A prospective evaluation of predictors of pain after arthroscopic rotator cuff repair: psychosocial factors have a stronger association than structural factors. J Shoulder Elbow Surg. 2018;27(10):1824–9.
65. Thorpe AM, O'Sullivan PB, Mitchell T, Hurworth M, Spencer J, Booth G, et al. Are Psychologic Factors Associated With Shoulder Scores After Rotator Cuff Surgery? Clin Orthop Relat Res. 2018;476(10):2062–73.
66. Woollard JD, Bost JE, Piva SR, Kelley Fitzgerald G, Rodosky MW, Irrgang JJ. The ability of preoperative factors to predict patient-reported disability following surgery for rotator cuff pathology. Disabil Rehabil. 2017;39(20):2087–96.
67. Yeoman TFM, Wigderowitz CA. The effect of psychological status on pain and surgical outcome in patients requiring arthroscopic subacromial decompression. European Journal of Orthopaedic Surgery Traumatology. 2012;22(7):549–53.

Tables

Table 1: Definitions of domains and constructs.

Domains and definitions	Constructs and definitions
Beliefs: cognitive responses to pain	● **Self-efficacy**: belief in one's ability to be successful at a task ● **Expectation of recovery**: belief that one will return to the premorbid state
Coping: active or palliative responses to pain	● **Catastrophizing**: thoughts that something is much worse than it is ● **Avoidant coping**: unhelpful avoidance of dealing with a stressful situation
Affect: emotional response to pain	● **Depression**: feelings of extreme sadness ● **Anxiety**: worrisome or fearful thoughts

Table 2
Characteristics of the reviewed studies. Bold font indicates high quality studies based on the SIGN review.

Author, year	Design	*Setting	Diagnosis	SS	N (% Female**)	Age: mean	Intervention	Treatment duration	Follow-up	D
Conservative treatment										
Berk et al. 1977	RCT	Advertisement recruitment, USA	Shoulder pain due to tendonitis or bursitis	No	42 (28%)	47	Group 1) Acupuncture - positive milieu, Group 2) Acupuncture - negative milieu, Group 3) Placebo acupuncture - positive milieu, Group 4) Placebo acupuncture - negative milieu	All groups 4 sessions	All groups 1 week after the end of treatment	N
Chester et al, 2016	Prosp. Cohort	PT clinic England	Shoulder or arm pain aggravated by shoulder movement	1000 patients	1030 (56%)	57	Non-specified PT treatment reflecting usual care	NR	6 weeks and 6 months after initiating PT treatment	2
Ekeberg et al. 2010	RCT, secondary analysis	Outpatient PT and rehabilitation department, Norway	Patients with a clinical diagnosis of rotator cuff disease included in the RCT	No	104 (61%)	52	Group 1 systemic corticosteroid injection (gluteal region), group 2 ultrasound guided corticosteroid injection.	1 injection	6 weeks	2
Engebretsen et al. 2010	RCT, secondary analysis	Physical Medicine and Rehabilitation clinic, Norway	Chronic subacromial pain	No	104 (50%)	48	Group 1) Supervised exercise, Group 2) Radial extracorporeal shockwave therapy	Group 1). twice a week for maximum of 12 weeks, Group 2) once a week for 4–6 weeks.	12 months	1
Geraets et al. 2005 [16]	RCT	GP clinic and advertisement; Netherlands	Chronic shoulder complaints	132	176 (55%)	52.2	Group 1) Graded exercise; Group 2) Usual GP care	Group 1) Up to 18 sessions over 12 weeks. Group 2) PRN	12 weeks	G G
Karel et al, 2017	Prosp. Cohort	PT, Netherlands	New episode of shoulder pain	Yes, 360 patients	389		PT, not specified	NR	6.5 Months	3

*Setting: represents location of intervention; SS calc: sample size calculation; **Female: percentage reported or author estimate; RCT: randomized controlled

4DSQ: Four-Dimensional Symptom Questionnaire; ASES: the American Shoulder and Elbow Surgeons' Scale; BPI: Brief Pain Inventory; CAT: Computerized Ad behavioural therapy ; DASH (and quickDASH): (Quick) Disability of the Arm, Shoulder and Hand Questionnaire; UCLA Scale: The University of California at Lo EQ-5D: EuroQol- 5 Dimension; FABQ: Fear Avoidance Beliefs Questionnaire (FABQ-P: physical activity subscale; FABQ-W, work subscale); FLEX-SF: Flexilevel S HADS: Hospital Anxiety and Depression Scale; HSCL-25: the Hopkins Symptoms Checklist; NRS: Numeric Rating Scale; MCID: minimal clinically important di Musculoskeletal Outcomes Data Evaluation and Management System; OSS: Oxford Shoulder Score; PCCL: Pain Coping and Cognition List; PCS: Pain Catast Patient Specific Functional Scale; PT: physical therapy; RCT: randomized controlled trial; SF-36: Short Form Survey; SDQ: Shoulder Disability Questionnaire; S Disability Index; SST: Simple Shoulder Test; TSK: Tampa Scale of Kinesiophobia; UC: usual care; VAS: Visual Analog Scale.

Author, year	Design	*Setting	Diagnosis	SS	N (% Female**)	Age: mean	Intervention	Treatment duration	Follow-up	D
Kennedy et al. 2006	Prosp. Cohort	PTs center, Canada	PTs included 5 clients undergoing treatment for soft tissue shoulder complaints	NR	361 (54%)	50	PT treatment		12 weeks or end of treatment	
Kromer et al. 2014 [24]	RCT, secondary analysis	PT clinic, Germany	Subacromial pain	90 (45 per group)	90 (51%)	51.8	Group 1) Exercise; Group 2) Exercise, manual therapy shoulder and cervical spine, and education	Both groups 10 treatments in 5 weeks followed by 7 weeks home exercise	3 months	2
Kuijpers et al. 2006 [25]	Prosp. Cohort	GP clinic, Netherlands	Acute shoulder pain	No	587 (50%)	51	Usual care including medical management and physical therapy	Not defined	6 weeks and 6 months	8
Kvalvaag et al. 2018	Double blind RCT	Department of Physical Medicine and Rehabilitation, Norway	Subacromial pain syndrome lasting at least three months	Yes, for RCT 143 pat.	143		Radial Extracorporeal Shock Wave Therapy (rESWT) + supervised exercises vs. sham rESWT + supervised exercises	Once per week for 4 weeks	12 months	
Laslett et al. 2015	Prosp. Cohort	Primary care/ PT clinic, New Zealand	Acute shoulder pain	NR	161 (49%)	44	Clinical exam, shoulder x-ray, diagnostic anesthetic injection in bursa + AC-joint or intra-articular glenohumeral joint, after 3 weeks usual PT care		3 weeks, 3, 6, and 12 months	3
O'Malley et al. 2004	Prosp. Cohort	Orthopedic clinic, USA	Shoulder pain	No	199 (47%)	52	Various interventions	NR	3 months	3
Reilingh et al. 2008	Prosp. Cohort	GP, Netherlands	Shoulder pain	No	587 (50%)	51	Various interventions	Not defined	6 months	8
Ryall et al. 2007	Prosp. Cohort	Primary care and PT clinics, U.K.	Shoulder pain	No	222 (of 375 with arm pain)	NR	Various interventions	NR	12 months	1 p
Sindhu et al. 2012	Retro. analysis of prosp. collected data	Outpatient rehab clinics, various locations throughout the United States	Shoulder impairment	No	3362 (54%)	54	Conservative care	NR	End of treatment	5
Smedbråten et al. 2018	Registry study	Outpatient Physiotherapy Norway, FysioPol database	Shoulder impairment	No	145 (72%)	44	Exercises physiotherapy	5 weeks (IQR 3 to 6)	End of treatment	N

*Setting: represents location of intervention; SS calc: sample size calculation; **Female: percentage reported or author estimate; RCT: randomized controlled

4DSQ: Four-Dimensional Symptom Questionnaire; ASES: the American Shoulder and Elbow Surgeons' Scale; BPI: Brief Pain Inventory; CAT: Computerized Ad behavioural therapy ; DASH (and quickDASH): (Quick) Disability of the Arm, Shoulder and Hand Questionnaire; UCLA Scale: The University of California at Lo EQ-5D: EuroQol- 5 Dimension; FABQ: Fear Avoidance Beliefs Questionnaire (FABQ-P: physical activity subscale; FABQ-W, work subscale); FLEX-SF: Flexilevel S HADS: Hospital Anxiety and Depression Scale; HSCL-25: the Hopkins Symptoms Checklist; NRS: Numeric Rating Scale; MCID: minimal clinically important di Musculoskeletal Outcomes Data Evaluation and Management System; OSS: Oxford Shoulder Score; PCCL: Pain Coping and Cognition List; PCS: Pain Catast Patient Specific Functional Scale; PT: physical therapy; RCT: randomized controlled trial; SF-36: Short Form Survey; SDQ: Shoulder Disability Questionnaire; S Disability Index; SST: Simple Shoulder Test; TSK: Tampa Scale of Kinesiophobia; UC: usual care; VAS: Visual Analog Scale.

Author, year	Design	*Setting	Diagnosis	SS	N (% Female**)	Age: mean	Intervention	Treatment duration	Follow-up	D
Van der Windt et al. 2007	Prosp. Cohort	Primary care clinic, Netherlands	Acute shoulder pain	NR	344 (48%)	51	Usual care by GP (Group 1), including steroid injection if indicated (Group 2)	NR	3 Months	1
Wolfensberger et al. 2016	Retro. Study	Rehabilitation clinic, Switzerland	Chronic nonspecific shoulder pain, on work disability	No	287 (18%)	47	Interdisciplinary care	4–5 weeks, at least 2 to 3 hours of daily (excl. weekend)	End of treatment	4
Surgical treatment										
Cho et al. 2015	Prosp. Cohort	Tertiary care institution, Korea	Rotator cuff tear	40	58 (57%)	57	Rotator cuff repair	NA	3, 6, 12 months post-surgery	1
Dambreville et al. 2007	Prosp. Cohort	Orthopedic surgical department, France	Patients undergoing surgery for shoulder complaints	No	86 (36%)	48	Several procedures (ablation of calcification, rotator cuff repair, arthroplasty)	NA	1 month	N
Dekker et al. 2016	Retro. analysis of prospectively collected data	Orthopedic surgical department, UK.	Subacromial impingement	No	61 (NR)	54	Arthroscopic subacromial decompression	NA	6 Months	2
George et al. 2008	Prosp. Cohort	Orthopaedics Sports Medicine Institute, USA	Patients scheduled for shoulder arthroscopy, nonspecific diagnosis	No	58 (41%)	50	Shoulder arthroscopy	NA	3–5 months post-surgery	1
George et al. 2015 George et al. 2016	Prosp. Cohort	Orthopaedics Sports Medicine, USA	Patients scheduled for shoulder arthroscopy, nonspecific diagnosis	360	150 (34%)	43	Shoulder arthroscopy	N/A	12 months	N
Henn et al. 2007	Retro. analysis of prospectively collected data	Department of Orthopaedic Surgery, USA	Primary repair of a chronic rotator cuff tear	No	12 (42%)	56	Three rotator cuff repair techniques: open repair, mini open repair, arthroscopic repair.	N/A	12 months	N
Jain et al. 2018	Prosp. Cohort	Sports/Shoulder clinics in 3 academic and 1 community setting, USA	Symptomatic (≥ 4 weeks) rotator cuff tears scheduled for surgery	No	50 (38%)	59	Surgery rotator cuff tear	N/A	3, 6, 12, 18 months	

*Setting: represents location of intervention; SS calc: sample size calculation; **Female: percentage reported or author estimate; RCT: randomized controlled

4DSQ: Four-Dimensional Symptom Questionnaire; ASES: the American Shoulder and Elbow Surgeons' Scale; BPI: Brief Pain Inventory; CAT: Computerized Ad behavioural therapy ; DASH (and quickDASH): (Quick) Disability of the Arm, Shoulder and Hand Questionnaire; UCLA Scale: The University of California at Lo EQ-5D: EuroQol- 5 Dimension; FABQ: Fear Avoidance Beliefs Questionnaire (FABQ-P: physical activity subscale; FABQ-W, work subscale); FLEX-SF: Flexilevel S HADS: Hospital Anxiety and Depression Scale; HSCL-25: the Hopkins Symptoms Checklist; NRS: Numeric Rating Scale; MCID: minimal clinically important di Musculoskeletal Outcomes Data Evaluation and Management System; OSS: Oxford Shoulder Score; PCCL: Pain Coping and Cognition List; PCS: Pain Catast Patient Specific Functional Scale; PT: physical therapy; RCT: randomized controlled trial; SF-36: Short Form Survey; SDQ: Shoulder Disability Questionnaire; S Disability Index; SST: Simple Shoulder Test; TSK: Tampa Scale of Kinesiophobia; UC: usual care; VAS: Visual Analog Scale.

Author, year	Design	*Setting	Diagnosis	SS	N (% Female**)	Age: mean	Intervention	Treatment duration	Follow-up	D
Koorevaar et al. 2016 Koorevaar et al. 2018	Prosp. Cohort	Single center teaching hospital, Netherlands	Patients eligible for shoulder surgery	No	315 patients (2016),142 (2018) (44%)	54	Surgery shoulder	N/A	After treatment (2016) and 12 months (2018)	P 9 m
Oh et al. 2012	Prosp. Cohort	Single center, all surgeries performed by the first author	Patients undergoing surgery for rotator cuff disorders, failed 3 months of conservative management	No	128 (45%)	59	Arthroscopy-assisted mini open repair or arthroscopic repair	NR	≥ 12 months	N
Potter et al. 2015	Prosp. Cohort		Patients aged ≥ 18 years, scheduled for shoulder arthroscopy for shoulder pain secondary to a reparable full-thickness rotator cuff tear.	No	70 (26%)	61	Patients underwent arthroscopic rotator cuff repair with one of three surgeons (PEG, RTB, RZT) between October 2011 and December 2013	N/A	12 months	N
Ravindra et al 2018	Prosp Cohort	Single orthopedic department, USA	Patient scheduled for arthroscopic rotator cuff repair with confirmed (MRI) partial or full rotator cuff tear		93 46%	56	Arthroscopic subacromial decompression, acromioplasty, labral debridement, distal clavicle excision, and biceps tenotomy or tenodesis as indicated	NA	Post-surgery 12 months	

*Setting: represents location of intervention; SS calc: sample size calculation; **Female: percentage reported or author estimate; RCT: randomized controlled

4DSQ: Four-Dimensional Symptom Questionnaire; ASES: the American Shoulder and Elbow Surgeons' Scale; BPI: Brief Pain Inventory; CAT: Computerized Ad behavioural therapy ; DASH (and quickDASH): (Quick) Disability of the Arm, Shoulder and Hand Questionnaire; UCLA Scale: The University of California at Lo EQ-5D: EuroQol- 5 Dimension; FABQ: Fear Avoidance Beliefs Questionnaire (FABQ-P: physical activity subscale; FABQ-W, work subscale); FLEX-SF: Flexilevel S HADS: Hospital Anxiety and Depression Scale; HSCL-25: the Hopkins Symptoms Checklist; NRS: Numeric Rating Scale; MCID: minimal clinically important di Musculoskeletal Outcomes Data Evaluation and Management System; OSS: Oxford Shoulder Score; PCCL: Pain Coping and Cognition List; PCS: Pain Catast Patient Specific Functional Scale; PT: physical therapy; RCT: randomized controlled trial; SF-36: Short Form Survey; SDQ: Shoulder Disability Questionnaire; S Disability Index; SST: Simple Shoulder Test; TSK: Tampa Scale of Kinesiophobia; UC: usual care; VAS: Visual Analog Scale.

Author, year	Design	*Setting	Diagnosis	SS	N (% Female**)	Age: mean	Intervention	Treatment duration	Follow-up	D
Thorpe et al. 2018	Prosp Cohort	Surgery performed by 6 surgeons in 1 private & 2 public hospitals, Australia	Patients scheduled for shoulder surgery for partial or full rotator cuff tear	No	124 (37%)	54	Surgery for rotator cuff repair with or without subacromial decompression (n = 55) and arthroscopic subacromial decompression only (n = 43)	N/A	3, 12 months	1(
Valencia et al. 2014	Prosp. Cohort	Orthopaedic Sports Medicine Institute, USA	Patients scheduled for shoulder arthroscopy nonspecific diagnosis	No	78 (28%)	47	Shoulder arthroscopic surgery	N/A	3 and 6 months	6'
Woollard et al. 2017	Prosp. Cohort	University Clinic, Sports Medicine, USA	Patients scheduled for arthroscopic subacromial decompression	Yes, 50 pat. 80% power	62 (63%)	46	Arthroscopic subacromial decompression with /without supraspinatus repair	N/A	6 months after surgery	2!
Yeoman et al. 2012	Prosp. Cohort	Department of Orthopaedics Surgery, Scotland	Patients scheduled for shoulder arthroscopy	49	31 (67%)	55	Shoulder arthroscopic surgery	NA	6 weeks	0

*Setting: represents location of intervention; SS calc: sample size calculation; **Female: percentage reported or author estimate; RCT: randomized controlled

4DSQ: Four-Dimensional Symptom Questionnaire; ASES: the American Shoulder and Elbow Surgeons' Scale; BPI: Brief Pain Inventory; CAT: Computerized Ad behavioural therapy ; DASH (and quickDASH): (Quick) Disability of the Arm, Shoulder and Hand Questionnaire; UCLA Scale: The University of California at Lo EQ-5D: EuroQol- 5 Dimension; FABQ: Fear Avoidance Beliefs Questionnaire (FABQ-P: physical activity subscale; FABQ-W, work subscale); FLEX-SF: Flexilevel S HADS: Hospital Anxiety and Depression Scale; HSCL-25: the Hopkins Symptoms Checklist; NRS: Numeric Rating Scale; MCID: minimal clinically important di Musculoskeletal Outcomes Data Evaluation and Management System; OSS: Oxford Shoulder Score; PCCL: Pain Coping and Cognition List; PCS: Pain Catast Patient Specific Functional Scale; PT: physical therapy; RCT: randomized controlled trial; SF-36: Short Form Survey; SDQ: Shoulder Disability Questionnaire; S Disability Index; SST: Simple Shoulder Test; TSK: Tampa Scale of Kinesiophobia; UC: usual care; VAS: Visual Analog Scale.

Table 3

A: Predictive utility of psychological factors on the outcome after conservative treatment for shoulder complaints. Bold font indicates high quality studies. Bold font indicates high quality studies based on the SIGN review.

Authors	Quality	Outcome (measure)	Beliefs		Cognitive Style		Affect: Distress		Effect
			1.Self efficacy / Coping	2. Expectation of recovery	3. Catastrophizing	4. Avoidance Coping Style	5. Depression	6. Anxiety / Worry/ Fear	
Berk et al. 1977 (41)	(+)	Pain (VAS)		-					Acupuncture in a negative and a positive milieu resulted in similar pain reduction (p = 0.053).
Chester et al. 2016 (4)	(++)	Pain and disability (SPADI, QuickDASH)					-	-	Patient expectation of 'complete recovery' compared to a 'slight improvement' as 'a result of physiotherapy treatment' (Beta 12.43, 95% CI 8.2-16.67 for 6 months). Depression and anxiety: no consistent association in the multivariate models.
Ekeberg et al. 2010 (42)		Pain and disability (SPADI) Shoulder complaint (*ADI)		- -			- -		Distress (HSCL-25) and self-efficiency for pain (single item question) not associated with SPADI and shoulder complaint as measured by Global Assessment Score at 6 weeks.
Engebretsen et al. 2010 (43)	(++)	Pain and disability (SPADI) Work status (*ADI)	- -				- -		Self-efficacy was significant in the univariate analysis but not in the final model for disability and not significant for return to work. Distress (Hopkins Symptoms Checklist) was not significant in the univariate analysis.
Geraets et al. 2005 (44)	(+)	Shoulder disability (SDQ)					+	-	Coping measured by PCCL, and FABQ and TSK measured but not used in the model; DSQ N.S.; Significant relationship between reduction of severity of main complaint (graded exercise group vs usual Care group Beta 7.6, 0.9–14.3) at 12 weeks and pain reduction (26.8, 95% CI 19.3–34.4) and baseline depression scores (8.3, CI 0.1–16.6, 4DSQ); Anxiety (4DSQ) N.S.

Authors	Quality	Outcome (measure)	Beliefs	Cognitive Style	Affect: Distress	Effect
Karel et al, 2017 (45)	(++)	Perceived recovery (*ADI)			-	No significant association between psychological factors and perceived recovery: OR for patient reported “no anxiety/depression” in (EQ-5D) 1.8 (95% CI 0.9–3.6), p = 0.06. Note: on the anxiety/depression dimension of the EQ-5D, only one patient scored “very anxious/depressed”, 83% reported “not anxious/depressed”, and 16% reported “moderately anxious/depressed”.
Kennedy et al. 2006 (46)	(++)	Pain and disability (SPADI)			+	Four patterns of response were found: cluster A had high disability at baseline and less improvement over a long course; cluster B had high disability at baseline but had a quick, steep improvement course; cluster C had moderate disability at baseline and, like A, a slow course with less improvement; and finally cluster D with lower disability at baseline and a short swift change to very low disability. Clusters C and D had a higher baseline Mental Component Score (SF-36 MCS, higher score indicates better health) than clusters A & B. In the final model, one unit increase on the MCS is associated with approximately a 1.1 increase in the odds ratio of being in clusters C and D vs. clusters A and B. Therefore, a 10-unit increase on the MCS would be associated with approximately a 2.6 increase in the odds ratio of being in clusters C and D vs. clusters A and B.
Kromer et al. 2014 (47)	(+)	Pain and disability (SPADI)		- -		Catastrophizing, measured by PCS, did not influence the baseline disability and change score in disability at 3 months; FABQ-P contributed significantly to baseline disability but not to the change score in disability at 3 months.

Authors	Quality	Outcome (measure)	Beliefs	Cognitive Style		Affect: Distress		Effect
Kuijpers et al. 2006 (34)	(+)	Perceived recovery (*ADI)		-	-	-	-	Coping with pain (PCCL) N.S.; FABQ and TSK N.S. Univariate analysis for pain at 6 weeks but not for 6 months (4DSQ) significant, but not in the multivariate model; In univariate analysis for pain at 6 weeks but not for 6 months (4DSQ), not in the multivariate model; Anxiety (4DSQ) significant in univariate analysis for pain at 6 weeks but not for 6 months, not in the multivariate model.
Kvalvaag et al. 2018 (48)	(++)	Pain and disability (SPADI) Work status (*ADI)	+ -			- -		Univariate significant: SPADI baseline score, age, gender, work status, marital status, education, duration of pain, medication, self-efficacy for pain, outcome expectations, general health status, number of PT sessions and emotional distress. Multivariate: low patient expectations were the strongest predictor of a negative outcome (Beta − 4.2, 95% CI -7.2 to -1.1, p < 0.01). Self-efficacy, distress (HSCL-25) were no longer significant. Outcome expectation, self-efficacy, distress univariate not significant.
Laslett et al. 2015 (49)	(++)	Pain and disability (SPADI)			+		-	Six months follow-up FABQ, OR 1.03 (95% CI 1.00-1.07), and 12 months FABQ OR 1.01 (95% CI 1.03–1.17) in the multivariate analysis. SF-8 lower SF mental score in the multivariate model OR 0.93 (95% CI 0.85–1.01) 3 weeks, not significantly associated with outcome (3, 6, 12 months follow-up) in the univariate analysis.
O'Malley et al. 2004 (50)	(++)	Function (FLEX-SF)	+					In the final statistical model, patients with higher outcome expectancies (Patient Shoulder Expectancy Fulfilment measure) reported better 3-month shoulder functioning (Beta 0.46, p = 0.002).

Authors	Quality	Outcome (measure)	Beliefs	Cognitive Style	Affect: Distress		Effect
Reilingh et al. 2008 (39)	(++)	Pain (NRS, in acute group) Pain (NRS, in chronic group)		- +			Catastrophizing (PCCL per point increase) univariate analysis (Beta 1.0, CI 0.44–1.57 (positive = more pain reduction) for decrease in pain at 6 months in acute shoulder pain patients but not in chronic shoulder pain patients. In the multivariate analysis catastrophizing is a negative predictor (less decrease of pain) in the chronic shoulder pain patients (Beta-0.62, CI -1.03- (-0.20)) and was no longer included in the acute pain patients; 4DSQ N.S.
Ryall et al. 2007 (51)	(++)	Pain (*ADI)	-		-	-	Belief that problem is likely to be causing difficulties in 3 months N.S.; Brief Symptom Inventory (BSI) > 2points N.S.; Depression Scale (HADS)-D > 7 for continuing pain at 12 months, frequent continuing pain, unremitting pain N.S.; HADS-A > 7 continuing pain at 12 months, frequent continuing pain, unremitting pain N.S.
Sindhu et al. 2012 (52)	(+)	Shoulder function (Computerized Adaptive Test)		+			FABP-P > 16 high FAB: the improvement of function was greater in low fear avoidance groups after adjustment for 8 disease categories. No difference was found for arthropathies, fractures, sprains and strains, postsurgical conditions.
Smedbråten et al, 2018 (53)	(++)	Pain (NRS) Function (PSFS)			+ -		In final multiple regression model, emotional distress (HSCL-25) associated with more pain (Beta 1.06, 95% CI 0.44–1.68, p = 0.001). Other significant predictors: pain intensity before treatment, duration of pain > 12 months. Emotional distress univariate significant, not included in the multiple regression model. Significant predictors were higher pre-treatment disability, pain duration > 12 months, concomitant neck pain, and a lower level of education.

Authors	Quality	Outcome (measure)	Beliefs	Cognitive Style		Affect: Distress		Effect
Van der Windt et al. 2007 (35)	(++)	Perceived recovery (*ADI) Shoulder disability (SDQ)		- -	- -	- -		Perceived recovery was measured by Likert scale. Catastrophizing (PCCL score) > 40 adjusted OR 0.94 (95% CI 0.52–1.68) for persisting symptoms, OR 1.32 (CI 0.78–2.24) for < 30% disability reduction; FABQ-P > 75 (0-100) adjusted OR 1.08 (CI 0.63–1.85) for persisting symptoms, OR 1.12 (0.568–1.85) for disability reduction; Somatization, measured by 4DSQ > 30 adjusted OR 1.46 (CI 0.63–3.42) for persisting symptoms, OR 1.49 (CI 0.74–3.01) for disability reduction; Distress 4DSQ > 12 adjusted OR 0.71 (CI 0.42–1.19) for persisting symptoms, OR 0.76 (CI 0.48–1.23) for disability reduction.
Wolfensberger et al., 2016 (54)	(++)	Shoulder disability (DASH) Pain (Patient Global Impression of Change)		+ +	- +	+ +	+ +	In the multivariable analysis factors were combined: HADS-A, HADS-D, and Pain Catastrophizing Scale (PCS) were associated with more disability (DASH, Beta 0.64 (95% CI 0.25–1.03, p = 0.002). Also, less Patient Global Impression of change associated with combination of: HADS-D + A + PCS + TSK (Beta 0.93, 95% CI 0.87–0.99, p = 0.026).

Table 3

B: Predictive utility of psychological factors on the outcome after surgical treatment for shoulder complaints. Bold font indicates high quality studies based on the SIGN review.

Authors	Quality	Outcome	Beliefs		Cognitive Style		Affect: Distress		Effect
			1.Self efficacy / Coping	2. Expectation of recovery	3. Catastrophizing	4. Avoidance Coping Style	5. Depression	6. Anxiety / Worry/ Fear	
Cho et al. 2015 (55)	(+)	Pain (VAS) Pain And function (UCLA) Pain and function (ASES)					+ + +	+ + +	Twelve months follow-up association in the multivariate linear regression analysis HADS-D with VAS − 0.073 (CI -0.298–0.152), with UCLA score − 0.027 (-0.565–0.511), ASES score − 0.235 (-1.49–1.96). HADS-A with VAS 0.12 (-0.05–0.28), UCLA − 0.09 (-0.49–0.31), ASES − 0.62 (-1.91–0.67).
Dambreville et al. 2007 (56)	(+)	Pain (VAS)					+	-	Preoperative depression (HADS) associated with pain at one month in a multivariate analysis (p = 0.03), not significant in postoperative pain; Anxiety (HADS) N.S.
Dekker et al. 2016 (57)	(++)	Pain (VAS) Shoulder Pain and function (OSS)					+ +		Preoperative depression score revealed a strong negative correlation between preoperative HADS score and 6-week OSS (r=- 0.490, p < .01), HADS and 6-month OSS (r=- 0.626, p < .01) and HADS and 6-month satisfaction (r=-0.259, p < .05). There as strong positive correlation (r=-0.508, p = 0.01) between HADS score and 6-month pain scores.

+ effect found; - no effect found.

Overall study quality, high (++), moderate (+), low (0)

+ effect found; - no effect found; N.S. not significant.

*ADI: Author defined instrument;

4DSQ: Four-Dimensional Symptom Questionnaire; ASES: the American Shoulder and Elbow Surgeons' Scale; BPI: Brief Pain Inventory; CBT: cognitive behavioural therapy approach; DASH (and quickDASH): (Quick) Disability of the Arm, Shoulder and Hand Questionnaire; UCLA Scale: The University of California at Los Angeles Shoulder Score; EQ-5D: EuroQol- 5 Dimension; FABQ: Fear Avoidance Beliefs Questionnaire (FABQ-P: physical activity subscale; FABQ-W, work subscale); FLEX-SF: Flexilevel Scale of Shoulder Function; GE: graded exercise; HADS: Hospital Anxiety and Depression Scale; HSCL-25: the Hopkins Symptoms Checklist; NRS: Numeric Rating Scale; MCID: A minimal clinically important difference; MODEMS: Musculoskeletal Outcomes Data Evaluation and Management System; OSS: Oxford Shoulder Score; PCCL: Pain Coping and Cognition List; PCS: Pain Catastrophizing Scale; PSFS: Patient Specific Functional Scale; PT: physical therapy; RCT: randomized controlled trial; SF-36: Short Form Survey; SDQ: Shoulder Disability Questionnaire; SPADI: Shoulder Pain and Disability Index; SST: Simple Shoulder Test; TSK: Tampa Scale of Kinesiophobia; UC: usual care; VAS: Visual Analog Scale.

Authors	Quality	Outcome	Beliefs	Cognitive Style		Affect: Distress		Effect
George et al 2016 (38)	(++)	Pain (BPI)		+	+	+	+	Strong statistical evidence was found for ADRB2 and depressive symptoms for postoperative course (pain and disability), and GCH1 and anxiety symptoms for 12-month pain-intensity outcome. Interactions involving inflammatory genes with strong statistical evidence for the 12-month postoperative course outcome were: two different IL6 single-nucleotide polymorphisms and pain catastrophizing, and IL6 and depressive symptoms; KCNS1 and kinesiophobia for preoperative pain intensity but not for postoperative pain.
		Shoulder disability (QuickDASH)		+	-			
George et al. 2008 (36)	(+)	Pain (BPI)		+	-			Postoperative pain measured by BPI > 4 points. Baseline PCS was associated with baseline pain, PCS baseline high score and low-COMT-phenotype the relative risk of high postoperative shoulder pain 6.8 (CI 2.8–16.7); Fear of pain or kinesiophobia were not associated with baseline pain or postoperative outcome (FPQ-III and TSK-11), however postoperative outcome was not systematically analysed.
George et al. 2015 (37)	(++)	Recovery (*ADI)		+	+			Pain recovery was defined by: current pain intensity at VAS 0/10 and worst pain intensity 2/10. PCS, the catastrophizing high risk subgroup (combination of COMT and PCS score) were less likely to recover at 12 months (HR 0.51, P = 0.002); FABQ-score high risk subgroup (combination of COMT and FABQ-score) was less likely to recover at 12 months (HR 0.69, p = 0.043).

+ effect found; - no effect found.

Overall study quality, high (++), moderate (+), low (0)

+ effect found; - no effect found; N.S. not significant.

*ADI: Author defined instrument;

4DSQ: Four-Dimensional Symptom Questionnaire; ASES: the American Shoulder and Elbow Surgeons' Scale; BPI: Brief Pain Inventory; CBT: cognitive behavioural therapy approach; DASH (and quickDASH): (Quick) Disability of the Arm, Shoulder and Hand Questionnaire; UCLA Scale: The University of California at Los Angeles Shoulder Score; EQ-5D: EuroQol- 5 Dimension; FABQ: Fear Avoidance Beliefs Questionnaire (FABQ-P: physical activity subscale; FABQ-W, work subscale); FLEX-SF: Flexilevel Scale of Shoulder Function; GE: graded exercise; HADS: Hospital Anxiety and Depression Scale; HSCL-25: the Hopkins Symptoms Checklist; NRS: Numeric Rating Scale; MCID: A minimal clinically important difference; MODEMS: Musculoskeletal Outcomes Data Evaluation and Management System; OSS: Oxford Shoulder Score; PCCL: Pain Coping and Cognition List; PCS: Pain Catastrophizing Scale; PSFS: Patient Specific Functional Scale; PT: physical therapy; RCT: randomized controlled trial; SF-36: Short Form Survey; SDQ: Shoulder Disability Questionnaire; SPADI: Shoulder Pain and Disability Index; SST: Simple Shoulder Test; TSK: Tampa Scale of Kinesiophobia; UC: usual care; VAS: Visual Analog Scale.

Authors	Quality	Outcome	Beliefs	Cognitive Style	Affect: Distress	Effect
Henn et al. 2007 (58)	(+)	Pain (VAS)	+			Preoperative expectation regarding the treatment (MODEM questionnaire): 6 questions, mean score: expectations were a significant independent predictor of better postoperative outcome scores (VAS (Beta 9.91, p = 0.005), DASH (Beta 11.93, p = < 0.001), SF-36, SST (Beta 15.34, p < 0.001)) at 12 months; Workers compensation in the multivariate model significant for VAS (Beta − 12.88, p = 0.009), DASH (Beta − 9.12, p = 0.011), SST (Beta − 1.33, p = 0.038), SF-36.
		Shoulder function (SST)	+			
		Shoulder disability (DASH)	+			
		Physical and mental health (SF-36)				
Jain et al. 2018 (59)	(++)	Pain and disability (SPADI)		+	-	Linear mixed prediction models incorporating a covariance structure using all available follow-up time points (3, 6, 12, and 18 months) for a given patient. Higher FABQ physical activity score predicted higher SPADI scores (worse shoulder pain and function), p for interaction = 0.001. Mental Health Inventory (MHI-5, distress) N.S.

+ effect found; - no effect found.

Overall study quality, high (++), moderate (+), low (0)

+ effect found; - no effect found; N.S. not significant.

*ADI: Author defined instrument;

4DSQ: Four-Dimensional Symptom Questionnaire; ASES: the American Shoulder and Elbow Surgeons' Scale; BPI: Brief Pain Inventory; CBT: cognitive behavioural therapy approach; DASH (and quickDASH): (Quick) Disability of the Arm, Shoulder and Hand Questionnaire; UCLA Scale: The University of California at Los Angeles Shoulder Score; EQ-5D: EuroQol- 5 Dimension; FABQ: Fear Avoidance Beliefs Questionnaire (FABQ-P: physical activity subscale; FABQ-W, work subscale); FLEX-SF: Flexilevel Scale of Shoulder Function; GE: graded exercise; HADS: Hospital Anxiety and Depression Scale; HSCL-25: the Hopkins Symptoms Checklist; NRS: Numeric Rating Scale; MCID: A minimal clinically important difference; MODEMS: Musculoskeletal Outcomes Data Evaluation and Management System; OSS: Oxford Shoulder Score; PCCL: Pain Coping and Cognition List; PCS: Pain Catastrophizing Scale; PSFS: Patient Specific Functional Scale; PT: physical therapy; RCT: randomized controlled trial; SF-36: Short Form Survey; SDQ: Shoulder Disability Questionnaire; SPADI: Shoulder Pain and Disability Index; SST: Simple Shoulder Test; TSK: Tampa Scale of Kinesiophobia; UC: usual care; VAS: Visual Analog Scale.

Authors	Quality	Outcome	Beliefs	Cognitive Style	Affect: Distress	Effect
Koorevaar et al 2018 (60)	(+)	Shoulder disability (DASH)			-	Comparison of group 1 (≥ 1 psychological disorder before and 12 months after surgery n = 32) and group 2 (no psychological disorders, n = 110). DASH scores before (Group 1 55.5 [SD 19.8], Group 2 35.3 [SD 21.2], p < 0.001) and 12 months after shoulder surgery (Group 1 34.8 [SD 20.5], (Group 2 12.1 [SD 12.1], p < 0.001) were significantly higher in patients with symptoms of psychological disorders. Change of DASH score (p = 0.559) and MCID (% complete recovery, p = 0.284) were not different between the two groups. No adjustment for differences in baseline variables.
Koorevaar et al. 2016 (61)	(++)	Shoulder disability (DASH)			+ +	Preoperative 4DSQ (distress, depression, anxiety, and somatization) was adjusted for age, gender and preoperative DASH score, associated with less of an improvement in DASH score.
Oh et al.72012 (62)	(++)	Shoulder function (SST) Shoulder function (Improvement Constant-Murley score) Physical and mental health (SF-36)	+ + +			Patients were classified into low (33%), middle (33%), and high (33%) expectation or concern groups (based on mean expectation (MODEMS score) or concern score). High-expectation group more improvement on SST (p = 0.24), Constant Murley scores (P < .001), and the SF-36 Physical Function (P = 0.006) compared to low expectation group. High-concern group no significant improvement compared with low-concern group on SST (p = 0.9), Constant Murley scores (p = 0.7), and SF-36 physical function (p = 0.4).

+ effect found; - no effect found.

Overall study quality, high (++), moderate (+), low (0)

+ effect found; - no effect found; N.S. not significant.

*ADI: Author defined instrument;

4DSQ: Four-Dimensional Symptom Questionnaire; ASES: the American Shoulder and Elbow Surgeons' Scale; BPI: Brief Pain Inventory; CBT: cognitive behavioural therapy approach; DASH (and quickDASH): (Quick) Disability of the Arm, Shoulder and Hand Questionnaire; UCLA Scale: The University of California at Los Angeles Shoulder Score; EQ-5D: EuroQol- 5 Dimension; FABQ: Fear Avoidance Beliefs Questionnaire (FABQ-P: physical activity subscale; FABQ-W, work subscale); FLEX-SF: Flexilevel Scale of Shoulder Function; GE: graded exercise; HADS: Hospital Anxiety and Depression Scale; HSCL-25: the Hopkins Symptoms Checklist; NRS: Numeric Rating Scale; MCID: A minimal clinically important difference; MODEMS: Musculoskeletal Outcomes Data Evaluation and Management System; OSS: Oxford Shoulder Score; PCCL: Pain Coping and Cognition List; PCS: Pain Catastrophizing Scale; PSFS: Patient Specific Functional Scale; PT: physical therapy; RCT: randomized controlled trial; SF-36: Short Form Survey; SDQ: Shoulder Disability Questionnaire; SPADI: Shoulder Pain and Disability Index; SST: Simple Shoulder Test; TSK: Tampa Scale of Kinesiophobia; UC: usual care; VAS: Visual Analog Scale.

Authors	Quality	Outcome	Beliefs	Cognitive Style	Affect: Distress	Effect
Potter et al. 2015 (63)	(+)	Pain (VAS) Shoulder function (SST) Pain and function (ASES)			- - -	Score stratified based on Distress Risk Assessment Method. No significant differences between group with preop distress and those non-distressed. VAS MCID in non-distressed group 59% and in distressed group 81% (OR, 2.91; 95% CI, 0.92–9.14; p = 0.06). SST MCID in non-distressed 89% and distressed 81% (OR, 0.54; 95% CI, 0.14–2.07; p = 0.36). ASES MCID in non-distressed 86% and distressed 88% (OR, 1.21; 95% CI, 0.28–5.32; p = 0.80).

+ effect found; - no effect found.

Overall study quality, high (++), moderate (+), low (0)

+ effect found; - no effect found; N.S. not significant.

*ADI: Author defined instrument;

4DSQ: Four-Dimensional Symptom Questionnaire; ASES: the American Shoulder and Elbow Surgeons' Scale; BPI: Brief Pain Inventory; CBT: cognitive behavioural therapy approach; DASH (and quickDASH): (Quick) Disability of the Arm, Shoulder and Hand Questionnaire; UCLA Scale: The University of California at Los Angeles Shoulder Score; EQ-5D: EuroQol- 5 Dimension; FABQ: Fear Avoidance Beliefs Questionnaire (FABQ-P: physical activity subscale; FABQ-W, work subscale); FLEX-SF: Flexilevel Scale of Shoulder Function; GE: graded exercise; HADS: Hospital Anxiety and Depression Scale; HSCL-25: the Hopkins Symptoms Checklist; NRS: Numeric Rating Scale; MCID: A minimal clinically important difference; MODEMS: Musculoskeletal Outcomes Data Evaluation and Management System; OSS: Oxford Shoulder Score; PCCL: Pain Coping and Cognition List; PCS: Pain Catastrophizing Scale; PSFS: Patient Specific Functional Scale; PT: physical therapy; RCT: randomized controlled trial; SF-36: Short Form Survey; SDQ: Shoulder Disability Questionnaire; SPADI: Shoulder Pain and Disability Index; SST: Simple Shoulder Test; TSK: Tampa Scale of Kinesiophobia; UC: usual care; VAS: Visual Analog Scale.

Authors	Quality	Outcome	Beliefs	Cognitive Style	Affect: Distress		Effect
Ravindra et al 2018 (64)	(+)	Pain (VAS) Pain and function (ASES)			- -		Correlation coefficients were calculated for VAS and ASES at 1 year for the following independent variables: preoperative demographic factors, MRI tear characteristics. Correlation coefficients were calculated for preoperative VAS scores and ASES and WORC, SST, and SF-36 scores Significant correlation found for higher 1-year VAS scores and higher preoperative VAS pain scores, narcotic use, and low WORC scores (both composite and emotion). Correlation with higher ASES scores at 1-year was found for higher preoperative VAS scores and increased supraspinatus atrophy.
Thorpe et al. 2018 (65)	(+)	Pain and function (ASES)		+	+	+	After adjustment for gender, workers compensation status, alcohol use and confidence in surgical outcome, cluster with poor psychological health was independently associated with worse ASES score at all time points (regression coefficient for ASES: 3 months after surgery − 15 [95% CI, -23 to -8], p < 0.001); and 12 months after surgery − 9 [95% CI, -17 to -1], p = 0.023). ASES scores improved in both clusters from before surgery to 12 months after surgery equally (regression coefficient for ASES: cluster 2 31 [95% CI, 26–36], p < 0.001); cluster 1 31 [95% CI, 23–39], p < 0.001).
Valencia et al. 2014 (40)	(+)	Pain (BPI) Shoulder disability (DASH)		- +	- +		PCS no significant correlation with 6 months pain, significant correlation with DASH at 6 months (r = 0.225); PHQ 9 not significant for pain but significant for disability (DASH, r = 0.287).

+ effect found; - no effect found.

Overall study quality, high (++), moderate (+), low (0)

+ effect found; - no effect found; N.S. not significant.

*ADI: Author defined instrument;

4DSQ: Four-Dimensional Symptom Questionnaire; ASES: the American Shoulder and Elbow Surgeons' Scale; BPI: Brief Pain Inventory; CBT: cognitive behavioural therapy approach; DASH (and quickDASH): (Quick) Disability of the Arm, Shoulder and Hand Questionnaire; UCLA Scale: The University of California at Los Angeles Shoulder Score; EQ-5D: EuroQol- 5 Dimension; FABQ: Fear Avoidance Beliefs Questionnaire (FABQ-P: physical activity subscale; FABQ-W, work subscale); FLEX-SF: Flexilevel Scale of Shoulder Function; GE: graded exercise; HADS: Hospital Anxiety and Depression Scale; HSCL-25: the Hopkins Symptoms Checklist; NRS: Numeric Rating Scale; MCID: A minimal clinically important difference; MODEMS: Musculoskeletal Outcomes Data Evaluation and Management System; OSS: Oxford Shoulder Score; PCCL: Pain Coping and Cognition List; PCS: Pain Catastrophizing Scale; PSFS: Patient Specific Functional Scale; PT: physical therapy; RCT: randomized controlled trial; SF-36: Short Form Survey; SDQ: Shoulder Disability Questionnaire; SPADI: Shoulder Pain and Disability Index; SST: Simple Shoulder Test; TSK: Tampa Scale of Kinesiophobia; UC: usual care; VAS: Visual Analog Scale.

Authors	Quality	Outcome	Beliefs	Cognitive Style	Affect: Distress		Effect
Woollard et al. 2017 (66)	(+)	Disability (*ADI)		+			Criteria for functional disability postoperative: (1) Global rating of change ≥ + 5, (2) ≥ 17-point improvement on the WORC from baseline to 6-months postoperative. Logistic regression model including (1) surgery on dominant shoulder, (2) work compensation status, (3) modified job duty, (4) baseline FABQ-work, internal rotation strength. FABQ-Work was associated with a lower success rate (OR 0.92, 95% CI 0.85–1.00). FABQ work subscale of ≤ 25 and surgery on the dominant shoulder were both strongly predictive of being a responder to surgery (FABQ work ≤ 25 points Beta 2.73, OR 15.29 (95% CI 2.30-101.9), p = 0.005)
Yeoman et al. 2012 (67)	(+)	Pain (VAS) Shoulder pain and function (OSS)			- -	- -	HADS (> 7 points) no significant difference in the postoperative function and VAS in the depression versus the no depression group (6 weeks follow-up); HADS (> 7 points) no significant difference in the postoperative function and VAS in the anxiety versus the no anxiety group (6 weeks follow-up).

+ effect found; - no effect found.

Overall study quality, high (++), moderate (+), low (0)

+ effect found; - no effect found; N.S. not significant.

*ADI: Author defined instrument;

4DSQ: Four-Dimensional Symptom Questionnaire; ASES: the American Shoulder and Elbow Surgeons' Scale; BPI: Brief Pain Inventory; CBT: cognitive behavioural therapy approach; DASH (and quickDASH): (Quick) Disability of the Arm, Shoulder and Hand Questionnaire; UCLA Scale: The University of California at Los Angeles Shoulder Score; EQ-5D: EuroQol- 5 Dimension; FABQ: Fear Avoidance Beliefs Questionnaire (FABQ-P: physical activity subscale; FABQ-W, work subscale); FLEX-SF: FIexilevel Scale of Shoulder Function; GE: graded exercise; HADS: Hospital Anxiety and Depression Scale; HSCL-25: the Hopkins Symptoms Checklist; NRS: Numeric Rating Scale; MCID: A minimal clinically important difference; MODEMS: Musculoskeletal Outcomes Data Evaluation and Management System; OSS: Oxford Shoulder Score; PCCL: Pain Coping and Cognition List; PCS: Pain Catastrophizing Scale; PSFS: Patient Specific Functional Scale; PT: physical therapy; RCT: randomized controlled trial; SF-36: Short Form Survey; SDQ: Shoulder Disability Questionnaire; SPADI: Shoulder Pain and Disability Index; SST: Simple Shoulder Test; TSK: Tampa Scale of Kinesiophobia; UC: usual care; VAS: Visual Analog Scale.

Table 4

Classification of studies based on the relationship between modifiable psychological constructs and outcome. Relationship between constructs and outcome is further classified based on clinical intervention, time from onset, and quality of study (high/ moderate) in each cell. Bold font indicates high quality studies.

	Predicting outcome	1.Self efficacy / Coping	2. Expectation of recovery	3. Catastrophizing	4. Avoidance Coping Style	5. Depression	6. Anxiety / Worry/ Fear
Conservative							
Number of studies that psychological factors found to:							
Predicting outcome			2	2	3	4	1
Not predicting outcome		1	3	3	3	8	5
Subacute	Yes				**High: (49)**		
	No			**High: (35)** Moderate: (34)	**High: (35)** Moderate: (34)	**High: (35)** Moderate:(34, 45)	Moderate: (34, 49)
Chronic	Yes		**High: (48)**	**High: (54)**	**High: (54)**	**High: (54)** Moderate: (44)	**High: (54)**
	No	**High: (43)**				**High: (43, 48)**	Moderate: (44)
Not specified / mixed	Yes		**High: (50)**	**High: (39)**	Moderate: (52)	**High: (46, 53)**	
	No		**High: (42, 51)** Moderate: (41)	Moderate: (47)	Moderate: (47)	**High: (4, 42, 51)**	**High: (4, 51)**
Surgery							
Number of studies that psychological factors found to:							
Predicting outcome			2	5	4	7	4
Not predicting outcome					1	5	2
Subacute	Yes				**High: (59)**		
	No					**High: (59)**	
Chronic	Yes		**High: (62)** Moderate: (58)			Moderate: (55)	Moderate: (55)
	No						
Not specified / mixed	Yes			**High: (37, 38)** Moderate: (36, 40, 65)	**High: (37, 38)** Moderate: (66)	**High: (38, 57, 61)** Moderate: (40, 56, 65)	**High: (38, 61)** Moderate: (65)
	No				Moderate: (36)	Moderate: (60, 63, 64, 67)	Moderate: (56, 67)

Figures

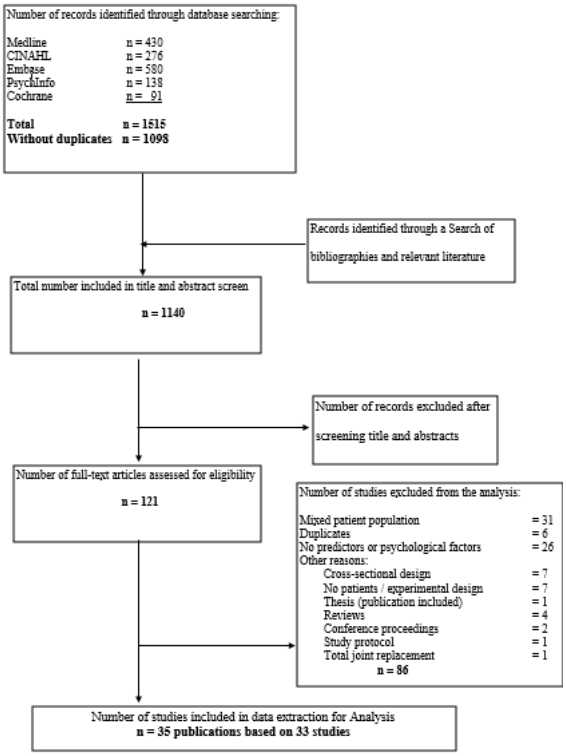

Figure 1

Systematic review flowchart

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Appendix.docx
- PRISMAP2015checklist1.docx