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

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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 shoulder 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.
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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 |
| 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 trial; 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 Los Angeles Disability Index; SST: Simple Shoulder Test; TSK: Tampa Scale of Kinesiophobia; UC: usual care; VAS: Visual Analog Scale.
| Author, year | Design | *Setting | Diagnosis | SS | Age: mean | Intervention | Treatment duration | Follow-up |
|--------------|--------|----------|-----------|----|-----------|--------------|-------------------|-----------|
| Kennedy et al. 2006 | Prosp. Cohort | PTs center, Canada | PTs included 5 clients undergoing treatment for soft tissue shoulder complaints | NR | 361 (54%) | PT treatment | 12 weeks or end of treatment |
| Kromer et al. 2014 | RCT, secondary analysis | PT clinic, Germany | Subacromial pain | 90 (45 per group) | 90 (51%) | 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 |
| Kuijpers et al. 2006 | Prosp. Cohort | GP clinic, Netherlands | Acute shoulder pain | No | 587 (50%) | Usual care including medical management and physical therapy | Not defined | 6 weeks and 6 months |
| Kvaalvaag 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%) | 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 |
| O’Malley et al. 2004 | Prosp. Cohort | Orthopedic clinic, USA | Shoulder pain | No | 199 (47%) | Various interventions | NR | 3 months |
| Reilingh et al. 2008 | Prosp. Cohort | GP, Netherlands | Shoulder pain | No | 587 (50%) | Various interventions | Not defined | 6 months |
| Ryall et al. 2007 | Prosp. Cohort | Primary care and PT clinics, U.K. | Shoulder pain | No | 222 (of 375 with arm pain) | Various interventions | NR | 12 months |
| Sindhu et al. 2012 | Retro. analysis of prosp. collected data | Outpatient rehab clinics, various locations throughout the United States | Shoulder impairment | No | 3362 (54%) | Conservative care | NR | End of treatment |
| Smedbråten et al. 2018 | Registry study | Outpatient Physiotherapy Norway, FysioPol database | Shoulder impairment | No | 145 (72%) | Exercises physiotherapy | 5 weeks (IQR 3 to 6) | End of treatment |

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

**4DSQ:** Four-Dimensional Symptom Questionnaire; **ASES:** the American Shoulder and Elbow Surgeons' Scale; **BPI:** Brief Pain Inventory; **CAT:** Computerized Ad behaviour therapy; **DASH (and quickDASH):** (Quick) Disability of the Arm, Shoulder and Hand Questionnaire; **UCLA Scale:** The University of California at Los Angeles Shoulder and Elbow Score; **EQ-5D:** EuroQol-5 Dimension; **FABQ:** Fear Avoidance Beliefs Questionnaire (FABQ-P: physical activity subscale; FABQ-W, work subscale); **FLEX-SF:** Flexilevel Scale; **HADS:** Hospital Anxiety and Depression Scale; **HSCL-25:** the Hopkins Symptoms Checklist; **NRS:** Numeric Rating Scale; **MCID:** minimal clinically important difference; **Musculoskeletal Outcomes Data Evaluation and Management System;** **OSS:** Oxford Shoulder Score; **PCCL:** Pain Coping and Cognition List; **PCS:** Pain Catastrophizing Scale; **PT:** physical therapy; **RCT:** randomized controlled trial; **SF-36:** Short Form Survey; **SDQ:** Shoulder Disability Questionnaire; **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 | 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) |    |
| 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                   |    |

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

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 Los Angeles Shoulder Scale; EQ-5D: EuroQol 5 Dimension; FABQ: Fear Avoidance Beliefs Questionnaire (FABQ-P: physical activity subscale; FABQ-W, work subscale); FLEX-SF: Flexilevel Shoulder Function Scale; HSCL-25: the Hopkins Symptoms Checklist; NRS: Numeric Rating Scale; MCID: minimal clinically important difference in Musculoskeletal Outcomes Data Evaluation and Management System; OSS: Oxford Shoulder Score; PCCL: Pain Coping and Cognition List; PCS: Pain Catastrophising Scale; PT: physical therapy; RCT: randomized controlled trial; SF-36: Short Form Survey; SDQ: Shoulder Disability Questionnaire; 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 trial.

4DSQ: Four-Dimensional Symptom Questionnaire; ASES: the American Shoulder and Elbow Surgeons' Scale; BPI: Brief Pain Inventory; CAT: Computerized Ad behaviour therapy; DASH (and quickDASH): (Quick) Disability of the Arm, Shoulder and Hand Questionnaire; UCLA Scale: The University of California at Los Angeles Shoulder and Elbow Score; EQ-5D: EuroQol 5 Dimension; FABQ: Fear Avoidance Beliefs Questionnaire (FABQ-P: physical activity subscale; FABQ-W, work subscale); FLEX-SF: Flexilevel Scale; HADS: Hospital Anxiety and Depression Scale; HSCL-25: the Hopkins Symptoms Checklist; NRS: Numeric Rating Scale; MCID: minimal clinically important difference; Musculoskeletal Outcomes Data Evaluation and Management System; OSS: Oxford Shoulder Score; PCCL: Pain Coping and Cognition List; PCS: Pain Catastrophizing Scale; Patient Specific Functional Scale; PT: physical therapy; RCT: randomized controlled trial; SF-36: Short Form Survey; SDQ: Shoulder Disability Questionnaire; SST: Simple Shoulder Test; TSK: Tampa Scale of Kinesiophobia; UC: usual care; VAS: Visual Analog Scale.
Table 3: 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                                                                 |
|--------------------------|---------|-------------------|---------------------|--------------------------|-----------------|------------------------------------------------------------------------|
| 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) | -                   | -                        | -               | Distress (HSCL-25) and self-efficacy 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) | -                   | -                        | -               | 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 PCLL 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       | -       | -               | -               | 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      | +       | -               | -               | 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      | +       | -               | -               | 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                 | +       | -               | -               | 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    | (+++)   | Pain (NRS, in acute 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       | (+++)   | 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      | (+)     | 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   | (+++)   | Pain (NRS)        | +                | -               | 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  | (+++)   | Perceived recovery (*ADI) | -       | -               | -               | 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 (0.566–1.85) 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  | (+++)   | Shoulder disability (DASH) | +       | -               | +               | 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                                      |
|------------------|---------|------------------------|--------------------------|-----------------|------------------|---------------------------------------------|
| Cho et al. 2015  | (+)     | Pain (VAS)             | Self efficacy / Coping   | (+)             | (+)              | 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). |
|                  |         | Pain And function (UCLA) |                         |                 |                  |                                             |
|                  |         | Pain and function (ASES) |                         |                 |                  |                                             |
| Dambreville et al. 2007 | (+) | 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 | (+++)  | Pain (VAS)             | Self efficacy / Coping   | (+)             |                  | 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. |
|                  |         | Shoulder Pain and function (OSS) |                    |                 |                  |                                             |

* 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; PSF: 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 | (+++)   | 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. |
| George et al 2008 | (+)     | 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 | (+++)   | 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)

*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; SP-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) | + | Cognitive Style | Affect: Distress | 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 | + |                      |                 |        |
| 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. |
|          |        | Physical and mental health (SF-36) | |                      |                 |        |
| Authors                  | Quality | Outcome                          | Beliefs                          | Cognitive Style | Affect: Distress | Effect |
|-------------------------|---------|----------------------------------|----------------------------------|-----------------|-----------------|--------|
| Koorevaar et al. 2018   | (+)     | Shoulder disability (DASH)       | -                                | -               | -               |        |
|                         |         |                                  |                                  |                 |                 |        |
|                         |         |                                  |                                  |                 |                 |        |
| Koorevaar et al. 2016   | (+++)   | Shoulder disability (DASH)       | +                                | +               | +               |        |
|                         |         |                                  |                                  |                 |                 |        |
|                         |         |                                  |                                  |                 |                 |        |
| Oh et al. 2012          | (+++)   | Shoulder function (SST)          | +                                | +               | +               |        |
|                         |         | Shoulder function (improvement Constant-Murley score) | + | + | + |        |
|                         |         | Physical and mental health (SF-36) |                  |                 |                 |        |

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.

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.

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)

*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.    | (+)     | Pain (VAS)   |                        |                 |                 | Score stratified based on Distress Risk Assessment Method. No significant differences between group with preop distress and those non-distressed. |
| 2015 (63)        |         | Shoulder function (SST) |                   |                 |                 |                                                                         |
|                  |         | Pain and function (ASES) |                   |                 |                 |                                                                         |

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    | (+)     | 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      | (+)     | 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    | (+)     | Pain (BPI)            | Should 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; SP-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    | (+)     | 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      | (+)     | 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-SD: 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.
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.

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

Figures
Supplementary Files

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

- Appendix.docx
- PRISMAP2015checklist1.docx