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Does the psychological profile of a patient with frozen shoulder predict future outcome? A systematic review

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# DOES THE PSYCHOLOGICAL PROFILE OF A PATIENT WITH FROZEN SHOULDER PREDICT FUTURE OUTCOME? A SYSTEMATIC REVIEW

## ABSTRACT

**Background and purpose.** Frozen shoulder (FS) is defined as a condition characterized by functional restriction and daily and nightly pain. As in other shoulder pathologies, the manifestation of psychological factors is recognized in FS; however, from a psychological point of view, only few studies reported on its prognostic value. The aim of this systematic review is to investigate, in patients with FS, the prognostic value of psychological factors on pain, function, disability, health-related quality of life, return to work and time to recovery.

**Materials and methods.** This systematic review was reported following the Preferred Reporting Items for Systematic reviews and Meta-Analysis - PRISMA 2020 guideline. Authors followed the Cochrane Handbook for Systematic review of Intervention as methodological guidance. The Quality in Prognostic Studies - QUIPS tool was used to assess the Risk of Bias.

**Results.** Pain-related fear and depression could be prognostic regarding patient-reported outcome measures assessing shoulder function, disability, and pain; instead, pain catastrophizing could have a prognostic value assessed by disability of the arm shoulder and hand -DASH scale. Anxiety would appear to impact on disability and pain.

**Discussion and conclusions.** As widely reported in numerous musculoskeletal conditions, also in FS some psychological factors influence the physical dimension such as pain, disability and function. Therefore, clinicians should be encouraged to identify these factors through a whole assessment of the bio-psychological profile of each individual with FS. Perhaps, patients with FS that show such psychological prognostic factors, could benefit from a comprehensive and shared approach with other dedicated professionals.

**Keywords.** Frozen shoulder; adhesive capsulitis; psychosocial factors; depression.

## BACKGROUND

Frozen shoulder (FS) is defined as a condition characterized by functional restriction of both active and passive shoulder motion for which radiographs of the glenohumeral joint are essentially unremarkable except for the possible presence of osteopenia (Zuckerman & Rokito, 2011). FS is mainly referred to the idiopathic form of stiff shoulder, with an unknown cause; while the secondary stiff shoulder, often refers to a shoulder stiffness related to a known/hypothesized cause associated to intrinsic, extrinsic or systemic pathologies (Zuckerman & Rokito, 2011). Clinically, FS is characterized by a constant, stabbing, daily and nightly pain and gradual glenohumeral joint active and passive range of movement (ROM) limitation (Mertens et al., 2022). Particularly, ROM restriction of at least 25% in at least 2 movement planes and more than 50% in external rotation at arm by side compared to the non-involved side are used as landmark; moreover, the complaints must be stable for at least one month or worsening (Kelley et al., 2013).

In the past years, authors searched for the value of psychological prognostic factors in various shoulder pathologies (de Baets et al., 2019; Martinez-Calderon, Struyf, et al., 2018). This interest and the results from evidence (Cho et al., 2013; Potter et al., 2014; Roh, Lee, et al., 2012; Roh, Noh, et al., 2012), could suggest the possibility/need to modify the actual assessment and treatment and emphasize a multi-disciplinary approach aiming to optimize the recovery in shoulder musculoskeletal complaints (de Baets et al., 2019; Martinez-Calderon, Meeus, et al., 2018).

So, the importance of assessing and properly consider psychological factors is found in patients with shoulder complaints with need of surgical or conservative treatment (Brindisino et al., 2022; de Baets et al., 2019; Kennedy et al., 2019; Martinez-Calderon et al., 2017; Martinez-Calderon, Meeus, et al., 2018; Martinez-Calderon, Struyf, et al., 2018; Wong et al., 2020) and evidence suggested that, at the beginning of the patients care, baseline psychological factors should be formally assessed using standardised measures and should also be taken into account considering their prognostic

value (Chester et al., 2018). In fact, although physical aspects were very important for patient firstly for the functional disability and then for the pain, equally importance was reported for the psychological aspects (Jones et al., 2013; King & Hebron, 2022; Martinez-Calderon, Struyf, et al., 2018). As in other shoulder pathologies (Brindisino et al., 2022; Kennedy et al., 2019; Martinez-Calderon, Struyf, et al., 2018; Wong et al., 2020), in FS the presence of psychological factors is well documented (Brindisino et al., 2022; King & Hebron, 2022) however, little is known about the prognostic association between psychological factors and the main patient-reported outcome measures (PROMs) and the literature is currently lacking of systematic reviews on this topic.

Therefore, the aim of this systematic review is to investigate, in patients with FS (P), the prognostic value of psychological factors such as avoidance behaviour, fear, fear of pain, fear of movement, pain catastrophizing, kinesiophobia, anxiety, depression, optimism, helplessness, self-efficacy, pessimism, threat, positive attitude, positive thinking, hypervigilance, motivation and expectation (E) on pain, function, disability, health-related quality of life, return to work and time to recovery (O). We hypothesize that patients with FS with a negative psychological load might present with a worse score on PROM of interest.

## **MATERIALS AND METHODS**

### **Reporting**

The current systematic review was reported following the Preferred Reporting Items for Systematic reviews and Meta-Analysis (PRISMA) 2020 guideline (Page et al., 2021). Authors followed the Cochrane Handbook for Systematic review of Intervention as methodological guidance (Higgins et al., 2022).

## **Protocol and Registration**

For increasing clarity, transparency and reproducibility of this research, this systematic review protocol was a-priori registered on the International Prospective Register of Systematic Reviews (PROSPERO) on 28th March 2022 (registration number CRD42022312887).

## **Selection criteria**

### ***Information sources and search***

Medline, Embase, Pubpsych, PsychInfo, PsychNET.APA, PEDro were searched to identify relevant studies. In addition, other potentially relevant studies will be searched in clinical trial and systematic review registers (i.e. PROSPERO, ClinicalTrials.gov), in relevant grey literature sources (i.e. other databases of conference abstracts) and further information about ongoing studies from experts identified by the authors. Furthermore, a manual cross-referencing will be performed on the reference lists of included articles. The search strategy and keywords are based on a Population, Exposure and Outcomes (PEO) design and different keywords related to our PEO were combined for the search and shown in **Appendix 1** for all databases. The first search was performed on 1st March 2022 and was updated on the 4<sup>th</sup> of February 2023.

### ***Participants***

Studies must include adult population with primary FS or secondary stiff shoulder. We excluded studies reporting subjects with medical history of proximal humeral fractures during the last year, rotator cuff tears during the last year, shoulder dislocation during the last year, previous shoulder surgery procedure during the last year. Moreover, studies concerning people with neoplasms,

infections and related symptoms, systemic disease (i.e. rheumatoid arthritis), and psychiatric diagnosed disorders were further excluded.

### ***Exposure***

Studies have to investigate the prognostic value of at least one of the following psychological factors: avoidance behaviour, fear, fear of pain, fear of movement, pain catastrophizing, kinesiophobia, anxiety, depression, helplessness, self-efficacy, optimism, pessimism, threat, positive attitude, positive thinking, hypervigilance, motivation and expectation.

### ***Outcomes and follow-up***

Pain, function, disability, health-related quality of life, return to work and time to recovery at any follow up were investigated.

### ***Study design and timing***

All types of study designs were included. Despite of the gold standard for the prognostic research is the prospective cohort studies with single cohort, the research was not restricted to only these studies because prognostic information should be found also in other type of study design such as survey, case-control studies and retrospective cohort studies. No studies were excluded on the basis of methodological standards, sample size, duration of follow-up, publication year or language.

### ***Study selection***

After all databases were searched, reports were replaced to EndNote 20 (Clarivate Analytic, PA, USA) and duplicates were removed. The remaining studies were imported to Rayyan QCRI (Ouzzani et al., 2016) online software and screened on the base of their title and abstract by two independent reviewers (██████████) and were excluded if they did not meet the eligibility criteria. If title and abstract were unclear concerning fulfilling the eligibility criteria, the full text was retrieved and screened for fulfilling the eligibility criteria by two independent authors (██████████). Differences were discussed in a consensus meeting. If consensus could not be reached the first author made the final decision (██████).

### **Data extraction**

All included full texts were used for data extraction. Information was extracted from each included study. Information retrieved were: title, first author, year of publication, journal, study design, characteristics of study participants, selection criteria, psychological factors, outcome measures (**Table 1**), and main results (**Table 2**). Data extraction was performed by two reviewers independently (██████████) and was checked by the first author (██████). When required, the authors of the included studies were contacted with a maximum of three email in one month to obtain missing data from the reports. To prevent selective inclusion of data, authors referred to the a-priori defined rules present in the protocol.

### **Quality of evidence**

Two independent authors (██████████) determined the Risk of Bias (RoB) using the Quality in Prognostic Studies (QUIPS) tool (Hayden et al., 2013). This tool consists of several prompting items categorized into six domains (i.e. Study Participants, Study Attrition, Prognostic Factor



Measurement, Outcome Measurement, Study Confounding, Statistical Analysis and Reporting), and each domain is judged on a three-grade scale (i.e. low, moderate or high RoB). The QUIPS scores from both authors (██████████) were compared and potential differences were discussed in a consensus meeting. If disagreements occurred, they were resolved by consulting the first author (██████).

### **Data analysis**

For the primary analysis, studies were grouped per exposition of interest (psychological factors). The potential sources of heterogeneity were assessed through subgroup analyses of participant's age, sample size, outcome measures, psychological factors questionnaires, statistical methods used, and study design. We extracted all unadjusted and adjusted measures of association (i.e. prognostic effect estimates) from included studies, and we recorded how psychological factors were measured and reported.

We separately synthesized dichotomous and continuous measures as they were reported in included studies, as well as for unadjusted and adjusted analyses, when available. To include the most and sufficiently similar studies available, we analysed data from: the longest follow-up period closest to 12 months, the best measure/type of the psychological factors, and the best adjusted model results.

A narrative synthesis (the most relevant summary measure with a precision estimate) was provided. For each comparison, we summarized the number of studies that reported positive, neutral or negative associations between psychological factors and the outcomes of interest. Studies reporting a statistically significant relationship between these factors and a good outcome were recorded as 'positive'; studies reporting a statistically significant relationship between negative psychological

traits and a good outcome were recorded as 'negative'; we recorded nonsignificant associations as 'neutral'.

## RESULTS

### **Study selection and characteristics**

Eight-hundred fifty-nine records were found and 80 were removed because of being duplicates, so 779 were screened for title and abstract. Many of these records did not fulfil inclusion criteria, therefore 755 records were excluded, and 24 reports were sought for retrieval, but one report was not retrieved (Zhang & Zhang, 2004). Finally, 23 studies were screened for full-text but only 3 (de Baets et al., 2020; Debeer et al., 2021; Fernandes, 2017) were included in this systematic review, fulfilling our eligibility criteria. The study selection process is shown in **Figure 1** and the characteristics of included studies and their results were presented in **Tables 1** and **2**, respectively. **Appendix 2** shows the excluded studies with relative reason.

### **Risk of Bias assessment**

The studies included were assessed as “low risk of bias” for “Study Attrition”, “Outcome Measurement”, “Statistical Analysis and Reporting”, while the other domains were judged as moderate or high RoB. The RoB of the included studies is detailed in **Table 3**.

### **Description of the included studies**

All included studies were prospective cohort studies (Debeer et al., 2021; Fernandes, 2017; de Baets et al., 2020). Overall, 135 subjects with FS were included, with a sample for the included studies ranging from 20 (de Baets et al., 2020) to 72 (Debeer et al., 2021). Subjects were treated with suprascapular nerve block (Fernandes, 2017), hydrodilatation (Debeer et al., 2021) and corticosteroid injections followed by physiotherapy (de Baets et al., 2020) according to the

guidelines as specified by the American Physical Therapy Association (Kelley et al., 2013). Patients' outcomes were evaluated at follow up using Disability of the Arm, Shoulder and Hand scale (DASH) (de Baets et al., 2020; Fernandes, 2017), Numeric Rating Scale (NRS) (de Baets et al., 2020) for pain, Visual Analogue Scale (VAS) (Debeer et al., 2021), Shoulder Pain and Disability Index (SPADI) (Debeer et al., 2021) for pain and disability, Constant Murley Score (CMS) (Debeer et al., 2021) and NRS for function and perceived stiffness (de Baets et al., 2020) and measurement of ROM restrictions (de Baets et al., 2020; Debeer et al., 2021). Psychological factors were identified by the World Health Organization Quality of Life (WHOQoL) questionnaire (Fernandes, 2017). This questionnaire takes into consideration positive feelings such as contentment, balance, peace, happiness, hopefulness, joy and enjoyment of the good things in life then thinking, learning, memory, concentration and the ability to make decisions, self-esteem, body image/appearance and negative feelings such as despondency, guilt, sadness, tearfulness, despair, nervousness, anxiety and a lack of pleasure in life; moreover, kinesiophobia (Debeer et al., 2021) and catastrophizing (de Baets et al., 2020), pain related fear (de Baets et al., 2020), depression and anxiety (Debeer et al., 2021) were investigated. Follow ups retrieved were four months follow-up (de Baets et al., 2020), three months (Debeer et al., 2021) and 7 days post treatment (Fernandes, 2017).

Unfortunately, no studies that investigated other psychological factors of interest such as avoidance behaviour, fear, helplessness, self-efficacy, optimism, pessimism, threat, positive attitude, positive thinking, hypervigilance, motivation, and expectation were retrieved. Furthermore, other outcomes such as return to work and time for recovery have not been investigated. Finally, because of the few included studies and the different variables of exposition retrieved, no metaanalysis was performed.

### **Main results**

Results of the included studies reported that pain-related fear is strongly related with PROMs assessing shoulder function, disability, and pain, while pain catastrophizing is only significant related with disability assessed by DASH. Moreover, it seems that depression was related with PROMs assessing function, disability and pain; while anxiety would appear to only impact disability and pain. The association between psychological domain of WHOQOL was reported as significant in the original article (Fernandes, 2017), even if no data out of the “r-coefficient” was provided. Detailed correlations were reported in **Table 4**.

## DISCUSSION

### General interpretation of results

The results of this systematic review suggest that in subjects with FS, could exist a relationship between anxiety, depression, pain catastrophizing and kinesiophobia and PROMs assessing pain intensity, function, and disability. At the best of the authors’ knowledge, this is the first systematic review that investigated this topic. Nevertheless, no firm conclusions can be drawn due to a paucity of literature that thoroughly examines the relationship between patient-reported scores and psychological distress in FS, the paucity of samples retrieved, the heterogeneity of the studies, methodological shortcomings and the presence of bias in the included studies. Unfortunately, the results of the present study were further weakened because the study from De Baets et al. (de Baets et al., 2020) presented only a correlation and no regression analysis. So, such correlation could indicate as relevant some factors that not really influenced the patients’ prognosis with certainty. Moreover, the other two studies (Debeer et al., 2021; Fernandes, 2017) showed moderate or high RoB in respect of confounding factors; this in turn could undermine the validity of the associations provided.

In the study of Rassi Fernandes et al. (Fernandes, 2017), some psychological factors were identified by the psychological sub-component of the WHOQoL score. This sub-component includes more psychological variables, so we don't know which parameter really contributed the most to the correlation with the outcome. However, that study suggested that the outcomes were influenced by psychological parameters, which is an additional sign from which it is possible to assume that these factors could be influential to patients' prognosis.

### **Psychological factors and post-surgical outcomes of shoulder pathologies**

In accordance with our results, the important role and the need of assess psychological factors in shoulder pathology was confirmed in conservative and post-surgical rehabilitation. In fact, psychological factors such as expectation of recovery, catastrophizing, avoidant coping, depression, and anxiety, affect recovery in patients complained shoulder pain managed surgically (Sheikhzadeh et al., 2021). Moreover, depression, anxiety, catastrophic thinking, distress, somatization, and decreased self-efficacy are among the most common psychological factors associated with adverse perioperative events and poor postoperative outcomes. (Roh, Lee, et al., 2012; Gil et al., 2018). In particular, depression and anxiety in patients with total shoulder arthroplasty are associated with increased risk of perioperative complications and lower final functional outcome scores, while patients with higher confidence and preoperative expectations gave better outcomes (Vajapey et al., 2020). This suggests that the prognostic value of the psychological factors could be a key variable also in surgical management, that is generally and strictly associated to biological aspects such as the success of surgery and tissues recovery (Huegel et al., 2015). With this in mind, it should be important to consider and value psychological factors in post-surgery patients with the same importance and consideration of biological ones.

### **Psychological factors and conservative outcome of shoulder pathologies**

The importance of psychological factors is also found in shoulder pain patients with no need of surgical treatment. In these subjects the disuse of the affected limb could diminish the ability to carry out daily life activities (Martinez-Calderon, Meeus, et al., 2018) and this could increase the levels of anxiety, depression, pain catastrophizing and fear avoidance behaviours, in turn increasing pain intensity and disability (Jones et al., 2013). In particular, in patients with shoulder instability, depression, fear of re-injury and kinesiophobia are correlated with pain, function, quality of life and return to sport (Brindisino et al., 2022). Supporting these findings, other studies with moderate evidence confirm that kinesiophobia and catastrophizing (Mallows et al., 2017), depression, anxiety, fear-avoidance but also sleep quality may affect the pain level, shoulder function and quality of life (Wong et al., 2020) in patients with rotator cuff tendinopathy. Moreover, the same psychological factors at baseline predict greater pain intensity and disability overtime (Martinez-Calderon, Struyf, et al., 2018), whereas higher levels of expectations of recovery and self-efficacy are significantly associated with better improvements in the same outcomes (Martinez-Calderon, Struyf, et al., 2018). This is an important finding that suggest and encourage the best managing of proactive psychological factors to improve PROMs in patient with shoulder complaints (Chester et al., 2018; Chester & Jerosch-Herold 2019; Guerrero et al., 2018).

### **Psychological domain in FS patients**

In the light of current evidence, few studies can demonstrate how psychological factors influence FS patient's outcomes. Nevertheless, knowledge about the importance of psychological distress in this particular shoulder pathology should emphasize the importance of rehabilitation, that shouldn't focus only toward physical management for gaining ROM and decreasing pain, but also toward psychological care (Guerrero et al., 2018) through a bio-psychosocial approach (Hush et al., 2011; Tseli et al., 2020), challenging the usual FS patients' assessment for early recognition and management of subjects at risk of developing worst outcomes.

The patients' psychological load could be better clarified and appreciated with qualitative researches that conveying the "patient voice" (Gillespie et al., 2017). Living with FS resulted to be complex and pervaded by uncertainty strikingly analogized as being in "no-man's land" (King & Hebron, 2022); moreover, "life-word" become disrupted and very difficult to live. In this clinical scenario, the power of psychological features in conditioning patients' recovery became striking.

The results of the present systematic review are in accordance with systematic reviews in other shoulder musculoskeletal disorders (Luque-Suarez et al., 2019; Martinez-Calderon et al., 2019), in other pathologies of the upper limb (Alizadehkhayat et al., 2007; Bot et al., 2005; Wilkens et al., 2019), in chronic musculoskeletal disorders (Hayward & Stynes, 2021; Martinez-Calderon et al., 2020; Martinez-Calderon, Zamora-Campos, et al., 2018) and in chronic pain conditions (Burns et al., 2015).

From a psychological perspective, patients with depression and anxiety may see themselves as more disabled than expected and, therefore, might not be capable of adapting and managing painful upper extremity problem (Roh, Noh, et al., 2012), decreasing adherence to prescribed therapy and response to treatment (Turk & Rudy, 1991). Moreover, people with high levels of pain catastrophizing or fear of movement, could perceive their pain as a threat (King & Hebron, 2022) probably due to a failure to early diagnose the condition or lack of awareness by the healthcare professionals (Jones et al., 2013). In fact, the invasiveness of the pain in the daily life could affect the mind as well as the body, with participants' perception of life as a whole being changed (King & Hebron, 2022), challenging the patient that struggle for went back for normality. Moreover, the experienced exhaustion and disability were meaningfully related to a change in participants' sense of self, which was poignantly characterized by feelings of uselessness, hopelessness and depression (King & Hebron, 2022).



In persistent pathologies as FS, these behaviours become maladaptive, because they facilitate the physical inactivity of the entire upper limb (Leeuw et al., 2007; Brindisino et al., 2022) . Hence, the extremely important role of education, that is the cornerstone of the treatment of the FS (Mertens et al., 2022), could also represent a strategy to manage psychological factors and improve patient outcomes, reassuring and reducing the perceived threat, contextualizing the patient's pain and managing the fear of pain and lower it at the same time (Brindisino et al., 2022; Guerrero et al., 2018).

According with results of the present systematic review, clinicians that manage persons with FS should take in greater account psychological factors both during patient evaluation, using specific psychological evaluation scales, and during the management, as psychological intervention combined with rehabilitation would be advantageous (Guerrero et al., 2018).

### **Implications for clinical practice**

In clinical practice, the principal assessment for FS are ROM and pain measurement (Hanchard et al., 2012); however, PROMs have become increasingly important for patients' comprehensive assessments (Tesio, 2007), as clinician-based outcome instruments do not reflect patients' psychological distress (Coulter, 2017). Therefore, as illustrated in the current review, efforts should be made to select and to better interpret shoulder patient-based outcome instruments, because they showed association with psychological features (Brindisino et al., 2022) that could be considered as barriers to the adherence to treatment in different shoulder conditions (Jack et al., 2010; Mohr et al., 2010). Hence, clinicians should be encouraged to identify these factors through an assessment of the psychological profile of each individual with FS; moreover, throughout the consultations, an increasing awareness and attention in managing psychological factors should be

addressed. Obtaining this information may be relevant to assist health providers in clinical decision-making with the aim of targeting which interventions (pharmacological and/or behavioural) and which management (biopsychosocial and multi-professional) could be appropriate.

Furthermore, it is essential that clinicians know how to communicate with the patient, to avoid a worsening of psychological factors when present and to prevent them from arising when absent.

Physiotherapists are often the health professionals that spend more time with the patient, and for patients with FS the communication with their health careers is meaningful (King & Hebron, 2022; Benedetti, 2013). Physiotherapist were requested to proper manage words that could results to trigger placebo effects, and therefore to improve or modify the patient's perceptions, as well as to enhance nocebo effect, inducing a state of anticipatory anxiety, threat sensation and altered pain beliefs (Miciak et al., 2018), with a significant effect on clinical outcomes (Rossettini et al., 2018). Therefore, education should not be limited to being a tool for promoting effective pain self-management strategies, but also the tool that allows you to encourage and make the patient understand, when necessary, the importance of psychological therapy support. Designing targeted treatment programs also focusing on psychological factors represents a challenge for clinicians and is perhaps an overlooked aspect in the treatment of FS.

### **Implications for further research**

Despite the results found in this systematic review, there is a high paucity of primary studies on psychological factors; moreover, fewer psychological factors are considered. Hence, authors of this paper recommended to guide future research with studies prospectively analysing the role of psychological factors on pain intensity and disability in people with FS. Moreover, studies of better methodological quality, with a larger sample size, that take in consideration all potential

confounding factors and with a longer follow-up period should be structured. Lastly, future studies should examine the role of more psychological factors such as optimism, positive attitude, positive thinking, hypervigilance, motivation and expectation.

It is desirable that specific definitions for each psychological factor construct (a clear distinction between fear of pain, fear avoidance beliefs or kinesiophobia) should be provided.

### **Strengths and weaknesses of the study**

This systematic review was developed following a strong methodology (i.e. a priori protocol was registered on PROSPERO, the reporting followed the PRISMA checklist and QUIPS Tool to evaluate the RoB was used). Moreover, this is the first systematic review that investigated this topic. Nevertheless, there are several limitations that should be mentioned. This review explored psychological factors in a specific pathological population and this limits the generalizability of our results, but enhances the specificity of our findings. Moreover, despite this review having been designed to be comprehensive with a robust search strategy that used a long variety of MeSH terms, as well as a manual search and grey literature search, it is possible that some studies were not identified.

### **CONCLUSION**

This systematic review provided a comprehensive summary of the research regarding the correlation between FS and the prognostic values of psychological factors. Specifically, in patients with FS, pain-related fear and depression are correlated with function, disability, and pain overtime, while anxiety with disability and pain, lastly catastrophizing was only related to disability. However,

due to the low quality of the studies included, the results of this systematic review should be interpreted cautiously.

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## APPENDIX

### *Appendix 1. Search strategy for each database.*

MEDLINE	
<i>POPULATION</i>	<ol style="list-style-type: none"> <li>1. Frozen Shoulder [MESH terms]</li> <li>2. "Frozen Shoulder"</li> <li>3. "Adhesive capsulitis"</li> <li>4. "Stiff shoulder"</li> <li>5. "Shoulder Adhesive Capsulitis"</li> <li>6. Capsulit*</li> <li>7. Bursitis [MESH terms]</li> <li>8. "Adhesive Capsulitis of the Shoulder"</li> <li>9. Periarthritis [MESH terms]</li> <li>10. "Periarthritis of the shoulder"</li> <li>11. <b>1-10 OR</b></li> </ol>
<b>EXPOSURE</b>	<ol style="list-style-type: none"> <li>12. Psychosocial</li> <li>13. "Psychosocial factors"</li> <li>14. Psychological</li> <li>15. Stress Psychological [MESH terms]</li> <li>16. Psychology [MESH terms]</li> <li>17. Fear [MESH terms]</li> <li>18. Fear</li> <li>19. Avoid*</li> <li>20. Avoidance learning [MESH terms]</li> <li>21. Catastrophization [MESH terms]</li> <li>22. Catastroph*</li> <li>23. Catastrophic thinking [MESH terms]</li> <li>24. "Pain Catastrophizing"</li> <li>25. Anxiety [MESH terms]</li> <li>26. Anxiety</li> <li>27. Hypervigilance</li> <li>28. Depression [MESH terms]</li> <li>29. Depressive disorder [MESH terms]</li> <li>30. Depress*</li> <li>31. Motivation [MESH terms]</li> <li>32. Disincentives [MESH terms]</li> <li>33. Expectations [MESH terms]</li> <li>34. Incentives</li> <li>35. Kinesiophobia</li> <li>36. Beliefs</li> <li>37. "Fear of pain"</li> <li>38. "Fear of movement"</li> <li>39. Helplessness</li> <li>40. Self efficacy [MESH terms]</li> <li>41. "Self efficacy"</li> <li>42. Optimism [MESH terms]</li> </ol>

	43. optimism 44. Pessimism [MESH terms] 45. Pessimism 46. Threat 47. "Acceptance of illness" 48. "Positive Attitude" 49. "Positive Thinking" 50. <b>12-49 OR</b> 51. <b>11 AND 50</b>
<b>EMBASE</b>	
<i>POPULATION</i>	1. Frozen Shoulder 2. "Adhesive capsulitis" 3. "Stiff shoulder" 4. "Shoulder Adhesive Capsulitis" 5. Capsulitis 6. Bursitis 7. Periarthritis 8. <b>1-8 OR</b>
<b>EXPOSURE</b>	9. Psychosocial 10. "Psychosocial factors" 11. Psychological 12. Psychology 13. Fear 14. Avoidance 15. Catastrophization 16. Catastrophic thinking 17. "Pain Catastrophizing" 18. Anxiety 19. Hypervigilance 20. Depression 21. Depressive disorder 22. Expectations 23. Incentives 24. Kinesiophobia 25. Beliefs 26. "Fear of pain" 27. "Fear of movement" 28. Helplessness 29. "Self efficacy" 30. Optimism 31. Pessimism 32. <b>9-32 OR</b> 33. <b>8 AND 32</b>
<b>PSYCHINFO</b>	
<i>POPULATION</i>	"Frozen shoulder"
<b>PUBPSYCH</b>	

<i>POPULATION</i>	"Frozen shoulder"
<b><i>PsychNET.APA</i></b>	
<i>POPULATION</i>	"Frozen shoulder"
<b><i>PEDro</i></b>	
<i>POPULATION</i>	"Frozen shoulder"

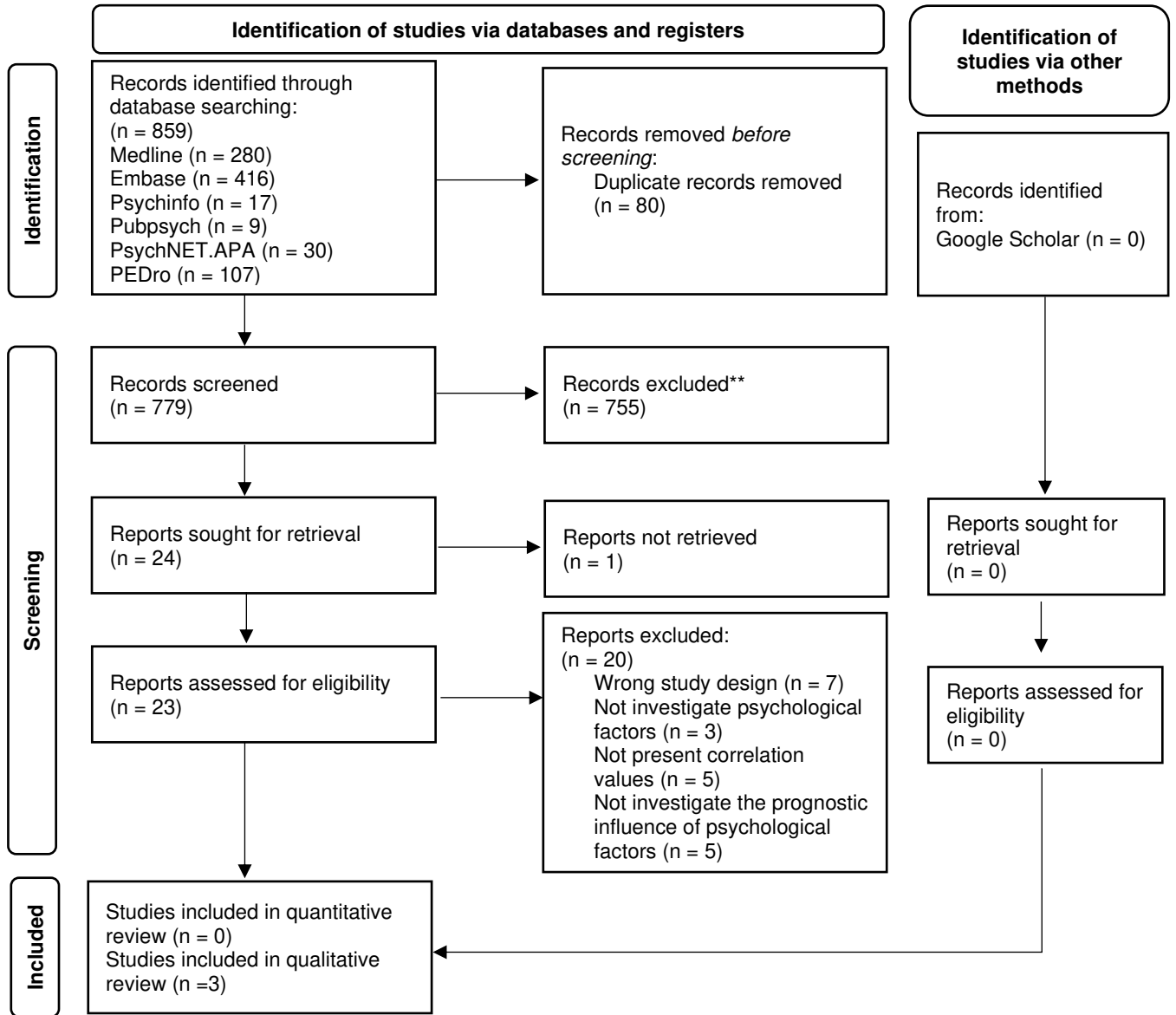
## Appendix 2. Excluded studies with reason

N°	FIRST AUTHOR	YEAR	TITLE	REASON FOR EXCLUSION
X	Zhang P. H. <i>et al</i>	2004	<i>Effects of depression on treatment progress of adhesiveness scapulohumeral periarthritis</i>	Paper not available
1.	Farshid Bagheri <i>et al.</i>	2016	<i>Factors Associated with Pain, Disability and Quality of Life in Patients Suffering from Frozen Shoulder</i>	Wrong study design
2.	M. Bensignor et R. Ducrot	1997	<i>Painful frozen shoulder. Clinical study, pathophysiology and treatment</i>	Did not investigate psychological factors
3.	Rita Chiaramonte <i>et al.</i>	2019	<i>A significant relationship between personality traits and adhesive capsulitis</i>	Did not present correlation values
4.	Dawson Church <i>et al.</i>	2016	<i>Pain, Range of Motion, and Psychological Symptoms in a Population with Frozen Shoulder: A Randomized Controlled Dismantling Study of Clinical EFT (Emotional Freedom Techniques)</i>	Did not investigate the prognostic influence of psychological factors
5.	De Baets Liesbet <i>et al.</i>	2020	<i>Pain-related beliefs are associated with arm function in persons with frozen shoulder</i>	Wrong study design
6.	Marcos Rassi Fernandes <i>et al.</i>	2017	<i>Quality of life and functional capacity of patients with adhesive capsulitis: identifying risk factors associated to better outcomes after treatment with nerve blocking</i>	Did not investigate the prognostic influence of psychological factors
7.	Mariano E. Menendez <i>et al.</i>	2015	<i>Psychological Distress Is Associated with Greater Perceived Disability and Pain in Patients Presenting to a Shoulder Clinic</i>	Did not investigate the prognostic influence of psychological factors
8.	Mercè Balasch-Bernat <i>et al.</i>	2021	<i>The spatial extent of pain is associated with pain intensity, catastrophizing and some measures of central sensitization in people with frozen shoulder</i>	Wrong study design
9.	Philippe Debeer <i>et al.</i>	2014	<i>Frozen shoulder and the Big Five personality traits</i>	Did not present correlation values
10.	Huairong Ding <i>et al.</i>	2014	<i>A report on the prevalence of depression and anxiety in patients with frozen shoulder and their relations to disease status</i>	Wrong study design
11.	Mohammad Hosein Ebrahimzadeh <i>et al.</i>	2019	<i>The Relationship between Depression or Anxiety Symptoms and Objective and Subjective Symptoms of Patients with Frozen Shoulder</i>	Wrong study design
12.	Junya Hirata <i>et al.</i>	2021	<i>Relationship between pain intensity, pain catastrophizing, and self-efficacy in patients with frozen shoulder: a cross-sectional study</i>	Wrong study design
13.	Murat Toprak <i>et al.</i>	2018	<i>Sleep quality, pain, anxiety, depression and quality of life in patients with frozen shoulder</i>	Did not investigate the prognostic influence of psychological factors
14.	Marcos Rassi Fernandes <i>et al.</i>	2015	<i>Correlation between functional disability and Quality of life in patients with adhesive capsulitis</i>	Did not investigate the prognostic influence of psychological factors
15.	Miao Zhang <i>et al.</i>	2019	<i>Clinical efficacy evaluation of body acupuncture and scalp acupuncture combined with extracorporeal shock wave for scapulohumeral periarthritis</i>	Did not investigate psychological factors
16.	Nathaniel Hiscock <i>et al.</i>	2015	<i>Pain, depression and the postoperative stiff shoulder</i>	Did not present correlation values
17.	Florence Aim <i>et al.</i>	2022	<i>Psychological risk factors for the occurrence of frozen shoulder after rotator cuff repair</i>	Did not investigate psychological factors
18.	Miao Zhang <i>et al.</i>	2019	<i>Regular acupuncture at combined with join valley needling at ashi point for scapulohumeral periarthritis: A randomized controlled trial</i>	Did not present correlation values

19.	Sarah Russell <i>et al.</i>	2014	<i>A blinded, randomized, controlled trial assessing conservative management strategies for frozen shoulder</i>	Did not present correlation values
20.	Kiryanova Vera Vasilievna. <i>et al.</i>	2012	<i>Method of psychological and reflex treatment of locomotive disorders (stroke, humeroscapular periarthritis, hip arthrosis)</i>	Wrong study design

## FIGURES

**Figure 1. PRISMA 2020 Flow Diagram**



From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71. doi: 10.1136/bmj.n71. For more information, visit: <http://www.prisma-statement.org/>

## TABLES

**Table 1.** Characteristics of included studies.

TITLE, FIRST AUTHOR, YEAR OF PUBLICATION, JOURNAL, STUDY DESIGN	CHARACTERISTICS OF STUDY PARTICIPANTS	SELECTION CRITERIA	PSYCHOLOGICAL FACTOR	OUTCOME MEASURES
<p><i>Patient-reported measures of quality of life and functional capacity in adhesive capsulitis</i></p> <p>Marcos Rassi Fernandes <i>et al.</i></p> <p>2017</p> <p><i>Revista da Associação Médica Brasileira</i></p> <p>Prospective cohort study</p>	<p>43 patients</p> <p>Females = 23</p> <p>Mean age = 54.7 years (40-75)</p> <p>I FS 15 patients II FS 28 patients</p>	<p><u>INCLUSION CRITERIA</u></p> <ul style="list-style-type: none"> <li>● Clinical diagnosis of adhesive capsulitis</li> <li>● Existence of shoulder X-ray exams with three views (true AP, axillary profile and scapular profile) and MRI scan in the previous 30 days</li> <li>● Not under any concomitant adhesive capsulitis treatment</li> <li>● No subacromial space injection in the previous 15 days</li> <li>● Glycosylated haemoglobin less than or equal to 7% in case of associated diabetes</li> </ul> <p><u>EXCLUSION CRITERIA</u></p> <ul style="list-style-type: none"> <li>● Complete lesion of the rotator cuff</li> <li>● Instability</li> <li>● Glenohumeral arthrosis</li> <li>● Locked dislocation of the shoulder</li> <li>● Stroke sequelae (hemiplegia or paresis)</li> <li>● Recent breast surgery</li> <li>● Current chemotherapy or radiotherapy treatment</li> <li>● Adhesive capsulitis with bilateral involvement</li> <li>● Surgery on the affected shoulder</li> </ul>	<p>Psychological domain (PD-WHOQOL)</p>	<p>Arm function (DASH)</p>



<p><i>Are clinical outcomes of frozen shoulder linked to pain, structural factors or pain related cognitions? An explorative cohort study</i></p> <p>De Baets Liesbet <i>et al.</i></p> <p>2020</p> <p><i>Musculoskeletal Science and Practice</i></p> <p>Prospective cohort study</p>	<p>20 patients (3 drop out)</p> <p>Females = 14</p> <p>Mean age = 56 years</p> <p>Mean duration of symptoms = 4.2 months</p>	<p><u>INCLUSION CRITERIA</u></p> <ul style="list-style-type: none"> <li>• Unilateral, clinically diagnosed idiopathic FS</li> </ul> <p><u>EXCLUSION CRITERIA</u></p> <ul style="list-style-type: none"> <li>• Surgical procedure for FS</li> <li>• Partial or full-thickness rotator cuff tear (which was not considered normal age-related degeneration) was seen on magnetic resonance arthrography</li> <li>• Systemic, neurological or psychiatric disease</li> </ul>	<p>Pain-related fear (TSK-11)</p> <p>Pain catastrophizing (PCS)</p>	<p>Arm function (DASH)</p> <p>Pain intensity (NPRS)</p> <p>Perceived stiffness (Numeric stiffness rating scale - NRS-stiffness)</p>
<p><i>The outcome of hydrodilatation in frozen shoulder patients and the relationship with kinesiophobia, depression, and anxiety</i></p> <p>Philippe Debeer <i>et al.</i></p> <p>2021</p> <p><i>Journal of Experimental Orthopaedics</i></p> <p>Prospective cohort study</p>	<p>72 patients</p> <p>Females = 44</p> <p>Mean age = 53 years (38–70, SD = 7)</p> <p>I FS 25</p> <p>II FS 47</p>	<p><u>INCLUSION CRITERIA</u></p> <ul style="list-style-type: none"> <li>• Diagnosis of frozen shoulder made on clinical grounds, based on the criteria of Zuckerman and Rokito</li> </ul> <p><u>EXCLUSION CRITERIA</u></p> <ul style="list-style-type: none"> <li>• Stiffness caused by glenohumeral osteoarthritis</li> <li>• Reflex sympathetic dystrophy of the ipsilateral hand</li> <li>• Stiffness after shoulder arthroplasty</li> <li>• Malignant neoplasms of the shoulder girdle</li> <li>• mental incapacity to fill in the questionnaires</li> </ul>	<p>Anxiety and Depression (HADS)</p> <p>Kinesiophobia (TSK)</p>	<p>Arm function (CMS)</p> <p>Pain and disability (SPADI)</p> <p>Pain (VAS)</p>

**Table 2.** Summary of the main results

STUDIES	MAIN RESULTS (BASELINE)	MAIN RESULTS (FOLLOW-UP)	CORRELATION
<p>Marcos Rassi Fernandes <i>et al.</i> 2017</p>	<p><b>PD-WHOQOL</b> Mean 63.95 Median 66.66 SD 16.33 CI 58.93-68.92</p> <p><b>DASH</b> Mean 61.68 Median 64.16 SD 18.71 CI 55.92-67.44</p> <p><i>P</i> 0.000 (Wilcoxon test)</p>	<p><b><u>7 days (post-treatment)</u></b></p> <p><b>PD-WHOQOL</b> Mean 73.54 Median 79.16 SD 15.77 CI 68.69-78.40</p> <p><b>DASH</b> Mean 42.11 Median 38.33 SD 18.30 CI 36.48-47.74</p> <p><i>P</i> 0.000 (Wilcoxon test)</p>	<p><b><u>Correlation DASH/ PD-WHOQOL post-treatment</u></b> r -0.521</p> <p><b><u>Multiple linear regression analysis of the PD-WHOQOL and DASH after treatment</u></b> PD-WHOQOL: Age group 0.38 p&lt;0.05 Educational status 0.47 p&lt;0.01. R2 0.29 Adjusted R2 0.21 F 3.89 Significance F 0.01</p>
<p>De Baets Liesbet <i>et al.</i> 2020</p>	<p><b>TSK-11</b> Mean 27.1 SD ± 6</p> <p><b>PCS</b> Mean 18.1 SD ± 10.8</p>	<p><b><u>4 months</u></b></p> <p><b>TSK-11</b> Mean 21.5 SD ± 3.4</p> <p><b>PCS</b> Mean 10 SD ± 10.2</p>	<p><b><u>Correlation coefficients (p-value) at baseline</u></b></p> <p><b>TSK-11</b> Perceived stiffness 0.07 (0.88) DASH 0.12 (0.09) Pain at rest 0,0265 (0,9118) Pain at night 0,0324 (0,8921) Pain ADL -0,3256 (0,1612)</p> <p><b>PCS</b> Perceived stiffness 0.1 (0.66) DASH 0.59 (0.006) Pain at rest 0,2615 (0,2654) Pain at night 0,3104 (0,1829) Pain ADL 0,2243 (0,3418)</p> <p><b>PCS: TSK-11</b> 0,2732 (0,2438)</p> <p><b><u>Correlation coefficients (p-value) at 4 months follow-up</u></b> <b>TSK-11</b></p>

			<p>Perceived stiffness 0.40 (0.11)  DASH 0.65 (0.005)  Pain at rest 0,0720 (0,7837)  Pain at night 0,2951 (0,2501)  Pain ADL 0,3887 (0,1231)</p> <p><b>PCS</b>  Perceived stiffness 0.37 (0.14)  DASH 0.48 (0.049)  Pain at rest 0,0813 (0,7564)  Pain at night 0,1716 (0,5101)  Pain ADL 0,2383 (0,3570)</p> <p><b>PCS: TSK-11</b> 0,5239 (0,0309)  <u>Mean difference between T1 at T2 (95% CI)</u>  TSK-11 6.2 (3.7-8.7), p&lt;.0001  PCS 8.9 (4.2-13.7), p=.001</p>
<p><i>Philippe Debeer et al. 2021</i></p>	<p><b>CMS</b>  Mean 46.2  SD 13.0</p> <p><b>SPADI-P</b>  Mean 33.1  SD 9.6</p> <p><b>SPADI-D</b>  Mean 46.8  SD 17.7</p> <p><b>VAS</b>  Mean 5.3  SD 2.4</p>	<p><b>3 months</b></p> <p><b>CMS</b>  Mean 72.0  SD 16.9</p> <p><b>SPADI-P</b>  Mean 18.0  SD 13.0</p> <p><b>SPADI-D</b>  Mean 23.0  SD 21.7</p> <p><b>VAS</b>  Mean 2.4  SD 2.8</p> <p>CMS improvement  CI 21.8–29.8  P &lt; 0.0001</p>	<p><b>The reciprocal effects between objective and subjective outcomes of hydrodilatation and kinesiophobia</b>  <u>Objective and subjective outcomes at 3-months follow-up</u></p> <p><b>TSK /CMS total</b>  <math>\beta</math> -0.89*  95% BCI -1.44; -0.34</p> <p><b>TSK/ SPADI-P</b>  <math>\beta</math> 0.58*  95% BCI 0.13; 1.01</p> <p><b>TSK/ SPADI-D</b>  <math>\beta</math> 0.59  95% BCI -0.21;1.33</p> <p><b>TSK/ VAS</b>  <math>\beta</math> 0.10*  95% BCI 0.02; 0.17</p>

		<p>Mean reduction VAS 2.9 95%CI = 2.3–3.5</p> <p>Mean reduction pain (CMS) = 15.9 95%CI = 12.4–17.8</p> <p>Mean reduction disability = 25.6 95%CI = 21.4–29.9</p> <p>Mean reduction HADS-D = 1.5 95%CI = 0.9–2.1</p> <p>Mean reduction HADS-A = 1.1 95%CI = 0.5–1.7 p &lt; 0.001 between T1 and T3.</p> <p>Females Mean reduction TSK 3.0 95%CI = 2.0–4.1, p &lt; 0.001</p> <p>Males Mean reduction TSK 95%CI = -1.7–3.1, p = 0.568</p>	<p><b><u>The reciprocal effects between objective and subjective outcomes of hydrodilatation and depression</u></b> <u>Objective and subjective outcomes at 3-months follow-up</u></p> <p><b>HADS-D/CMS total</b> <math>\beta</math> -1.74* 95% BCI -3.16; -0.20</p> <p><b>HADS-D/ SPADI-P</b> <math>\beta</math> 0.67 95% BCI -0.10; 1.51</p> <p><b>HADS-D/ SPADI-D</b> <math>\beta</math> 1.29* 95% BCI 0.09; 2.48</p> <p><b>HADS-D / VAS</b> <math>\beta</math> 0.18* 95% BCI 0.04. 0.32</p> <p><b><u>The reciprocal effects between objective and subjective outcomes of hydrodilatation and anxiety</u></b> <u>Objective and subjective outcomes at 3-months follow-up</u></p> <p><b>HADS-A/CMS total</b> <math>\beta</math> -1.11 95% BCI -2.35; 0.23</p> <p><b>HADS-A /SPADI-P</b> <math>\beta</math> 0.57 95% BCI -0.34; 1.40</p> <p><b>HADS-A/SPADI-D</b> <math>\beta</math> 1.27* 95% BCI 0.03; 2.31</p> <p><b>HADS-A/VAS</b> <math>\beta</math> 0.14* 95% BCI 0.01; 0.28</p>
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			*p<0.001
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**ACRONYMS:**

*PD-WHOQOL= Psychological Domain World Health Organization Quality Of Life; DASH = Disability of the Arm, Shoulder and Hand Questionnaire; r = Pearson correlation coefficient; SD = Standard Deviation; CI = Confidence Interval; P = p-value; R2 = Coefficient of determination; F = Fisher's test; TSK-11 = Tampa Scale for Kinesiophobia -11 item version; PCS = Pain catastrophizing Scale; ADL = Activities of Daily Living; CMS = Constant Murley Score; SPADI-P = Shoulder Pain and Disability Index – Pain; SPADI-D = Shoulder Pain and Disability Index – Disability; VAS = Visual Analogue Scale;  $\beta$  = Bootstrap correlation coefficient; BCI = Bootstrap Confidence Interval; HADS-D= Hospital Anxiety and Depression Scale- Depression; HADS-A= Hospital Anxiety and Depression Scale- Anxiety*

**Table 3.** Risk of bias assessment (QUIPS tool).

STUDIES	BIAS DOMAINS					
	Study Participation	Study Attrition	Prognostic Factor Measurement	Outcome Measurement	Study Confounding	Statistical Analysis and Reporting
Marcos Rassi Fernandes <i>et al.</i> 2017	LOW	LOW	MODERATE	LOW	HIGH	LOW
De Baets Liesbet <i>et al.</i> 2020	LOW	LOW	LOW	LOW	MODERATE	LOW
Philippe Debeer <i>et al.</i> 2021	MODERATE	LOW	LOW	LOW	MODERATE	LOW

**Table 4. Main results**

	Pain-related fear (TSK-11)	Pain catastrophizing (PCS)	Depression (HADS-D)	Anxiety (HADS-A)	Psychological domain (WHOQOL)	
NRS for perceived stiffness	$r = 0.40$ , $p=0.11$ <sup>a</sup>	$r = 0.37$ , $p=0.14$ <sup>a</sup>				DE BEATS, 2020
DASH	$r = 0.65$ , $p=0.005$ <sup>a</sup>	$r = 0.48$ ; $p=0.049$ <sup>a</sup>				
CMS	$\beta = -0.89$ ; 95%CI -1.44; -0.34 <sup>s</sup>		$\beta = -1.74$ ; 95%CI -3.16; - <b>0.20</b> <sup>s</sup>	$\beta = -1.11$ ; 95%CI -2.35; 0.23 <sup>s</sup>		DEBEER, 2021
SPADI-P	$\beta = 0.58$ ; 95%CI 0.13; <b>1.01</b> <sup>s</sup>		$\beta = 0.67$ ; 95%CI -0.10; 1.51 <sup>s</sup>	$\beta = 0.57$ ; 95%CI -0.34; 1.40 <sup>s</sup>		
SPADI-D	$\beta = 0.59$ ; 95%CI - 0.21;1.33 <sup>s</sup>		$\beta = 1.29$ ; 95%CI <b>0.09; 2.48</b> <sup>s</sup>	$\beta = 1.27$ ; 95%CI <b>0.03; 2.31</b> <sup>s</sup>		
VAS-P	$\beta = 0.10$ ; 95%CI 0.02; <b>0.17</b> <sup>s</sup>		$\beta = 0.18$ ; 95%CI <b>0.04; 0.32</b> <sup>s</sup>	$\beta = 0.14$ ; 95%CI <b>0.01; 0.28</b> <sup>s</sup>		
DASH					$r = -0.521$ <sup>e</sup>	FERNANDES, 2017

<sup>a</sup> = 4 months follow up; <sup>s</sup> = 3 months follow up; <sup>e</sup> = 7 days follow up.

**Bold data** reported statistically significant association

**Acronyms:** TSK-11, Tampa Scale of Kinesiophobia-11 items; PCS, Pain catastrophizing Scale; HADS-D, Hamilton Anxiety and Depression Score-Depression subscore; HADS-A, Hamilton Anxiety and Depression Score-Anxiety subscore; WHOQOL, World Health Organization Quality of Life score; DASH, Disability of the Arm Shoulder and Hand; CMS, Constant Murley Score; SPADI-P, Shoulder pain and disability Index- Pain subscore; SPADI-D, Shoulder pain and disability Index- Disability subscore; VAS, Visual Analogue Scale