The association between pain beliefs and pain intensity and/or disability in people with shoulder pain : a systematic review

RUNNING TITLE: PAIN BELIEFS IN SHOULDER PAIN

THE ASSOCIATION BETWEEN PAIN BELIEFS AND PAIN INTENSITY AND/OR DISABILITY IN PEOPLE WITH SHOULDER PAIN: A SYSTEMATIC REVIEW

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have made a substantial scientific contribution to the study and they are thoroughly familiar with the primary data. All authors have read the complete manuscript and take responsibility for the content and completeness of the manuscript and understand that if the paper, or part of the paper, is found to be faulty or fraudulent, all authors share responsibility.

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ABSTRACT

Background: Pain beliefs might play a role in the development, transition, and perpetuation of shoulder pain.

Objective: To systematically review and critically appraise the association and the predictive value of pain beliefs on pain intensity and/or disability in shoulder pain.

Methods: An electronic search of PubMed, EBSCOhost, AMED, CINAHL, EMBASE, and PubPsych, and grey literature was searched from inception to July 2017. Study selection was based on observational studies exploring the association and the predictive value of pain beliefs on pain intensity and/or disability in shoulder pain.

Results: A total of thirty-three articles were included with a total sample of 10,293 participants with shoulder pain. In the cross-sectional analysis, higher levels of pain catastrophizing and kinesiophobia were significantly associated with more pain intensity and disability, whereas higher levels of expectations of recovery and self-efficacy were significantly associated with lower levels of pain intensity and disability. In the longitudinal analysis, higher levels of pain catastrophizing, fear-avoidance and kinesiophobia at baseline predicted greater pain intensity and disability overtime. Higher levels of self-efficacy and expectations of recovery at baseline predicted a reduction in levels of pain intensity and disability overtime.

Conclusions: Evidence suggests that pain beliefs are associated with and predict the course of pain intensity and disability in shoulder pain. However, the overall body of the evidence after applying the GRADE approach was very low across studies. Further research using higher quality longitudinal designs and procedures would be needed to establish firm conclusions.

PROSPERO: **CRD42017072758**

Key Words: shoulder pain; pain beliefs; psychological factors; systematic review

INTRODUCTION

Shoulder pain (SP) is a highly prevalent musculoskeletal pain condition (Luime et al., 2004; McBeth and Jones 2007). The socioeconomic burden of SP is considerable, being a common cause of sick absence and disability (Pribicevic, 2012; Virta et al., 2012). However, almost 60% still report persistence of symptoms (mostly pain intensity and disability) twelve months after the onset (van der Windt et al., 1996; Winters et al., 1999).

In this context, research has been targeting the question why some people, but not others, recover after developing an acute episode of SP (Badcock et al., 2002; Cho et al., 2015; Gill et al., 2013). Many factors such as biological, social, biomechanical, and psychological are associated with poor outcomes in SP (Kuijpers et al., 2004; Pribicevic, 2012). From a cognitive-behavioural perspective, individuals with musculoskeletal pain who show a trait tendency to have fearful and catastrophic thoughts in response to pain, could have more difficulties to exert any control over their pain (Sandborgh et al., 2016). These individuals have greater risk to develop chronic pain and disability than individuals who do not show this tendency (Leeuw et al., 2007).

Beliefs about pain play a role in the development, transition, and perpetuation of musculoskeletal pain in general (Leeuw M et al., 2007; Main et al., 2010; Wertli et al., 2014), and in SP complaints particularly (Feleus et al., 2007; George et al., 2007; Reilingh et al., 2008). Specifically in SP, George et al. (George et al., 2007) reported that fear is associated with pain intensity and disability in healthy people after induced pain. Feleus et al. (Feleus et al., 2007) showed that higher levels of kinesiophobia at baseline were associated with more shoulder complaints at twelve months. Reilingh et

al. (Reilingh et al., 2008) showed that higher levels of pain catastrophizing at baseline were associated with the perpetuation of chronic SP at six months.

A few research has emerged to explore the association between pain beliefs and several outcome measures such as pain intensity and disability in SP. However, findings remain inconsistent (Ekeberg et al., 2010; Laslett et al., 2014; Sindhu et al., 2012; Valencia et al., 2011), regarding the significance and the direction of the obtained results. A systematic review of the association between pain beliefs and pain intensity and/or disability would contribute to a better understanding and clarification of these relationships in individuals with SP. Likewise, the study of the predictive value of pain beliefs on pain intensity and disability, would facilitate a greater understanding of SP mechanisms, and, thus, a better clinical decision-making.

The synthesis of the evidence through a systematic review of the literature will permit to achieve stronger conclusions than those achieved by any one study (Chan and Arvey, 2012). It will help readers who often have broad difficulties to track down and review all the evidence provided by primary studies. Hence, the aim of this study was twofold: (i) to explore the association between pain beliefs with pain intensity and/or disability and, (ii) to analyse the prognostic role that pain beliefs play on pain intensity and/or disability, by performing a systematic review of the literature of observational studies (cross-sectional and longitudinal studies) that address these questions in individuals with SP.

METHODS

The review was conducted according to the Cochrane Handbook for Systematic Reviews Version 5.1.0 (Higgins JPT, 2011) and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Liberati et al., 2009). The systematic review protocol was registered at the International Prospective Register

of Systematic Reviews (PROSPERO: CRD 42017072758). The expertise of the team is summarized as follows: systematic reviews experts (JMC and MM); statistician (ALS); reference management and database searching (JMC and ALS); content experts (JMC, FS, and ALS).

Data Sources and Search Strategy

When the research aims of the present review were determined, one investigator (JMC) carried out a scoping search to ensure that this aim had not been addressed by previous reviews. The following databases were explored: PROSPERO, Cochrane Library, NICE Evidence Search, and Turning Research into Practice (TRIP). Two investigators (JMC and ALS) independently searched in several electronic databases (PubMed, EBSCOhost, AMED, CINAHL, EMBASE, and PubPsych) from the inception to July 2017 using optimized search strategies. Manual searches of relevant eligible studies were also searched through cross-references identified in journals associated with the topic of this review, and reference lists within both original and review articles, selecting studies missed during the electronic search. A sensitive search strategy using relevant search terms that were developed from Medical Subject Headings (MeSH), and keywords generated from the subject headings, were used: "shoulder pain" [MeSH Terms], "rotator cuff" [MeSH Terms], "shoulder impingement syndrome" [MeSH Terms], "self-efficacy" [MeSH Terms], "optimism" [MeSH Terms], "pessimism" [MeSH Terms], beliefs, psychological factors, expectations, pain catastrophizing, fear-avoidance, kinesiophobia, fear of pain, fear of movement, helplessness, threat, and acceptance of illness. The complete search strategy report is shown in **Appendix A**. Grey literature was also searched to detect any relevant unpublished work. National Guideline Clearinghouse, Open Grey, and Google Scholar (Haddaway et al., 2015) were

explored. References were exported, and duplicates were removed using citation management software (Mendeley desktop v1.17.4).

Eligibility Criteria

Based on the PICO statement (P= population; I= intervention; C= comparator; O= outcome) (Higgins JPT, 2011) the PECO statement (P= population; E= exposure; C= comparator; O= outcome) was followed by two reviewers (JMC and ALS) independently to determine which studies satisfied the inclusion criteria. Each study had to meet the following inclusion criteria:

(i) Observational studies (cross-sectional and longitudinal) examining the association (cross-sectional analysis) or the predictive value (longitudinal analysis) of pain beliefs on pain intensity and/or disability.

(ii) Adults with a diagnosis of SP.

(iii) Recruited from any setting (general population, primary, secondary, or tertiary care).

(iv) No restrictions were applied regarding participants' gender, ethnicity, and the duration of follow-up.

(v) Pain beliefs were selected according to previous evidence (Carroll, 2011; DeGood and Tait, 2001; Jia and Jackson, 2016; Main et al., 2010).

(vi) Only English-language studies.

Exclusion criteria were as follows:

(i) Adults with SP due to systemic diseases (e.g rheumatoid arthritis), neurological disorders (e.g. stroke), and/or chronic non-musculoskeletal pain (e.g. breast cancer).

(ii) Studies trying to modify pain beliefs levels through any therapy.

(iii) Reviews, clinical studies, case-control studies, case reports, editorial, abstracts, and studies investigating psychometric properties of pain beliefs assessment measures.

Study Selection

All studies identified by the search strategy were screened using the eligibility criteria. The first step involved the screening of titles and abstracts by two independent reviewers (JMC and ALS). The same pair of reviewers undertook the second screening based on the full text. In cases of disagreement, a decision was made by consensus or, when necessary, a third reviewer (MM) was consulted. A short checklist was developed for the present review, being applied to guide the selection of relevant studies (**Figure 1**) (Adom et al., 2017).

Data Extraction

Two reviewers (JMC and ALS) independently extracted the following relevant data from each included study: study details (first author and year of publication), characteristics of participants (mean age, clinical presentation, and mean duration of symptoms), setting, sample size, pain beliefs measures which have been grouped in this review as cognitive factors (expectations of recovery, self-efficacy, pain catastrophizing, internal and external locus of control, preoperative concerns, optimism, and beliefs about preferences of treatment) and behavioural factors (fear of pain, fear-avoidance, and kinesiophobia) (Carver et al., 2010; Turk DC, 1992; Urquhart et al., 2014), outcome (pain intensity and disability) measures, duration of follow-up (in case of longitudinal studies), and study design. If there was any discrepancy between reviewers, a third reviewer was consulted (MM). When necessary, an email was sent to the original authors to obtain further information on participants' data.

Risk of bias Assessment

Two reviewers (JMC and ALS) independently analysed the risk of bias of the included studies. The risk of bias of observational studies is commonly assessed with the

Newcastle-Ottawa Scale (NOS) (Wells, G. A, Shea, B., O'Connel, 2009). The NOS is a reliable and valid tool for assessing the quality of non-randomised studies (Wells, G. A, Shea, B., O'Connel, 2009). However, many of the included studies were cross-sectional in nature. Furthermore, none of the longitudinal included studies presented a non-exposed cohort. For that, we decided to evaluate the risk of bias of included studies with an adapted version of the NOS which has been used by previous systematic reviews to evaluate the quality of any observational design (Bawor et al., 2015). It includes four domains of risk of bias assessment: methods for selecting study participants (selection bias), methods to control for confounding (performance bias), statistical methods (detection bias), and methods of exposure and outcome assessment (information bias). Seven items compose the four domains. Each item is scored from zero (high risk) to three (low risk) points. Therefore, studies with a total score from 0 to 6 were considered as high risk of bias, whereas total score from 7 to 13 and 14 to 21 were considered as moderate and low risk of bias, respectively.

Data synthesis and analysis

Following the proposed objectives for this review, we tried to carry out multiples meta-analyses by pooling the results based on the study design: (1) cross-sectional (first objective) and; (2) longitudinal (second objective) designs. However, there was considerable clinical heterogeneity within the included studies in terms of patient population (age, sample size, clinical shoulder presentation), outcome measures, pain beliefs measures, statistical methods used, and study design. Thus, meta-analyses could not be carried out. Therefore, a narrative synthesis was deemed to analyse the data to respond the aim of this study. The narrative synthesis was separately conducted for cross-sectional and longitudinal studies. In cross-sectional analyses, the association between pain beliefs and pain intensity and/or disability was explored. In longitudinal

analyses, the predictive value of pain beliefs in the course of pain intensity and/or disability was analysed. Additionally, two reviewers (JMC and ALS) assessed the overall quality and the strength of the evidence per outcome using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach (Atkins et al., 2004). In brief, the GRADE classification was conducted according to the presence, or not, of the following identified factors: (i) risk of bias, (ii) inconsistency of results (iii) indirectness, (iv) imprecision, and (v) other considerations (e.g. reported bias). Review Manager (RevMan) version 5.3 (Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014) software was used along the review to process data.

RESULTS

Study characteristics

A total of 2,341 citations were identified through electronic databases, with 141 additional studies identified through reference screening and grey literature. One thousand thirty-seven titles and abstracts were screened with 199 full-text articles being evaluated. The number of studies retrieved from each database and the number of studies excluded in each screening phase are shown in **Figure 2**. The full reference of excluded studies in the last screening (n=166) is reported in **Appendix B**. Of the 199 studies that were evaluated, 33 observational studies (twenty-two longitudinal studies and eleven cross-sectional studies) with a total of 10,293 individuals with SP fulfilled our inclusion criteria and were included in this review (**Table 1**). The outcome measures included in this review were pain intensity and disability. The pain beliefs assessed, were: pain catastrophizing, fear-avoidance, kinesiophobia, expectations of recovery, optimism, self-efficacy, fear of pain, internal and external locus of control,

preoperative concerns, and beliefs about preferences of treatment. The characteristics of the included studies are reported in **Table 1**.

Risk of bias

The risk of bias of included studies varied considerably. The risk of bias assessment of all included studies is presented in **Table 2**. The conflict of interest of included studies is also shown in **Table 2**.

Pain beliefs and pain intensity and/or disability in people with SP: synthesis of the evidence

The overall body of the evidence in terms of risk of bias, inconsistency, indirectness, imprecision, and the presence of potential reported bias after applying the GRADE approach was very low across studies (see **Table 3** for cross-sectional studies and **Table 4** for longitudinal studies). Summarizes of the association between pain beliefs with pain intensity and/or disability according to shoulder pain complaints is shown in **Appendix C**. Summarizes of the prognostic role that pain beliefs on pain intensity and disability is reported in **Appendix D**.

The association between pain beliefs and pain intensity (cross-sectional analysis)

The association between pain beliefs and pain intensity based on cross-sectional analyses was explored by ten studies (Clausen et al., 2017; George et al., 2008; George and Hirsh, 2009; Henn et al., 2011; Lentz et al., 2009; Kindler et al., 2011; Kromer et al., 2014; Menendez et al., 2015; Plath et al., 2017; Warth et al., 2013). A summary of the association between pain beliefs and pain intensity is shown in **Appendix C**.

The predictive value of pain beliefs on pain intensity (longitudinal analysis)

The predictive value of pain beliefs on pain intensity in people with SP based on longitudinal analyses was explored by fourteen studies (Chester et al., 2016; Coronado

et al., 2017; Ekeberg et al., 2010; Engebretsen et al., 2010; Henn et al., 2007; Jawa et al., 2016; Karlsson et al., 2016; Laslett et al., 2014; Reilingh et al., 2008; Sindhu et al., 2012; Styron et al., 2015; Valencia et al., 2014, 2011; Wolfensberger et al., 2016). A summary of the prognostic role that pain beliefs paly on pain intensity is reported in **Appendix D**.

The association between pain beliefs and disability (cross-sectional analysis)

The association between pain beliefs and disability in people with SP based on cross-sectional analyses was explored by seven studies (Clausen et al., 2017; Henn et al., 2011; Lentz et al., 2009; Menendez et al., 2015; Razmjou et al., 2009; Tashjian et al., 2004; Warth et al., 2013). A summary of the association between pain beliefs and disability is shown in **Appendix C.**

The predictive value of pain beliefs on disability (longitudinal analysis)

The predictive value of pain beliefs on disability in people with SP based on longitudinal analyses was explored by twenty studies (Chester et al., 2016; Coronado et al., 2017; Ekeberg et al., 2010; Engebretsen et al., 2010; Henn et al., 2007; Jawa et al., 2016; Kennedy et al., 2006a, 2006b; Kromer et al., 2014; Laslett et al., 2014; O'Malley et al., 2004; Oh et al., 2012; Razmjou et al., 2011; Reilingh et al., 2008; Sindhu et al., 2012; Styron et al., 2015; Thomas et al., 2004; Valencia et al., 2014; van der Windt et al., 2007; Wolfensberger et al., 2016). A summary of the prognostic role that pain beliefs play on disability is also reported in **Appendix D**.

DISCUSSION

The objective of this review was twofold: (i) to explore the association (cross-sectional analysis) between pain beliefs with pain intensity and/or disability and, (ii) to analyse the prognostic role (longitudinal analysis) that pain beliefs play on pain intensity and/or

disability in individuals with SP. Cross-sectional analyses reported that: (i) higher levels of pain catastrophizing and kinesiophobia were significantly associated with more pain intensity and disability; (ii) higher levels of expectations of recovery and self-efficacy were significantly associated with lower levels of pain intensity and disability; (iii) there was no statistical significant association between fear of pain and fear-avoidance with pain intensity. The overall body of the evidence after applying the GRADE approach was very low for all the associations.

Longitudinal analyses reported that: (i) higher levels of pain catastrophizing at baseline predicted the course of pain intensity and disability; (ii) higher levels of fear-avoidance and kinesiophobia at baseline predicted the course of disability; (iii) higher levels of self-efficacy and expectations of recovery at baseline predicted a reduction of the levels of pain intensity and disability overtime; (iv) there was inconsistency of the results in the predictive value of fear-avoidance on pain intensity; (v) kinesiophobia, optimism, and internal and external locus of control did not predict significant changes in pain intensity; (vi) internal and external locus of control, preoperative concerns, optimism, and beliefs about treatment did not predict significant changes in disability. The overall body of the evidence after applying the GRADE approach was very low for all the relationships.

Comparison with other studies

To our knowledge, this is the first synthesis of the evidence exploring the association and the predictive value that pain beliefs play on pain intensity and/or disability in individuals with SP. Our findings are in accordance with the fear-avoidance model of pain (Leeuw et al., 2007). In brief, this model hypothesised that people who show negative beliefs about pain (e.g. catastrophic thoughts) prior to an injury, give a

misleading appreciation to its pain experience. This affect the way in which they respond to pain in terms of functional status, adaptation, and development of disability (Pincus et al., 2002). Avoidance behaviours are considered as a normal response against to a stressful event in acute stage (Steimer, 2002). However, recent reviews have shown that the presence of pain beliefs such as fear or pain catastrophizing cause maladaptive escape behaviours, even in acute stage, favouring the transition from acute to chronic pain (Pozek et al., 2016; Wertli et al., 2014; Wertli et al., 2014). The brain creates pain as an alarm signal in order to warn to specific body regions of a potential threat (Williams, 2013). Pain beliefs also play a role disturbing certain brain regions associated with the processing and attention of pain (Malfliet et al., 2017). Therefore, it seems presumable that fearful and catastrophic individuals with SP could have more probability of avoiding certain movements due to the erroneous belief that these activities will cause a potential or real injury/re-injury (Feleus et al., 2007; Lentz et al., 2009). In this sense, different hypothesises suggest that if an individual with SP has fear and catastrophize while executing certain activities, this individual will have more risk to develop pain, disability and depression (George et al., 2008; Leeuw et al., 2007; Parr et al., 2014, 2012). However, our results also showed that if an individual with SP has higher levels of positive pain beliefs such as expectations of recovery and self-efficacy (longitudinal analysis), he/she will have greater probability to confront their pain experience, which will favour a positive trajectory of recovery (lower levels of pain intensity and disability).

Supporting our results, several reviews have explored the importance of pain beliefs in other musculoskeletal conditions (Jackson et al., 2014; Jia and Jackson, 2016; Main et al., 2010; Martinez-Calderon et al., 2017; Sullivan et al., 2011). Main et al. (Main et al., 2010) concluded that pain beliefs such as pain catastrophizing or self-efficacy are a

noteworthy part not only in the processing of pain, but also in how people with back disorders respond that pain. Sullivan et al. (Sullivan et al., 2011) showed how pain beliefs (e.g. perceived injustice) reduce favourable trajectories of recovery after a whiplash injury. Jia et al. (Jia and Jackson, 2016) reported moderate evidence about the relationship between pain beliefs (e.g. helplessness) and disability, pain severity, and emotional distress. In a recent systematic review, Martinez-Calderon et al. (Martinez-Calderon et al., 2017) reported that high levels of self-efficacy are associated with low pain intensity and disability in people with chronic musculoskeletal pain.

Despite the guiding results of this and previous reviews (Jackson et al., 2014; Jia and Jackson, 2016; Main et al., 2010; Martinez-Calderon et al., 2017; Sullivan et al., 2011) about the potential association and predictive value of pain beliefs on pain intensity and/or disability in musculoskeletal pain, the overall body of the evidence in the present review after applying the GRADE approach was very low. Therefore, the obtained findings should be interpreted with caution. Several reasons could specifically explain the inconsistency of the results. First, pain intensity may play a moderator role in the relationship between pain beliefs (e.g. pain catastrophizing) and pain-related outcomes, such as pain interference and physical health status, which could drive to avoidance, hypervigilance and physical inability (Eccleston and Crombez, 1999; Suso-Ribera et al., 2017). This could explain the inconsistency of the results showed in this review when certain negative beliefs such as fear-avoidance were associated with the outcome (pain intensity and disability). Second, multiple pathways are related to the development and perpetuation of pain-related disability. It exists a broad variability in terms of duration of episodes, fluctuations of pain intensity, severity of pain, social and contextual factors, as well as the biopsychosocial profile of every person with musculoskeletal pain (Kuijpers et al., 2004; Wideman et al., 2013). Thus, it is questionable to think that an

individual with SP will develop disability in the simplistic pathway proposed in the fear-avoidance model of pain (Wideman et al., 2013).

Strengths and weaknesses of the study

The strengths of this review included: (i) the use of a pre-specified protocol registered on PROSPERO; (ii) the current guidelines to conduct a systematic review (the Cochrane Handbook for Systematic Reviews Version 5.1.0 and the PRISMA checklist) and; (iii) the use of specific review tools to evaluate the risk of bias and the overall body of the evidence. Likewise, there are some limitations that should be mentioned: (i) some pain beliefs are quite broad in definition. It may increase the risk of inconsistency of the results; (ii) risk of bias was found in most of included studies (see table 2). This could limit the findings of the present systematic review; (iii) the causality and the impact of pain beliefs in pain intensity and disability in this population cannot be determined due to the observational nature of the included studies (cross-sectional and cohort studies without a non-exposed cohort); (iv) some shoulder presentations (e.g. traumatic) were not considered in our search strategy, giving rise to the possible missing of potential articles; (v) despite the post-traumatic stress disorder profile is considered a relevant factor in other musculoskeletal conditions, e.g. whiplash, this profile was not considered as inclusion criteria in the present review; (vi) finally, our conclusion should be interpreted with caution. This is due to the overall body of the evidence after applying the GRADE approach showed very low evidence across studies.

Clinical implications

Pain catastrophizing and fear are considered potential barriers in order to achieve successful results after applying a therapy (Turner et al., 2007; Wertli et al., 2014). On the other hand, self-efficacy (Picha and Howell, 2017) and expectations of recovery (Henn et al., 2007) have been shown to facilitate adherence to treatment, which favours

the consecution of better outcomes. Interestingly, both (negative and positive pain beliefs) are also known for being modifiable factors (van Hecke et al., 2013; Picha and Howell, 2017). In that point, our results suggest that people with SP who catastrophize in response to pain, can do it even without much disability, or that people with SP might have substantial fear of movement and avoidance activities, but low levels of pain. In this sense, clinicians should consider pain beliefs as potential factors during the anamnesis as they may influence the course of pain intensity and disability. However, despite these guiding results, due to the very low evidence of our findings, more longitudinal studies using higher quality study designs and procedures would be needed before advising clinicians whether these modifiable variables can influence specifically pain intensity and disability in individuals with SP.

Future Research

The results of the present study may have been influenced by flaws observed in most of the observational studies included in this review. Hence, there are some recommendations to guide future research: (i) further longitudinal studies (including a non-exposed group) analysing prospectively the predictive value of pain beliefs on pain intensity and/or disability in the transition from acute to chronic SP, and the perpetuation of shoulder chronicity, are needed; (ii) studies focusing on the modification of these factors through biopsychosocial approaches are required to draw causal conclusions; (iii) warranted to help inform development of clinical prediction rules for improvement in prognosis, that encompass biological, psychological, and contextual domains.

CONCLUSIONS

This systematic review provided information about the association and the predictive value of pain beliefs on pain intensity and/or disability in individuals with SP. In the

cross-sectional analysis, higher levels of pain catastrophizing and kinesiophobia were significantly associated with more pain intensity and disability, whereas higher levels of expectations of recovery and self-efficacy were significantly associated with lower levels of pain intensity and disability. In the longitudinal analysis, higher levels of pain catastrophizing at baseline predicted greater pain intensity and disability overtime. Higher levels of fear-avoidance and kinesiophobia at baseline predicted greater disability during the course of SP. Higher levels of self-efficacy and expectations of recovery at baseline predicted a reduction in levels of pain intensity and disability overtime. In this sense, clinicians should consider pain beliefs as potential factors during the anamnesis as they may influence the course of pain intensity and disability. However, the overall body of the evidence after applying the GRADE approach was very low across studies. Further research using higher quality longitudinal designs and procedures would be needed to establish firm conclusions.

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Table 1: Characteristics of included studies

First Author	Study N (completed follow-up)	Setting	Mean age (years)	Clinical presentation	Mean duration of symptoms	Psychological factor	Outcome measure: pain intensity	Outcome measure: disability	Data collection (follow-up)	Study design	Statistical results
Chester et al. 2016 (Chester et al., 2016)	1030 (772)	11 NHS trusts and social enterprises	57 (SD 15)	Unspecific Shoulder pain	14 months (SD 28)	Pain self-efficacy (PSEQ); expectations of recovery (not reported)	SPADI and QuickDASH	SPADI and QuickDASH	(T1) at baseline; (T2) at six months	Longitudinal (prospective cohort study)	Baseline expectations of recovery-pain intensity at six months: much improve: B [95% CI] = -5.21 [-1.80 to 8.61] p=0.003; slightly improve: B [95% CI] = −12.43 [−8.20 to −16.67] p<0.001; no changes/worse: B [95% CI] = −0.94 [−8.53 to 6.66] p=0.809 (statistical data of QuickDASH not reported) Baseline self-efficacy for pain-pain intensity at six months: B [95% CI] = −0.36[−0.50 to −0.22] p<0.001 (statistical data of QuickDASH not reported) Baseline expectations of recovery-disability at six months: much improve: B [95% CI] = -5.21[-1.80 to 8.61] p=0.003; slightly improve: B [95% CI] = −12.43[−8.20 to −16.67] p<0.001; no changes/worse: B [95% CI] = −0.94[−8.53 to 6.66] p=0.809 (statistical data of QuickDASH not reported)

											Baseline self-efficacy for pain-disability at six months: B [95% CI] = −0.36[−0.50 to −0.22] p<0.001 (statistical data of QuickDASH not reported)
Clausen et al. 2017 (Clausen et al., 2017)	157	Arthroscopic Center Amager	54 (SD 13)	Shoulder impingement syndrome	Acute (1.3%); subacute (17.5%); chronic (81.1%)	Kinesiophobia (TSK-11)	SPADI	SPADI-F	-	C-S	Kinesiophobia-pain intensity: R^2 adj= 55.5% variance adj= 0.5% Kinesiophobia-disability: R^2adj= 47.1% variance adj=-0.1%
Coronado et al. 2017 (Coronado et al., 2017)	78 (63)	the University of Florida and Shands Hospital campus and the local surrounding community	38.8 (SD 14.9)	Unspecific shoulder pain	<6 months	Pain catastrophizing (PCS) fear-avoidance beliefs (FABQ) optimism (LOT-R)	BPI	Penn-F	(T1) at baseline; (T2) at three months	Longitudinal (secondary data analysis)	Baseline fear-avoidance beliefs (physical activity subscale)-pain intensity at three months: B[95%CI] = -0.01[-0.20 to 0.19] p=0.090 Baseline pain catastrophizing-pain intensity at three months: B[95%CI] = 0.11[-0.11 to 0.32] p=0.213 Baseline optimism-pain intensity at three months: B [95%CI] = -0.01[-0.20 to 0.19] Baseline fear-avoidance (physical activity subscale)-disability (function) at three months: B [95%CI] = -0.13[-0.31 to 0.05] p=0.092

											Baseline pain catastrophizing-disability (function) at three months: B [95%CI] = -0.19[-0.37 to -0.01] p<0.05 Baseline optimism-disability (function) at three months: B [95%CI] = 0.05[-0.12 to 0.22]
Ekeberg et al. 2010 (Ekeberg et al., 2010)	106 (104)	the outpatient clinic of the Physical Medicine and Rehabilitation Department at University Hospital	52 (SD 12)	Rotator cuff disease	Between 6 months- more than 24 months	Self-efficacy for pain (seven-point ordinal scale) expectations of recovery (seven-point ordinal scale)	SPADI	SPADI	(T1) at baseline; (T2) at six weeks	Longitudinal (secondary data analysis)	Baseline expectations of recovery-pain intensity at six weeks after intervention: B[95%CI] = 2.3[-8.0 to 12.6] p=0.66 Baseline self-efficacy for pain-pain intensity at six weeks after intervention: B[95%CI] = 0.9[-0.2 to 1.9] p=0.1 Baseline expectations of recovery-disability at six weeks after intervention: B [95%CI] = 2.3[-8.0 to 12.6] p=0.66 Baseline self-efficacy for pain-disability at six weeks after intervention: B [95%CI] = 0.9[-0.2 to 1.9] p=0.1
Engebretsen et al. 2010 (Engebretsen et al., 2010)	104 (94)	the outpatient Department of the Physical Medicine and Rehabilitation at University Hospital	48 (SD 10.7)	Subacromial shoulder pain	3 months-> 12 months	Self-efficacy for pain (four items from ASES)	SPADI	SPADI	(T1) at baseline; (T2) at twelve months	Longitudinal (prospective cohort study)	Baseline pain self-efficacy-pain intensity at twelve months: B [95% CI] = 6.0[2.0 to 9.9] p=0.004 Baseline self-efficacy for pain-disability at twelve months: B [95% CI] = 6.0[2.0 to 9.9] p=0.004

George et al. 2008 a (George et al., 2008)	59 (47)	the University of Florida's Orthopaedics Sports Medicine Institute	50.3 (SD 15.0)	Unspecific shoulder pain	-	Fear of pain (FPQ-III) kinesiophobia (TSK-11) pain catastrophizing (PCS)	BPI	-	(T1) at baseline (pre-surgery); (T2) at three-five months after surgery	C-S	Kinesiophobia-pain intensity: Standardized B= -0.15 p=0.329 Fear of pain-pain intensity: Standardized B= 0.08 p=0.584 Pain catastrophizing-pain intensity: Standardized B= 0.53 p=0.001
George et al. 2009 b (George and Hirsh, 2009)	59	-	50.4 (SD 14.9)	Rotator cuff disease	-	Fear of pain (FPQ-III) pain catastrophizing (PCS)	BPI	-	-	C-S	Fear of pain-pain intensity: B=0.03 p= 0.81 Pain catastrophizing-pain intensity: B= 0.43 p<0.01
Henn et al. 2007 a (Henn et al., 2007)	125	Hospital	56.2 (SD 11.4)	Unilateral rotator cuff tear	16.0 months (SD 25.9)	Preoperative expectations (MODEMS)	VAS and DASH	SST, VAS, and DASH	(T1) at baseline; (T2) at twelve months after surgery	Longitudinal (retrospective cohort study)	Preoperative expectations-pain intensity at twelve months: VAS B=9.91 p=0.005; DASH: B=11.93 p<0.001 Preoperative expectations-disability at twelve months: VAS B= 8.30 p=0.023; DASH: B= 11.93 p<0.001; SST: B= 15.34 p<0.001
Henn et al. 2011 b (Henn et al., 2011)	116 (98)	One tertiary-care teaching institution	67.6 (SD 10.6)	Glenohumeral osteoarthritis	-	Preoperative expectations (the Hospital for Special	VAS	ASES	-	C-S	Expectations of recovery (improved activity to exercise or participate in sports)-pain intensity: p<0.05

						Surgery's Shoulder Surgery Expectations Survey)					Expectations of recovery (Improved self-care)-disability: p<0.05
Jawa et al. 2016 (Jawa et al., 2016)	74	Hospital	60.8	Glenohumeral osteoarthritis	-	Preoperative expectations (list of 10 items)	VAS	ASES	(T1) at baseline; (T2) at minimum of thirty-six months after surgery	Longitudinal (retrospective cohort study)	Data not reported
Karlsson et al. 2016 (Karlsson et al., 2016)	57	The Pain and Rehabilitation Centre at Linköping University Hospital	43 (SD 8.5)	Unspecific shoulder pain	8.5 years	Pain catastrophizing (PCS) fear-avoidance beliefs (FABQ) general self-efficacy (GSES) pain self-efficacy (PSEQ)	NRS	-	(T1) at baseline; (T2) at four-six months; (T3) at twelve months	Longitudinal (prospective cohort study)	Baseline fear-avoidance beliefs-pain intensity at baseline: r= 0.04 p=0.75; at four-six months: r= -0.33 p=0.029; at twelve months: r= -0.29 p=0.08 Baseline pain catastrophizing-pain intensity at baseline: r=0.02 p=0.88; at four-six months: r= -0.20 p=0.21; at twelve months: r= -0.06 p=0.73 Baseline self-efficacy for pain-pain intensity at baseline: r= -0.10 p=0.45; at four-six months: r= 0.10 p=0.51; at twelve months: r= -0.20 p=0.23

											Baseline general self-efficacy-pain intensity at baseline: r= 0.12 p=0.37; at four-six months: r= 0.21 p=0.18; at twelve months: r= 0.19 p=0.27
Kennedy et al. 2006 a (Kennedy et al., 2006b)	361	-	49.9 (SD 14.9)	Soft tissue shoulder disorders	<4 weeks (24.1%); 4-12 weeks (24.7%); >12 weeks (48.5%)	Expectations of recovery (four Likert-point (get better soon or already better; get better slow; don't know; stay same or get worse)	-	DASH	(T1) at baseline; (T2) at three months	Longitudinal (prospective cohort study)	Baseline expectations of recovery (client prediction for recovery)-disability at three months: Wald statistic= 27.52 p<0.0001; Baseline expectations of recovery (client estimate of time to return to activity)-disability at three months: Wald statistic= 30.56 p<0.0001
Kennedy et al. 2006 b (Kennedy et al., 2006a)	361	-	49.9 (SD 14.9)	Soft tissue shoulder disorders	<4 weeks (24.1%); 4-12 weeks (24.7%); >12 weeks (48.5%)	Expectations of recovery (four Likert-point (get better soon or already better; get better slow; don't know; stay same or get worse)	-	DASH	(T1) at baseline; (T2) at three months	Longitudinal (prospective cohort study)	Baseline expectations of recovery (client prediction for recovery)-disability at three months: B [95%CI] = -3.04[-6.23 to 0.15] p=0.0618; baseline expectations of recovery (client estimate of time to return to activity <4 weeks)-disability at three months: B [95%CI]= 0.75[-5.60 to 7.10] p=0.8164; baseline expectations of recovery (client estimate of time to return to activity ≥4 weeks)-disability

											at three months: B [95%CI] = 0.95[-3.88 to 5.78] p=0.8164
Kindler et al. 2011 (Kindler et al., 2011)	59	the University of Florida's Orthopaedics Sports Medicine Institute	47.0 (SD 14.6)	Rotator cuff disease	-	Pain catastrophizing (PCS)	BPI	-	-	C-S	Pain catastrophizing-pain intensity: r= 0.511
Kromer et al. 2014 (Kromer et al., 2014)	90 (88)	General practice	51.8 (SD 11.2)	Subacromial shoulder pain	15.3% 2 months or less; 84.7% more than 3 months	Pain catastrophizing (PCS) fear-avoidance beliefs (FABQ)	NRS and SPADI	SPADI	(T1) at baseline; (T2) at three months	Longitudinal (prospective cohort study)	Fear-avoidance-pain intensity: r= -0.061 Pain catastrophizing-pain intensity: r=0.318 p<0.01 Baseline fear-avoidance beliefs-disability at three months: B [95%CI] = -0.102[-1.14 to -0.36] p=0.305 Baseline pain catastrophizing-disability at three months: B [95%CI] = 0.083[-0.23 to 0.59] p=0.381
Laslett et al. 2015 (Laslett et al., 2015)	161 (135)	Primary care	-	Unspecific shoulder pain	7 (SD 13)	Fear-avoidance beliefs (FABQ)	SPADI	SPADI	(T1) at baseline; (T2) at six months; (T3) at twelve months	Longitudinal (prospective cohort study)	Baseline fear-avoidance-pain intensity at six months: OR [95%CI] = 1.03[1.00 to 1.07] p=0.08; baseline fear-avoidance-pain intensity at twelve months: OR [95%CI] = 1.01[1.03 to 1.17] p=0.00 Baseline fear-avoidance-disability at six months: OR [95%CI] = 1.03[1.00 to 1.07]

											p=0.08; baseline fear-avoidance-disability at twelve months: OR [95%CI] = 1.01[1.03 to 1.17] p=0.00
Lentz et al. 2009 (Lentz et al., 2009)	142	the clinical database of impairment and outcome measures in the Department of Physical Therapy at the UF & Shands Orthopaedic and Sports Medicine Institute	41.4 (SD 18.5)	Unspecific shoulder pain	-	Kinesiophobia (TSK-11)	NRS and SPADI	SPADI	-	C-S	Kinesiophobia-pain intensity: r= 0.309 p<0.01 Kinesiophobia-disability: Standardized B= 0.172 p=0.026
Menendez et al. 2015 (Menendez et al., 2015)	139	An academic hospital-based shoulder surgeon	58.1 (SD 14.3)	Multiples shoulder pain complaints	18.7 (SD 26.8) months	Pain catastrophizing (PCS) self-efficacy for pain (PSEQ)	SPADI	SPADI	-	C-S	Pain catastrophizing-pain intensity: B= 0.003 p=0.029 Self-efficacy for pain-pain intensity: B= -0.005 p=0.001 Pain catastrophizing-disability: B= 0.003 p=0.029 Self-efficacy for pain-disability: B= -0.005 p=0.001

Oh et al. 2012 (Oh et al., 2012)	128	Hospital	58.8	Rotator cuff disease	-	Preoperative expectations (MODEMS) preoperative concerns (64 items with a four-point Likert scale)	-	SST and Constant-Murley score	(T1) at baseline; (T2) mean 13.7 months (ranging 12-37 months) after surgery	Longitudinal (prospective cohort study)	Preoperative expectations-disability at a mean of 13.7 months Constant Murley: p<0.01 and SST: p=0.024 High preoperative concerns-disability at a mean of 13.7 months Constant Murley and SST no significant results
O'Malley et al. 2004 (O'Malley et al., 2004)	199 (122)	One orthopaedic surgeon's office	51.6 (SD 15.7)	Multiples shoulder pain complaints	Chronic shoulder pain (67%)	Expectations of recovery (PSOE)	-	FLEX-SF	(T1) at baseline; (T2) at three months	Longitudinal (prospective cohort study)	Baseline expectations of recovery-disability at three months: B= 0.46 p=0.002
Plath et al. 2017 (Plath et al., 2017)	145	the Department of Orthopaedic Sports Medicine (tertiary care facility)	27.6 (SD 8.2)	Shoulder instability	51.2 (SD 63.9) months	Expectations of recovery (six-items)	VAS	-	-	C-S	Expectations of recovery-pain intensity: Overall n/s
Razmjou et al. 2009 a (Razmjou et al., 2009)	185 (170)	a large academic institution	57 (SD 11)	Rotator cuff disease	Women 45.06 (SD 71) months; men 47.98	Expectations of recovery (seven items with a five-point Likert scale)	-	WORC, ASES, QuickDASH	-	C-S	Expectations for improved activity daily life (no difficulty B= 16.93; moderate expectations B= 2.12; high expectations B= 0.00 p=0.0038)

					(SD 60) months						
Razmjou et al. 2011 b (Razmjou et al., 2011)	185 (160)	a large academic institution	57 (SD 11)	Rotator cuff disease	Mean 43.42-46.48 months	Preoperative expectations (seven items with a five-point Likert scale)	-	WORC, ASES, and QuickDASH	(T1) at baseline; (T2) at six months after surgery	Longitudinal (prospective cohort study)	Preoperative expectations-disability at six months: working B= 7.06; N/A B= 5.98; light B= 1.07; full B= 0.00 p=0.1349
Reilingh et al. 2008 (Reilingh et al., 2008)	587 (242 with chronic shoulder pain at baseline)	General practice	52.9 (SD 13.3)	Unspecific shoulder pain	>3 months	Pain catastrophizing, internal and externa locus of control (PCCL)	NRS	SDQ	(T1) at baseline; (T2) at six months	Longitudinal (prospective cohort study)	Baseline pain catastrophizing-pain intensity (acute shoulder pain) at six months: Mean[95%CI] = 1.00[0.44 to 1.57] p=0.01 Baseline pain catastrophizing-pain intensity (chronic shoulder pain) at six months: Mean[95%CI] = -0.62[-1.03 to -0.20] p=0.001 Baseline external locus of control-pain intensity (in acute shoulder pain) at six months: 3-4: Mean[95%CI] = 0.35[-0.63 to 1.32] p=0.49; >4: Mean[95%CI] = 0.22[-0.89 to 1.33] p=0.70 Baseline external locus of control-pain intensity (in chronic shoulder pain) at six months: 3-4: Mean[95%CI] = -0.79[-1.60 to

											0.02] p=0.06; >4: Mean[95%CI] = 0.21[-0.92 to 1.35] p=0.71 The predictive value of pain catastrophizing on disability was not reported The predictive value of locus of control on disability was not reported
Sindhu et al. 2012 (Sindhu et al., 2012)	3,362 (1,519)	Outpatient rehabilitation clinics	54.1 (SD 15.8)	Multiples shoulder pain complaints	Acute 0-21 days (19.2%); subacute 22-90 days (32%); chronic more than 3 months (48.8%)	Fear-avoidance beliefs (FABQ-PA)	NRS	CAT	(T1) at baseline; (T2) at discharge	Longitudinal (secondary data analysis)	Baseline high fear-avoidance-change (intake-discharge) pain intensity: Mean(SD): -2.4(2.9); low fear-avoidance-change (intake-discharge) pain intensity: Mean(SD): -2.5(2.7) Baseline low fear-avoidance-low disability at discharge: muscle, tendon, and soft tissue disorders: B= 1.37 p=0.01; osteopathies, chondropaties, and acquired musculoskeletal deformities: B= 5.52 p=0.02
Styron et al. 2015 (Styron et al., 2015)	467 (436)	A large health care system	66.6 (SD 10.3)	Unspecific shoulder pain	20.9 months	Expectations of recovery (ten-point Likert scale)	PSS pain subscore	PSS function subscore and SF-12-PCS score	(T1) at baseline; (T2) at six months after surgery	Longitudinal (prospective cohort study)	Preoperative expectation of recovery-pain intensity at six months (PSS pain subscore): Mean[95%CI] = 1.99[0.17 to 3.82] p=0.033 Preoperative expectation of recovery-disability at six months (PSS-function subscore): Mean [95%CI] = 2.65[0.14 to 5.16] p=0.039; (SF-12-

											PCS score): Mean [95%CI] = -0.06[-0.78 to 0.65] p=0.858
Tashjian et al. 2004 (Tashjian et al., 2004)	199	Hospital	56	Rotator cuff tear	16.95 (SD 26.57) months	Expectations of recovery (MODEMS)	-	DASH; SF-36 physical function; SST	-	C-S	Expectations of recovery-disability: SF-36-physical function: p=0.046. Data not reported with DASH and SST
Thomas et al. 2004 (Thomas et al., 2004)	207 (195)	Nine general practices	58 (SD 14)	Unspecific shoulder pain	No preferences 60 days (IQR 21-120); physiotherapy 40 (IQR 21-90); injection 42 (IQR 21-120)	Beliefs about preference of treatment: one item at baseline: "if you had a free choice, would you choose to have physiotherapy or an injection?"; one item six months after intervention: "if you had a similar shoulder problem again,	-	Shoulder disability questionnaire	(T1) at baseline; (T2) at six months	Longitudinal (prospective cohort study)	Baseline beliefs about treatment preferences-disability at six months: Better outcome: no preferences (72%), randomised to treatment preferences (74%); not randomised to treatment preferences (58%); poor outcome: no preferences (21%), randomised to treatment preferences (48%); not randomised to treatment preferences (0)

						which treatment do you prefer?"					
Valencia et al. 2011 a (Valencia et al., 2011)	59 (48)	the University of Florida's Orthopaedics Sports Medicine Institute	50.39 (SD 14.92)	Unspecific shoulder pain	-	Pain catastrophizing (PCS)	BPI	-	(T1) at baseline; (T2) at three months after surgery	Longitudinal (prospective cohort study)	Baseline pain catastrophizing-pain intensity at three months: standardized B=0.34 p=0.04
Valencia et al. 2014 b (Valencia et al., 2014)	78 (73)	the University of Florida's Orthopaedics Sports Medicine Institute	43.25 (SD) to 51.35 (SD 20.73)	Multiples shoulder pain complaints	68.98 (SD 68.59) to 88.78 (SD 137.13) weeks	Pain catastrophizing (PCS)	BPI	DASH	T1) at baseline; (T2) at six months after surgery	Longitudinal (prospective cohort study)	Baseline pain catastrophizing-pain intensity at six months: standardized B= 0.05 p=0.70 Baseline pain catastrophizing-disability at six months: standardized B= 0.23 p=0.11
Warth et al. 2013 (Warth et al., 2013)	313	Hospital	48.7	Unspecific shoulder pain	-	Expectations of recovery (17 items)	ASES	QuickDASH, ASES, and SF-12 physical component	-	C-S	Expectations of recovery-pain intensity: decrease AM pain p<0.001; decrease PM pain p<0.001 Expectations of recovery-disability with ASES: Improve ROM p<0.001; reach above shoulder p<0.001; participate in recreation p<0-001; reach sideways p<0.001; carry 10 pounds p<0.001; perform ADLs p<0.001; dress oneself p<0.001

											Expectations of recovery-disability with SF-12: reach above shoulder p<0.001; participate in recreation p<0-001; reach sideways p<0.001; carry 10 pounds p<0.001; perform ADLs p<0.001; dress oneself p<0.001 Expectations of recovery-disability with QuickDASH: improve ROM p<0.05; reach above shoulder p<0.001; participate in recreation p<0-001; reach sideways p<0.001; carry 10 pounds p<0.001; perform ADLs p<0.001; dress oneself p<0.001
Van der Windt et al. 2007 (van der Windt et al., 2007)	587 (517)	Primary care	51.5 (SD 14)	Unspecific shoulder pain	0-2 weeks (14.2%); 3-6 weeks (20.8%); 6-13 weeks (23.7%); more than 13 weeks (41.3%)	Pain catastrophizing (PCCL-Catastrophizing subscale) fear-avoidance beliefs (FABQ-P)	-	SDQ	(T1) at baseline; (T2) at three months	Longitudinal (prospective cohort study)	Baseline fear-avoidance-disability at three months: adjusted 50-75 OR [95%CI] = 1.22[0.81 to 1.83]; >75 OR [95%CI] = 1.12[0.68 to 1.85] Baseline pain catastrophizing-disability at three months: adjusted 20-40 OR [95%CI] = 1.33[0.88 to 1.99]; >40 OR [95%CI] = 1.32[0.78 to 2.24]
Wolfensberger et al. 2016	314 (158)	the Clinique Romande de Readaptation	18-65 years	Multiples shoulder pain complaints	More than 3 months	Pain catastrophizing (PCS)	BPI	DASH	(T1) at baseline; (T2) at	Longitudinal (retrospective cohort study)	Baseline kinesiophobia-pain intensity at discharge (four-five weeks): B[95%CI] = 0.01[-0.03 to 0.05] p=0.521

(Wolfensberger et al., 2016)	kinesiophobia (TSK)	discharge (four-five weeks)	Baseline pain catastrophizing-pain intensity at discharge (four-five weeks): B[95%CI] = 0.03[0.01 to 0.06] p=0.011 Kinesiophobia-disability (DASH) at discharge (four-five weeks): B [95%CI] = 0.15[-0.14 to 0.44] p=0.310; kinesiophobia-disability (Constant Murley) at discharge (four-five weeks): B [95%CI] = -0.29[-0.51 to -0.06] p=0.013 Pain catastrophizing-disability (DASH) at discharge (four-five weeks): B [95%CI] = 0.30[0.12 to 0.47] p=0.001; pain catastrophizing-disability (Constant Murley) at discharge (four-five weeks): B [95%CI] = -0.19[-0.33 to -0.04] p=0.012

Note: C-S: cross-sectional; PSEQ: the Pain Self-Efficacy Questionnaire; SPADI: the Shoulder Pain and Disability Index; TSK-11: the Tampa Scale for Kinesiophobia-11 items; QuickDASH: Quick Disability of the Arm, Shoulder and Hand Questionnaire; PCS: the Pain Catastrophizing Scale; FABQ: the Fear-Avoidance Beliefs Questionnaire; BPI: the Brief Pain Inventory; Penn-F: Pennsylvania Shoulder Score function subscale; LOT-R: Life Orientation Test-Revised); ASES: Arthritis Self-Efficacy Scale; FPQ-III: the Fear of Pain Questionnaire; NRS: the numerical rating scale; VAS: Visual Analogue Scale; GSES: the General Self-Efficacy Scale; SST: the Simple Shoulder Test; MODEMS: the Musculoskeletal Outcomes

Data Evaluation and Management System Questionnaire; ASES: the American Shoulder and Elbow Surgeons; FLEX-SF: the Flexilevel Scale of Shoulder Function; PSOE: Patient Shoulder Outcome Expectancies; WORC: the Western Ontario Rotator Cuff Index; PCCL: the 43-item Pain Coping and Cognition List; CAT: the Shoulder Computerized Adaptive Test; PSS: the Penn Shoulder Score; SF-12-PCS score: the General Health-Related Quality of life Physical Component Summary (PCS) Score; B: Betta Coefficient; r: Pearson's Coefficient of Correlation; R^2: Coefficient of Determination; p: P value; CI: confidence interval.

Table 2. Risk of bias assessment for observational studies (The Newcastle Ottawa Scale (NOS) adapted version).

First Author	Year	Selection bias	Performance bias		Detection bias		Information bias		Total score	Conflict of interest of included studies
		A	B	C	D	E	F	G		
Chester et al.	2016	3	3	2	2	0	0	2	12/21	NCI
Clausen et al.	2017	1	0	1	1	3	2	2	10/21	NCI
Coronado et al.	2017	1	0	2	2	2	3	2	12/21	NCI
Ekeberg et al.	2010	1	0	2	2	3	2	2	12/21	NCI
Engebretsen et al.	2010	1	0	3	2	3	2	2	13/21	NCI
George et al. a	2008	1	0	1	2	0	2	2	8/21	NR
George et al. b	2009	1	0	2	2	3	2	2	12/21	NR
Henn et al. a	2007	1	0	2	2	3	2	2	12/21	NR
Henn et al. b	2011	1	0	1	1	0	2	2	7/21	NCI
Jawa et al.	2016	1	0	0	0	3	1	2	7/21	NR
Karlsson et al.	2016	0	0	2	2	3	3	2	12/21	NCI
Kennedy et al. a	2006	1	0	2	2	3	2	2	12/21	NR
Kennedy et al. b	2006	1	0	2	2	3	2	2	12/21	NR
Kindler et al.	2011	1	0	0	1	3	2	2	9/21	NR
Kromer et al.	2014	1	0	2	2	3	3	2	13/21	NR
Laslett et al.	2015	1	0	0	1	0	1	2	5/21	NR
Lentz et al.	2009	1	0	1	2	3	3	2	12/21	NR
Menendez et al.	2015	1	0	0	1	3	2	2	9/21	NCI
Oh et al.	2012	1	0	0	1	3	2	2	9/21	NR
O'Malley et al.	2004	1	0	1	1	2	3	2	10/21	NR
Plath et al.	2017	2	3	0	1	3	1	2	12/21	NCI
Razmjou et al. a	2009	2	1	2	2	3	3	2	15/21	NCI
Razmjou et al. b	2011	2	1	1	2	1	3	2	12/21	NCI
Reilingh et al.	2008	1	0	3	2	0	2	2	10/21	NCI
Sindhu et al.	2012	1	0	2	2	1	3	2	11/21	NR
Styron et al.	2015	1	0	2	1	1	1	2	8/21	NR
Tashjian et al.	2004	1	0	1	1	3	2	2	10/21	NR
Thomas et al.	2004	1	0	0	1	3	1	2	8/21	NR
Valencia et al. a	2011	1	0	0	1	0	3	2	7/21	NCI
Valencia et al. b	2014	1	0	2	2	3	3	2	13/21	NCI
Warth et al.	2013	1	0	0	1	3	1	2	8/21	NR
Van der Windt et al.	2007	1	0	2	2	2	2	2	11/21	NCI
Wolfensberger et al.	2016	1	0	2	2	0	1	2	8/21	NCI

Note: A = Is the source population (cases, controls, cohorts) appropriate and representative of the population of interest?; B = Is the sample size adequate and is there sufficient power to detect a meaningful

difference in the outcome of interest?; C = Did the study identify and adjust for any variables or confounders that may influence the outcome?; D = Did the study use appropriate statistical analysis methods relative to the outcome of interest?; E = Is there little missing data and did the study handle it accordingly?; F = Is the methodology of the outcome measurement explicitly stated and is it appropriate?; G = Is there an objective assessment of the outcome of interest?; NCI = No conflict of interest; NR = not reported.

Table 3. Summary of findings and Quality of evidence assessment (cross-sectional studies)

Summary of findings			Quality of evidence assessment (GRADE)						
Outcome	No of studies	No. of participants	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Level of evidence	Importance
Fear-avoidance									
Pain intensity	1	90	Serious[1]	No[2]	No[3]	Very serious[4]	Undetected [5]	Very low	Critical
Kinesiophobia									
Pain intensity	3	358	Serious[1]	Serious[2]	Serious[3]	Very serious[4]	Undetected [5]	Very low	Critical
Disability	2	299	Serious[1]	No[2]	Serious[3]	Very serious[4]	Undetected [5]	Very low	Critical
Fear of pain									
Pain intensity	2	118	Serious[1]	No[2]	No[3]	Very serious[4]	Undetected [5]	Very low	Critical
Pain catastrophizing									
Pain intensity	5	406	Serious[1]	No[2]	Serious[3]	Very serious[4]	Undetected [5]	Very low	Critical
Disability	1	139	Serious[1]	No[2]	No[3]	Very serious[4]	Undetected [5]	Very low	Critical
Expectations of recovery									
Pain intensity	3	574	Serious[1]	No[2]	Serious[3]	Very serious[4]	Reported bias [5]	Very low	Critical
Disability	4	813	Serious[1]	Serious[2]	Serious[3]	Very serious[4]	Reported bias [5]	Very low	Critical
Self-efficacy									
Pain intensity	1	139	Serious[1]	No[2]	No[3]	Very serious[4]	Undetected [5]	Very low	Critical
Disability	1	139	Serious[1]	No[2]	No[3]	Very serious[4]	Undetected [5]	Very low	Critical

Note: 1. Randomized trials (lack of allocation concealment; lack of blinding; incomplete accounting of patients and outcomes events; selective outcome reporting bias; other limitations); observational studies (failure to develop and apply appropriate eligibility criteria; flawed measurement of both exposure and outcome; failure to adequate control confounding; incomplete follow-up; non-presence of an unexposed

cohort) 2. Point estimates vary widely across studies; confidence intervals show minimal or no overlap 3. Differences in population, differences in how to measure pain catastrophizing, differences in how to measure the outcome, indirect comparison, differences in statistical methods used 4. Optimal information size (OIS) criterion is not met and the sample size is small; OIS criterion is met but the 95% CI around an effect does not exclude 1.0 (wide confidence intervals); 95% CI is not reported 5. Outcome data not included in the predictive model.

Table 4. Summary of findings and Quality of evidence assessment (longitudinal studies)

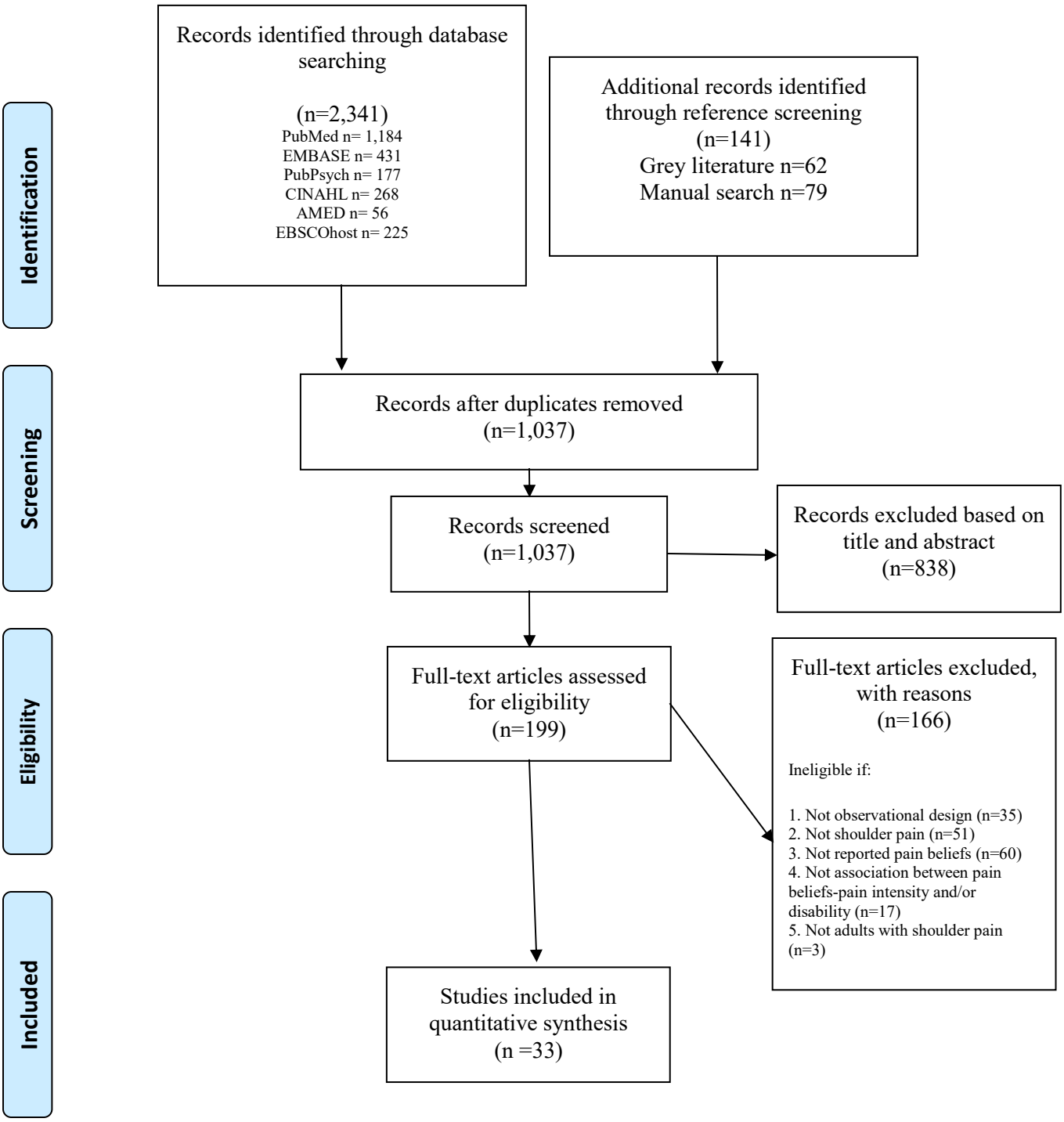
Summary of findings			Quality of evidence assessment (GRADE)						
Outcome	No of studies	No. of participants	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Level of evidence	Importance
Fear-avoidance									
Pain intensity	4	3,658	Serious[1]	Serious[2]	Serious[3]	Serious[4]	Undetected [5]	Very low	Critical
Disability	5	4,278	Serious[1]	Serious[2]	Serious[3]	No[4]	Undetected [5]	Very low	Critical
Kinesiophobia									
Pain intensity	1	314	Serious[1]	No[2]	No[3]	Very serious[4]	Undetected [5]	Very low	Critical
Disability	1	314	Serious[1]	No[2]	No[3]	Very serious[4]	Undetected [5]	Very low	Critical
Pain catastrophizing									
Pain intensity	6	1,173	Serious[1]	Serious[2]	Serious[3]	Serious[4]	Undetected [5]	Very low	Critical
Disability	6	1,734	Serious[1]	Serious[2]	Serious[3]	Serious[4]	Reported bias [5]	Very low	Critical
Expectations of recovery									
Pain intensity	5	1,802	Serious[1]	Serious[2]	Serious[3]	Serious[4]	Reported bias [5]	Very low	Critical
Disability	10	3,036	Serious[1]	Serious[2]	Serious[3]	Serious[4]	Reported bias [5]	Very low	Critical
Self-efficacy									
Pain intensity	4	1,297	Serious[1]	Serious[2]	Serious[3]	No[4]	Reported bias [5]	Very low	Critical
Disability	3	1,240	Serious[1]	Serious[2]	Serious[3]	No[4]	Reported bias [5]	Very low	Critical
Internal and external locus of control									
Pain intensity	1	587	Serious[1]	No[2]	No[3]	Serious[4]	Undetected [5]	Very low	Critical
Disability	1	587	Serious[1]	Very serious[2]	No[3]	Very serious[4]	Reported bias [5]	Very low	Critical
Optimism									
Pain intensity	1	78	Serious[1]	No[2]	No[3]	Very serious[4]	Undetected [5]	Very low	Critical
Disability	1	78	Serious[1]	No[2]	No[3]	Very serious[4]	Undetected [5]	Very low	Critical
Preoperative concerns									
Disability	1	128	Serious[1]	No[2]	No[3]	Very serious[4]	Reported bias [5]	Very low	Critical
Beliefs about preferences of treatment									
Disability	1	207	Serious[1]	No[2]	No[3]	Very serious[4]	Undetected [5]	Very low	Critical

Note: 1. Randomized trials (lack of allocation concealment; lack of blinding; incomplete accounting of patients and outcomes events; selective outcome reporting bias; other limitations); observational studies (failure to develop and apply appropriate eligibility criteria; flawed measurement of both exposure and outcome; failure to adequate control confounding; incomplete follow-up; non-presence of an unexposed cohort) 2. Point estimates vary widely across studies; confidence intervals show minimal or no overlap 3. Differences in population, differences in how to measure pain catastrophizing, differences in how to measure the outcome, indirect comparison, differences in statistical methods used. 4. Optimal information size (OIS) criterion is not met and the sample size is small; OIS criterion is met but the 95% CI around an effect does not exclude 1.0 (wide confidence intervals); 95% CI is not reported 5. Outcome data not included in the predictive model.

Figure 1. A short question guide for the selection of relevant studies based on inclusion criteria.

Item	Question	Action
1	Did the study use any of the eligible study design (cross-sectional or longitudinal studies)?	Yes, move to the next question No, exclude
2	Did the study involve people with shoulder pain?	Yes, move to the next question No, exclude
3	Was shoulder pain caused by a systemic disease, neurological disorders, and/or chronic non-musculoskeletal pain?	No, move to the next question Yes, exclude
4	Did the study report pain beliefs measures?	Yes, move to the next question No, exclude
5	Did the study show the predictive value of pain beliefs on pain intensity and/or disability, or at least an association between pain beliefs and pain intensity or disability?	Yes, move to the next question No, exclude
6	Did the study try to modify pain beliefs levels through any therapy?	No, Include in the review. Yes, exclude

Figure 2. Flow diagram of review process.



From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). *P*referred *R*eporting *I*tems for *S*ystematic Reviews and *M*eta-*A*nalyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

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