


The influence of cognitions, emotions and behavioral factors on treatment outcomes in musculoskeletal shoulder pain: a systematic review

Clinical Rehabilitation
1–12
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DOI: 10.1177/0269215519831056
journals.sagepub.com/home/cre


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Abstract

Objective: To examine the predictive, moderating and mediating role of cognitive, emotional and behavioral factors on pain and disability following shoulder treatment.

Data sources: Electronic databases (PubMed, Web of Science, Embase and PsycINFO) were searched until 14 January 2019.

Study selection: Studies including persons with musculoskeletal shoulder pain that describe the predictive, moderating or mediating role of baseline cognitive, emotional or behavioral factors on pain or disability following treatment were selected.

Results: A total of 23 articles, describing 21 studies and involving 3769 participants, were included. Three studies had a high risk of bias. There was no predictive role of baseline depression, anxiety, coping, somatization or distress on pain or disability across types of shoulder treatment. No predictive role of fear-avoidance beliefs was identified in patients receiving physiotherapy, which contrasted to the results found when surgical treatment was applied. Baseline catastrophizing was also not predictive for pain or disability in patients receiving physiotherapy. After conservative medical treatments, results on the predictive role of catastrophizing were inconclusive. Treatment expectations and baseline self-efficacy predicted pain and disability in patients receiving physiotherapy, which was not the case in patients receiving conservative medical treatment. Finally, there was a moderating role for optimism in the relationship between pain catastrophizing and disability in patients receiving physiotherapy.

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Conclusion: There is evidence that expectations of recovery and self-efficacy have a predictive role and optimism a moderating role on pain and/or disability following physiotherapy for musculoskeletal shoulder pain. After surgical treatment, fear-avoidance is a predictor of pain and disability.

Keywords

Shoulder, treatment outcome, pain, psychological factor

Received: 14 May 2018; accepted: 24 January 2019

Introduction

With a one year prevalence of 31% in the general population, shoulder pain is one of the most common musculoskeletal complaints.¹ It hampers proper movement of the upper limb and negatively affects daily activity performance and daily life autonomy.²⁻⁴ Only 21%–50% of patients with shoulder pain treated in primary healthcare recover within six months after treatment start.⁵⁻⁷ Percentages of recovery are slightly higher after physiotherapy, with 60% of patients being recovered at six months.⁸ These figures clearly indicate that current treatments are failing for a large group of patients.

A potential reason for these rather disappointing results is that treatment mainly focuses on the painful or damaged tissue. However, shoulder complaints regularly outlast the time that damaged tissue needs for recovery,⁹ and the severity of local tissue damage is not related to perceived shoulder pain.¹⁰ This suggests that current interventions are not optimal or that persistent pain cannot be simply related to tissue damage alone.

Psychological factors can influence treatment outcome for patients with various musculoskeletal problems, such as chronic low back pain or tendinopathy,^{11,12} or for competitive athletes with sports injuries.¹³ Although psychological factors are clearly associated with shoulder pain,¹⁴ the role of psychological factors as contributors to the outcome of treatment for shoulder pain has not been systematically reviewed. This information is essential since psychological factors that influence treatment outcome might induce a vicious circle of maladaptive emotions, cognitions or behaviors when left untreated, leading to suboptimal outcomes from standard therapy for shoulder pain.

Influencing psychological factors can be defined as predictive, mediating or moderating factors for treatment outcome. A predictive factor is a variable that predicts and explains changes in the outcome. A moderating factor influences the relationship between a predictor and an outcome and measures the strength of the relation. A mediating factor, on the other hand, explains the relationship between a predictor and an outcome, that is, when the mediator is removed, the relationship between the predictor and outcome disappears.¹⁵ The aim of this review was therefore to systematically describe the available knowledge on the predictive, moderating and mediating role of cognitions, emotions and behavioral factors on pain and disability following shoulder treatment. Identification of these factors is imperative to optimize treatment and its outcomes.

Methods

Protocol details were registered in the international prospective register of systematic reviews (PROSPERO, registration number RD420170 71707). Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines were followed.¹⁶

Papers were selected from PubMed, Web of Science, Embase and PsycINFO (until 14 January 2019), using a combination of search terms for the shoulder, type of disorder, intervention and cognitions, emotions and behavioral factors. The search terms and the used strategies can be found in Supplemental Appendices 1 and 2.

Eligibility criteria are described in Table 1. Eligibility assessment was done in a blinded manner by two assessors (L.D.B. and A.T.) by screening the title and abstract of all studies retrieved from the

Table 1. Eligibility criteria.

Inclusion criteria	Exclusion criteria
Inclusion of adult participants with a primary musculoskeletal shoulder disorder	Retrospective designs
Description of a prospective cohort study or randomized controlled trial that reports the outcome(s) of any shoulder treatment	Studies without ethical approval and patient informed consent
Treatment outcomes are pain and/or disability	Studies including participants with shoulder disorders secondary to other pathologies/treatments (e.g. breast cancer (treatment), stroke, cardiac surgery)
The influence of emotional, cognitive and behavioral factors on treatment outcome is investigated ^a	Studies including participants with shoulder disorders secondary to cervical, thoracic or other upper extremity disorders
At least a pre-intervention assessment of cognitions, emotions or behavioral factors is performed	Studies that performed an analysis on a population with different upper extremity problem types (e.g. inclusion of persons with wrist pain and elbow pain and shoulder pain)
Articles are peer-reviewed, in full-text available and written in English or Dutch language	

^aInfluencing psychological factors are defined as predictive, mediating or moderating factors. To identify predictive factors, regression analysis is needed. To be identified as a moderating or mediating factor, the influence of the psychological factor on the relation between a predictor and an outcome should be analyzed.

electronic database search. From all eligible studies based on title and abstract, and from those studies whose abstract did not provide enough information for eligibility, full texts were read to finally select the papers for inclusion. Reference lists of included papers were manually screened by both reviewers for additional eligible papers. In case of disagreement between the two assessors, a third assessor (T.M.) was contacted for consensus. Furthermore, experts were consulted to ensure that no relevant papers for inclusion were missed.

Risk of bias assessment of selected studies was done using the Quality In Prognosis Studies tool.¹⁷ This tool includes questions related to six important domains to consider when evaluating risk of bias in studies of prognostic factors: participation, attrition, prognostic factor measurement, confounding measurement and account, outcome measurement and analysis and reporting. According to responses to items, risk of bias for each of the six domains was determined as high, moderate or low (high risk was scored 2 points, moderate risk 1 point and low risk 0 points). The overall risk of bias rating was determined based on the mean scores of the six domains per study. Mean scores from 0 to 0.65, from 0.66 to 1.32 and from 1.33 to 2 were considered low, moderate and high risk of bias, respectively. The Quality In Prognosis Studies tool is recommended to assess

risk of bias by the Cochrane Prognosis Methods Group for prognosis studies.¹⁷

Two reviewers (L.D.B. and A.T.) independently rated the risk of bias of the included papers. Reviewers were blinded to each other's results. In case of disagreement between assessors, consensus was reached after discussion with a third reviewer (T.M.).

Following data were extracted from the included papers: (1) author, year of publication; (2) characteristics of the study population; (3) specifications on the received treatment; (4) primary treatment outcome(s); (5) assessed cognitions, emotions and behavioral factors; and (5) key findings related to the influence of assessed cognitions, emotions and behavioral factors on treatment outcome(s). Data were extracted by one person (L.D.B.) and verified by a second person (A.T.).

No meta-analysis could be performed due to study heterogeneity in study population, received treatment, assessed cognitions, emotions and behavioral factors. Therefore, a best-evidence synthesis was performed.

Results

Our database search identified 2987 articles. The selection process is visualized in the flow diagram in Figure 1. Based on the predefined eligibility

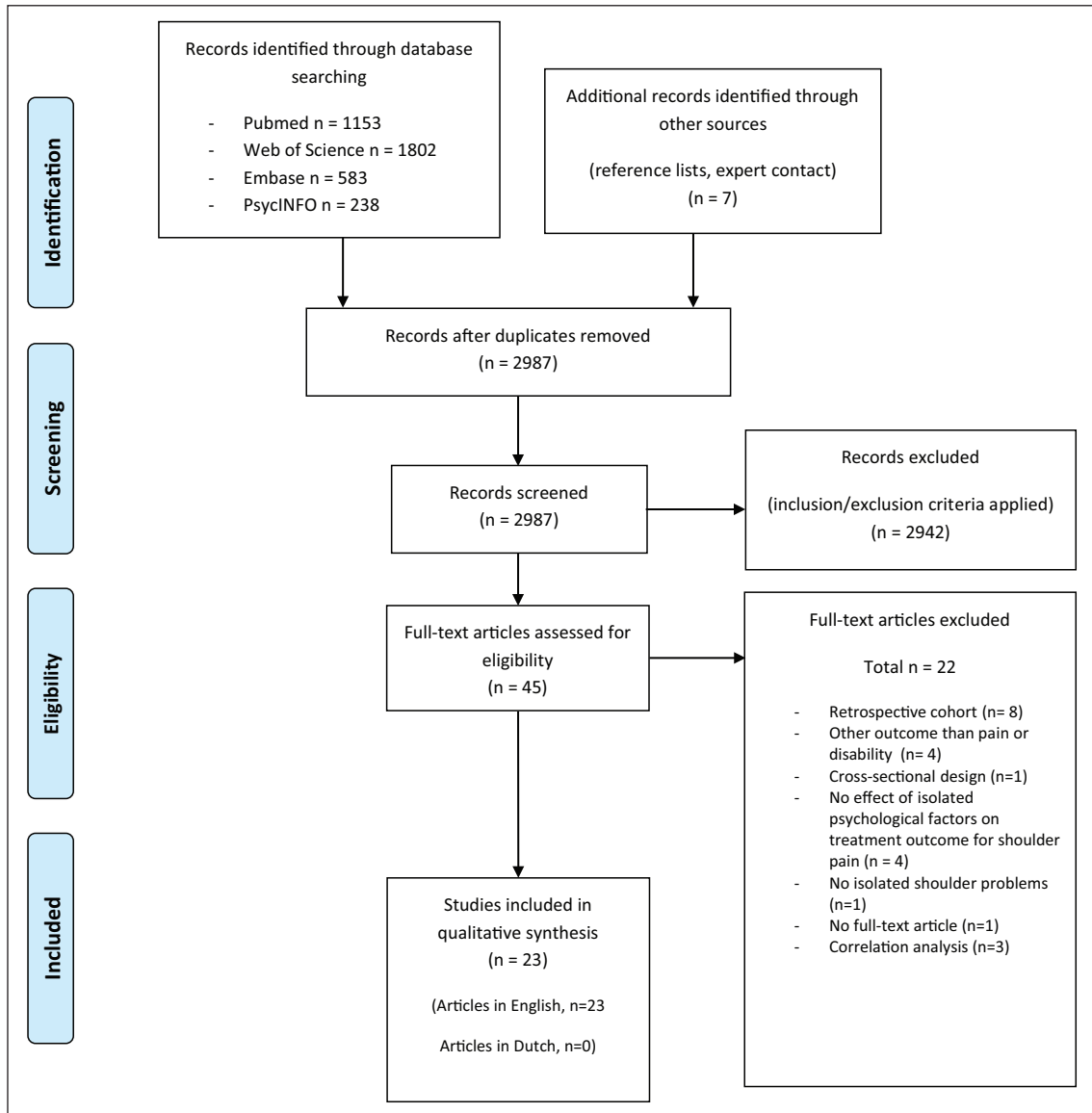


Figure 1. Flowchart showing the study selection process.

criteria, a total of 23 papers, describing 21 studies, were included, with a total of 4078 participants.

Risk of bias results (per domain and overall risk of bias rating) for included studies are shown in Supplemental Table 1. Nine studies had a low risk of bias, and 11 studies had a moderate risk of bias. Three studies had high risk of bias.

Four studies specifically included patients with subacromial shoulder pain,^{18–21} and in five studies persons with rotator cuff tears were assessed.^{22–26} In 13 studies, participants with mixed shoulder diagnoses were included.^{8,27–38} One study included persons with osteoarthritis undergoing shoulder arthroplasty.³⁹

In 12 studies, patients with any duration of shoulder pain participated.^{8,18,20,22,27–30,33,34,36,39} The other studies included patients with shoulder pain of less than three months,³² less than six months,³¹ at least one month^{21,23} or at least three months.^{19,38}

All studies, except for the study of Coronado et al.³¹ described a predictive model in which several multidimensional prognostic factors for the outcome of shoulder treatment were simultaneously considered,^{8,18–20,23–25,27–30,32,35,38} or in which the predictive value of a particular psychological variable on suboptimal treatment outcome was assessed.^{21,22,26,33,34,36,37,39} One study additionally identified risk groups for persistent shoulder pain and disability.²⁸

Postoperative symptoms of psychological disorders were added as independent variables to the prediction model in three papers.^{24,25,34} In the other 20 papers, only the results of a baseline assessment of psychological factors were added to the prediction model.

With regard to moderating or mediating psychological factors, one study assessed the moderating influence of optimism on the relation between pain catastrophizing and fear-avoidance beliefs on one hand and shoulder pain and disability on the other hand.³¹

Assessed cognitions, emotions and behavioral factors were anxiety and depression, distress, somatization, coping, self-efficacy, patient's expectation of recovery, optimism, fear-avoidance beliefs and pain catastrophizing. The assessment scales and questionnaires that were used are specified in Supplemental Table 2.

Disability and pain outcomes were assessed by the Shoulder Pain and Disability Index, the complete and short version of the Disabilities of the Arm, Shoulder and Hand questionnaire, the Function Subscale of the Pennsylvania Shoulder Score, the Shoulder Disability Questionnaire, the American Shoulder and Elbow Surgeons Shoulder Score, the Flexilevel Scale of Shoulder Function, the Simple Shoulder Test, the Western Ontario Rotator Cuff Index, the Brief Pain Inventory and a Numeric Pain Rating Scale.

The applied treatment consisted of surgery in seven papers.^{22,24,26,34,37–39} Physiotherapy without

other medical interventions was applied in six papers.^{8,21,23,25,27,28} In two studies, a cohort receiving mixed treatments (surgical, non-surgical medical or physiotherapy interventions) was assessed.^{35,36} In another seven studies, a cohort receiving mixed conservative treatments (non-surgical medical and physiotherapy interventions) was included.^{18–20,29,30,32,33}

Other study characteristics are described in greater detail in Supplemental Table 2.

Results on the predictive role of psychological factors on pain and disability are summarized in Table 2. Ten studies could identify a predicting role of a psychological factor. Across all treatments, no predictive role of depression, anxiety, somatization, distress or coping was identified.^{8,18,19,22,26,27,30,32–34,38,39} In the study of Thorpe et al.,³⁷ however, a predictive role for a psychological cluster consisting of depression, stress, anxiety, self-efficacy, fear-avoidance beliefs and pain catastrophizing was revealed. The predictive value of fear-avoidance beliefs, pain catastrophizing, self-efficacy and expectations of recovery depended on treatment type. Baseline fear-avoidance results were predictive for pain and disability after surgical treatment,^{24,37,38} but not after physiotherapy treatment.^{21,25} Also regarding pain catastrophizing, results indicated that catastrophizing was not predictive for the outcome after physiotherapy treatment.^{21,23} The results on the predictive value of pain catastrophizing on the outcome after mixed conservative treatments were furthermore inconsistent.^{30,33} In contrast, expectations of recovery and self-efficacy were predictors of pain and disability in cohorts receiving physiotherapy treatment.^{27,28} In persons receiving mixed treatments, results on the predictive value of expectation of recovery were conflicting.^{18,20,35,36}

Regarding moderating psychological factors on pain or disability, Coronado et al.³¹ reported that baseline optimism moderated the relation between pain catastrophizing and shoulder disability following physiotherapy treatment, that is, optimism decreased the negative influence of pain catastrophizing on shoulder disability. On the contrary, optimism was not found to moderate the

Table 2. Summary of psychological variables at baseline with or without predictive value for treatment outcomes pain and/or disability per treatment type, plus timing of follow-up assessment and used assessment scale.

Baseline psychological factors with predictive value (follow-up time)		Baseline psychological factors without predictive value (follow-up time)			
Surgery	Mixed interventions	Physiotherapy treatment	Surgery	Mixed interventions	Physiotherapy treatment
Fear-avoidance	6 months (DASH and Western Ontario RC index) (Woolliard)	6/12 months (SPADI) (Laslett) ^b		3 weeks/3 months (SPADI) (Laslett)	3 months (SPADI function) (Kromer)
	3 and 12 months (ASES) (Thorpe) ^a			3 months (SDQ) (Van der Windt)	3, 6, 12 and 18 months (SPADI) (Jain)
	3, 6, 12 and 18 months (SPADI) (Jain)				
Pain catastrophizing	3 and 12 months (ASES) (Thorpe) ^a	6 weeks/6 months (SDQ) (De Bruijn) 6 months (VAS) (Reilingh) ^c		3 months (SDQ) (Van der Windt)	3 months (SPADI function) (Kromer) 3 months (Western Ontario RC index) (Braun)
	3 and 12 months (ASES) (Thorpe) ^a				
Self-efficacy				1 year (SPADI) (Engebretsen)	
	3 and 12 months (ASES) (Thorpe) ^a	6 weeks/6 months (SPADI-QuickDASH) (Chester et al. ^{27,28})		1 year (SPADI) (Kvalvaag)	
Expectations of recovery				6 weeks (SPADI) (Ekeberg)	
		1 year (SPADI) (Kvalvaag) 3 months (Flexilevel) (O'Malley) ^d	6 weeks/6 months (SPADI-QuickDASH) (Chester et al. ^{27,28})	3 months ((DASH) (Kennedy) ^e	
Anxiety				6 weeks/6 months (SDQ) (De Bruijn)	6 weeks/6 months (SPADI-QuickDASH) (Chester)
			1 year (ASES—VAS) (Cho et al. ^{22,39})	6 months (VAS) (Reilingh)	6 months (NPRS) (Karel)
Depression				6 weeks/6 months (SDQ) (De Bruijn)	6 weeks/6 months (SPADI-QuickDASH) (Chester)
	3 and 12 months (ASES) (Thorpe) ^a		1 year (ASES—VAS) (Cho et al. ^{22,39})	6 weeks/6 months (SDQ) (De Bruijn)	

(continued)

Table 2. (Continued)

	Baseline psychological factors with predictive value (follow-up time)		Baseline psychological factors without predictive value (follow-up time)			
	Surgery	Mixed interventions	Physiotherapy treatment	Surgery	Mixed interventions	Physiotherapy treatment
Distress	3 and 12 months (ASES) (Thorpe) ^a	1 year (DASH) (Kooorevaar) ^f 6 months (DASH and Western Ontario RC index) (Woollard) 1 year (DASH) (Kooorevaar) ^f 1 year (VAS, SST, ASES) (Potter)	6 months (VAS) (Reilingh) 6 weeks/6 months (SDQ) (De Bruijn) 3 months (SDQ) (Van der Windt) 1 year (SPADI) (Engelbreetsen) 6 months (VAS) (Reilingh) 6 weeks (SPADI) (Ekeberg) 6 weeks/6 months (SDQ) (De Bruijn) 3 months (SDQ) (Van der Windt) 6 months (VAS) (Reilingh) 6 weeks and 6 months (SDQ) (De Bruijn)	6 months (NPRS) (Karel)		
Somatization		1 year (DASH) (Kooorevaar) ^f				
Coping						

ASES: American Shoulder and Elbow Score; DASH: Disabilities of the Arm, Shoulder and Hand questionnaire; NPRS: numeric pain rating scale; Penn-F: Function Subscale of the Pennsylvania Shoulder Score; SDQ: Shoulder Disability Questionnaire; SPADI: Shoulder Pain and Disability Index; SST: Simple Shoulder test; VAS: visual analogue scale for pain. Studies with high risk of bias are marked in gray coloring.

^aPatients were categorized in a cluster with lower or higher scores on the psychologic functioning measures depression, anxiety and stress, pain catastrophizing, pain self-efficacy and fear-avoidance. The cluster with poorer psychologic function exhibited moderate levels of depression and stress, anxiety within normal limits, high levels of kinesiophobia, mild to moderate levels of catastrophizing, and low levels of pain self-efficacy.

^bAlthough Laslett et al.²⁹ reported a predictive role of baseline fear-avoidance beliefs on pain and disability at six months and one year following treatment, a closer look at the results indicated clinically irrelevant odds ratios for the fear-avoidance beliefs questionnaire (FABQ) (odds ratio (95% CI) = 1.03 (1.00–1.07), $P=0.08$ at six months; odds ratio (95% CI) = 1.01 (1.03–1.17), $P=0.00$ at one year).

^cIn chronic pain patients only.

^dWithin the assessed cohort, 45% started physiotherapy, 40% received medication and 16% underwent surgery.

^eWithin the assessed cohort, 89% received non-surgical treatment and 8% underwent surgery.

^fWhen post-operative psychological symptoms are included in the prediction model. If not included, there is a predictive value of psychological factors.

relation between pain catastrophizing and pain. Optimism was furthermore no moderator in the relation between fear-avoidance beliefs and disability or pain following physiotherapy treatment.³¹

Discussion

This review indicates that there is no predictive value of fear-avoidance beliefs in patients receiving physiotherapy, which contrasts to the results found after surgical treatment. Regarding baseline catastrophizing, results show that baseline catastrophizing neither is predictive for pain or disability in patients receiving physiotherapy. There is a predictive role of treatment expectations and baseline self-efficacy in patients receiving physiotherapy, which is not consistently found after conservative medical treatment. Finally, there is a moderating role for optimism in the relationship between pain catastrophizing and disability in patients receiving physiotherapy.

The result that higher levels of *optimism* decreased the strength of the relation between pain catastrophizing and disability is in line with research in other musculoskeletal complaints. This research indicates that the relation between catastrophizing and treatment outcome is weaker in persons with positive personality traits such as hope or optimism, and higher in persons with negative personality traits, such as neuroticism or negative affect.^{40–42}

The reported protective role of positive recovery *expectations* in this review on pain and disability in a physiotherapeutic setting is furthermore in line with available literature on the positive role of expectations for recovery in a broad range of healthcare problems.^{43,44} With regard to *self-efficacy*, evidence systematically suggests that higher self-efficacy levels are associated with lower levels of pain and disability in chronic musculoskeletal pain.^{45,46} In this systematic review, contradictory results were found regarding the role of self-efficacy in a medical versus physiotherapy setting. The physiotherapy treatment presumed the patient to actively participate in its rehabilitation program in the form of a home-based exercise program. In such a setting, where an active

and independent patient involvement was required, a predictive role of self-efficacy was identified for a successful treatment outcome.²⁷ In this context, high levels of self-efficacy have already been recognized as an enabler for treatment adherence in a musculoskeletal physiotherapy setting.⁴⁷

The results of this review regarding the predictive role of *fear avoidance beliefs* and *pain catastrophizing* on pain or disability also seem to be dependent on the applied type of treatment. Following surgery, baseline fear avoidance beliefs are predictive for outcome. Following physiotherapy treatment, no predictive role of baseline fear avoidance beliefs and catastrophizing is reported. This difference emphasizes the opportunity of physiotherapy to target maladaptive beliefs at treatment start in order to optimize treatment response.

With regard to *somatization*, *depression*, *anxiety*, *distress* or *coping*, no predictive role was identified in the papers included in this review, which is in contrast with available research in other musculoskeletal complaints.^{48–50}

A potential reason why no or only a limited predictive value was found in the studies included in this review might be attributed to methodological issues like selection of participants. In the studies specifically aiming to identify the predictive value of a distinct psychological factor, only a low number of participants had deviating scores on these psychological factors. This non-specific recruitment with regard to baseline scores on these psychological factors decreases the chance to find predictive associations between psychological factors and outcome.

A lack of construct validity of applied measurement tools might be another explanation why only a limited predictive value for some psychological factors was found. Depression and anxiety were assessed using a study-specific scale that examined whether patients were not, moderately or extremely anxious and depressed in the previous seven days.²⁷ In another study, one item of the EQ-5D that asked a patient whether he or she felt not, a little, moderately, very or extremely anxious or depressed that day was used.⁸ These self-reported one-item

questionnaires might have a low specificity to detect depression or anxiety.⁵¹

It is furthermore known that the relation between a psychological construct and pain or disability might be influenced by other psychological factors. Only one trial in this review investigated the moderating effect of a psychological variable (i.e. optimism) on the relation between another psychological variable (i.e. catastrophizing) and disability/pain.³¹ The fact that no other studies included the analysis of potential moderating/mediating role might contribute to the fact that limited associations were found between psychological factors at baseline and treatment outcome.

Apart from three studies,^{24,25,34} no study included the assessment of cognitions, emotions or behavioral factors at follow-up in their prediction model. However, it is clear from cross-sectional research that fear-avoidance beliefs and catastrophizing are important predictors of reported disability.^{21,52,53} It is possible that cognitions, emotions or behavioral factors change over time as a result of received treatment. In the trial of George and Stryker, patients with high fear-avoidance beliefs reported larger improvements in pain intensity and function from therapy start to discharge. In their study, patients with elevated fear-avoidance received a patient-centered treatment plan, based on a biopsychosocial model, in which fear was addressed when it was detected.⁵⁴ These patients might have reported less fear-avoidance beliefs at discharge due to their specific treatment. In contrast, when these maladaptive beliefs are not targeted during treatment, they might not change or become worse at follow-up. Abovementioned is supported by the results of this review which indicate no predictive value of baseline fear-avoidance beliefs following physiotherapy treatment and a predictive value of baseline fear avoidance after surgical treatment. This means that research aiming to explain the extent to which cognitions, emotions or behavioral factors influence the outcome of treatment should additionally include assessments of these factors at follow-up.

Apart from potential methodological limitations in the included studies, there might also have been

limitation to the search used for this systematic review. Although a large search strategy in multiple databases was performed and experts were contacted, it is possible that relevant studies were not identified for this review.

The results of this review have implications for clinical practice. Better knowledge in healthcare workers about psychological predictors, moderators and mediators of outcome in shoulder pain may help to identify patients with good prognosis and patients at risk for long-term disability. As such, a potential evolution toward chronicity can be prevented (e.g. targeting a low level of self-efficacy when treatment requires the performance of home-exercises to prevent poor treatment results, or targeting fear-avoidance behavior in patients undergoing surgery). This implicates that the assessment of these constructs should be part of the regular shoulder patient assessment in primary and physiotherapy care. Several screening measures are recently proposed that can support such a multidimensional examination, that is, the modified version of the STarT Back Screening Tool;⁵⁵ a PSCEBSM model including the assessment of pain, and somatic, cognitive, emotional, behavioral, social and motivational factors;⁵⁶ or the OSPRO Yellow Flag Assessment Tool.⁵⁷

Multidimensional biopsychosocial treatment that addresses physical and psychological factors related to perceived pain and disability is an effective treatment approach in chronic pain patients.⁵⁸⁻⁶⁰ Patient education to expand patients' understanding regarding pathology, pain and influencers of pain and disability (e.g. psychological factors such expectation of recovery, self-efficacy, fear avoidance, pain catastrophizing by means of cognitive behavioral approach)^{61,62} seems essential as it is shown in recent qualitative studies that persons with shoulder pain believed that their pain was caused by structures local to the shoulder region.^{63,64} Appropriate physical activity interventions based on individual goal-setting and preferences are furthermore suggested.^{59,65} Multidisciplinary treatment programs administered by healthcare professionals from different backgrounds, that is, medical

doctors, physical therapists and psychologists, can be provided. A recent systematic review and meta-analysis indicated moreover that psychological interventions delivered by physiotherapists were promising to improve psychological factors in musculoskeletal pain conditions.⁶⁰

This review results also highlight potential future research paths. The potential protective role of positive traits (e.g. hope, optimism, resilience, self-efficacy and positive expectations) as predictors of pain and disability, or as moderators of the negative effect of emotional or cognitive factors (e.g. fear of pain or pain catastrophizing), should be further elaborated on in shoulder pain. To fully identify the impact of psychological factors on treatment outcome, future research should include the assessment of psychological factors at follow-up. Finally, to increase the power of the research that aims to detect associations between psychological factors and pain or disability, patients with psychological risk factors should specifically be recruited.

Clinical Messages

- Depression, anxiety, coping, somatization or distress baseline scores are not predictive for pain or disability following treatment for shoulder pain.
- Fear-avoidance beliefs at baseline predict treatment outcome after shoulder surgery, which contrasts to results found after physiotherapy treatment.
- Expectations of recovery and self-efficacy are predictors for treatment outcome following physiotherapy for shoulder pain.
- Optimism is a moderator for shoulder disability in persons receiving physiotherapy for shoulder pain.

Acknowledgements

All authors made substantial contributions to conception and design, and analysis and interpretation of data. All authors participated in drafting the article and revising it critically for important intellectual content; all authors gave final approval of the version to be submitted.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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Supplemental material

Supplemental material for this article is available online.

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