

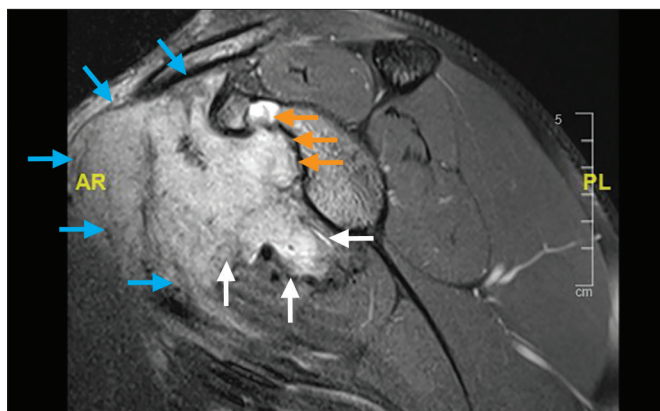


FIGURE 1. Sagittal proton-density, fat-suppressed magnetic resonance image revealing a 10-cm, ill-defined, infiltrative, multilobulated soft tissue mass involving the subclavicular space, with extension to the subcoracoid recess (blue arrows) and invasion and mass effect on the superior subscapularis muscle (white arrows). Additionally, the mass erodes the adjacent scapula from the level of the coracoid to the level of the glenoid (orange arrows).

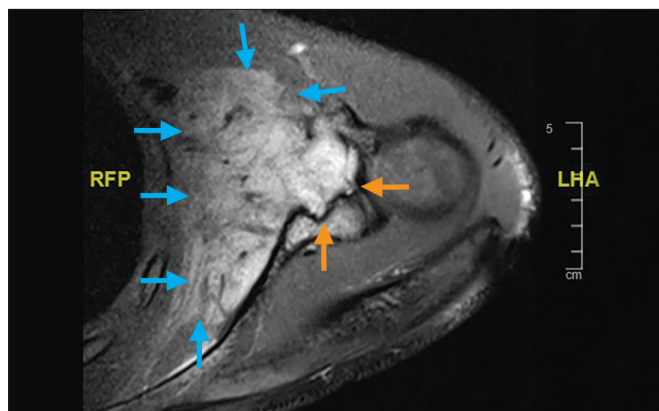


FIGURE 2. Axial proton-density, fat-suppressed magnetic resonance image revealing a soft tissue mass extending to the subcoracoid recess (blue arrows), and associated erosion of the subjacent scapula from the level of the coracoid to the level of the glenoid (orange arrows).

Desmoid Tumor Causing Shoulder Pain in an Adolescent Male

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A 17-YEAR-OLD, RIGHT HAND-DOMINANT adolescent boy was referred by an orthopaedic physician to physical therapy for chronic left shoulder pain and a clinical diagnosis of labral tear. Onset was attributed to a fall 5 years prior, with a 2-month exacerbation reported from carrying a heavier school backpack. The physician ordered current radiographs, which were noncontributory.

Neurological testing, cervical spine screening, and special tests for local musculoskeletal shoulder pathology were negative. Shoulder range of motion revealed focal deficit, concordant pain, and an abnormally hard end feel with external rotation in neutral. Shoulder strength was limited in the external rotators and

lower and middle trapezius (3/5). In other regions, his range of motion and strength were unremarkable. Palpation revealed atrophy of the infraspinatus and nontender fullness over the suprascapular notch and infraclavicular space. The abnormal end feel and palpable fullness warranted referral back to the physician, with a request for magnetic resonance imaging on suspicion of a space-occupying lesion.

Magnetic resonance imaging revealed a soft tissue abnormality in the infraclavicular and subcoracoid spaces (**FIGURES 1 and 2; FIGURE 3**, available at www.jospt.org). The patient was referred to orthopaedic oncology, where biopsy confirmed a desmoid tumor. Treatment included a regimen of sulindac/tamoxifen and 7

physical therapy visits over 8 weeks to improve pain and shoulder strength and prevent motion loss.

Desmoid tumors (also known as aggressive fibromatosis) are rare, benign, locally invasive connective tissue growths.^{1,2} Presentation is highly variable, can be nonpainful, and common sites include the abdomen, shoulder, and head/neck.^{1,2} Incidence is higher in females and individuals aged 15 to 60 years, with approximately 900 cases annually.^{1,2} The recurrence rate is 40% to 50%.¹ This case illustrates the need for physical therapists to perform thorough examination and medical screening in patients of all ages prior to initiating treatment. ● *J Orthop Sports Phys Ther* 2020;50(8):467. doi:10.2519/jospt.2020.9596

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Types of Research Questions: Descriptive, Predictive, or Causal

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A previous Evidence in Practice article explained why a specific and answerable research question is important for clinicians and researchers.³ As a reader, if you cannot specify the question and summarize it simply in your own words, you might as well not read the study. The type of research question has critical implications for the study methods. Good-quality, clinically useful research begins with the research question and requires that the study design match the type of question.

Question Types

Research questions fall into 1 of 3 mutually exclusive types: descriptive, predictive, or causal. Imagine you are seeking information about whiplash injuries. You might find studies that address the following questions.

1. Descriptive questions: What is the number of whiplash injuries per head of population? What proportion of people who attend the emergency department with a whiplash injury completely recover within 3 months? What impact do whiplash symptoms have on individuals?
2. Predictive question: How well does a set of simple clinical measures predict the likelihood of recovery within 3 months?
3. Causal questions: Are people who receive education and reassurance more likely to recover in 3 months than people who receive a neck brace and advice to rest? Do posttraumatic stress symptoms immediately after whiplash injury cause slower recovery?

There is a critical distinction between question type and study design (TABLE).

Descriptive questions can be answered with cross-sectional or longitudinal designs, but predictive and causal questions usually need longitudinal designs.

Descriptive Questions

Descriptive questions seek to describe the “landscape,” to provide an overview of the situation. These types of questions use “data to provide a quantitative summary of certain features of the world.”² Preva-

lence questions are descriptive, as is mapping the clinical course of a condition or describing associations between clinical features. Studies that assess accuracy of diagnostic tests and qualitative studies are also descriptive.

Descriptive research questions can be addressed using data collected at a single time point (cross-sectional) or at multiple time points (longitudinal). For example, researchers might record the incidence of ankle sprain injuries that occur in a football competition over the course of a season.

Predictive Questions

Predictive questions help readers form expectations about what is likely to hap-

TABLE

QUESTION TYPES AND STUDY DESIGNS

Question Type	Study Aim	Study Design
Descriptive	• Prevalence • Incidence • Practice audits, case mix • Cost of illness • Clinical/natural course • Diagnostic test accuracy • Understanding patient experiences	• Cross-sectional population survey • Longitudinal population survey • Clinical notes review • Health systems data review • Longitudinal observational cohort • Cross-sectional study (clinical sample) • Qualitative study
Predictive	• Risk or prognostic models	• Longitudinal study
Causal	• Treatment effectiveness • Treatment target(s) • Treatment effect mechanisms or pathological mechanisms	• Randomized controlled trial, quasi-randomized controlled trial, controlled cohort study, natural experiment • Longitudinal study (clinical sample), case-control study, natural experiment • Mediation analyses in longitudinal studies or randomized controlled trials

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pen in the future. The aim is to learn something about the future using information from the present, which requires a longitudinal study design. Examples might be to identify people who are at risk of developing a condition (risk) or people who are less likely to recover from an injury (prognosis). Well-designed studies that address predictive questions aim to produce a model with a set of baseline variables that provide an accurate indicator of prognosis or risk. For example, researchers might collect data on player age, previous ankle sprains, weight, and playing position at the beginning of the season to try to predict which players are at higher risk of spraining their ankle over a football season.

Identifying people who are at risk of a poor outcome is not the same as identifying what should be done to manage the problem. For example, people who have surgery straight after an ankle sprain take longer to recover, but surgery itself does not cause slow recovery. In practical terms, this means that the variables that appear in prediction models are not necessarily treatment targets, even when the variables are “modifiable.” This is an error of interpretation that researchers and readers make frequently: they interpret the finding of a study designed to answer a predictive question in a causal way.

Causal Questions

Causal research questions aim to find treatment targets, identify factors that increase the risk of getting a condition or injury, or estimate what will happen to people who receive one treatment compared to another. The question is whether

a certain feature, exposure, or treatment causes a particular outcome. Causal questions nearly always require longitudinal designs. For example, does ankle instability cause ankle sprains, or do balance exercises reduce the risk of recurrent ankle sprains compared to calf strengthening?

There is a misconception that only experimental studies (randomized controlled trials) can address causal questions. This is not true. Randomization does provide important advantages in answering causal questions, but valid causal inferences can be made from observational studies if the methods and analyses are sound.¹ Nonrandomized study designs such as longitudinal observational cohorts, case-control studies, and natural experiments can also be used to address causal questions.

A Common Problem With Observational Studies

Lack of clarity regarding whether or not a study is answering a causal question is a big problem in the musculoskeletal rehabilitation research field. Many studies state an aim of “exploring associations” but do not specify whether this is for the purposes of description, prediction, or causation. Exploring associations is *only* useful when the researcher specifies how the associations can be interpreted (ie, for description, prediction, or to understand cause).

Adjusting for confounders is not relevant for description or prediction; the concept of confounding only applies to causal questions. If a study analysis controls for confounding and the authors do not specify a causal question, then the results cannot be sensibly interpreted.

Many studies construct multivariable regression models, interpret strength of independent associations, discuss confounding/adjustment, or use words such as “influence” and “effect,” all of which imply causation—yet they also include a line in the Limitations section that states the study is not designed to infer causation. A study that uses methods to investigate a causal question but does not state a causal question as an aim is not useful for guiding clinical practice.

Summary

Determining whether a study aims to answer a descriptive, predictive, or causal question should be one of the first things a reader does when reading an article. Different question types often require different study designs and analyses. If an article or research question is unclear, there is likely no point reading on. At best, the study findings will be impossible to interpret. Any type of question can be relevant and useful to support evidence-based practice, but only if the question is well defined, matched to the right study design, and reported correctly. ●

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Which Interventions Enhance Pain Self-efficacy in People With Chronic Musculoskeletal Pain?

A Systematic Review With Meta-analysis of Randomized Controlled Trials, Including Over 12 000 Participants

Pain self-efficacy is the belief in one's ability to manage and complete a task, despite pain.⁶⁴ A person's pain self-efficacy can influence whether he or she attains functional and lifestyle goals.¹³ Greater pain self-efficacy is associated with lower

disability, less pain, reduced disease activity, fewer depressive symptoms, less fatigue and emotional distress, and greater efficacy beliefs and adherence to physical activity.^{46,58} Clinically, pain self-efficacy facilitates physical activity participation⁷² and moderates treatment response in those with chronic pain.^{53,82,90}

Cognitive behavioral therapy,⁵² guided imagery,⁵⁹ exercise,^{47,88} and multicomponent interventions¹⁹ may improve pain self-efficacy in people with chronic musculoskeletal pain. However, interventions to improve pain self-efficacy vary in type, frequency, intensity, mode, time, and rest intervals.⁴² Building pain self-efficacy is crucial to fostering a therapeutic alliance with patients^{21,71} that promotes positive health behaviors¹² and treatment adherence.²¹ Information about the certainty of the evidence of interventions that aim to improve pain self-efficacy and the content of effective pain self-efficacy interventions is required to help clinicians choose the best intervention to enhance pain self-efficacy.

We aimed (1) to assess which interventions enhance pain self-efficacy in

● **OBJECTIVE:** To find out which interventions enhance pain self-efficacy in people with chronic musculoskeletal pain and to evaluate the reporting of interventions designed to enhance pain self-efficacy.

● **DESIGN:** Intervention systematic review with meta-analysis.

● **LITERATURE SEARCH:** PubMed, Embase, Scopus, PsycINFO, CINAHL, PEDro, and the Cochrane Central Register of Controlled Trials were searched from inception up to September 2019.

● **STUDY SELECTION CRITERIA:** Randomized controlled trials evaluating pain self-efficacy as a primary or secondary outcome in chronic musculoskeletal pain.

● **DATA SYNTHESIS:** We used the Cochrane risk of bias tool and the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach to evaluate the risk of bias and the certainty of the evidence, respectively.

● **RESULTS:** Sixty randomized controlled trials were included (12 415 participants). There was a small effect of multicomponent, psychological, and exercise interventions improving pain self-efficacy

at follow-ups of 0 to 3 months, a small effect of exercise and multicomponent interventions enhancing pain self-efficacy at follow-ups of 4 to 6 months, and a small effect of multicomponent interventions improving pain self-efficacy at follow-ups of 7 to 12 months. No interventions improved pain self-efficacy after 12 months. Self-management interventions did not improve pain self-efficacy at any follow-up time. Risk of bias, the nature of the control group, and the instrument to assess pain self-efficacy moderated the effects of psychological therapies at follow-ups of 7 to 12 months. The certainty of the evidence for all included interventions was low, due to serious risk of bias and indirectness. No trial reported the intervention in sufficient detail to allow full replication.

● **CONCLUSION:** There was low-quality evidence of a small effect of multicomponent exercise and psychological interventions improving pain self-efficacy in people with chronic musculoskeletal pain. *J Orthop Sports Phys Ther* 2020;50(8):418-430. doi:10.2519/jospt.2020.9319

● **KEY WORDS:** chronic pain, cognition, musculoskeletal pain, rehabilitation

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people with chronic musculoskeletal pain and (2) to evaluate the reporting of interventions designed to enhance pain self-efficacy.

METHODS

WE FOLLOWED THE *COCHRANE Handbook for Systematic Reviews of Interventions*³⁸ and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines³⁴ when conducting this systematic review. The review protocol was registered with PROSPERO (CRD42018117361) before the identification of articles and data extraction. Two reviewers (J.M.C. and M.F.C.) independently performed the study selection, data extraction, risk of bias assessment, and certainty-of-evidence assessment. Patients partners were not involved in the research.

Data Sources and Search Strategy

An exhaustive scoping search in PROSPERO and the Turning Research Into Practice (TRIP) database was performed to ensure that our research question had not been addressed by prior systematic reviews. Then, PubMed, Embase, Scopus, PsycINFO, CINAHL, PEDro, and the Cochrane Central Register of Controlled Trials were searched from inception up to September 2019. A systematic search strategy (APPENDIX A, available at www.jospt.org) was developed using medical subject heading (MeSH) terms and key words generated from subject headings. Gray literature (Open Grey and Google Scholar²⁹) was searched to identify any relevant unpublished work. Reference lists of all included studies and journals related to the scope of this review were also searched. There were no restrictions with regard to language, ethnicity, setting, or sex.

Eligibility Criteria

The inclusion criteria were (1) a randomized controlled trial study design; (2) adult patients with chronic musculoskeletal pain, according to the multidimensional diagnostic criteria for chronic

pain²²; (3) experimental interventions that were compared to (a) no intervention, (b) sham control, (c) wait-list control, (d) usual-care control, or (e) active control (trials that compared 2 or 3 experimental interventions without a control group were also included); and (4) pain self-efficacy as a primary or secondary outcome.

The exclusion criteria were (1) trials where statistical analyses were not separately conducted by musculoskeletal pain duration (acute, subacute, and chronic), (2) trials evaluating postoperative pain self-efficacy, (3) pilot and feasibility trials, or (4) trials reporting pain self-efficacy values only at baseline.

Trial Selection

Potential articles were screened by title and abstract. When the trial selection was unclear after reading the title and abstract, the full text was screened. Any disagreements were resolved via consensus or a third reviewer (A.L.S.) if required.

Data Extraction

The following information was extracted from every trial: year and country of the trial; participant age, sex, and pain duration; trial setting; intervention details; control details; pain self-efficacy details; covariates in the adjustment of treatment effects; and main findings. Any disagreements were resolved via consensus or a third reviewer (A.L.S.) if required.

Risk of Bias Assessment

We used the Cochrane tool³⁷ to assess the risk of bias. We assessed random sequence generation method, allocation concealment, blinding of participants and health professionals, blinding of assessors, the method of addressing incomplete outcome data, potential selective reporting, and other potential sources of bias (ie, adherence bias) in each trial. The overall risk of bias within a trial was evaluated following the recommendations of the Cochrane Bias Methods Group and

the Cochrane Statistical Methods Group³⁷ and previous systematic reviews.⁸¹ We considered random sequence generation method, allocation concealment, blinding of participants and health professionals, method of addressing incomplete outcome data, and selective reporting as key bias domains.^{37,81} When all the key domains were judged as “low,” we judged the overall risk of bias as low. When 1 or more key domains were judged as “unclear,” we judged the overall risk of bias as unclear. When 1 or more key domains were judged as “high,” we judged the overall risk of bias as high.³⁷

Intervention Categories

We considered psychological therapies to be interventions based exclusively on psychological principles (ie, cognitive behavioral therapy) that aimed to control pain. We considered exercise interventions to be exercise modalities (ie, aerobic or resistance training) designed to address pain.¹⁰ We considered self-management interventions to be based solely on educational and/or self-management principles promoting the individual's self-confidence to manage the consequences and lifestyle changes inherent to living with a chronic condition.³ We considered multicomponent interventions as those involving a combination of different therapies (ie, exercise plus psychological therapy or self-management strategies plus exercise) for managing pain.

Data Synthesis and Analysis

When any cohort was included in multiple publications, the older publication was used for data extraction, risk-of-bias assessment, the Template for Intervention Description and Replication (TIDieR) checklist, and the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach to avoid double counting participants. Pain self-efficacy details were extracted for all included publications only when pain self-efficacy was measured at different time points.

[LITERATURE REVIEW]

We used Stata Version 14.0 (Stata-Corp LLC, College Station, TX) to meta-analyze data for the pain self-efficacy outcome. We used a random-effect model (DerSimonian and Laird²⁰) to calculate a pooled standardized mean difference (SMD) and 95% confidence intervals (CIs).³⁵ We considered a *P* value of .05 or less to be statistically significant. We calculated SMDs and 95% CIs by using reported means and standard deviations. We presented these results in forest plots. Trials that reported insufficient data to compute SMDs between groups were excluded from meta-analyses (see **APPENDIX B**, available at www.jospt.org). Meta-analyses were stratified by intervention follow-up periods: 0 to 3 months, 4 to 6 months, 7 to 12 months, and 12 months or later.

If a publication reported outcomes at multiple follow-ups (ie, data at post-treatment and data at 3-month follow-up), we analyzed data from the longest follow-up. When trials reported data from different intervention categories (eg, mindfulness trial arm, cognitive behavioral therapy arm, and control trial arm in Turner et al⁸⁹), we extracted and analyzed outcomes for each trial arm (eg, mindfulness group versus control group and cognitive behavioral therapy group versus control group). Trials included in meta-analyses were arranged by year of publication.

Heterogeneity was explored using the *I*² statistic^{39,40}; values greater than 25%, 50%, and 75% reflected low, moderate, and high heterogeneity, respectively.^{39,40} When high statistical heterogeneity was detected, we conducted meta-regression and sensitivity analyses to explore sources of heterogeneity. We constructed funnel plots and performed Egger regression tests to explore potential publication bias for each meta-analysis.²³

Sensitivity Analysis

We performed sensitivity analyses using a common approach, where each trial was excluded one by one to check whether the estimate changed.

Meta-regression Analysis

We conducted meta-regression analyses by intervention timing to assess the influence of several factors as potential confounders. We performed individual meta-regression analyses for each potential confounder, including each confounder in a separate model. We analyzed the following items as confounders: (1) age, (2) intervention dose, (3) chronic musculoskeletal pain diagnosis, (4) risk of bias, (5) type of control group, (6) experimental facilitator, and (7) instrument to assess pain self-efficacy.

Intervention dose was treated as a continuous variable. Age was coded as 1, less than 30 years; 2, 30 to less than 40 years; 3, 40 to less than 50 years; 4, 50 to less than 60 years; and 5, 60 years or older. Chronic musculoskeletal pain diagnosis was coded as follows: 1, neck pain; 2, low back pain; 3, fibromyalgia; 4, arthritis; 5, mixed samples of musculoskeletal pain. Risk of bias was coded as follows: 1, low risk of bias; 2, unclear risk of bias; 3, high risk of bias. Type of control group was coded as follows: 1, usual care/active control; 2, wait list; 3, no intervention; 4, advice/education booklet; 5, sham intervention. The experimental facilitator was

coded as follows: 1, physical therapist; 2, other professional (eg, yoga instructor); 3, multidisciplinary team; 4, psychologist; 5, nurse. The instrument to assess pain self-efficacy was coded as follows: 1, the Pain Self-Efficacy Questionnaire; 2, the Arthritis Self-Efficacy Scale; 3, the Chronic Pain Self-Efficacy Scale; 4, the Self-Efficacy Scale.

Summary of Findings

The GRADE approach⁷⁹ was used to assess the certainty of the evidence for the pain self-efficacy outcome. The certainty of the evidence can be graded as high, moderate, low, and very low.⁸⁰ Evidence from randomized controlled trials started as high certainty, and we downgraded for risk of bias, inconsistency, indirectness, imprecision, and publication bias.⁸⁰

Description of Interventions

We used the TIDieR checklist to summarize intervention detail.⁴¹ We analyzed whether each trial described the intervention in terms of “why” (theoretical framework), “what” (intervention type, intervention materials and procedures, control description), “who” (intervention provider), “how” (use of technology, individual or groups), “where” (location of

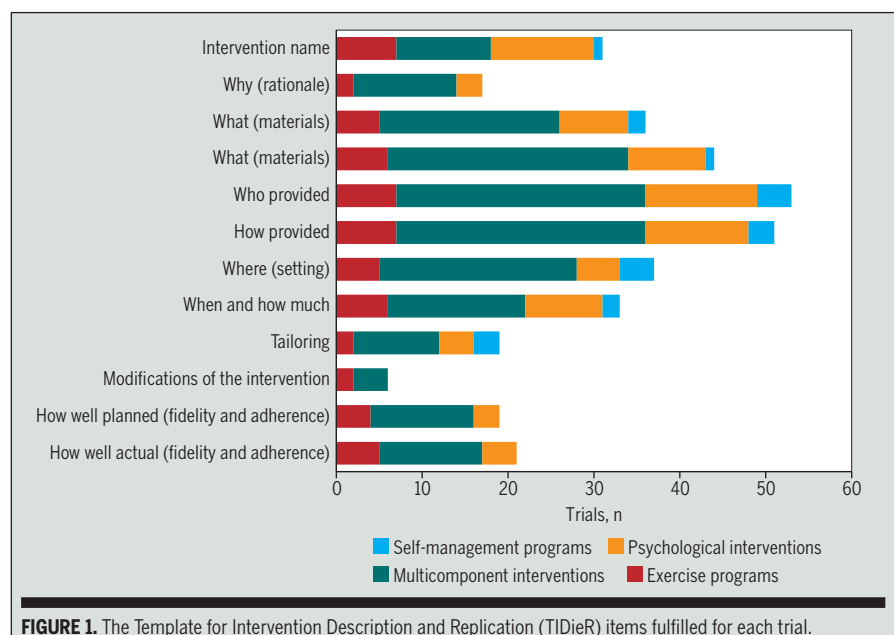


FIGURE 1. The Template for Intervention Description and Replication (TIDieR) items fulfilled for each trial.

intervention), “when and how much” (duration, number of sessions), “tailoring,” and “how well” (attrition, compliance).⁴¹ We presented the number of TIDieR items fulfilled for each trial in **FIGURE 1**.

RESULTS

THE ELECTRONIC DATABASES RETRIEVED 2895 citations. Manual searches and gray literature added 45 citations. We screened 2343 titles and abstracts after removing duplicates, and 489 full texts. We included 60 trials based on 68 publications (**FIGURE 2**), with 12 415 individually randomized participants (73% women). The characteristics

of the 60 trials and their full references are listed in **APPENDIX B**.

The most common settings were community-based settings (20%), primary health care (18%), outpatient rehabilitation centers (17%), and home-based programs (12%). Arthritis was the most frequent pain condition. The overall sample size ranged from 57 to 812 participants. The mean $\pm$ SD age ranged from 38 ± 11.3 years to 78 ± 7.5 years. Pain duration ranged from 3 months to 22 years. Multicomponent, psychological, exercise, and/or self-management interventions were used as the intervention group. Usual care and wait list were commonly used as the control group. Pain self-effi-

cacy was the primary outcome in 15 trials. Pain self-efficacy was frequently assessed with the Arthritis Self-Efficacy Scale pain subscale (62%) and the Pain Self-Efficacy Questionnaire (23%).

Risk-of-Bias Assessment

Blinding of participants, personnel, and outcome assessors and allocation concealment were the domains most frequently at high risk of bias (**APPENDIX C**, available at www.jospt.org). Thirty-nine trials were at high risk of bias, 15 trials had an unclear risk of bias, and 6 trials were at low risk of bias.

Completeness of Intervention Descriptions

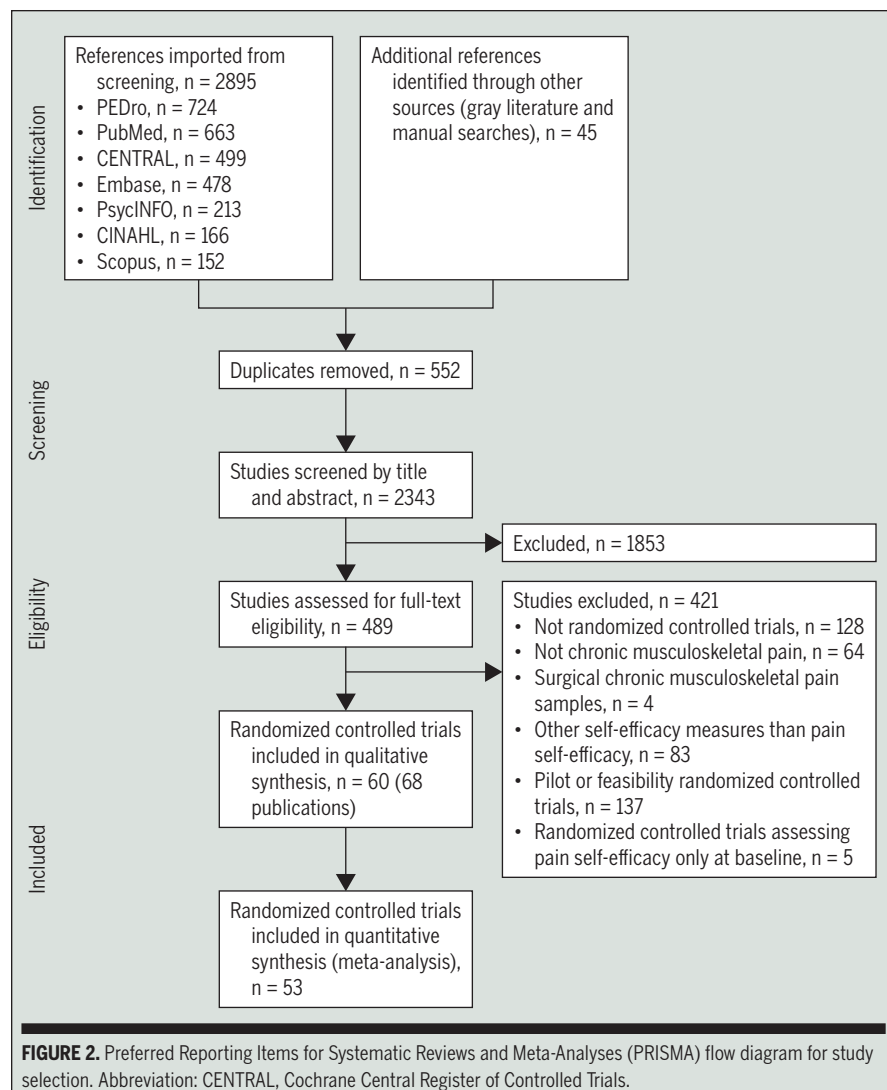
No trial provided complete information for all the TIDieR checklist items (**FIGURE 1**). A multicomponent intervention was the type of treatment that completed more TIDieR items. Trials frequently reported which procedures were applied, who provided the intervention, and how the intervention was provided. Trials scarcely reported the theoretical framework of the intervention and the possible modifications of the intervention.

Certainty of the Evidence According to the GRADE Approach

The certainty of the evidence for all included interventions was low due to serious risk of bias and indirectness (**TABLE**).

Meta-analysis: Effects on Pain Self-efficacy at 0-to-3-Month Follow-up

Compared to control, there was a small effect of multicomponent interventions (SMD, 0.35; 95% CI: 0.20, 0.51; $I^2 = 67.4\%$), psychological therapies (SMD, 0.32; 95% CI: 0.09, 0.55; $I^2 = 82.3\%$), and exercise interventions (SMD, 0.24; 95% CI: 0.09, 0.39; $I^2 = 0\%$) improving pain self-efficacy (**FIGURE 3**). There were no effects on pain self-efficacy of self-management interventions (SMD, 0.17; 95% CI: -0.21, 0.55; $I^2 = 0\%$). We found funnel plot asymmetry, and the Egger regression test was positive (regression coefficient = 1.79; 95% CI: 0.24, 3.35;



[LITERATURE REVIEW]

$P = .025$) (APPENDIX D, available at www.jospt.org).

Sensitivity Analyses: Effects on Pain Self-efficacy at 0-to-3-Month Follow-up

Sensitivity analyses suggested no significant changes in the pooled SMD after the elimination of any trial (APPENDIX E, available at www.jospt.org).

Meta-regression Analyses: Effects on Pain Self-efficacy at 0-to-3-Month Follow-up

Age, intervention dose, chronic musculoskeletal pain diagnosis, risk of bias, type of control group, the experimental facilitator, and the instrument used to assess pain self-efficacy did not moderate the effects of any intervention (APPENDIX F, available at www.jospt.org).

Meta-analysis: Effects on Pain Self-efficacy at 4-to-6-Month Follow-up

Compared to control, there was a small effect of exercise interventions (SMD, 0.33; 95% CI: 0.07, 0.60; $I^2 = 49.4\%$) and multicomponent interventions (SMD, 0.27; 95% CI: 0.15, 0.39; $I^2 = 40.9\%$) improving pain self-efficacy (FIGURE 4). There were no effects of self-management interventions (SMD, 0.59; 95% CI: -0.02, 1.20; $I^2 = 81.7\%$) and psychological therapies (SMD, 0.21; 95% CI: -0.03, 0.46; $I^2 = 86.4\%$). There was funnel plot asymmetry and the Egger regression test was positive (regres-

sion coefficient = 1.61; 95% CI: 0.08, 3.15; $P = .039$) (APPENDIX G, available at www.jospt.org).

Sensitivity Analyses: Effects on Pain Self-efficacy at 4-to-6-Month Follow-up

When 3 trials^{77,88,97} were removed, one by one, the effect estimate of exercise interventions on pain self-efficacy was no longer significant. This could be explained by the type of control group used in these studies (APPENDIX H, available at www.jospt.org). When 1 trial⁶⁶ was removed, the effect estimate of psychological therapies on pain self-efficacy became significant. This change could be explained by the use of cognitive behavioral therapy as the control group⁶⁶ (APPENDIX H).

Meta-regression Analyses: Effects on Pain Self-efficacy at 4-to-6-Month Follow-up

Age, intervention dose, chronic musculoskeletal pain diagnosis, risk of bias, type of control group, the experimental facilitator, and the instrument used to assess pain self-efficacy did not moderate the effects of any intervention (APPENDIX I, available at www.jospt.org).

Meta-analysis: Intervention at 7-to-12-Month Follow-up

Compared to control, there was a small effect of multicomponent interventions (SMD, 0.23; 95% CI: 0.10, 0.36; $I^2 = 50.1\%$) improving pain self-efficacy (FIG-

URE 5). There were no effects of exercise interventions (SMD, 0.19; 95% CI: -0.13, 0.52; $I^2 = 0\%$), psychological therapies (SMD, 0.19; 95% CI: -0.01, 0.39; $I^2 = 77.5\%$), and self-management interventions (SMD, 0.26; 95% CI: -0.03, 0.54; $I^2 = 79.4\%$). There was funnel plot asymmetry and the Egger regression test was positive (regression coefficient = 1.65; 95% CI: 0.44, 2.86; $P = .009$) (APPENDIX J, available at www.jospt.org).

Sensitivity Analyses: Effects on Pain Self-efficacy at 7-to-12-Month Follow-up

When 1 trial⁵² was removed, the effect estimate of psychological therapies on pain self-efficacy became significant. This change could be associated with the large sample size⁵² (APPENDIX K, available at www.jospt.org). When 1 trial⁶⁰ was removed, the effect estimate of self-management interventions on pain self-efficacy became significant. This could be explained by the specific experimental facilitator (multidisciplinary team) who applied the intervention (APPENDIX K).

Meta-regression Analyses: Effects on Pain Self-efficacy at 7-to-12-Month Follow-up

Risk of bias (SMD, 0.20; 95% CI: 0.00, 0.40; $P = .049$), type of control group (SMD, -0.18; 95% CI: -0.30, -0.05; $P = .011$), and the instrument used to assess pain self-efficacy (SMD, 0.25; 95% CI: 0.00, 0.51; $P = .049$) moderated the

TABLE

THE CERTAINTY OF THE EVIDENCE (GRADE)^a

Summary of Findings				Certainty of Evidence Based on the GRADE Approach				
Pain Self-efficacy	Trials, k	Participants, n	Risk of Bias	Inconsistency	Indirectness	Imprecision	Level of Evidence	Importance
Psychological therapy	15	3527	Serious ^b	No	Serious ^c	No	Low	Critical
Self-management intervention	6	2153	Serious ^b	No	Serious ^c	No	Low	Critical
Exercise intervention	7	1137	Serious ^b	No	Serious ^c	No	Low	Critical
Multicomponent intervention	32	5425	Serious ^b	No	Serious ^c	No	Low	Critical

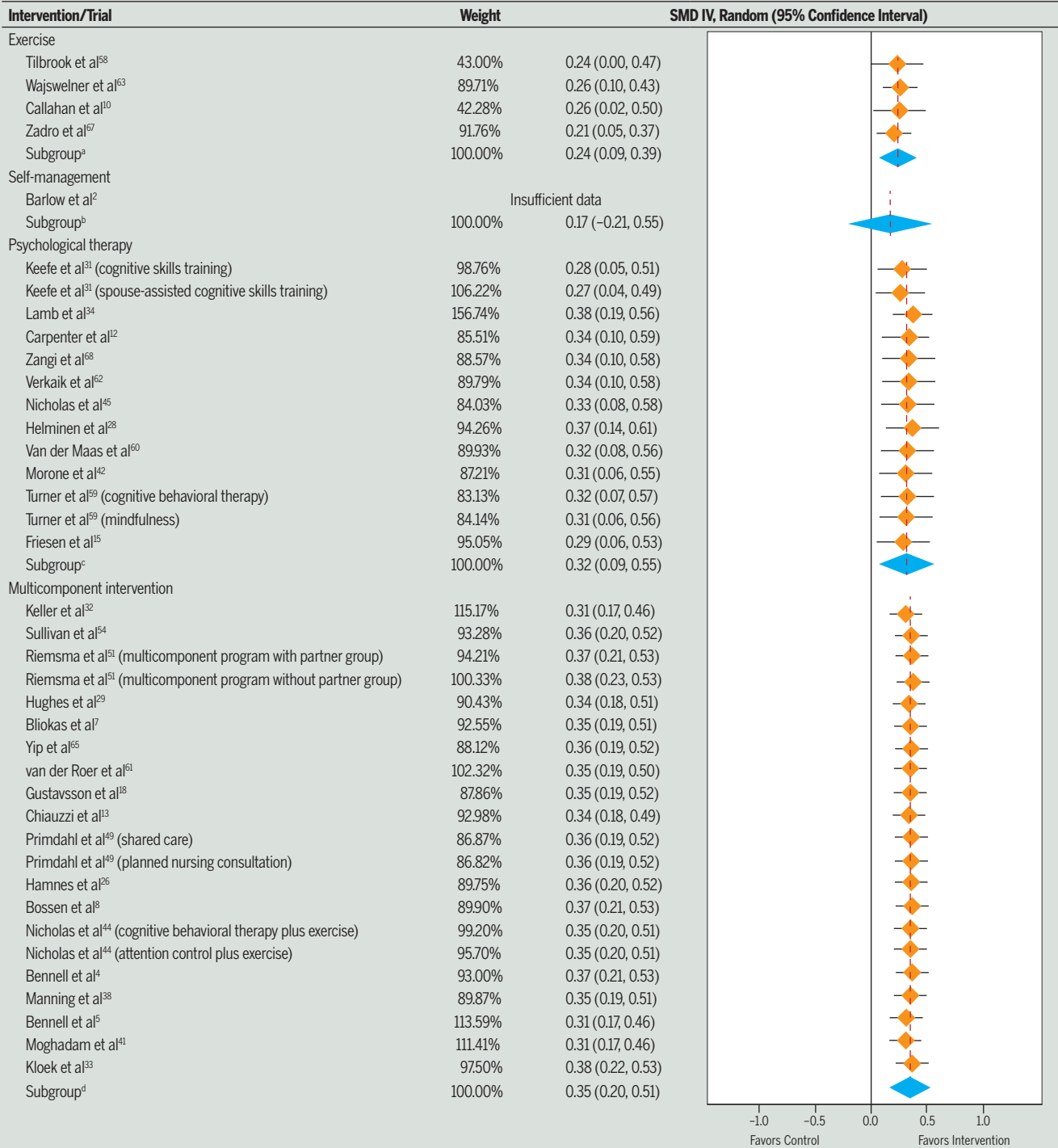
Abbreviation: GRADE, Grading of Recommendations Assessment, Development and Evaluation.

^aPotential publication bias was detected at 0-to-3-month follow-up, 4-to-6-month follow-up, and 7-to-12-month follow-up (see APPENDICES D, G, and J).

^bDowngraded 1 level due to most information being from randomized controlled trials with unclear/high risk of bias, with potential limitations that are likely to lower confidence in the estimate of effect.

^cDowngraded 1 level due to the presence of serious indirectness in terms of interventions and comparisons.

Follow-up: 0-3 Months



Abbreviations: IV, inverse variance; SMD, standardized mean difference.

^a $I^2 = 0.0\%$. Test of effect: $z = 3.049$, $P = .002$.

^bTest of effect: $z = 0.894$, $P = .371$.

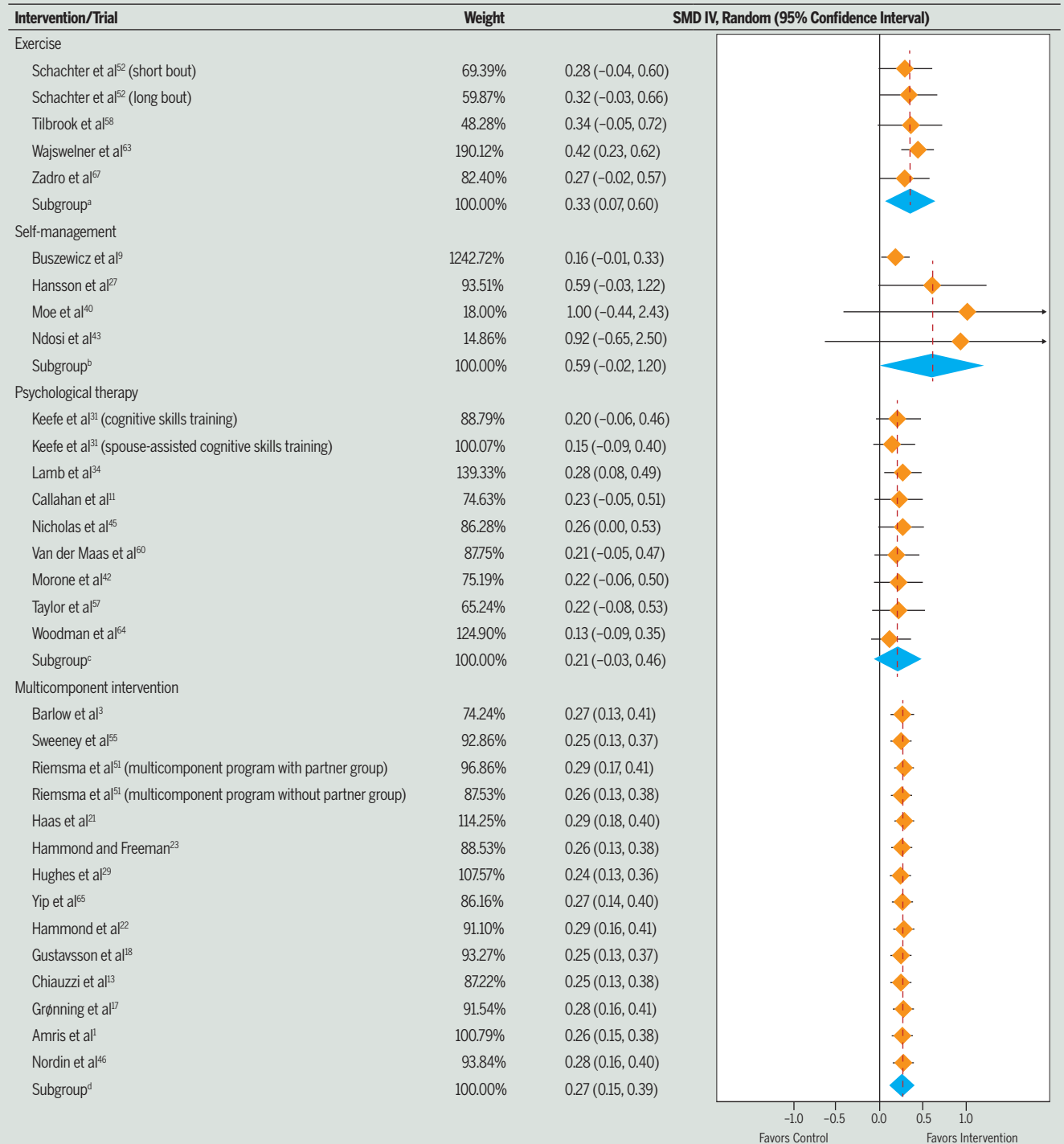
^c $I^2 = 82.3\%$. Test of effect: $z = 2.762$, $P = .006$.

^d $I^2 = 67.4\%$. Test of effect: $z = 4.475$, $P < .001$.

FIGURE 3. Pooled effects on pain self-efficacy of different interventions at 0-to-3-month follow-up. See **APPENDIX B** for full citation details.

[LITERATURE REVIEW]

Follow-up: 4-6 Months



Abbreviations: IV, inverse variance; SMD, standardized mean difference.

^a $I^2 = 49.4\%$. Test of effect: $z = 2.461$, $P = .014$.

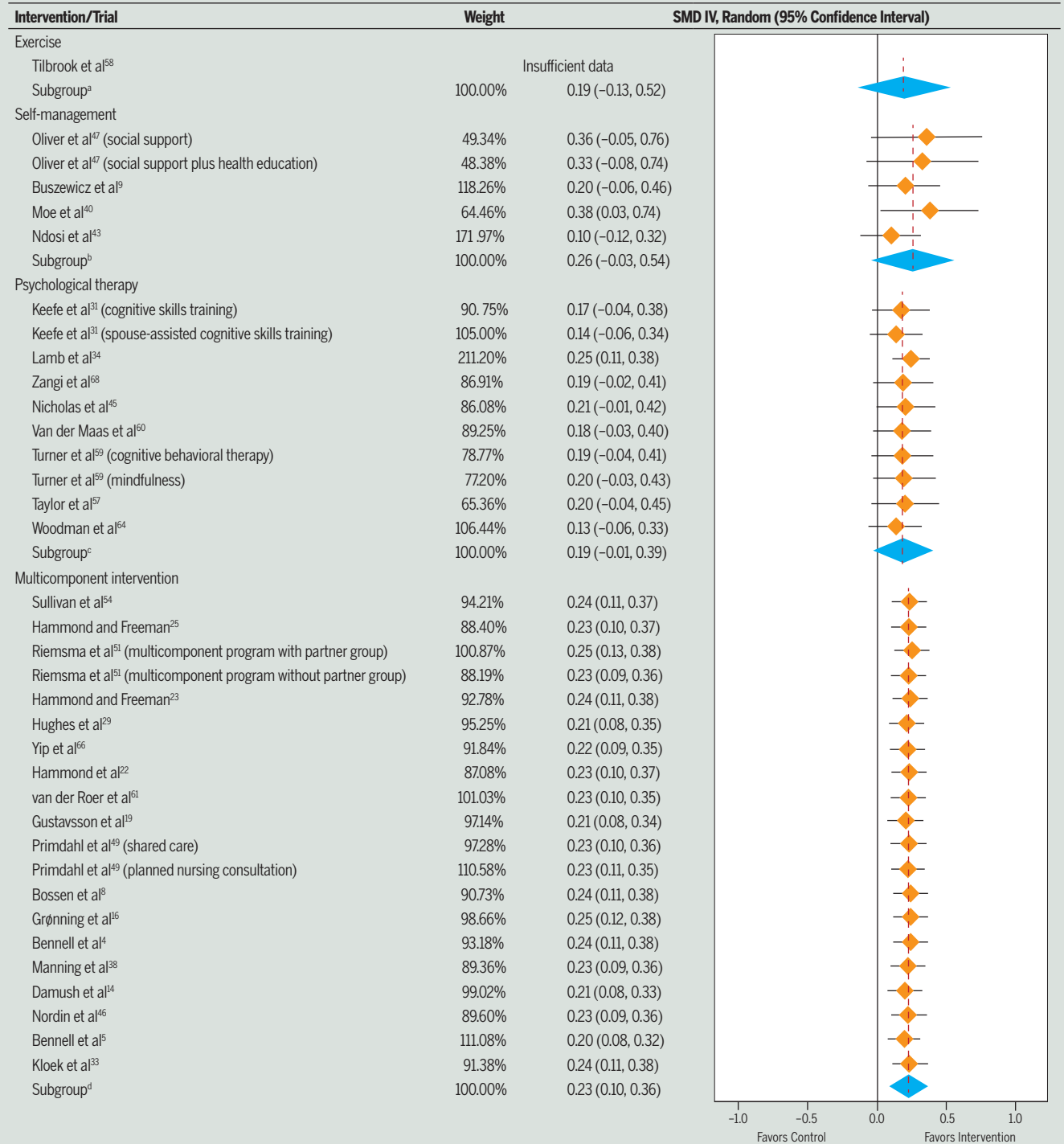
^b $I^2 = 81.7\%$. Test of effect: $z = 1.897$, $P = .058$.

^c $I^2 = 86.4\%$. Test of effect: $z = 1.698$, $P = .090$.

^d $I^2 = 40.9\%$. Test of effect: $z = 4.469$, $P < .001$.

FIGURE 4. Pooled effects on pain self-efficacy of different interventions at 4-to-6-month follow-up. See **APPENDIX B** for full citation details.

Follow-up: 7-12 Months



Abbreviations: IV, inverse variance; SMD, standardized mean difference.

^aTest of effect: $z = 1.164$, $P = .244$.

^b $I^2 = 79.4\%$. Test of effect: $z = 1.781$, $P = .075$.

^c $I^2 = 77.5\%$. Test of effect: $z = 1.827$, $P = .068$.

^d $I^2 = 50.1\%$. Test of effect: $z = 3.542$, $P < .001$.

FIGURE 5. Pooled effects on pain self-efficacy of different interventions at 7-to-12-month follow-up. See **APPENDIX B** for full citation details.

[LITERATURE REVIEW]

effects of psychological therapies. The pooled effect of psychological therapies among trials being evaluated at high risk of bias was larger than trials being evaluated at low and unclear risk of bias. The pooled effect of psychological therapies among trials using usual care or a wait-list control group was larger. The pooled effect of psychological therapies among trials that evaluated pain self-efficacy using the Self-Efficacy Scale or the Chronic Pain Self-Efficacy Scale was larger. The risk of bias, type of control group, and the instrument used to assess pain self-efficacy did not moderate the effects of the rest of the interventions. Age, intervention dose, chronic musculoskeletal pain diagnosis, and the experimental facilitator did not moderate the effects of any intervention (APPENDIX L, available at www.jospt.org).

Meta-analysis: Intervention at Greater Than 12-Month Follow-up

Compared to control, there were no effects of psychological therapies (SMD, 0.17; 95% CI: -0.04, 0.39; $I^2 = 29.1\%$) and multicomponent interventions (SMD, 1.52; 95% CI: -1.41, 4.45; $I^2 = 48.2\%$) (FIGURE 6). There was no funnel plot asymmetry and the Egger regression test was negative (regression coefficient = 1.26; 95% CI: -0.99, 3.51; $P = .173$) (APPENDIX M, available at www.jospt.org).

Sensitivity Analyses: Effects on Pain Self-efficacy at Greater Than 12-Month Follow-up

When the mindfulness group of 1 trial⁸⁹ was removed, the effect estimate of psychological therapies on pain self-efficacy became significant. The type of intervention in the experimental group could explain this change (APPENDIX N, available at www.jospt.org).

Meta-regression Analyses: Effects on Pain Self-efficacy at Greater Than 12-Month Follow-up

Age, intervention dose, chronic musculoskeletal pain diagnosis, risk of bias, type of control group, the experimental facilitator, and the instrument used to assess pain self-efficacy did not moderate the effects of any intervention (APPENDIX O, available at www.jospt.org).

DISCUSSION

WE FOUND SMALL EFFECTS IN FAVOR of multicomponent, psychological, and exercise interventions improving pain self-efficacy at 0-to-3-month follow-up. Exercise and multicomponent interventions improved pain self-efficacy at 4-to-6-month follow-up, with small effects. Multicomponent interventions improved pain self-efficacy at 7-to-12-month follow-up, with small effects. No interven-

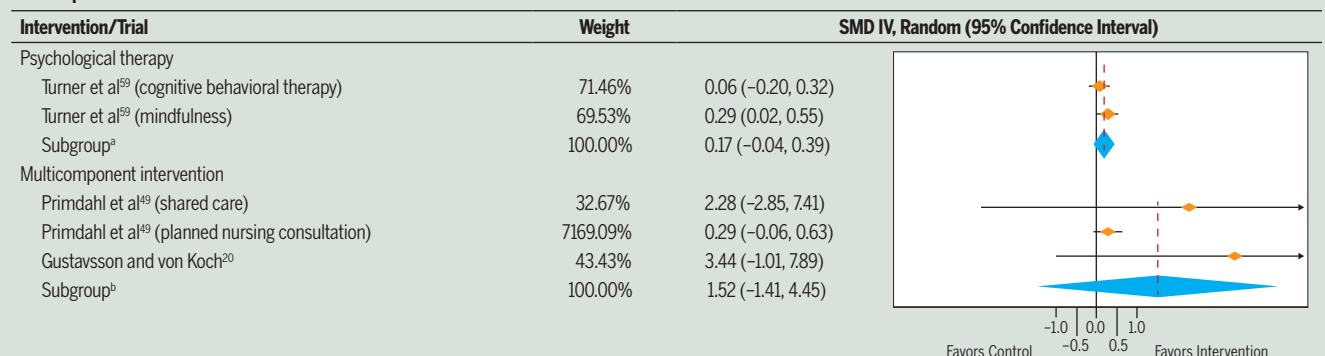
tions enhanced pain self-efficacy at follow-ups longer than 1 year. Self-management interventions did not improve pain self-efficacy at any follow-up.

A previous systematic review also concluded that psychological therapies improved pain self-efficacy in older adults with chronic pain, with small effects.⁶⁷ Contrary to our results, another systematic review concluded that self-management interventions improved self-efficacy in those with chronic pain, with a small effect.²⁴ The difference in results in regard to self-management interventions may be because researchers focused their analyses on general self-efficacy beliefs, rather than focusing on pain self-efficacy and function self-efficacy.²⁴

We found that trials with a high risk of bias moderated the effect of psychological therapies on pain self-efficacy at 7-to-12-month follow-up. This finding supports previous research illustrating how trials tend to exaggerate subjective outcome effect estimates when there is inadequate allocation concealment or lack of blinding.⁹⁵ Trial characteristics, such as the nature of the control group and the outcome measure, moderated the effect of psychological therapies on pain self-efficacy at 7-to-12-month follow-up, which supports previous research.⁴⁸

There were limitations in how interventions were reported in the trials we

Follow-up: Greater Than 12 Months



Abbreviations: IV, inverse variance; SMD, standardized mean difference.

^a $I^2 = 29.1\%$. Test of effect: $z = 1.564$, $P = .118$.

^b $I^2 = 48.2\%$. Test of effect: $z = 1.016$, $P = .310$.

FIGURE 6. Pooled effects on pain self-efficacy of different interventions at follow-ups greater than 12 months. See APPENDIX B for full citation details.

included, which hinders translation to clinical practice.⁴³ There was a frequent absence of the theoretical framework of interventions, the reporting of possible modifications of the intervention, along with a lack of tailoring of interventions. The certainty of the evidence in our systematic review was low, owing to high risk of bias and indirectness associated with the indirect comparison of treatments. Psychological outcomes may be sensitive to bias if participants and personnel know the assigned intervention.³⁸ Cultural and ethnic factors are associated with chronic musculoskeletal pain outcomes.⁷⁰ However, we could not include these factors as treatment effect moderators in our meta-regression analyses due to insufficient data.

Clinical Implications

The effects of multicomponent, exercise, and psychological interventions on improving pain self-efficacy in people with chronic musculoskeletal pain were small. The certainty of the evidence was low, due to serious limitations in terms of risk of bias and indirectness across included trials. However, the large number of included trials suggests that pain self-efficacy is considered a therapeutic target in chronic musculoskeletal pain.

Clinicians can enhance pain self-efficacy beliefs by facilitating mastery of experience, vicarious experience, verbal persuasion, and the education of body response.² Graded exercise, or continually improving exercise and activity tolerance, can enhance mastery of, and promote confidence in, physical activity.⁷⁴ The physical therapist acting as a role model may improve the vicarious experience. Group exercise also promotes practicing exercise in a safe environment while receiving feedback from physical therapists and other participants.⁷⁴ Providing feedback related to patient progress and focusing on treatment benefits may also be helpful.⁷⁴ This information may help patients to believe in their capabilities to attain a goal,² provide reassurance, and guide problem solving to help patients overcome barriers.⁷⁴

Future Research

Further high-quality research is needed before drawing more definite conclusions about the effects of multicomponent, exercise, and psychological interventions on enhancing pain self-efficacy. In this systematic review, we detected where the certainty of the evidence is most lacking. All interventions were at serious risk of bias and were limited by indirectness in terms of indirect comparison of treatments. No trial reported sufficient detail to allow intervention replication. Future research must aim to (1) reduce indirectness by closely collaborating with clinical experts to describe how preclinical outcomes may be related to patient-important outcomes,⁴⁴ (2) follow the Consolidated Standards of Reporting Trials (CONSORT) recommendations to improve the quality of trials,⁷⁸ and (3) follow the TIDieR checklist when reporting interventions.⁴¹

Limitations

We did not evaluate self-efficacy perceptions other than pain self-efficacy. Seven trials (12%) did not report sufficient information to be included in meta-analyses. We did not contact authors to seek data that were unavailable in the trial report. The conclusions of this review cannot be extrapolated to other chronic pain conditions such as cancer pain, chronic head pain, or chronic abdominal pain.

CONCLUSION

THERE WAS LOW-CERTAINTY EVIDENCE of a small effect of multicomponent, exercise, and psychological interventions on improving pain self-efficacy in people with chronic musculoskeletal pain. Self-management interventions did not improve pain self-efficacy at any follow-up. No trial reported sufficient detail to allow intervention replication. ●

KEY POINTS

FINDINGS: There were small effects of multicomponent, exercise, and psychological interventions on improving pain self-efficacy.

IMPLICATIONS: Clinicians can enhance pain self-efficacy beliefs by facilitating mastery of experience, vicarious experience, verbal persuasion, and the education of body response.

CAUTION: The certainty of the evidence was low across the included interventions, and the replication of interventions discussed in this systematic review should be undertaken with caution.

STUDY DETAILS

AUTHOR CONTRIBUTIONS: All authors made a substantial scientific contribution to the study in terms of the conception or design of the study; the acquisition, analysis, and interpretation of data; drafting and revising the study critically for important intellectual content; and the final approval of the version to be published. All authors agree to be accountable for all aspects of the study to ensure that questions related to the accuracy and integrity of any part of the work are appropriately investigated and resolved. All authors take responsibility for its content and completeness.

DATA SHARING: All data relevant to the study are included in the article or are available as online appendices.

PATIENT AND PUBLIC INVOLVEMENT: Patients partners were not involved in the study.

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SEARCH STRATEGIES

PubMed (663 articles retrieved)

1. ("self efficacy"[mh] AND ("shoulder pain"[mh] OR "neck pain"[mh] OR "low back pain"[mh] OR "fibromyalgia"[mh] OR "osteoarthritis"[mh] OR "arthritis, rheumatoid"[mh] OR "arthritis"[mh] OR "spondylarthritis"[mh] OR "musculoskeletal pain"[mh])) AND (Controlled Clinical Trial[pt] OR Randomized Controlled Trial[pt] OR Review[pt]) (169 articles retrieved)
2. ("self efficacy"[tiab] AND ("shoulder pain"[tiab] OR "neck pain"[tiab] OR "low back pain"[tiab] OR "fibromyalgia"[tiab] OR "osteoarthritis"[tiab] OR "arthritis, rheumatoid"[tiab] OR "arthritis"[tiab] OR "spondylarthritis"[tiab] OR "musculoskeletal pain"[tiab])) AND (Controlled Clinical Trial[pt] OR Randomized Controlled Trial[pt] OR Review[pt]) (393 articles retrieved)
3. ("self efficacy"[mh] AND ("whiplash associated-disorder"[tiab] OR "knee pain"[tiab] OR "hip pain"[tiab] OR "ankle pain"[tiab] OR "epicondylalgia"[tiab])) AND (Controlled Clinical Trial[pt] OR Randomized Controlled Trial[pt] OR Review[pt]) (18 articles retrieved)
4. ("self efficacy"[tiab] AND ("whiplash associated-disorder"[tiab] OR "knee pain"[tiab] OR "hip pain"[tiab] OR "ankle pain"[tiab] OR "epicondylalgia"[tiab])) AND (Controlled Clinical Trial[pt] OR Randomized Controlled Trial[pt] OR Review[pt]) (44 articles retrieved)
5. ("pain beliefs"[tiab] AND ("shoulder pain"[mh] OR "neck pain"[mh] OR "low back pain"[mh] OR "fibromyalgia"[mh] OR "osteoarthritis"[mh] OR "arthritis, rheumatoid"[mh] OR "arthritis"[mh] OR "spondylarthritis"[mh] OR "musculoskeletal pain"[mh])) AND (Controlled Clinical Trial[pt] OR Randomized Controlled Trial[pt] OR Review[pt]) (16 articles retrieved)
6. ("pain beliefs"[tiab] AND ("shoulder pain"[tiab] OR "neck pain"[tiab] OR "low back pain"[tiab] OR "fibromyalgia"[tiab] OR "osteoarthritis"[tiab] OR "arthritis, rheumatoid"[tiab] OR "arthritis"[tiab] OR "spondylarthritis"[tiab] OR "musculoskeletal pain"[tiab])) AND (Controlled Clinical Trial[pt] OR Randomized Controlled Trial[pt] OR Review[pt]) (23 articles retrieved)
7. ("pain beliefs"[tiab] AND ("whiplash associated-disorder"[tiab] OR "knee pain"[tiab] OR "hip pain"[tiab] OR "ankle pain"[tiab] OR "epicondylalgia"[tiab])) AND (Controlled Clinical Trial[pt] OR Randomized Controlled Trial[pt] OR Review[pt]) (0 articles retrieved)

Cochrane Central Register of Controlled Trials (499 articles retrieved)

1. MeSH descriptor: [Self Efficacy] explode all trees
2. MeSH descriptor: [Shoulder Pain] explode all trees
3. MeSH descriptor: [Neck Pain] explode all trees
4. MeSH descriptor: [Low Back Pain] explode all trees
5. MeSH descriptor: [Fibromyalgia] explode all trees
6. MeSH descriptor: [Osteoarthritis] explode all trees
7. MeSH descriptor: [Arthritis, Rheumatoid] explode all trees
8. MeSH descriptor: [Arthritis] explode all trees
9. MeSH descriptor: [Spondylarthritis] explode all trees
10. MeSH descriptor: [Musculoskeletal Pain] explode all trees
11. #1 AND (#2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10) in Cochrane Reviews, Cochrane Protocols and Trials (131 articles retrieved)
12. Pain Beliefs
13. #12 AND (#2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10) in Cochrane Reviews, Cochrane Protocols and Trials (226 articles retrieved)
14. Whiplash Associated-Disorder
15. Knee Pain
16. Hip Pain
17. Ankle Pain
18. Epicondylalgia
19. #1 AND (#14 OR #15 OR #16 OR #17 OR #18) in Cochrane Reviews, Cochrane Protocols and Trials (41 articles retrieved)
20. #12 AND (#14 OR #15 OR #16 OR #17 OR #18) in Cochrane Reviews, Cochrane Protocols and Trials (101 articles retrieved)

Scopus (152 articles retrieved)

1. TITLE-ABS-KEY (self,efficacy AND (shoulder,pain OR neck,pain OR low,back,pain OR fibromyalgia OR osteoarthritis OR arthritis,rheumatoid OR arthritis OR spondylarthritis OR musculoskeletal,pain)) AND (controlled AND clinical AND trial OR randomized AND controlled) OR DOCTYPE (ar OR re) (20 articles retrieved)
2. TITLE-ABS-KEY (self,efficacy AND (whiplash,associated-disorder OR knee,pain OR hip,pain OR ankle,pain OR epicondylalgia)) AND (controlled AND clinical AND trial OR randomized AND controlled) OR DOCTYPE (ar OR re) (57 articles retrieved)
3. TITLE-ABS-KEY (pain,beliefs AND (shoulder,pain OR neck,pain OR low,back,pain OR fibromyalgia OR osteoarthritis OR arthritis,rheumatoid OR arthritis OR spondylarthritis OR musculoskeletal,pain)) AND (controlled AND clinical AND trial OR randomized AND controlled) OR DOCTYPE (ar OR re) (47 articles retrieved)

APPENDIX A

4. TITLE-ABS-KEY (pain,beliefs AND (whiplash,associated-disorder OR knee,pain OR hip,pain OR ankle,pain OR epicondylalgia)) AND (controlled AND clinical AND trial OR randomized AND controlled) OR DOCTYPE (ar OR re) (28 articles retrieved)

CINAHL (166 articles retrieved)

1. ("self efficacy" AND ("shoulder pain" OR "neck pain" OR "low back pain" OR "fibromyalgia" OR "osteoarthritis" OR "arthritis, rheumatoid" OR "arthritis" OR "spondylarthritis" OR "musculoskeletal pain")) AND (Randomized Controlled Trial[pt]) (143 articles retrieved)
2. ("pain beliefs" AND ("shoulder pain" OR "neck pain" OR "low back pain" OR "fibromyalgia" OR "osteoarthritis" OR "arthritis, rheumatoid" OR "arthritis" OR "spondylarthritis" OR "musculoskeletal pain")) AND (Randomized Controlled Trial[pt]) (5 articles retrieved)
3. ("self efficacy" AND ("whiplash associated disorder" OR "knee pain" OR "hip pain" OR "ankle pain" OR "epicondylalgia")) AND (Randomized Controlled Trial[pt]) (17 articles retrieved)
4. ("pain beliefs" AND ("whiplash associated disorder" OR "knee pain" OR "hip pain" OR "ankle pain" OR "epicondylalgia")) AND (Randomized Controlled Trial[pt]) (1 article retrieved)

PsycINFO (213 articles retrieved)

1. ("self efficacy" AND ("shoulder pain" OR "neck pain" OR "low back pain" OR "fibromyalgia" OR "osteoarthritis" OR "arthritis, rheumatoid" OR "arthritis" OR "spondylarthritis" OR "musculoskeletal pain")) AND (Clinical Trial OR Longitudinal Study OR Meta-analysis OR Systematic Review OR Treatment Outcome)) (188 articles retrieved)
2. ("pain beliefs" AND ("shoulder pain" OR "neck pain" OR "low back pain" OR "fibromyalgia" OR "osteoarthritis" OR "arthritis, rheumatoid" OR "arthritis" OR "spondylarthritis" OR "musculoskeletal pain")) AND (Clinical Trial OR Longitudinal Study OR Meta-analysis OR Systematic Review OR Treatment Outcome)) (17 articles retrieved)
3. ("self efficacy" AND ("whiplash associated disorder" OR "knee pain" OR "hip pain" OR "ankle pain" OR "epicondylalgia"))AND (Clinical Trial OR Longitudinal Study OR Meta-analysis OR Systematic Review OR Treatment Outcome)) (8 articles retrieved)
4. ("pain beliefs" AND ("whiplash associated disorder" OR "knee pain" OR "hip pain" OR "ankle pain" OR "epicondylalgia")) AND (Clinical Trial OR Longitudinal Study OR Meta-analysis OR Systematic Review OR Treatment Outcome)) (0 articles retrieved)

PEDro (730 articles retrieved)

1. Abstract & Title: self efficacy AND shoulder pain. Method: clinical trial (23 articles retrieved)
2. Abstract & Title: self efficacy AND neck pain. Method: clinical trial (34 articles retrieved)
3. Abstract & Title: self efficacy AND low back pain. Method: clinical trial (76 articles retrieved)
4. Abstract & Title: self efficacy AND fibromyalgia. Method: clinical trial (43 articles retrieved)
5. Abstract & Title: self efficacy AND osteoarthritis. Method: clinical trial (99 articles retrieved)
6. Abstract & Title: self efficacy AND rheumatoid arthritis. Method: clinical trial (43 articles retrieved)
7. Abstract & Title: self efficacy AND arthritis. Method: clinical trial (109 articles retrieved)
8. Abstract & Title: self efficacy AND spondylarthritis. Method: clinical trial (0 articles retrieved)
9. Abstract & Title: self efficacy AND musculoskeletal pain. Method: clinical trial (33 articles retrieved)
10. Abstract & Title: self efficacy AND whiplash associated disorder. Method: clinical trial (3 articles retrieved)
11. Abstract & Title: self efficacy AND knee pain. Method: clinical trial (79 articles retrieved)
12. Abstract & Title: self efficacy AND hip pain. Method: clinical trial (29 articles retrieved)
13. Abstract & Title: self efficacy AND ankle pain. Method: clinical trial (6 articles retrieved)
14. Abstract & Title: self efficacy AND epicondylalgia. Method: clinical trial (0 articles retrieved)
15. Abstract & Title: pain beliefs AND shoulder pain. Method: clinical trial (6 articles retrieved)
16. Abstract & Title: pain beliefs AND neck pain. Method: clinical trial (20 articles retrieved)
17. Abstract & Title: pain beliefs AND low back pain. Method: clinical trial (83 articles retrieved)
18. Abstract & Title: pain beliefs AND fibromyalgia. Method: clinical trial (3 articles retrieved)
19. Abstract & Title: pain beliefs AND osteoarthritis. Method: clinical trial (6 articles retrieved)
20. Abstract & Title: pain beliefs AND rheumatoid arthritis. Method: clinical trial (1 article retrieved)
21. Abstract & Title: pain beliefs AND arthritis. Method: clinical trial (4 articles retrieved)
22. Abstract & Title: pain beliefs AND spondylarthritis. Method: clinical trial (0 articles retrieved)
23. Abstract & Title: pain beliefs AND musculoskeletal pain. Method: clinical trial (16 articles retrieved)
24. Abstract & Title: pain beliefs AND whiplash associated disorder. Method: clinical trial (1 article retrieved)
25. Abstract & Title: pain beliefs AND knee pain. Method: clinical trial (10 articles retrieved)
26. Abstract & Title: pain beliefs AND hip pain. Method: clinical trial (3 articles retrieved)
27. Abstract & Title: pain beliefs AND ankle pain. Method: clinical trial (0 articles retrieved)
28. Abstract & Title: pain beliefs AND epicondylalgia. Method: clinical trial (0 articles retrieved)

APPENDIX A

Embase (478 articles retrieved)

1. 'self efficacy':ab,ti AND ('shoulder pain'/exp OR 'neck pain'/exp OR 'low back pain'/exp OR 'fibromyalgia'/exp OR 'osteoarthritis'/exp OR 'rheumatoid arthritis'/exp OR 'arthritis'/exp OR 'spondylarthritis'/exp OR 'musculoskeletal pain'/exp OR 'whiplash associated disorder'/exp OR 'knee pain'/exp OR 'hip pain'/exp OR 'ankle pain'/exp OR 'epicondylalgia':ab,ti) AND ([cochrane review]/lim OR [systematic review]/lim OR [meta analysis]/lim OR [controlled clinical trial]/lim OR [randomized controlled trial]/lim) AND [embase]/lim (463 articles retrieved)
2. 'pain beliefs':ab,ti AND ('shoulder pain'/exp OR 'neck pain'/exp OR 'low back pain'/exp OR 'fibromyalgia'/exp OR 'osteoarthritis'/exp OR 'rheumatoid arthritis'/exp OR 'arthritis'/exp OR 'spondylarthritis'/exp OR 'musculoskeletal pain'/exp OR 'whiplash associated disorder'/exp OR 'knee pain'/exp OR 'hip pain'/exp OR 'ankle pain'/exp OR 'epicondylalgia':ab,ti) AND ([cochrane review]/lim OR [systematic review]/lim OR [meta analysis]/lim OR [controlled clinical trial]/lim OR [randomized controlled trial]/lim) AND [embase]/lim (15 articles retrieved)

CHARACTERISTICS OF INCLUDED TRIALS

Chronic Neck Pain

Study/Country	Sample and Setting	Type of Intervention	Experimental Group, Duration/ Contact	Control Group, Duration/ Contact	Treatment Facilitator	Treatment Format	Follow-up After Intervention	Pain Self-efficacy		Main Findings
								Experimental Group ^a	Control Group ^a	
Gustavsson et al ^{18,19} , Gustavsson and von Koch ²⁰ Sweden	Experimental: n = 77 (female, n = 69); mean $\pm$ SD age, 45.7 $\pm$ 11.5 y; pain duration: 3-6 mo, 9%; 7-12 mo, 5%; 1-2 y, 16%; >2 y, 70% Control: n = 79 (female, n = 70); age, 45.7 $\pm$ 11.6 y; pain duration: 3-6 mo, 14%; 7-12 mo, 11%; 1-2 y, 15%; >2 y, 60% Primary health care	Multicomponent intervention	Applied relaxation training plus body awareness exercises plus lectures and group discussions addressing pain (theories, concepts, and beliefs) 1 session for a 7-wk period; 90 min for each session; a booster session at 20 wk after the initial session	Physical therapy sessions based on current practice and with standardized treatment procedure	Physical therapist trained to conduct this intervention	Face-to-face group for the first session	T0, at baseline; T1, 10 wk; T2, 20 wk; T3, 12 mo; T4, 24 mo; T5, 9 y	The Self-Efficacy Scale Baseline, 137.4 $\pm$ 40 Change from baseline: 10 wk, 147.4 $\pm$ 38.8; 20 wk, 152.1 $\pm$ 33.9; 12 mo, 154 $\pm$ 38.5; 24 mo, 156.8 $\pm$ 36.4; 9 y, 168.5 $\pm$ 37.7	The Self-Efficacy Scale Baseline, 129.4 $\pm$ 43.8 Change from baseline: 10 wk, 134.1 $\pm$ 41.7; 20 wk, 132.2 $\pm$ 46.3; 12 mo, 132.3 $\pm$ 42.1; 24 mo, 135.8 $\pm$ 43.6; 9 y, 157 $\pm$ 43	Adjusted for the Neck Disability Index at baseline The experimental group showed a large effect at 12 mo compared to the control group: mean, 13.50; 95% CI: 2.67, 24.33; $P = .015$ There was no difference between groups at 10 wk: mean, 5.00; 95% CI: -5.83, 15.83; $P = .364$; 20 wk: mean, 11.72; 95% CI: 0.89, 22.55; $P = .034$; 24 mo: mean, 12.70; 95% CI: 1.87, 23.53; $P = .022$; and 9 y: coefficient = 14.5; 95% CI: -0.58, 29.58; $P = .059$
Ludvigsson et al ³⁵ Sweden	Neck-specific exercises: n = 76 (female, n = 57); mean $\pm$ SD age, 38 $\pm$ 11.3 y; pain duration, 19 $\pm$ 8.7 mo Neck-specific exercises with a behavioral approach: n = 71 (female, n = 47); age, 40 $\pm$ 11.6 y; pain duration, 20 $\pm$ 8.9 mo Prescription of physical activity: n = 69 (female, n = 38); age, 43 $\pm$ 10.7 y; pain duration, 20 $\pm$ 10.3 mo Primary health care	Multicomponent intervention	(1) Physical therapist-led neck-specific exercise, based on supervised exercise plus basic information about the neck relevant to the exercise 2 sessions per week for a 12-wk period plus home exercises (2) Physical therapist-guided neck-specific exercise with a behavioral approach (biopsychosocial education plus activities aimed at pain management plus problem solving) 2 sessions per week for a 12-wk period (3) Prescription of physical activity for a 12-wk period (short motivational interview plus individualized physical activity, avoiding head-resistance exercises)	Not applicable	Physical therapist	Individual face-to-face session	T0, at baseline; T1, 3 mo; T2, 6 mo	The Self-Efficacy Scale Baseline: neck-specific exercises, 150 $\pm$ 34; neck-specific exercises with a behavioral approach, 153 $\pm$ 35; prescription of physical activity, 147 $\pm$ 41 Change from baseline 3 mo, whiplash grade 2: neck-specific exercises, 12 $\pm$ 25; neck-specific exercises with a behavioral intervention, 2 $\pm$ 18; prescription of physical activity, 3 $\pm$ 17 3 mo, whiplash grade 3: neck-specific exercises, 6 $\pm$ 23; neck-specific exercises with a behavioral intervention, 9 $\pm$ 27; prescription of physical activity, 11 $\pm$ 34 6 mo, whiplash grade 2: neck-specific exercises, 12 $\pm$ 27; neck-specific exercises with a behavioral intervention, -1 $\pm$ 28; prescription of physical activity, 6 $\pm$ 21 6 mo, whiplash grade 3: neck-specific exercises, 8 $\pm$ 28; neck-specific exercises with a behavioral intervention, 2 $\pm$ 34; prescription of physical activity, 0 $\pm$ 53	Not applicable	There was no difference between groups at 3 mo and 6 mo

Table continues on page A5.

APPENDIX B

								Pain Self-efficacy		
Study/Country	Sample and Setting	Type of Intervention	Experimental Group, Duration/ Contact	Control Group, Duration/ Contact	Treatment Facilitator	Treatment Format	Follow-up After Intervention	Experimental Group ^a	Control Group ^a	Main Findings
MacPherson et al ^{36,37} ; Woodman et al ⁶⁴ United Kingdom	Alexander technique: n = 172 (female, n = 120); mean ± SD age, 53.6 ± 14.6 y; pain duration, 60 mo (range, 6-540) Acupuncture: n = 173 (female, n = 119); age, 52.0 ± 13.8 y; pain duration, 60 mo (range, 5-600) Control: n = 172 (female, n = 118); age, 53.9 ± 13.0 y; pain duration, 96 mo (range, 5-600) Primary health care	Psychological therapy (Alexander technique) Passive therapy (acupuncture)	Alexander technique 20 sessions, 30 min each; treatment as usual Acupuncture 12 sessions, 50 min each; treatment as usual	Treatment as usual	Alexander teachers (Alexander technique) Acupuncturist (acupuncture group)	Individual face-to-face session	T0, at baseline; T1, 6 mo; T2, 12 mo	The Chronic Pain Self-Efficacy Scale pain subscale Baseline: Alexander technique, 4.11 ± 1.68; acupuncture, 4.18 ± 1.53 Change from baseline 6 mo: Alexander technique, 5.05 ± 1.69; acupuncture, 4.80 ± 1.80 12 mo: Alexander technique, 5.01 ± 1.78; acupuncture, 4.88 ± 1.79	The Chronic Pain Self-Efficacy Scale pain subscale Baseline, 4.17 ± 1.54 Change from baseline 6 mo: Alexander technique, 3.92 ± 1.52; acupuncture, 3.92 ± 1.52 12 mo: Alexander technique, 4.14 ± 1.68; acupuncture, 4.14 ± 1.68	Adjusted for baseline Northwick Park Neck Pain Questionnaire score, duration of neck pain, age, sex, city, and general practitioner practice The Alexander technique group showed a large effect at 6 mo: coefficient = 1.09; 95% CI: 0.63, 1.55; <i>P</i> < .001 and 12 mo: coefficient = 0.81; 95% CI: 0.37, 1.24; <i>P</i> = .001 compared to the control group The acupuncture group showed a large effect at 6 mo: coefficient = 0.80; 95% CI: 0.46, 1.15; <i>P</i> < .001 and 12 mo: coefficient = 0.65; 95% CI: 0.18, 1.13; <i>P</i> = .009 compared to the control group

Abbreviation: CI, confidence interval.

^aValues are mean ± SD.

Chronic Low Back Pain

								Pain Self-efficacy		
Study/Country	Sample and Setting	Type of Intervention	Experimental Group, Duration/Contact	Control Group (duration/contact)	Treatment Facilitator	Treatment Format	Follow-up After Intervention	Experimental Group ^a	Control Group ^a	Main Findings
Carpenter et al ¹² United States	Total: n = 141 (female, n = 117); mean ± SD age, 42.5 ± 10.3 y; pain duration, 103.7 ± 94.1 mo Home-based program (online)	Psychological therapy	An internet-based program on cognitive behavioral therapy (wellness workbook) 2 chapters per week for a 3-wk period	Wait list	Psychologist (responsible for leading the content development efforts)	Not applicable	T0, at baseline; T1, posttreatment (3 wk); T2, 6 wk	The Self-Efficacy Scale Baseline, 4.9 ± 2.0 Change from baseline: 3 wk, 7.0 ± 1.8; 6 wk, 7.0 ± 1.7	The Self-Efficacy Scale Baseline, 4.8 ± 2.2 Change from baseline: 3 wk, 5.0 ± 2.3; 6 wk, 6.8 ± 2.0	Adjusted for baseline individual differences in the dependent measures The experimental group showed a large effect at posttreatment (Cohen's <i>d</i> = 0.89, <i>P</i> <.001) compared to the control group There was no difference between groups at 6 wk

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APPENDIX B

Study/Country	Sample and Setting	Type of Intervention	Experimental Group, Duration/Contact	Control Group (duration/contact)	Treatment Facilitator	Treatment Format	Follow-up After Intervention	Pain Self-efficacy		Main Findings
								Experimental Group ^a	Control Group ^a	
Chiauzzi et al ¹³ United States	Experimental: n = 95 (female, n = 64); mean $\pm$ SD age, 47.34 $\pm$ 12.23 y; pain duration, 100% for at least 3 mo Control: n = 104 (female, n = 70); age, 45.05 $\pm$ 11.72 y; pain duration, 100% for at least 3 mo Home-based program (online)	Multicomponent intervention	An internet-based program on cognitive behavioral therapy and self-management principles 2 sessions per week for a 4-wk period, 20 min per session	A back pain guide based on the structure of the back, causes and associated conditions, treatments, prevention, practical tips, and additional resources To be read over a 4-wk period	...	Not applicable	T0, at baseline; T1, posttreatment; T2, 3 mo; T3, 6 mo	The Pain Self-Efficacy Questionnaire Baseline, 30.81 $\pm$ 1.52 Change from baseline: posttreatment, 34.09 $\pm$ 1.61; 3 mo, 33.50 $\pm$ 1.65; 6 mo, 33.87 $\pm$ 1.76	The Pain Self-Efficacy Questionnaire Baseline, 30.79 $\pm$ 1.45 Change from baseline: posttreatment, 33.35 $\pm$ 1.49; 3 mo, 32.55 $\pm$ 1.52; 6 mo, 33.17 $\pm$ 1.62	There was no difference between groups at posttreatment, 3 mo, and 6 mo
Haas et al ²¹ United States	Experimental: n = 60 (female, n = 49); mean $\pm$ SD age, 78.6 $\pm$ 7.5 y; pain duration, 100% for more than 3 mo Control: n = 49 (female, n = 43); age, 75.5 $\pm$ 7.5 y; pain duration, 100% for more than 3 mo Community-based program	Multicomponent intervention	Program based on overview of self-management principles, care-seeking options, community resources, goal setting, problem solving 1 session per week for a 6-wk period, 150 min per session	Wait list	Lay leader who lived with chronic back condition	Group face-to-face session	T0, at baseline; T1, 6 mo	The Arthritis Self-Efficacy Scale pain subscale Baseline, 59.3 $\pm$ 25.3 Change from baseline: 6 mo, 60.7 $\pm$ 24.2	The Arthritis Self-Efficacy Scale pain subscale Baseline, 66.1 $\pm$ 16.6 Change from baseline: 6 mo, 65.4 $\pm$ 22.7	Adjusted for baseline scores There was no difference between groups at 6 mo: mean $\pm$ standard error, -3.9 $\pm$ 4.9; $P = .427$
Keller et al ³² Germany	Experimental: n = 35 (female, n = 25); mean $\pm$ SD age, 46.89 $\pm$ 12.25 y; pain duration, 9.6 $\pm$ 7.1 y Control: n = 29 (female, n = 20); age, 49.10 $\pm$ 12.75 y; pain duration, 10.9 $\pm$ 12.2 y Outpatient rehabilitation	Multicomponent intervention	Multicomponent program (biopsychosocial education, relaxation, pleasant activity scheduling and distraction, training posture and exercise 3 group sessions per week for a 6-wk period, 120 min per session plus 18 individualized sessions, 30 min per session	Wait list	Physicians and physical therapists, among others, supervised by a psychologist	Individual and group face-to-face sessions	T0, at baseline; T1, posttreatment	Pain self-efficacy (a 7-point scale) Baseline, 3.99 $\pm$ 1.22 Change from baseline: posttreatment, 5.25 $\pm$ 1.27	Pain self-efficacy (a 7-point scale) Baseline, 3.17 $\pm$ 1.47 Change from baseline: posttreatment, 3.42 $\pm$ 1.48	Adjusted for baseline scores The experimental group showed a large effect at posttreatment: $F = 16.62$, $P < .001$ compared to the control group There was no difference between groups at 6 mo: $t = -2.25$, $P = .031$
Lamb et al ³⁴ United Kingdom	Experimental: n = 468 (female, n = 278); mean $\pm$ SD age, 53 $\pm$ 14.6 y; pain duration, 13 $\pm$ 13.2 y Control: n = 233 (female, n = 142); age, 54 $\pm$ 14.9 y; pain duration, 13 $\pm$ 12.7 y General practice	Psychological therapy	Cognitive behavioral therapy 7 sessions, 90 min per session Advice 1 session of 15 min	Advice alone 1 session of 15 min	Psychologist, physical therapist, nurse, and occupational therapist trained to conduct cognitive behavioral therapy	Individual face-to-face session (initial assessment) Group face-to-face sessions (rest of sessions)	T0, at baseline; T1, 3 mo; T2, 6 mo; T3, 12 mo	The Pain Self-Efficacy Questionnaire Baseline, 40 $\pm$ 13.4 Change from baseline: 3 mo, -2.4 (95% CI: -3.46, -1.27); 6 mo, -2.6 (95% CI: -3.82, -1.44); 12 mo, -3.0 (95% CI: -4.20, -1.88)	The Pain Self-Efficacy Questionnaire Baseline, 41 $\pm$ 12.5 Change from baseline: 3 mo, 0.9 (95% CI: -0.70, 2.42); 6 mo, 1.5 (95% CI: -0.09, 3.13); 12 mo, 0.8 (95% CI: -0.85, 2.43)	Adjusted for age, sex, center, severity of back pain, baseline value, and clustering to estimate treatment effects The experimental group showed a large effect at 3 mo: mean, -3.2 (95% CI: -4.98, -1.48; $P < .0001$); 6 mo: mean, -4.2 (95% CI: -6.00, -2.31; $P < .0001$); and 12 mo: mean, -3.8 (95% CI: -5.70, -1.96; $P < .0001$) compared to the control group

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Study/Country	Sample and Setting	Type of Intervention	Experimental Group, Duration/Contact	Control Group (duration/contact)	Treatment Facilitator	Treatment Format	Follow-up After Intervention	Pain Self-efficacy		Main Findings
								Experimental Group ^a	Control Group ^a	
Morone et al ⁴² United States	Experimental: n = 140 (female, n = 93); mean $\pm$ SD age, 75 $\pm$ 72 y; pain duration, 137 $\pm$ 156.5 mo Control: n = 142 (female, n = 94); age, 74 $\pm$ 6.0 y; pain duration, 138 $\pm$ 160.3 mo Community-based program	Psychological therapy	The mindfulness-based stress reduction program, based on mindfulness meditation 1 session per week for an 8-wk period, 90 min per session 1 monthly booster session for a 6-mo period, 60 min per session	The 10 Keys to Healthy Aging program, based on key health topics on healthy aging (ie, hypertension management) 1 group session per week for an 8-wk period 1 monthly session for a 6-mo period, 60 min per session	Mindfulness-based stress reduction teacher	Group face-to-face session (10-12 participants)	T0, at baseline; T1, posttreatment (8 wk); T2, 6 mo	The Chronic Pain Self-Efficacy Scale pain subscale Baseline, 59.6 $\pm$ 17.3 Change from baseline: posttreatment (8 wk), 65.3 $\pm$ 19.5; 6 mo, 62.0 $\pm$ 20.8	The Chronic Pain Self-Efficacy Scale pain subscale Baseline, 55.7 $\pm$ 18.9 Change from baseline: posttreatment (8 wk), 55.4 $\pm$ 19.1; 6 mo, 57.9 $\pm$ 19.3	Adjusted for group, time, the interaction of group by time, and sex The experimental group showed a large effect at posttreatment: coefficient = 9.8 (95% CI: 5.3, 14.3; P = .007, Cohen's d = 0.51) compared to the control group There was no difference between groups at 6 mo: coefficient = 3.5 (95% CI: -1.2, 8.2; Cohen's d = 0.17)
Tilbrook et al ⁵⁸ United Kingdom	Experimental: n = 156 (female, n = 106); mean $\pm$ SD age, 46.4 $\pm$ 11.3 y; pain duration, 130.28 $\pm$ 117.0 mo Control: n = 157 (female, n = 114); age, 46.3 $\pm$ 11.5 y; pain duration, 113.5 $\pm$ 115.3 mo General practice	Exercise intervention	(1) Yoga 1 session per week for a 12-wk period, 75 min per session (2) Treatment as usual plus <i>The Back Book</i>	Treatment as usual and <i>The Back Book</i>	Yoga teacher	Group face-to-face session (no more than 15 participants)	T0, at baseline; T1, 3 mo; T2, 6 mo; T3, 12 mo	The Pain Self-Efficacy Questionnaire Baseline, 44.04 $\pm$ 10.71 Change from baseline: 3 mo, 3.85 (95% CI: 1.85, 5.84); 6 mo, 4.29 (95% CI: 2.27, 6.32); 12 mo, 3.35 (95% CI: 1.33, 5.37)	The Pain Self-Efficacy Questionnaire Baseline, 43.78 $\pm$ 11.76 Change from baseline: 3 mo, 0.88 (95% CI: -1.22, 2.99); 6 mo, 0.97 (95% CI: -1.15, 3.08); 12 mo, 1.60 (95% CI: -0.50, 3.70)	Adjusted for month, age, sex, eligibility score, class preference, duration of back pain, and random intercepts The experimental group showed a large effect at 3 mo: mean, 2.96 (95% CI: 0.35, 5.58; P = .027) and 6 mo: mean, 3.33 (95% CI: 0.68, 5.97; P = .014) compared to the control group There was no difference between groups at 12 mo: mean, 1.75 (95% CI: -0.87, 4.38; P = .190)

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APPENDIX B

Study/Country	Sample and Setting	Type of Intervention	Experimental Group, Duration/Contact	Control Group (duration/contact)	Treatment Facilitator	Treatment Format	Follow-up After Intervention	Pain Self-efficacy		Main Findings
								Experimental Group ^a	Control Group ^a	
Turner et al ⁵⁹ United States	Cognitive behavioral therapy: n = 112 (female, n = 66); mean $\pm$ SD age, 49.1 $\pm$ 12.6 y; pain duration, 89% for more than 12 mo Mindfulness: n = 116 (female, n = 71); age, 50.0 $\pm$ 11.9 y; pain duration, 80% for more than 12 mo Control: n = 113 (female, n = 87); age, 48.9 $\pm$ 12.5 y; pain duration, 76% for more than 12 mo Integrated health care system	Psychological therapy	(1) Cognitive behavioral therapy 1 session per week for an 8-wk period, 120 min per session (2) Mindfulness-based stress reduction 1 session per week for an 8-wk period, 120 min per session Optional booster session for 6 h	Treatment as usual	Psychologist (cognitive behavioral therapy), mindfulness-based stress reduction teacher (mindfulness)	Group face-to-face session	T0, at baseline; T1, 8 wk; T2, 26 wk; T3, 52 wk	The Pain Self-Efficacy Questionnaire Baseline: cognitive behavioral therapy, 46.44 $\pm$ 9.66; mindfulness, 44.86 $\pm$ 9.47 Change from baseline: 8 wk: cognitive behavioral therapy, 4.02 (95% CI: 2.83, 5.22) and mindfulness, 4.36 (95% CI: 3.08, 5.64); 26 wk: cognitive behavioral therapy, 4.63 (95% CI: 3.08, 6.19) and mindfulness, 4.05 (95% CI: 2.37, 5.73); 52 wk: cognitive behavioral therapy, 5.72 (95% CI: 4.44, 7.00) and mindfulness, 4.14 (95% CI: 2.94, 5.34)	The Pain Self-Efficacy Questionnaire Baseline, 46.88 $\pm$ 8.56 Change from baseline: 8 wk, 1.33 (95% CI: 0.10, 2.57); 26 wk, 2.99 (95% CI: 1.71, 4.27); 52 wk, 3.70 (95% CI: 2.39, 5.02)	Adjusted for age, sex, education, whether at least 1 y since a week without pain, baseline score on the Roland-Morris Disability Questionnaire, pain bothersomeness, and the therapeutic mechanism measure The cognitive behavioral therapy group showed a large effect at 8 wk: mean, 2.69 (95% CI: 0.96, 4.42; $P < .05$) compared to the control group The mindfulness group showed a large effect at 8 wk: mean, 3.03 (95% CI: 1.23, 4.82; $P < .05$) compared to the control group There was no difference between the cognitive behavioral therapy group and the control group at 26 wk: mean, 1.64 (95% CI: -0.39, 3.68) and 52 wk: mean, 2.02 (95% CI: 0.16, 3.87) There was no difference between the mindfulness group and the control group at 26 wk: mean, 1.06 (95% CI: -1.06, 3.18) and 52 wk: mean, 0.43 (95% CI: -1.36, 2.23) There was no difference between the cognitive behavioral therapy group and the mindfulness group at 8 wk: mean, 0.34 (95% CI: -1.43, 2.10); 26 wk: mean, 0.58 (95% CI: -2.90, 1.74); and 52 wk: mean, -1.58 (95% CI: -3.38, 0.21)

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APPENDIX B

Study/Country	Sample and Setting	Type of Intervention	Experimental Group, Duration/Contact	Control Group (duration/contact)	Treatment Facilitator	Treatment Format	Follow-up After Intervention	Pain Self-efficacy		Main Findings
								Experimental Group ^a	Control Group ^a	
van der Roer et al ⁶¹ the Netherlands	Experimental: n = 60 (female, n = 33); mean $\pm$ SD age, 41.5 $\pm$ 8.8 y; pain duration, 53.9 $\pm$ 70.6 wk Control: n = 54 (female, n = 26); age, 42.0 $\pm$ 9.9 y; pain duration, 47.2 $\pm$ 64.3 wk Primary health care	Multicomponent intervention	Multicomponent program (exercise intervention plus back school plus a behavioral approach) 10 individual and 20 group sessions	Usual physical therapy guideline care (mean, 13 sessions per individual)	Physical therapist trained to conduct this intervention	Individual and group face-to-face sessions	T0, at baseline; T1, 6 wk; T2, 13 wk; T3, 26 wk; T4, 52 wk	The Pain Self-Efficacy Questionnaire Baseline, ^b 375 Change from baseline ^b : 6 wk, 40.1; 13 wk, 43.4; 26 wk, 41.4; 52 wk, 43.8	The Pain Self-Efficacy Questionnaire Baseline, ^b 377 Change from baseline ^b : 6 wk, 37.9; 13 wk, 40.1; 26 wk, 41.8; 52 wk, 41.2	Adjusted for baseline scores, ethnicity, and work status There was no difference between groups at 6 wk: regression coefficient = 2.41 (95% CI: -0.80, 5.61); 13 wk: regression coefficient = 3.55 (95% CI: -0.49, 7.59); 26 wk: regression coefficient = -0.16 (95% CI: -4.42, 4.11); and 52 wk: regression coefficient = 2.80 (95% CI: -1.86, 7.46)
Wajswelner et al ⁶³ Australia	Experimental: n = 44 (female, n = 25); mean $\pm$ SD age, 49.3 $\pm$ 14.1 y; pain duration, 13.6 $\pm$ 14.2 y Control: n = 43 (female, n = 23); age, 48.9 $\pm$ 16.4 y; pain duration, 14.2 $\pm$ 12.7 y Private practice	Exercise intervention	Pilates with equipment 2 sessions per week for a 6-wk period, 60 min per session	Standardized set of exercises (ie, leg stretches or upper-body weights) 2 sessions per week for a 6-wk period, 60 min per session	Physical therapist	Group face-to-face sessions (no more than 4 participants)	T0, at baseline; T1, posttreatment (6 wk); T2, 12 wk; T3, 24 wk	The Pain Self-Efficacy Questionnaire Baseline, 43.1 $\pm$ 10.6 Change from baseline: posttreatment (6 wk), 51.2 $\pm$ 10.4; 12 wk, 51.7 $\pm$ 10.5; 24 wk, 50.1 $\pm$ 9.2	The Pain Self-Efficacy Questionnaire Baseline, 46.3 $\pm$ 9.3 Change from baseline: posttreatment (6 wk), 50.7 $\pm$ 8.0; 12 wk, 51.5 $\pm$ 11.9; 24 wk, 52.4 $\pm$ 7.6	Adjusted for baseline scores There was no difference between groups at posttreatment (6 wk): mean, 2.1 (95% CI: -0.8, 5.1); 12 wk: mean, 1.9 (95% CI: -3.1, 6.9); and 24 wk: mean, 1.3 (95% CI: -4.2, 6.8)
Zadro et al ⁶⁷ Australia	Experimental: n = 30 (female, n = 18); mean $\pm$ SD age, 68.8 $\pm$ 5.5 y; pain duration, 5.27 $\pm$ 3.41 mo Control: n = 30 (female, n = 13); age, 67.8 $\pm$ 6.0 y; pain duration, 7.45 $\pm$ 4.36 mo Community and waiting list	Exercise intervention	Video-game exercises, based on unsupervised home-based exercises using video games 3 sessions per week for an 8-wk period, 60 min per session	Treatment as usual	Physical therapist (initial assessment)	Individual face-to-face session (first assessment) Unsupervised (rest of sessions)	T0, at baseline; T1, posttreatment (8 wk); T2, 3 mo; T3, 6 mo	The Pain Self-Efficacy Questionnaire Baseline, 50.7 $\pm$ 8.2 Change from baseline: posttreatment (8 wk), 47.8 $\pm$ 10.3; 3 mo, 49.2 $\pm$ 8.8; 6 mo, 48.8 $\pm$ 10.5	The Pain Self-Efficacy Questionnaire Baseline, 48.2 $\pm$ 8.3 Change from baseline: posttreatment (8 wk), 44.6 $\pm$ 9.6; 3 mo, 43.1 $\pm$ 12.1; 6 mo, 41.7 $\pm$ 11.2	Adjusted for baseline scores and functional status The experimental group showed a large effect at 6 mo: β = 5.17 (95% CI: 0.52, 9.82; P = .03) compared to the control group There was no difference between groups at posttreatment: β = 1.20 (95% CI: -3.23, 5.64; P = .59) and 3 mo: β = 4.33 (95% CI: -0.24, 8.80; P = .06)

Abbreviation: CI, confidence interval.

^aValues are mean $\pm$ SD.

^bStandard deviations were not reported for this study.

APPENDIX B

Fibromyalgia

Study/Country	Sample and Setting	Type of Intervention	Experimental Group, Duration/Contact	Control Group (duration/contact)	Treatment Facilitator	Treatment Format	Follow-up After Intervention	Pain Self-efficacy		Main Findings
								Experimental Group ^a	Control Group ^a	
Amris et al ¹ Denmark	Experimental: n = 96 (all female); mean $\pm$ SD age, 44.4 $\pm$ 10.9 y; pain duration: median, 11 y Control: n = 95 (all female); age, 44.2 $\pm$ 10.8 y; pain duration: median, 10 y Tertiary care	Multicomponent intervention	Multicomponent program (biopsychosocial education plus group discussion plus physical therapy plus supervised exercise sessions plus relaxation) A daily scheduled program between 3 and 5 h (a total of 35 h)	Wait list	Multidisciplinary team (rheumatologist, psychologist, occupational therapist, and physical therapist)	Group face-to-face session Individual session (psychologist for 2 h and rheumatologist for 30 min)	T0, at baseline; T1, 6 mo	The Pain Self-Efficacy Questionnaire Baseline: median, 25.0 Change from baseline: 6 mo, 3.10 (95% CI: 1.37, 4.82)	The Pain Self-Efficacy Questionnaire Baseline: median, 22.0 Change from baseline: 6 mo, 1.48 (95% CI: -0.25, 3.22)	Adjusted for baseline scores There was no difference between groups at 6 mo: mean, 1.61 (95% CI: -0.84, 4.06; $P = .20$)
Friesen et al ¹⁵ Canada	Experimental: n = 30 (female, n = 28); mean $\pm$ SD age, 49 $\pm$ 10 y; pain duration, 20 $\pm$ 9 y Control: n = 30 (female, n = 29); age, 46 $\pm$ 13 y; pain duration, 13 $\pm$ 10 y Home-based program (online)	Psychological therapy	An internet cognitive behavioral pain management course 5 lessons for an 8-wk period	Wait list	...	Not applicable	T0, at baseline; T1, post-treatment (8 wk)	The Pain Self-Efficacy Questionnaire Baseline, 22.93 $\pm$ 9.78 Change from baseline: posttreatment (8 wk), 29.99 $\pm$ 11.10	The Pain Self-Efficacy Questionnaire Baseline, 19.83 $\pm$ 10.25 Change from baseline: posttreatment (8 wk), 22.00 $\pm$ 10.18	There was no difference between groups at posttreatment: effect size, 0.75 (95% CI: 0.23, 1.27)
Hammond and Freeman ²³ United Kingdom	Experimental: n = 71 (female, n = 63); mean $\pm$ SD age, 48.36 $\pm$ 10.91 y; pain duration, 2.68 $\pm$ 2.80 y Control: n = 62 (female, n = 57); age, 48.73 $\pm$ 10.95 y; pain duration, 2.77 $\pm$ 2.95 y Community-based program	Multicomponent intervention	Biopsychosocial education plus exercise (ie, tai chi or postural training) 1 session per week for a 10-wk period, 120 min per session	The Arthritis Research Campaign booklet on fibromyalgia and relaxation (ie, deep breathing) 1 session per week for a 10-wk period, 60 min per session	Occupational therapist and physical therapist trained to conduct biopsychosocial education	Group face-to-face session (no more than 8 participants)	T0, at baseline; T1, 4 mo; T2, 8 mo	The Arthritis Self-Efficacy Scale pain subscale Baseline, 4.22 $\pm$ 1.94 Change from baseline: 4 mo, 4.85 $\pm$ 2.03; 8 mo, 4.23 $\pm$ 1.85	The Arthritis Self-Efficacy Scale pain subscale Baseline, 4.20 $\pm$ 1.53 Change from baseline: 4 mo, 4.08 $\pm$ 1.65; 8 mo, 4.22 $\pm$ 1.90	The experimental group showed a large effect at 4 mo ($P = .003$) compared to the control group There was no difference between groups at 8 mo ($P = .93$)

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APPENDIX B

Study/Country	Sample and Setting	Type of Intervention	Experimental Group, Duration/Contact	Control Group (duration/contact)	Treatment Facilitator	Treatment Format	Follow-up After Intervention	Pain Self-efficacy		Main Findings
								Experimental Group ^a	Control Group ^a	
Hamnes et al ²⁶ Norway	Experimental: n = 75 (female, n = 69); mean ± SD age, 45.4 ± 9.4 y; pain duration, 7.03 ± 7.21 y Control: n = 72 (all female); age, 49.7 ± 4.0 y; pain duration, 6.13 ± 6.53 y Inpatient rehabilitation	Multicomponent intervention	Multicomponent program (overview of self-management principles plus cognitive behavioral approach plus exercise (ie, walking) A total of 24 h	Wait list	Nurse, rheumatologist, physical therapist, dietitian, among others	Individual face-to-face session (ie, individual consultation) Group face-to-face session (ie, group exercises)	T0, at baseline; T1, posttreatment (3 wk)	The Arthritis Self-Efficacy Scale pain subscale Baseline, ^b 50.6 Change from baseline ^b : posttreatment (3 wk), 54.8	The Arthritis Self-Efficacy Scale pain subscale Baseline, ^b 51.4 Change from baseline ^b : posttreatment (3 wk), 52.3	Adjusted for sex, education, marital status, and currently employed There was no difference between groups at posttreatment: coefficient = -1.83 (95% CI: -6.0, 2.3; <i>P</i> = .387)
Jones et al ³⁰ United States	Experimental: n = 51 (female, n = 47); mean age, 53.3 y; pain duration, 17.0 y Control: n = 47 (female, n = 44); age, 54.8 y; pain duration, 19.8 y Community-based program	Exercise intervention	Tai chi 2 sessions per week for a 12-wk period, 90 min per session	Biopsychosocial education 2 sessions per week for a 12-wk period, 90 min per session	Tai chi master	Group face-to-face session (8-12 participants)	T0, at baseline; T1, posttreatment (12 wk)	The Arthritis Self-Efficacy Scale pain subscale Baseline, ^b 52.3 Change from baseline, 9.2 (95% CI: 2.1, 18.3)	The Arthritis Self-Efficacy Scale pain subscale Baseline, ^b 51.4 Change from baseline, -1.5 (95% CI: -0.7, -0.2)	Adjusted for baseline differences The experimental group showed a large effect at posttreatment (<i>P</i> < .001) compared to the control group
Menzies et al ³⁹ United States	Total: n = 48 (all female); mean ± SD age, 49.6 ± 10.53 y; pain duration not reported Physician office and clinics	Psychological therapy	Guided imagery 3 guided imagery audiotapes used daily for a 6-wk period and a 4-wk follow-up, 20 min per audiotape, plus treatment as usual	Treatment as usual	...	Individual (audiotapes)	T0, at baseline; T1, posttreatment (6 wk); T2, 10 wk	The Arthritis Self-Efficacy Scale pain subscale Baseline, 51.91 ± 4.72 Change from baseline: posttreatment (6 wk), 58.25 ± 4.82; 10 wk, 64.73 ± 4.69	The Arthritis Self-Efficacy Scale pain subscale Baseline, 50.75 ± 4.52 Change from baseline: posttreatment (6 wk), 45.75 ± 4.61; 10 wk, 49.83 ± 4.49	Adjusted for absorption and baseline scores The experimental group showed a large effect at posttreatment (<i>P</i> = .03) and at 10 wk (<i>P</i> = .03) compared to the control group

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APPENDIX B

Study/Country	Sample and Setting	Type of Intervention	Experimental Group, Duration/Contact	Control Group (duration/contact)	Treatment Facilitator	Treatment Format	Follow-up After Intervention	Pain Self-efficacy		Main Findings
								Experimental Group ^a	Control Group ^a	
Oliver et al ⁴⁷ United States	Social support and health education: n = 207 (female, n = 199); mean ± SD age, 55.1 ± 11.0 y; pain duration, 14.4 ± 14.2 y Social support: n = 200 (female, n = 191); age, 53.7 ± 11.6 y; pain duration, 13.6 ± 13.2 y Control: n = 193 (female, n = 182); age, 52.9 ± 11.7 y; pain duration, 11.7 ± 12.1 y Health maintenance organization	Self-man-agement intervention	(1) Social support plus health education 1 session per week for a 10-wk period plus 10 monthly sessions, 120 min per session (2) Social support 1 session per week for a 10-wk period plus 10 monthly sessions, 60 min per session	No intervention	Education (professional health educator) Social support (staff member)	Group face-to-face session	T0, at baseline; T1, 12 mo	Adapted Arthritis Self-Efficacy Scale pain subscale Baseline: social support and health education, 46.5 ± 21.9; social support, 45.7 ± 21.4 Change from baseline: 12 mo: social support and health education, 55.4 ± 18.7; social support, 53.6 ± 22.1	Adapted Arthritis Self-Efficacy Scale pain subscale Baseline, 47.4 ± 23.3 Change from baseline: 12 mo, 52.0 ± 19.6	Adjusted for comorbidities There was no difference between groups at 12 mo (F = 1.27)
Schachter et al ⁵² Canada	Long bout of exercise: n = 51 (all female); mean ± SD age, 41.3 ± 8.67 y; pain duration, 8.8 ± 6.18 y Short bout of exercise: n = 56 (all female); age, 41.9 ± 8.57 y; pain duration, 8.6 ± 6.04 y Control: n = 36 (all female); age, 44.5 ± 6.69 y; pain duration, 8.8 ± 4.97 y Home-based videotape-based program	Exercise intervention	(1) Long bout of aerobic exercise 1 session per day for a 16-wk period, 10 min per session, progressed to 30 min by week 9 and maintained up to week 16 (2) Short bout of aerobic exercise 2 sessions per day for a 16-wk period, 5 min per session, progressed to 15 min by week 9 and maintained up to week 16	No exercise	Fitness instructor	Group face-to-face session	T0, at baseline; T1, post-treatment (16 wk)	The Chronic Pain Self-Efficacy Scale pain subscale Baseline: long bout of exercise, 55.4 ± 24.30; short bout of exercise, 57.8 ± 22.48 Change from baseline: posttreatment (16 wk): long bout of exercise, 58.8 ± 25.73; short bout of exercise, 63.4 ± 27.27	The Chronic Pain Self-Efficacy Scale pain subscale Baseline, 50.6 ± 23.28 Change from baseline: posttreatment (16 wk), 48.8 ± 25.60	There was no difference between the short-bout group or the long-bout group and the control group at posttreatment

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APPENDIX B

								Pain Self-efficacy		
Study/Country	Sample and Setting	Type of Intervention	Experimental Group, Duration/Contact	Control Group (duration/contact)	Treatment Facilitator	Treatment Format	Follow-up After Intervention	Experimental Group ^a	Control Group ^a	Main Findings
Verkaik et al ⁶² the Netherlands	Experimental: n = 32 (all female); mean $\pm$ SD age, 47.3 $\pm$ 10.3 y; pain duration: 53% for less than 12 mo, 38% for 2-4 y, 9% for 5-6 y Control: n = 33 (female, n = 32); age, 47.7 $\pm$ 12.5 y; pain duration: 37% for less than 12 mo, 48% for 2-4 y, 12% for 5-6 y Unclear	Psychological therapy	Group discussion plus information about guided imagery plus a compact disc with guided imagery exercises 2 sessions, 90 min per session; 1-2 guided imagery exercises per day for a 4-wk period	Group discussion 2 sessions, 90 min per session	Rheumatology nurse (group discussion) A qualified trainer (guided imagery)	Group face-to-face session (6-12 individuals)	T0, at baseline; T1, post-treatment; T2, 6 wk	The Chronic Pain Self-Efficacy Scale pain subscale Baseline, 52.4 $\pm$ 2.82 Change from baseline ($\pm$ SE): posttreatment, 56.3 $\pm$ 3.57; 6 wk, 54.3 $\pm$ 3.08	The Chronic Pain Self-Efficacy Scale pain subscale Baseline, 51.9 $\pm$ 3.13 Change from baseline ($\pm$ SE): posttreatment, 49.5 $\pm$ 2.29; 6 wk, 52.8 $\pm$ 2.87	Adjusted for baseline scores, medication use, and duration of fibromyalgia diagnosis There was no difference between groups at posttreatment and at 6 wk

Abbreviations: CI, confidence interval; SE, standard error.

^aValues are mean $\pm$ SD.

^bStandard deviations were not reported for this study.

Arthritis

								Pain Self-efficacy		
Study/Country	Sample and Setting	Type of Intervention	Experimental Group, Duration/Contact	Control Group (duration/contact)	Treatment Facilitator	Treatment Format	Follow-up After Intervention	Experimental Group ^a	Control Group ^a	Main Findings
Barlow et al ² United Kingdom RA	Experimental: n = 53 (female, n = 44); mean $\pm$ SD age, 58.62 $\pm$ 11.25 y; pain duration, 14.62 $\pm$ 11.49 y Control: n = 55 (female, n = 44); age, 60.04 $\pm$ 10.82 y; pain duration, 17.04 $\pm$ 12.29 y Outpatient rehabilitation	Self-management intervention	Education through RA leaflets	No intervention	Not applicable	Not applicable	T0, at baseline; T1, 3 wk	The Arthritis Self-Efficacy Scale pain subscale Baseline, 20.73 $\pm$ 11.91 Change from baseline: 3 wk, 2.79 $\pm$ 9.47	The Arthritis Self-Efficacy Scale pain subscale Baseline, 19.64 $\pm$ 11.08 Change from baseline: 3 wk, 1.13 $\pm$ 9.78	Adjusted for baseline scores There was no difference between groups at 3 wk (P = .199)

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Study/Country	Sample and Setting	Type of Intervention	Experimental Group, Duration/Contact	Control Group (duration/contact)	Treatment Facilitator	Treatment Format	Follow-up After Intervention	Pain Self-efficacy		Main Findings
								Experimental Group ^a	Control Group ^a	
Barlow et al ³ United Kingdom Heterogeneous arthritis	Experimental: n = 311 (female, n = 264); mean ± SD age, 57.3 ± 13.2 y; pain duration, 10.7 ± 11.2 y Control: n = 233 (female, n = 193); age, 59.1 ± 12.3 y; pain duration, 11.3 ± 10.9 y Community-based program	Multicomponent intervention	The arthritis self-management program (ie, information about arthritis, overview of self-management principles, cognitive symptoms management, dealing with depression) 1 session per week for a 6-wk period, 120 min per session	Wait list	Lay leaders, most of whom had arthritis themselves	Group face-to-face session	T0, at baseline; T1, 4 mo	The Arthritis Self-Efficacy Scale pain subscale Baseline, 23.02 (95% CI: 21.54, 24.49) Change from baseline: 4 mo, 4.11 (95% CI: 2.84, 5.38)	The Arthritis Self-Efficacy Scale pain subscale Baseline, 23.70 (95% CI: 21.94, 25.46) Change from baseline: 4 mo, 1.46 (95% CI: 0.18, 2.74)	Adjusted for age, sex, disease duration, comorbidities, and education The experimental group showed a large effect at 4 mo (mean, 2.65; 99% CI: 0.85, 4.44; <i>P</i> < .0005)
Bennell et al ⁴ Australia Hip OA	Experimental: n = 49 (female, n = 26); mean ± SD age, 64.5 ± 8.6 y; pain duration: median, 36 mo (IQR, 24-60) Control: n = 53 (female, n = 36); age, 62.7 ± 6.4 y; pain duration: median, 30 mo (IQR, 24-60) Community-based program	Multicomponent intervention	Manual therapy, home exercise, education, and advice 10 sessions for a 12-wk period, 45-60 min for the initial 2 sessions and 30 min for the remaining 8 sessions	Sham intervention 10 sessions for a 12-wk period, 45-60 min for the initial 2 sessions and 30 min for the remaining 8 sessions	Physical therapist	Individual face-to-face session	T0, at baseline; T1, 13 wk; T2, 36 wk	The Arthritis Self-Efficacy Scale pain subscale Baseline, 5.0 ± 1.7 Change from baseline: 13 wk, 6.3 ± 2.2; 36 wk, 5.9 ± 2.4	The Arthritis Self-Efficacy Scale pain subscale Baseline, 5.3 ± 1.8 Change from baseline: 13 wk, 6.2 ± 2.1; 36 wk, 5.9 ± 1.9	Adjusted for baseline scores There was no difference between groups at 13 wk (mean, 0.3; CI: -0.7, 1.3) and 36 wk (mean, 0.1; CI: -1.1, 1.3)
Bennell et al ⁵ Australia Chronic knee pain	Experimental: n = 74 (female, n = 43); mean ± SD age, 60.8 ± 6.5 y; pain duration: 15% for <2 y, 51% for 2-10 y, 34% for >10 y Control: n = 74 (female, n = 40); age, 61.5 ± 7.6 y; pain duration: 32% for <2 y, 47% for 2-10 y, 20% for >10 y Community-based program	Multicomponent intervention	Internet-based program based on biopsychosocial education plus pain coping skills training (30-45 min per module) plus video-call sessions with a physical therapist 7 sessions, 12-45 min per session, plus home exercise (3 sessions per week)	Internet-based biopsychosocial education program	Physical therapist (exercise intervention)	Individual face-to-face exercise Self-management (internet-delivered material)	T0, at baseline; T1, 3 mo; T2, 9 mo	The Arthritis Self-Efficacy Scale pain subscale Baseline, 6.1 ± 1.8 Change from baseline: 3 mo, 7.6 ± 2.0; 9 mo, 7.5 ± 2.0	The Arthritis Self-Efficacy Scale pain subscale Baseline, 5.9 ± 1.8 Change from baseline: 3 mo, 5.7 ± 2.1; 9 mo, 6.2 ± 1.8	Adjusted for baseline scores of outcome, sex, and geographic location, as well as clustering effects for physical therapist and measurements from the same participant The experimental group showed a large effect at 3 mo (mean, -1.9; CI: -2.5, -1.2; <i>P</i> < .001) and 9 mo (mean, -1.2; CI: -1.9, -0.6; <i>P</i> < .001)

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APPENDIX B

Study/Country	Sample and Setting	Type of Intervention	Experimental Group, Duration/Contact	Control Group (duration/contact)	Treatment Facilitator	Treatment Format	Follow-up After Intervention	Pain Self-efficacy		Main Findings
								Experimental Group ^a	Control Group ^a	
Bieler et al ⁶ Denmark Hip OA	Experimental (Nordic walking): n = 50 (female, n = 33); mean $\pm$ SD age, 70.0 $\pm$ 6.3 y; pain duration, 6.5 $\pm$ 7.8 y Experimental (strength training): n = 50 (female, n = 34); age, 69.6 $\pm$ 5.4 y; pain duration, 5.1 $\pm$ 4.5 y Control group: n = 52 (female, n = 36); age, 69.3 $\pm$ 6.4 y; pain duration, 6.7 $\pm$ 5.9 y Private center and home-based program	Exercise intervention	(1) Nordic walking 3 sessions per week, 60 min per session (2) Strength training 3 sessions per week, 60 min per session	Unsupervised home-based exercise	Physical therapist	Group face-to-face session	T0, at baseline; T1, 12 mo	The Arthritis Self-Efficacy Scale pain subscale Baseline, 63.4 $\pm$ 17.9 Change from baseline: 12 mo, not reported	The Arthritis Self-Efficacy Scale pain subscale Baseline, 67.8 $\pm$ 19.5 Change from baseline: 12 mo, not reported	Adjusted for participant characteristics and the values of the corresponding outcome at preceding time points The Nordic walking group showed a large effect at 12 mo (11.1 points; 95% CI: 0.1, 22.2; $P = .0471$) compared to the strength training group Differences between groups at 12 mo, considering the effectiveness of Nordic walking or strength training compared to the control group, were not reported
Bossen et al ⁸ the Netherlands Knee and/or hip OA	Experimental: n = 100 (female, n = 60); mean $\pm$ SD age, 61 $\pm$ 5.9 y; pain duration: 12% for <12 mo, 28% for >1-3 y, 27% for >3-7 y, 33% for $\geq$ 7 y Control: n = 99 (female, n = 69); age, 63 $\pm$ 5.4 y; pain duration: 6.1% for <12 mo, 27.3% for >1-3 y, 27.3% for >3-7 y, 39.4% for $\geq$ 7 y Home-based program (online)	Multicomponent intervention	An internet-based program that incorporates a baseline test, goal setting, time-contingent physical activity objectives, and text messages to promote physical activity 1 module per week for a 9-wk period	Wait list	Not applicable	Not applicable	T0, at baseline; T1, 3 mo; T2, 12 mo	The Arthritis Self-Efficacy Scale pain subscale Baseline, 4.1 (95% CI: 3.6, 4.6) Change from baseline: 3 mo, 4 (95% CI: 3.6, 4.4); 12 mo, 4 (95% CI: 3.6, 4.4)	The Arthritis Self-Efficacy Scale pain subscale Baseline, 3.8 (95% CI: 3.6, 4.2) Change from baseline: 3 mo, 3.7 (95% CI: 3.3, 4.1); 12 mo, 3.9 (95% CI: 3.5, 4.3)	Adjusted for baseline scores, age, OA location, and sex The experimental group showed a large effect at 3 mo (coefficient = 0.31; 95% CI: 0.1, 0.5; $P = .008$; effect size, 0.17) compared to the control group There was no difference between groups at 12 mo (coefficient = 0.12; 95% CI: -0.1, 0.4; $P = .35$; effect size, 0.06)
Buszewicz et al ⁹ United Kingdom Knee and/or hip OA	Experimental: n = 406 (female, n = 255); mean $\pm$ SD age, 68.4 $\pm$ 8.2 y; pain duration not reported Control: n = 406 (female, n = 255); age, 68.7 $\pm$ 8.6 y; pain duration not reported Primary health care	Self-management intervention	An education booklet plus a self-management arthritis course	An education booklet	...	...	T0, at baseline; T1, 4 mo; T2, 12 mo	The Arthritis Self-Efficacy Scale pain subscale Baseline, 18.9 $\pm$ 6.7 Change from baseline: 4 mo and 12 mo, not reported	The Arthritis Self-Efficacy Scale pain subscale Baseline, 19.2 $\pm$ 6.4 Change from baseline: 4 mo and 12 mo, not reported	Adjusted for baseline scores The experimental group showed a large effect at 4 mo (mean, 1.63; CI: 0.83, 2.43) and 12 mo (mean, 0.98; CI: 0.07, 1.89) compared to the control group

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APPENDIX B

Study/Country	Sample and Setting	Type of Intervention	Experimental Group, Duration/Contact	Control Group (duration/contact)	Treatment Facilitator	Treatment Format	Follow-up After Intervention	Pain Self-efficacy		Main Findings
								Experimental Group ^a	Control Group ^a	
Callahan et al ¹¹ United States Heterogeneous arthritis	Experimental: n = 172 (female, n = 149); mean ± SD age, 67.8 ± 0.8 y; pain duration: 100% for >12 mo Control: n = 167 (female, n = 134); age, 69.9 ± 0.8 y; pain duration: 100% for >12 mo Community-based program	Psychological therapy	Program based on a cognitive behavioral approach (ie, setting goals and managing time) 1 session per week for a 20-wk period, 60 min per session	Wait list	Health instructor	Group face-to-face session	T0, at baseline; T1, posttreatment (20 wk)	The Arthritis Self-Efficacy Scale pain subscale Baseline, 6.59 ± 0.17 Change from baseline: posttreatment (20 wk), 6.93 (95% CI: 6.59, 7.26)	The Arthritis Self-Efficacy Scale pain subscale Baseline, 6.65 ± 0.14 Change from baseline: posttreatment (20 wk), 6.69 (95% CI: 6.35, 7.03)	Adjusted for baseline scores, sex, age, ethnicity, education, and nonarthritis comorbidities There was no difference between groups at post-treatment (effect size, 0.12)
Callahan et al ¹⁰ United States Heterogeneous arthritis	Experimental: n = 151 (female, n = 134); mean ± SD age, 66.5 ± 11.1 y; pain duration not reported Control: n = 133 (female, n = 114); age, 66.3 ± 11.8 y; pain duration not reported Community-based program	Exercise intervention	Tai chi 2 sessions per week for an 8-wk period, 60 min per session	Wait list	Tai chi instructor	Group face-to-face session	T0, at baseline; T1, posttreatment (8 wk)	The Arthritis Self-Efficacy Scale pain subscale Baseline, 7.35 ± 1.55 Change from baseline: posttreatment (8 wk), 7.48 ± 2.08	The Arthritis Self-Efficacy Scale pain subscale Baseline, 6.99 ± 1.90 Change from baseline: posttreatment (8 wk), 7.05 ± 1.92	Adjusted for sex, age, body mass index, and comorbidities There was no difference between groups at post-treatment (effect size, 0.04; 95% CI: -0.27, 0.35)
Grønning et al ^{16,17} Norway Heterogeneous arthritis	Experimental: n = 71 (female, n = 48); mean ± SD age, 58 ± 12 y; pain duration, 13 ± 14 y Control: n = 70 (female, n = 49); age, 58 ± 11 y; pain duration, 11 ± 12 y Hospital	Multicomponent intervention	Program based on self-management, education, and coping skills 3 group sessions for a 6-wk period, 180 min per session plus 1 individual session, 45 min	Treatment as usual	Nurse	Group face-to-face session (8-10 participants) Individual face-to-face session	T0, at baseline; T1, 4 mo; T2, 12 mo	The Arthritis Self-Efficacy Scale pain subscale Baseline, 57.7 ± 19.5 Change from baseline: 4 mo, 58.48 ± 18.9; 12 mo, 56.9 ± 20.7	The Arthritis Self-Efficacy Scale pain subscale Baseline, 59.7 ± 17.0 Change from baseline: 4 mo, 57.26 ± 16.3; 12 mo, 58.6 ± 17.5	Adjusted for baseline scores There was no difference between groups at 4 mo (coefficient = 2.53; 95% CI: -1.8, 6.9; P = .25) and 12 mo (coefficient = -0.4; 95% CI: -5.4, 4.6; P = .879)
Hammond and Freeman ^{24,25} United Kingdom RA	Experimental: n = 65 (female, n = 53); mean ± SD age, 49.49 ± 11.43 y; pain duration, 17.52 ± 14.79 mo Control: n = 62 (female, n = 44); age, 51.56 ± 9.73 y; pain duration, 21.34 ± 18.68 mo Outpatient rehabilitation	Multicomponent intervention	Program based on educational, behavioral, motor learning, and self-efficacy strategies 4 sessions, 120 min per session	Short talks about alternative therapies, diet, exercise, rest and positioning, assistive devices 4 sessions, 120 min per session	Rheumatology occupational therapist	Group face-to-face session (4-8 participants)	T0, at baseline; T1, 12 mo; T2, 48 mo	The Arthritis Self-Efficacy Scale pain subscale Baseline, 50.67 ± 19.82 Change from baseline: 12 mo, 58.41 ± 21.90; 48 mo: median, 54 (IQR, 36-76)	The Arthritis Self-Efficacy Scale pain subscale Baseline, 51.42 ± 20.76 Change from baseline: 12 mo, 54.15 ± 22.89; 48 mo: median, 52 (IQR, 40-69)	There was no difference between groups at 12 mo (P = .31) and 48 mo (P = .37)

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APPENDIX B

Study/Country	Sample and Setting	Type of Intervention	Experimental Group, Duration/Contact	Control Group (duration/contact)	Treatment Facilitator	Treatment Format	Follow-up After Intervention	Pain Self-efficacy		Main Findings
								Experimental Group ^a	Control Group ^a	
Hammond et al ²² United Kingdom Heterogeneous arthritis	Experimental: n = 86 (female, n = 57); mean $\pm$ SD age, 55.29 $\pm$ 11.84 y; pain duration, 756 $\pm$ 709 y Control: n = 81 (female, n = 51); age, 55.56 $\pm$ 13.10 y; pain duration, 720 $\pm$ 6.68 y Hospital	Multicomponent intervention	Multicomponent program based on education, exercise, electrotherapy, cognitive symptoms management 8 sessions, 150 min per session, plus 120-min review meeting	Short talks about alternative therapies, diet, exercise, rest and positioning, assistive devices 5 sessions, 120 min per session	Rheumatology nurse, consultant rheumatologist, occupational therapist, and physical therapist	Group face-to-face session	T0, at baseline; T1, 6 mo; T2, 12 mo	The Arthritis Self-Efficacy Scale pain subscale Baseline, 4.75 $\pm$ 1.80 Change from baseline: 6 mo, 0.60 $\pm$ 1.77; 12 mo, 0.64 $\pm$ 2.04	The Arthritis Self-Efficacy Scale pain subscale Baseline, 4.49 $\pm$ 1.70 Change from baseline: 6 mo, 0.47 $\pm$ 1.73; 12 mo, 0.35 $\pm$ 1.52	Adjusted for baseline scores There was no difference between groups at 6 mo (F = 1.05, P = .31) and 12 mo (F = 2.48, P = .12)
Hansson et al ²⁷ Sweden Heterogeneous OA	Experimental: n = 61; mean $\pm$ SD age, 62 $\pm$ 9.43 y; pain duration not reported Control: n = 53; age, 63 $\pm$ 9.51 y; pain duration not reported Female, n = 97 in total Primary health care	Self-management intervention	Education based on a biopsychosocial approach 1 session per week for a 5-wk period, 180 min per session	Treatment as usual	Physical therapist, occupational therapist, nurse, orthopaedic specialist, and nutritionist	Group face-to-face session (8-10 participants)	T0, at baseline; T1, 6 mo	The Arthritis Self-Efficacy Scale pain subscale Baseline, not reported Change from baseline ^b : 6 mo, 4.94	The Arthritis Self-Efficacy Scale pain subscale Baseline, not reported Change from baseline ^b : 6 mo, 4.08	There was no difference between groups at 6 mo (mean, 0.86; 95% CI: -6.72, 8.44; P = .82)
Helminen et al ²⁸ Finland Knee OA	Experimental: n = 55 (female, n = 39); mean $\pm$ SD age, 64.5 $\pm$ 7.3 y; pain duration, 6.6 $\pm$ 4.5 y Control: n = 56 (female, n = 38); age, 62.8 $\pm$ 7.2 y; pain duration, 8.9 $\pm$ 8.7 y Primary health care	Psychological intervention	Cognitive behavioral therapy 1 session per week for a 6-wk period, 120 min per session, plus treatment as usual	Treatment as usual	Psychologist and physical therapist	Group face-to-face session (7-13 participants)	T0, at baseline; T1, posttreatment (6 wk)	The Pain Self-Efficacy Questionnaire Baseline, 44.0 (95% CI: 41.5, 46.4) Change from baseline: posttreatment (6 wk), 43.1 (95% CI: 40.1, 46.2)	The Pain Self-Efficacy Questionnaire Baseline, 43.5 (95% CI: 40.6, 46.4) Change from baseline: posttreatment (6 wk), 46.2 (95% CI: 43.3, 49.0)	Adjusted for age, sex, and disease severity The control group showed a large effect at posttreatment (mean, -3.01; 95% CI: -7.2, -1.1; P = .022) compared to the experimental group
Moghadam et al ⁴¹ Iran RA	Experimental: n = 32 (all female); mean $\pm$ SD age, 48.06 $\pm$ 10.51 y; pain duration: 9.4% for <12 mo, 31.3% for 1-5 y, 59.4% for >5 y Control: n = 32 (all female); age, 48.87 $\pm$ 9.24 y; pain duration: 31.3% for 1-5 y, 68.8% for >5 y Hospital	Multicomponent intervention	(1) Program based on education about RA, planning and scheduling daily activities, scheduling time for rest and sleep, diet, strategies for coping with pain and joint protection, and promotion of knowledge about methods of taking medications and the side effects of the medicine 2 sessions per week for an 8-wk period, 30 min per session (2) A guideline booklet at the end of the intervention	Treatment as usual	Researcher	Group face-to-face session	T0, at baseline; T1, posttreatment (8 wk); T2, 3 mo	The Arthritis Self-Efficacy Scale pain subscale Baseline, 6.31 $\pm$ 2.79 Change from baseline: posttreatment (8 wk), 9.18 $\pm$ 2.48; 3 mo, 8.90 $\pm$ 2.40	The Arthritis Self-Efficacy Scale pain subscale Baseline, 6.25 $\pm$ 2.77 Change from baseline: posttreatment (8 wk), 5.84 $\pm$ 2.66; 3 mo, 5.87 $\pm$ 2.74	The experimental group showed a large effect at posttreatment (P<.001) and 3 mo (P<.001)

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APPENDIX B

Study/Country	Sample and Setting	Type of Intervention	Experimental Group, Duration/Contact	Control Group (duration/contact)	Treatment Facilitator	Treatment Format	Follow-up After Intervention	Pain Self-efficacy		Main Findings
								Experimental Group ^a	Control Group ^a	
Hughes et al ²⁹ United States Knee and/or hip OA	Experimental: n = 115 (female, n = 93); age, 73.3 y; pain duration not reported Control: n = 100 (female, n = 86); age, 74.4 y; pain duration not reported Community-based program	Multicomponent intervention	Program based on fitness walking, strengthening exercises, education behavior strategies, and reinforcement 3 sessions per week for an 8-wk period, 90 min per session	Wait list	Physical therapist	Group face-to-face session (up to 15 participants)	T0, at baseline; T1, 2 mo; T2, 6 mo; T3, 12 mo	The Arthritis Self-Efficacy Scale pain subscale Baseline, 72.89 ± 20.53 Change from baseline: 2 mo, 75.37 ± 20.10; 6 mo, 73.86 ± 23.22; 12 mo, 74.52 ± 19.56	The Arthritis Self-Efficacy Scale pain subscale Baseline, 64.40 ± 22.44 Change from baseline: 2 mo, 65.70 ± 18.69; 6 mo, 59.26 ± 21.29; 12 mo, 64.00 ± 20.27	Adjusted for baseline disease severity There was no difference between groups at 2 mo (coefficient = 1.489, P = .319), 6 mo (coefficient = 5.550, P = .052), and 12 mo (coefficient = 1.770, P = .320)
Keefe et al ³¹ United States Knee OA	Cognitive skills training: n = 29 (female, n = 15); age, 61.4 y; pain duration not reported Spouse-assisted cognitive skills training: n = 30 (female, n = 18); age, 63.5 y; pain duration not reported Control: n = 28 (female, n = 19); age, 62.8 y; pain duration not reported Unclear	Psychological therapy	Cognitive skills training 1 session per week for a 10-wk period, 120 min per session Spouse-assisted cognitive skills training 1 session per week for a 10-wk period, 120 min per session	Spouse-assisted education (information about the nature and treatment of OA) 1 session per week for a 10-wk period, 120 min per session	Psychologist and nurse	Group face-to-face session (4-6 participants)	T0, at baseline; T1, posttreatment; T2, 6 mo; T3, 12 mo	The Arthritis Self-Efficacy Scale pain subscale Baseline: cognitive skills training, 56.41 ± 18.20; spouse-assisted cognitive skills training, 62.62 ± 18.09 Change from baseline: posttreatment: cognitive skills training, 71.92 ± 16.29; spouse-assisted cognitive skills training, 77.85 ± 18.82; 6 mo: cognitive skills training, 65.75 ± 18.19; spouse-assisted cognitive skills training, 77.28 ± 16.44; 12 mo: cognitive skills training, 66.83 ± 18.16; spouse-assisted cognitive skills training, 76.40 ± 18.46	The Arthritis Self-Efficacy Scale pain subscale Baseline, 58.62 ± 20.81 Change from baseline: posttreatment, 53.33 ± 23.38; 6 mo, 58.69 ± 23.84; 12 mo, 59.76 ± 19.90	Adjusted for age, sex, obesity status, pretreatment rating of how logical the treatment seemed The spouse-assisted cognitive skills training group showed a large effect at 6 mo (P<.006) and 12 mo when compared to the spouse-assisted biomedical education control group There was no difference between the cognitive skills training group and the spouse-assisted biomedical education control group at 6 mo (P<.030) and 12 mo
Kloek et al ³³ the Netherlands Knee and/or hip OA	Experimental: n = 109 (female, n = 74); mean ± SD age, 63.8 ± 8.5 y; pain duration: 19.3% for <12 mo, 38.5% for 1-5 y, 42.2% for >5 y Control: n = 99 (female, n = 67); age, 62.3 ± 8.9 y; pain duration: 20.2% for <12 mo, 38.4% for 1-5 y; 41.4% for >5 y Primary health care	Multicomponent intervention	Physical therapy sessions plus an internet-based program based on graded activity, strength and stability exercises, and education (ie, information about pain management or social influences of pain) 5 face-to-face sessions for a 12-wk period	Usual physical therapy	Physical therapist	Individual face-to-face multimodal exercise	T0, at baseline; T1, 3 mo; T2, 12 mo	The Arthritis Self-Efficacy Scale pain subscale Baseline, 3.6 (95% CI: 3.3, 4.0) Change from baseline: 3 mo, 3.9 (95% CI: 3.6, 4.3); 12 mo, 4.1 (95% CI: 3.6, 4.6)	The Arthritis Self-Efficacy Scale pain subscale Baseline, 3.5 (95% CI: 3.2, 3.9) Change from baseline: 3 mo, 4.0 (95% CI: 3.6, 4.4); 12 mo, 4.0 (95% CI: 3.5, 4.5)	Adjusted for baseline scores, sex, body mass index, education, pain, type of OA, and physical therapist There was no difference between groups at 3 mo (mean, -0.1; 95% CI: -0.4, 0.1; P = .33) and 12 mo (mean, 0; 95% CI: -0.3, 0.3; P = .99)

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APPENDIX B

Study/Country	Sample and Setting	Type of Intervention	Experimental Group, Duration/Contact	Control Group (duration/contact)	Treatment Facilitator	Treatment Format	Follow-up After Intervention	Pain Self-efficacy		Main Findings
								Experimental Group ^a	Control Group ^a	
Manning et al ³⁸ United Kingdom RA	Experimental: n = 52 (female, n = 44); mean ± SD age, 53 ± 16 y; pain duration, 20 ± 18 mo Control: n = 56 (female, n = 38); age, 57 ± 15 y; pain duration, 20 ± 19 mo Hospital	Multicom- ponent interven- tion	Program based on biopsych- education (4 h) plus self- management plus global upper extremity exercise 2 sessions per week for a 2-wk period plus home exercises for a 12-wk period plus treatment as usual	Treatment as usual	Physical therapist	Group face-to- face session (4-6 partici- pants)	T0, at baseline; T1, 12 wk; T2, 36 wk	The Arthritis Self-Efficacy Scale pain subscale Baseline, 57.5 (95% CI: 50.7, 64.2) Change from baseline: 12 wk, 4.8 (95% CI: -3.1, 12.8); 36 wk, 6.6 (-0.8, 14.0)	The Arthritis Self-Efficacy Scale pain subscale Baseline, 59.2 (95% CI: 52.9, 65.6) Change from baseline: 12 wk, -5.7 (95% CI: -13.2, 1.8); 36 wk, -1.8 (-8.8, 5.2)	The experimental group showed a large effect at 12 wk (coefficient = 10.5; 95% CI: 1.6, 19.5; <i>P</i> = .021; effect size, 0.52) and 36 wk (coefficient = 8.4; 95% CI: 0.1, 16.7; <i>P</i> = .047; effect size, 0.45)
Moe et al ⁴⁰ Norway Heterogeneous OA	Experimental: n = 197 (female, n = 170); mean ± SD age, 60.98 ± 8.2 y; pain duration not reported Control: n = 194 (female, n = 168); age, 61.47 ± 7.5 y; pain duration not reported Outpatient rehabilitation	Self-man- agement interven- tion	Program based on education about OA A 210-min group session plus individual consultation	Treatment as usual	Rheumatolo- gist, ortho- paedic surgeon, physical therapist, occu- pational therapist, pharma- cist, and dietitian	Group face-to- face session	T0, at baseline; T1, 4 mo; T2, 12 mo	The Arthritis Self-Efficacy Scale pain subscale Baseline, 56.86 ± 17.9 Change from baseline: 4 mo, 58.17 (95% CI: 55.57, 60.77); 12 mo, 57.84 (95% CI: 55.2, 60.49)	The Arthritis Self-Efficacy Scale pain subscale Baseline, 57.33 ± 19.0 Change from baseline: 4 mo, 55.86 (95% CI: 53.26, 58.46); 12 mo, 58.98 (95% CI: 56.27, 61.68)	There was no difference between groups at 4 mo (mean, 2.31; 95% CI: -1.00, 5.62) and 12 mo (mean, -1.13; 95% CI: -4.55, 2.29)
Ndosi et al ⁴³ United Kingdom RA	Experimental: n = 68 (female, n = 46); mean ± SD age, 54 ± 12.3 y; pain duration, 5.2 ± 4.9 y Control: n = 60 (female, n = 38); age, 56 ± 13.3 y; pain duration, 6.7 ± 8.9 y Rheumatology centers	Self-man- agement interven- tion	Needs-based patient education (ie, patient coping) 3 sessions at 0, 16, and 32 wk	Treatment as usual 3 sessions at 0, 16, and 32 wk	Rheumatology nurse	...	T0, at baseline; T1, 16 wk; T2, 32 wk	The Arthritis Self-Efficacy Scale pain subscale Baseline, 23 ± 9.1 Change from baseline: 16 wk, 27.7 (95% CI: 26.2, 29.2); 32 wk, 31.2 (95% CI: 30.0, 32.5)	The Arthritis Self-Efficacy Scale pain subscale Baseline, 25 ± 11.2 Change from baseline: 16 wk, 25.8 (95% CI: 23.8, 27.8); 32 wk, 26.9 (95% CI: 25.2, 28.5)	Adjusted for baseline scores The experimental group showed a large effect at 32 wk (mean, 4.36; 95% CI: 1.17, 7.55; <i>P</i> = .008) There was no difference between groups at 16 wk (mean, 1.86; 95% CI: -0.63, 4.35; <i>P</i> = .142)

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APPENDIX B

Study/Country	Sample and Setting	Type of Intervention	Experimental Group, Duration/Contact	Control Group (duration/contact)	Treatment Facilitator	Treatment Format	Follow-up After Intervention	Pain Self-efficacy		Main Findings
								Experimental Group ^a	Control Group ^a	
Primdahl et al ^{48,49} Denmark RA	Shared care: n = 96 (female, n = 71); mean $\pm$ SD age, 61.6 $\pm$ 10.2 y; pain duration: median, 8 y (IQR, 4-16) Planned nursing consultation: n = 94 (female, n = 65); age, 60.8 $\pm$ 12.4 y; pain duration: median, 7 y (IQR, 4-13) Control: n = 97 (female, n = 64); age, 60.9 $\pm$ 11.1 y; pain duration: median, 7 y (IQR, 4-13) Outpatient rehabilitation	Multicomponent intervention	Shared care based on medication monitoring, as well as a nurse-led telephone helpline and short course that aimed to enhance patient beliefs about the management of disease-related problems and knowledge about when and how to seek help from a health professional Planned nursing consultation every 3 mo, 30 min per session, plus a short course that aimed to enhance patient beliefs about the management of disease-related problems and knowledge about when and how to seek help from a health professional	Treatment as usual 20- to 30-min consultations with a rheumatologist every 3-12 mo A short course that aimed to enhance patient beliefs about the management of disease-related problems and knowledge about when and how to seek help from a health professional	General practitioner, rheumatologist, physical therapist, occupational therapist, and nurse	Individual face-to-face session	T0, at baseline; T1, 3 mo; T2, 12 mo; T3, 24 mo	The Arthritis Self-Efficacy Scale pain subscale Baseline: shared care, 67.8 $\pm$ 19.1; planned nursing consultation, 63.4 $\pm$ 18.7 Change from baseline: 3 mo: shared care, 65.4 $\pm$ 18.8; planned nursing consultation, 65.4 $\pm$ 20.2; 12 mo: shared care, 63.8 $\pm$ 20.6; planned nursing consultation, 66.5 $\pm$ 23.8; 24 mo, not reported	The Arthritis Self-Efficacy Scale pain subscale Baseline: shared care, 63.7 $\pm$ 18.2 Change from baseline: 3 mo: shared care, 60.0 $\pm$ 19.6; 12 mo: shared care, 60.6 $\pm$ 22.7; 24 mo, not reported	Adjusted for hospital clustering effects The planned nursing consultation group showed a large effect at 12 mo (coefficient = 6.07; 95% CI: 0.62, 11.51; $P < .05$) and 24 mo (coefficient = 5.71; 95% CI: 0.26, 11.16; $P < .05$) compared to the control group There was no difference between the shared care group and the control group at 3 mo ($P = .066$), 12 mo (coefficient = -0.35; 95% CI: -5.80, 5.11), and 24 mo (coefficient = 1.17; 95% CI: -4.28, 6.63) There was no difference between the planned nursing consultation group and the control group at 3 mo ($P = .059$)
Riemsma et al ⁵⁰ the Netherlands RA	Program plus an arthritis passport: n = 69 (female, n = 46); mean $\pm$ SD age, 56.70 $\pm$ 10.39 y; pain duration, 14.24 $\pm$ 10.72 y Program: n = 75 (female, n = 49); age, 59.09 $\pm$ 9.63 y; pain duration, 12.89 $\pm$ 9.82 y Control: n = 72 (female, n = 47); age, 57.72 $\pm$ 9.22 y; pain duration, 12.99 $\pm$ 10.94 y Outpatient rehabilitation	Multicomponent intervention	(1) Program based on several chapters: contracting, goal setting and feedback, self-management and problem solving, information on RA and treatment, pain management and relaxation, physical exercise, communication skills, and coping with depression Under the guidance of regular health care providers, whose activities were coordinated through arthritis passports (2) Program based on several chapters: contracting, goal setting and feedback, self-management and problem solving, information on RA and treatment, pain management and relaxation, physical exercise, communication skills, and coping with depression	Treatment as usual	Rheumatologist, physical therapist, visiting nurse, and general practitioner	Individual face-to-face session	T0, at baseline; T1, 7 mo; T2, 19 mo	The Arthritis Self-Efficacy Scale pain subscale Baseline ^b : program plus arthritis passport, 3.19; program, 3.28 Change from baseline ^b : 7 mo: program plus arthritis passport, 3.22; program, 3.45; 19 mo: program plus arthritis passport, 3.17; program, 3.33	The Arthritis Self-Efficacy Scale pain subscale Baseline ^b : 2.88 Change from baseline ^b : 7 mo, 2.94; 19 mo, 3.42	Adjusted for baseline scores There was no difference between groups at 7 mo and 19 mo

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APPENDIX B

Study/Country	Sample and Setting	Type of Intervention	Experimental Group, Duration/Contact	Control Group (duration/contact)	Treatment Facilitator	Treatment Format	Follow-up After Intervention	Pain Self-efficacy		Main Findings
								Experimental Group ^a	Control Group ^a	
Riemsma et al ⁵¹ the Netherlands RA	Program with a partner: n = 71 (female, n = 41); mean $\pm$ SD age, 57.2 $\pm$ 10.3 y; pain duration, 12.1 $\pm$ 9.3 y Program without a partner: n = 71 (female, n = 47); age, 55.1 $\pm$ 10.3 y; pain duration, 11.7 $\pm$ 11.1 y Control: n = 76 (female, n = 47); age, 57.0 $\pm$ 8.3 y; pain duration, 11.4 $\pm$ 8.9 y Outpatient rehabilitation	Multicomponent intervention	(1) Program based on group session covering several chapters: contracting, goal setting and feedback, self-management and problem solving, information on RA and treatment, pain management and relaxation, physical exercise, communication skills, and coping with depression, with the participation of a partner 1 session per week for a 5-wk period, 120 min per session, plus 3 booster sessions at 3, 6, and 9 mo, 120 min per booster session (2) Program based on group sessions covering several chapters: contracting, goal setting and feedback, self-management and problem solving, information on RA and treatment, pain management and relaxation, physical exercise, communication skills, and coping with depression 1 session per week for a 5-wk period, 120 min per session, plus 3 booster sessions at 3, 6, and 9 mo, 120 min per booster session	Same program content, but without group sessions	Nurse	Group face-to-face session (8 participants)	T0, at baseline; T1, 2 mo; T2, 6 mo; T3, 12 mo	The Arthritis Self-Efficacy Scale pain subscale Baseline: program with a partner, 3.1 $\pm$ 0.9; program without a partner, 3.2 $\pm$ 1.0 Change from baseline: 2 mo: program with a partner, 0.1 $\pm$ 0.7; program without a partner, 0.0 $\pm$ 0.7; 6 mo: program with a partner, 0.0 $\pm$ 0.7; program without a partner, 0.3 $\pm$ 0.7; 12 mo: program with a partner, 0.0 $\pm$ 0.7; program without a partner, 0.3 $\pm$ 0.7	The Arthritis Self-Efficacy Scale pain subscale Baseline, 3.4 $\pm$ 0.9 Change from baseline: 2 mo, 0.1 $\pm$ 0.8; 6 mo, 0.0 $\pm$ 0.8; 12 mo, 0.1 $\pm$ 0.8	Adjusted for baseline scores, coping with pain, and problematic support There was no difference between groups at 2 mo ($P > .1$), 6 mo ($P > .1$), and 12 mo ($P = .06$)
Solomon et al ⁵³ United States Heterogeneous arthritis	Experimental: n = 104 (female, n = 72); mean $\pm$ SD age, 68 $\pm$ 10 y; pain duration, 12 $\pm$ 12 y Control: n = 74 (female, n = 55); age, 61 $\pm$ 12 y; pain duration, 11 $\pm$ 12 y Primary health care	Multicomponent intervention	The arthritis self-management program (ie, information about arthritis, overview of self-management principles, cognitive symptoms management, dealing with depression) 1 session per week for a 6-wk period, 120 min per session, plus <i>The Arthritis Helpbook</i>	<i>The Arthritis Helpbook</i>	Trained instructor	Group face-to-face session	T0, at baseline; T1, 4 mo	The Arthritis Self-Efficacy Scale pain subscale Baseline, not reported Change from baseline: 4 mo, not reported	The Arthritis Self-Efficacy Scale pain subscale Baseline, not reported Change from baseline: 4 mo, not reported	Adjusted for age, sex, household income, primary arthritis diagnosis, and whether the patient was treated by a rheumatologist There was no difference between groups at 4 mo ($P = .20$)

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APPENDIX B

Study/Country	Sample and Setting	Type of Intervention	Experimental Group, Duration/Contact	Control Group (duration/contact)	Treatment Facilitator	Treatment Format	Follow-up After Intervention	Pain Self-efficacy		Main Findings
								Experimental Group ^a	Control Group ^a	
Sullivan et al ⁵⁴ United States Knee OA	Experimental: n = 52 (female, n = 40); mean $\pm$ SD age, 70.38 $\pm$ 9.11 y; pain duration: 100% for >4 mo Control: n = 50 (female, n = 45); age, 68.48 $\pm$ 11.32 y; pain duration: 100% for >4 mo Hospital-based program	Multicomponent intervention	Program based on supervised fitness walking plus biopsychosocial education 3 sessions per week for an 8-wk period, 90 min per session	Treatment as usual	Trained instructor	Group face-to-face session (10-15 participants)	T0, at baseline; T1, 8 wk; T2, 12 mo	The Arthritis Self-Efficacy Scale pain subscale Baseline, 69.72 $\pm$ 16.9 Change from baseline: posttreatment (8 wk), 72.62 $\pm$ 20.36; 12 mo, 59.65 $\pm$ 23.99	The Arthritis Self-Efficacy Scale pain subscale Baseline, 70.96 $\pm$ 19.27 Change from baseline: posttreatment (8 wk), 69.48 $\pm$ 18.24; 12 mo, 59.65 $\pm$ 20.02	Adjusted for baseline scores There was an apparent initial gain in scores in favor of the experimental group. However, there was no difference between groups at 12 mo ($P = .99$)
Sweeney et al ⁵⁵ United Kingdom Ankylosing spondylitis	Experimental: n = 100 (female, n = 30); mean $\pm$ SD age, 47 $\pm$ 10.2 y; pain duration, 22.3 $\pm$ 12.7 y Control: n = 100 (female, n = 32); age, 47 $\pm$ 9.6 y; pain duration, 21.1 $\pm$ 11.1 y Home-based program	Multicomponent intervention	Program based on an exercise/educational video plus an educational booklet plus an easy exercise regime plus a concluding discussion (ie, benefits of and barriers to exercise) plus an exercise progress wall chart and exercise reminder stickers	...	Rheumatologist, psychologist, and physical therapist	Individual (delivered by mail)	T0, at baseline; T1, 6 mo	The Arthritis Self-Efficacy Scale pain subscale Baseline, 6.80 $\pm$ 1.21 Change from baseline: 6 mo, 0.31 $\pm$ 1.49	The Arthritis Self-Efficacy Scale pain subscale Baseline, 6.24 $\pm$ 1.1 Change from baseline: 6 mo, 0.21 $\pm$ 1.54	There was no difference between groups at 6 mo ($t = 0.431$, $P = .67$)
Taal et al ⁵⁶ the Netherlands RA	Experimental: n = 27 (female, n = 20); age, 49.7 y; pain duration, 3.9 y Control: n = 30 (female, n = 22); age, 49.5 y; pain duration, 4.7 y Unclear	Multicomponent intervention	Program based on several chapters: contracting, goal setting and feedback, self-management and problem solving, information on RA and treatment, pain management and relaxation, physical exercise, communication skills, and coping with depression 1 session per week for a 5-wk period, 120 min per session	Referred to physical therapy	Nurse, physical therapist, and social worker	Group face-to-face session (6-8 individuals)	T0, at baseline; T1, 6 wk; T2, 4 mo; T3, 14 mo	The Arthritis Self-Efficacy Scale pain subscale Baseline, ^b 3.9 Change from baseline ^b : 6 wk, 0.43; 4 mo, 0.40; 14 mo, 0.33	The Arthritis Self-Efficacy Scale pain subscale Baseline, ^b 3.68 Change from baseline ^b : 6 wk, 0.11; 4 mo, 0.24; 14 mo, 0.15	Adjusted for baseline scores of dependent variables, baseline joint tenderness, and baseline pain self-efficacy There was no difference between groups at 6 wk, 4 mo, and 14 mo
Yip et al ^{65,66} China Knee OA	Total: n = 182 (female, n = 136); age, 65 y; pain duration, 8 y Outpatient rehabilitation	Multicomponent intervention	The modified arthritis self-management program (coping with and managing common knee OA consequences, such as arthritis pain, fatigue, daily activity limitations, and stress) 1 session per week for a 6-wk period, 120 min per session, plus multimodal exercises (stretching, walking, and tai chi) plus treatment as usual	Treatment as usual	Nurse	Group face-to-face session (10-15 individuals)	T0, at baseline; T1, 16 wk; T2, 12 mo	The Arthritis Self-Efficacy Scale pain subscale Baseline, 29.20 $\pm$ 3.32 Change from baseline: 16 wk, 36.09 $\pm$ 13.09; 12 mo, 38.30 $\pm$ 7.02	The Arthritis Self-Efficacy Scale pain subscale Baseline, 31.73 $\pm$ 8.08 Change from baseline: 16 wk, 33.27 $\pm$ 7.98; 12 mo, 35.48 $\pm$ 7.46	The experimental group showed a large effect at 16 wk (effect size, 0.534; $P = .0001$) and 12 mo (effect size, 0.58; $P = .02$)

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APPENDIX B

Study/Country	Sample and Setting	Type of Intervention	Experimental Group, Duration/Contact	Control Group (duration/contact)	Treatment Facilitator	Treatment Format	Follow-up After Intervention	Pain Self-efficacy		Main Findings
								Experimental Group ^a	Control Group ^a	
Zangi et al ⁶⁸ Norway Heterogeneous arthritis	Experimental: n = 36 (female, n = 28); mean $\pm$ SD age, 53.0 $\pm$ 9.4 y; pain duration, 18.7 $\pm$ 13.1 y Control: n = 35 (female, n = 28); age, 54.9 $\pm$ 8.0 y; pain duration, 19.6 $\pm$ 12.7 y Outpatient rehabilitation	Psychological therapy	Vitality training program based on mindfulness exercises 1 session per week for a 10-wk period, 270 min per session, plus a booster session at 6 mo plus treatment as usual	Treatment as usual plus a CD, for voluntary use, with mindfulness-based home exercises	Physical therapist, nurse, occupational therapist, and social worker	Group face-to-face session (8-12 individuals)	T0, at baseline; T1, posttreatment; T2, 12 mo	The Arthritis Self-Efficacy Scale pain subscale Baseline, 55.4 (95% CI: 50.3, 60.6) Change from baseline: posttreatment, 65.9 (95% CI: 61.7, 70.0); 12 mo, 67.8 (95% CI: 62.4, 73.3)	The Arthritis Self-Efficacy Scale pain subscale Baseline, 60.9 (95% CI: 55.7, 66.4) Change from baseline: posttreatment, 61.0 (95% CI: 55.3, 66.7); 12 mo, 61.5 (95% CI: 55.8, 67.3)	Adjusted for the baseline mean values as well as for sex, age, disease duration, education, and civil status The experimental group showed a large effect at posttreatment (coefficient = 8.2; 95% CI: 2.1, 14.2; $P = .001$; effect size, 0.54) and 12 mo (coefficient = 9.1; 95% CI: 3.4, 14.8; $P = .001$; effect size, 0.59)

Abbreviations: CI, confidence interval; IQR, interquartile range; OA, osteoarthritis; RA, rheumatoid arthritis.

^aValues are mean $\pm$ SD.

^bStandard deviations were not reported for this study.

Mixed Samples of Chronic Musculoskeletal Pain

Study/Country	Sample and Setting	Type of Intervention	Experimental Group, Duration/Contact	Control Group (duration/contact)	Treatment Facilitator	Treatment Format	Follow-up After Intervention	Pain Self-efficacy		Main Findings
								Experimental Group ^a	Control Group ^a	
Bliokas et al ⁷ Australia	Graded exposure in vivo plus education based on a biopsychosocial approach: n = 58 (female, n = 34); mean $\pm$ SD age, 45.5 $\pm$ 10.8 y; pain duration: median, 4.0 y Education based on a biopsychosocial approach: n = 44 (female, n = 25); age, 46.3 $\pm$ 9.8 y; pain duration: median, 4.0 y Control: n = 41 (female, n = 22); age, 43.9 $\pm$ 8.3 y; pain duration: median, 4.5 y General practice (pain management service)	Multicomponent intervention	(1) Graded exposure in vivo plus a pain management program based on goal setting and education 2 sessions per week for an 8-wk period, 240 min per session (2) A pain management program based on goal setting and education 2 sessions per week for an 8-wk period, 240 min per session	Wait list	Psychologist	Group face-to-face session	T0, at baseline; T1, posttreatment (8 wk)	The Pain Self-Efficacy Questionnaire Baseline: graded exposure in vivo plus pain management, 24.2 $\pm$ 11.2; pain management, 28.1 $\pm$ 12.5 Change from baseline: posttreatment (8 wk): graded exposure in vivo plus pain management, 9.71 $\pm$ 11.34; pain management, 9.32 $\pm$ 14.10	The Pain Self-Efficacy Questionnaire Baseline, 23.5 $\pm$ 11.9 Change from baseline: posttreatment (8 wk), 5.60 $\pm$ 8.26	Adjusted for baseline scores and compensation status Both experimental groups showed a large effect at posttreatment ($\beta = 8.67$; 95% CI: 3.64, 13.70; $P < .001$) when compared to the control group There was no difference between the graded exposure in vivo plus pain management group and the pain management group at posttreatment ($\beta = -2.69$; 95% CI: -7.62, 2.23; $P = .279$)

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APPENDIX B

Study/Country	Sample and Setting	Type of Intervention	Experimental Group, Duration/Contact	Control Group (duration/contact)	Treatment Facilitator	Treatment Format	Follow-up After Intervention	Pain Self-efficacy		Main Findings
								Experimental Group ^a	Control Group ^a	
Damush et al ¹⁴ United States	Experimental: n = 123 (female, n = 69); mean $\pm$ SD age, 55.1 $\pm$ 12.6 y; pain duration, 100% for >3 mo Control: n = 127 (female, n = 63); age, 55.8 $\pm$ 11.0 y; pain duration, 100% for >3 mo Primary health care	Multicomponent intervention	Optimized antidepressant therapy (12 wk) followed by a pain management program (ie, problem solving, goal setting, and biopschoeducation) 6 sessions, 30 min per session, plus 2 booster sessions at 8 and 10 mo	Treatment as usual	Nurse	...	T0, at baseline; T1, 12 mo	The Arthritis Self-Efficacy Scale pain subscale Baseline, 4.79 $\pm$ 2.03 Change from baseline: 12 mo, 6.24 $\pm$ 2.43	The Arthritis Self-Efficacy Scale pain subscale Baseline, 4.59 $\pm$ 2.11 Change from baseline: 12 mo, 5.03 $\pm$ 2.25	The experimental group showed a large effect at 12 mo (effect size, 0.28; $P < .05$) compared to the control group
Nicholas et al ¹⁵ Australia	Experimental: n = 66 (female, n = 34); mean $\pm$ SD age, 42.05 $\pm$ 12.33 y; pain duration, 6716 $\pm$ 8714 mo Control: n = 74 (female, n = 41); age, 43.22 $\pm$ 11.08 y; pain duration, 7771 $\pm$ 8928 mo Hospital	Psychological therapy	Cognitive behavioral therapy plus interoceptive exposure (behavioral exposure) 3 sessions daily for a 3-wk period, 20 min per session	Cognitive behavioral therapy plus a combined relaxation and distraction technique 3 sessions daily for a 3-wk period, 20 min per session	Psychologist, physical therapist, nurse, rehabilitation advisor, and medical pain specialist	Group face-to-face session (8-10 individuals)	T0, at baseline; T1, posttreatment (3 wk); T2, 1 mo; T3, 6 mo; T4, 12 mo	The Pain Self-Efficacy Questionnaire Baseline, 25.81 $\pm$ 11.26 Change from baseline: posttreatment (3 wk), 39.55 $\pm$ 12.09; 1 mo, 37.81 $\pm$ 13.52; 6 mo, 36.78 $\pm$ 15.36; 12 mo, 37.85 $\pm$ 13.82	The Pain Self-Efficacy Questionnaire Baseline, 23.49 $\pm$ 12.05 Change from baseline: posttreatment (3 wk), 36.38 $\pm$ 16.23; 1 mo, 34.53 $\pm$ 14.98; 6 mo, 39.53 $\pm$ 13.63; 12 mo, 38.05 $\pm$ 15.67	Adjusted for baseline scores, treatment group, and time (fitted as continuous) There was no difference between groups from pretreatment to 12 mo (mean, 1.09; 95% CI: -2.75, 4.94; $P = .57$)
Nicholas et al ¹⁴ Australia	Pain management program: n = 49 (female, n = 32); mean $\pm$ SD age, 74.59 $\pm$ 5.98 y; pain duration, 207 $\pm$ 219 mo Attention control plus exercise: n = 53 (female, n = 37); age, 72.40 $\pm$ 5.5 y; pain duration, 179 $\pm$ 216 mo Control: n = 39 (female, n = 20); age, 74.95 $\pm$ 6.6 y; pain duration, 135 $\pm$ 177 mo Hospital	Multicomponent intervention	(1) The pain management program (the self-management text <i>Manage Your Pain</i>) plus group sessions of activities/exercise plus cognitive behavioral therapy) 2 sessions per week for a 4-wk period, 120 min per session (2) Attention control plus exercise 2 sessions per week for a 4-wk period, 120 min per session	Wait list	Psychologist (behavioral approach) and physical therapist (exercise)	Group face-to-face session (5-10 individuals)	T0, at baseline; T1, 1 mo	The Pain Self-Efficacy Questionnaire Baseline: pain management program, 35.18 $\pm$ 12.8; attention control plus exercise, 33.11 $\pm$ 13.2 Change from baseline: posttreatment: pain management program, -6.7 $\pm$ 8.7; attention control plus exercise, -3.9 $\pm$ 8.5; 1 mo: pain management program, -2.6 $\pm$ 8.6; attention control plus exercise, -0.68 $\pm$ 8.1	The Pain Self-Efficacy Questionnaire Baseline, 33.85 $\pm$ 11.7 Change from baseline: 1 mo, 0.46 $\pm$ 8.6	Adjusted for visit, treatment, and baseline score The pain management program group showed a large effect at posttreatment (mean, -3.59; 95% CI: -6.51, -0.39; $P = .02$; effect size, 0.47) compared to the attention control plus exercise group There was no difference between groups at 1 mo for the behavioral approach plus exercise group versus the attention control plus exercise group (mean, -1.96; 95% CI: -5.34, 1.41; $P = .19$; effect size, 0.27), the behavioral approach plus exercise group versus the control group (mean, -2.49; 95% CI: -1.29, 6.28; $P = .18$; effect size, 0.31), and the attention control plus exercise group versus the control group (mean, 0.52; 95% CI: -3.19, 4.26; $P = .86$; effect size, 0.06)

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APPENDIX B

Study/Country	Sample and Setting	Type of Intervention	Experimental Group, Duration/Contact	Control Group (duration/contact)	Treatment Facilitator	Treatment Format	Follow-up After Intervention	Pain Self-efficacy		Main Findings
								Experimental Group ^a	Control Group ^a	
Nordin et al ¹⁶ Sweden	Experimental: n = 55 (female, n = 47); mean ± SD age, 44 ± 10 y; pain duration, 79 ± 97 mo Control: n = 44 (female, n = 37); age, 42 ± 11 y; pain duration, 78 ± 99 mo Primary health care	Multicomponent intervention	An internet-based program on cognitive behavioral therapy principles (24 h available for a 16-wk period; mean time spent in the program, 304 min) and a multidisciplinary intervention based on exercise, manual therapy, acupuncture, electrotherapy, counseling, pharmacological treatment, ergonomics, activity planning, and functional training 2-3 sessions per week for a 6- to 8-wk period	Multidisciplinary intervention based on exercise, manual therapy, acupuncture, electrotherapy, counseling, pharmacological treatment, ergonomics, activity planning, and functional training 2-3 sessions per week for a 6- to 8-wk period	Psychologist, physical therapist, occupational therapist, nurse, psychosocial counselor, and physician	Individual or group face-to-face session	T0, at baseline; T1, 4 mo; T2, 12 mo	The Arthritis Self-Efficacy Scale pain subscale Baseline, 45.8 ± 21.6 Change from baseline: 4 mo, 50.0 ± 23.4; 12 mo, 53.2 ± 22.3	The Arthritis Self-Efficacy Scale pain subscale Baseline, 49.0 ± 20.4 Change from baseline: 4 mo, 49.3 ± 21.9; 12 mo, 46.9 ± 22.2	There was no difference between groups at 4 mo (mean, 3.9; 95% CI: -2.5, 10.3; <i>P</i> = .23; effect size, 0.19) and 12 mo (mean, 9.5; 95% CI: 1.2, 17.7; <i>P</i> = .02; effect size, 0.45)
Taylor et al ¹⁷ United Kingdom	Experimental: n = 403 (female, n = 271); mean ± SD age, 60.3 ± 13.5 y; pain duration: 4% for 4-12 mo, 11% for 13-24 mo, 14% for 3-4 y, 12% for 5-6 y, 20% for 7-10 y, 39% for >10 y Control: n = 300 (female, n = 202); age, 59.4 ± 13.8 y; pain duration: 3% for 4-12 mo, 14% for 13-24 mo, 15% for 3-4 y, 13% for 5-6 y, 17% for 7-10 y, 36% for >10 y Community-based program	Psychological therapy	Cognitive behavioral therapy (24 individual components delivered in a community setting over 3 alternate days in 1 wk, with a follow-up session 2 wk later; total duration, 14 h) plus a relaxation CD plus treatment as usual	Treatment as usual and a relaxation CD	Physical therapist, psychologist, osteopath, or general practitioner trained to conduct cognitive behavioral therapy, as well as a lay person living with chronic pain	...	T0, at baseline; T1, 6 mo; T2, 12 mo	The Pain Self-Efficacy Questionnaire Baseline, 31.2 ± 13.8 Change from baseline: 6 mo, 35.5 ± 14.0; 12 mo, 35.4 ± 14.1	The Pain Self-Efficacy Questionnaire Baseline, 30.6 ± 14.1 Change from baseline: 6 mo, 32.7 ± 15.0; 12 mo, 33.4 ± 15.1	Adjusted for age, sex, site of recruitment, and baseline level of outcome The experimental group showed a large effect at 6 mo (mean, 2.3; 95% CI: 0.6, 4.1) compared to the control group There was no difference between groups at 12 mo (mean, 1.4; 95% CI: -0.2, 3.1)

Table continues on page A26.

Study/Country	Sample and Setting	Type of Intervention	Experimental Group, Duration/Contact	Control Group (duration/contact)	Treatment Facilitator	Treatment Format	Follow-up After Intervention	Pain Self-efficacy		Main Findings
								Experimental Group ^a	Control Group ^a	
Van der Maas et al ⁶⁰ the Netherlands	Experimental: n = 49 (female, n = 45); mean $\pm$ SD age, 38.6 $\pm$ 11.1 y; pain duration: 4.1% for 3-12 mo, 32.7% for 1-2 y, 28.6% for 2-5 y, 34.7% for >5 y Control: n = 45 (female, n = 32); age, 45.4 $\pm$ 11.1 y; pain duration: 4.4% for 3-12 mo, 8.9% for 1-2 y, 31.1% for 2-5 y, 55.6% for >5 y Outpatient rehabilitation	Psychological therapy	Psychomotor therapy 10 sessions, 90 min per session Treatment as usual (multi-component intervention) 3 sessions per week for a 12-wk period, with a total of 94 h, plus 2 booster sessions at 3 and 6 mo	Treatment as usual (multi-component intervention) 3 sessions per week for a 12-wk period, with a total of 94 h, plus 2 booster sessions at 3 and 6 mo	Psychologist, physical therapist, and/or occupational therapist (booster sessions)	Group face-to-face session (4-6 individuals)	T0, at baseline; T1, post-treatment (12 wk); T2, 6 mo; T3, 12 mo	The Pain Self-Efficacy Questionnaire Baseline, ^b 32.77 Change from baseline ^b : posttreatment (12 wk), 40.44; 3 mo, 39.45; 6 mo, 41.03; 12 mo, 38.54	The Pain Self-Efficacy Questionnaire Baseline, ^b 30.70 Change from baseline ^b : posttreatment (12 wk), 33.63; 3 mo, 35.03; 6 mo, 38.04; 12 mo, 36.04	Adjusted for age, sex, pain duration, and pain diagnosis There was no difference between groups at posttreatment (3.83; 95% CI: -0.32, 7.98), 3 mo (1.30; 95% CI: -3.10, 5.70), 6 mo (-0.02; 95% CI: -4.49, 4.45), and 12 mo (1.07; 95% CI: -3.56, 5.69)

Abbreviation: CI, confidence interval.

^aValues are mean $\pm$ SD.

^bStandard deviations were not reported for this study.

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APPENDIX B

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APPENDIX C

RISK-OF-BIAS ASSESSMENT

Study	Selection Bias		Performance Bias	Detection Bias	Attrition Bias	Reporting Bias	Overall Risk of Bias	
	Random Sequence Generation	Allocation Concealment	Blinding of Participants and Personnel	Blinding of Outcome Assessment	Incomplete Outcome Data	Selective Reporting		Other Bias ^a
Amris et al ¹	Low	Unclear	High	Low	Low	Low	Low	High
Barlow et al ⁴	High	High	High	High	Low	Unclear	Low	High
Barlow et al ⁵	Unclear	Unclear	High	High	Low	Unclear	Low	High
Bennell et al ⁶	Low	Low	Low	Low	Low	Low	Low	Low
Bennell et al ⁷	Low	Low	Low	Low	Low	Low	Low	Low
Bieler et al ⁸	Low	Unclear	Low	Low	Unclear	Low	Unclear	Unclear
Bliokas et al ⁹	Low	Unclear	Low	High	High	Unclear	Low	High
Bossen et al ¹¹	Unclear	Low	High	High	Unclear	Low	Low	High
Buszewicz et al ¹⁴	Low	Unclear	Unclear	High	Low	Low	Unclear	Unclear
Callahan et al ¹⁶	Unclear	High	High	Low	Low	Unclear	Unclear	High
Callahan et al ¹⁵	Unclear	Unclear	High	High	Low	Low	Unclear	High
Carpenter et al ¹⁷	Unclear	High	Low	High	Low	Unclear	Low	High
Chiauzzi et al ¹⁸	Unclear	High	Low	High	Low	Unclear	Low	High
Damush et al ¹⁹	Low	Low	High	Low	Low	Low	Low	High
Friesen et al ²⁵	Low	Unclear	High	Unclear	Low	Low	Low	High
Grønning et al ²⁶	Low	Unclear	High	High	Low	Low	Low	High
Gustavsson et al ²⁷	Low	Low	Unclear	Unclear	Low	Unclear	Low	Unclear
Haas et al ²⁸	Unclear	Unclear	High	High	Low	Low	Low	High
Hammond and Freeman ³²	Unclear	Low	Low	Low	Low	Unclear	Unclear	Unclear
Hammond and Freeman ³¹	Low	Low	Low	Unclear	Low	Unclear	Low	Unclear
Hammond et al ³⁰	Low	Low	Low	High	Low	Unclear	Low	Unclear
Hamnes et al ³³	Unclear	Unclear	High	Low	Low	Low	Low	High
Hansson et al ³⁴	Low	Low	High	Low	Low	Low	Unclear	High
Helminen et al ³⁶	Low	Low	High	Low	Low	Low	Low	High
Moghadam et al ⁶¹	Low	Unclear	High	High	Low	Low	Low	High
Hughes et al ⁴⁵	Low	High	High	High	High	Unclear	Unclear	High
Jones et al ⁴⁷	Low	Unclear	Low	High	Low	Low	Unclear	Unclear
Keefe et al ⁴⁹	Unclear	High	Low	High	Low	Unclear	Unclear	High
Keller et al ⁵⁰	Unclear	Unclear	High	High	Low	Unclear	Low	High
Kloek et al ⁵¹	Low	Unclear	High	Unclear	Unclear	Low	Low	High
Lamb et al ⁵²	Low	Low	Unclear	Low	Low	Low	Low	Unclear
Ludvigsson et al ⁵⁵	Low	Low	Low	Low	Unclear	Low	Unclear	Unclear
MacPherson et al ⁵⁶	Low	Unclear	High	High	Low	Low	Low	High
Manning et al ⁵⁷	Low	Unclear	High	Low	Low	Low	Low	High
Menzies et al ⁵⁹	Low	Low	High	High	Low	Unclear	Unclear	High
Moe et al ⁶⁰	Low	Low	High	Low	Low	Low	Unclear	High
Morone et al ⁶²	Low	Low	Low	Low	Low	Low	Low	Low
Ndosi et al ⁶³	Low	Low	Low	High	Low	Low	Unclear	Low
Nicholas et al ⁶⁶	Low	Unclear	Low	High	Low	Unclear	Low	Unclear
Nicholas et al ⁶⁵	Low	Unclear	Unclear	Low	Low	Low	Low	Unclear

Table continues on page A30.

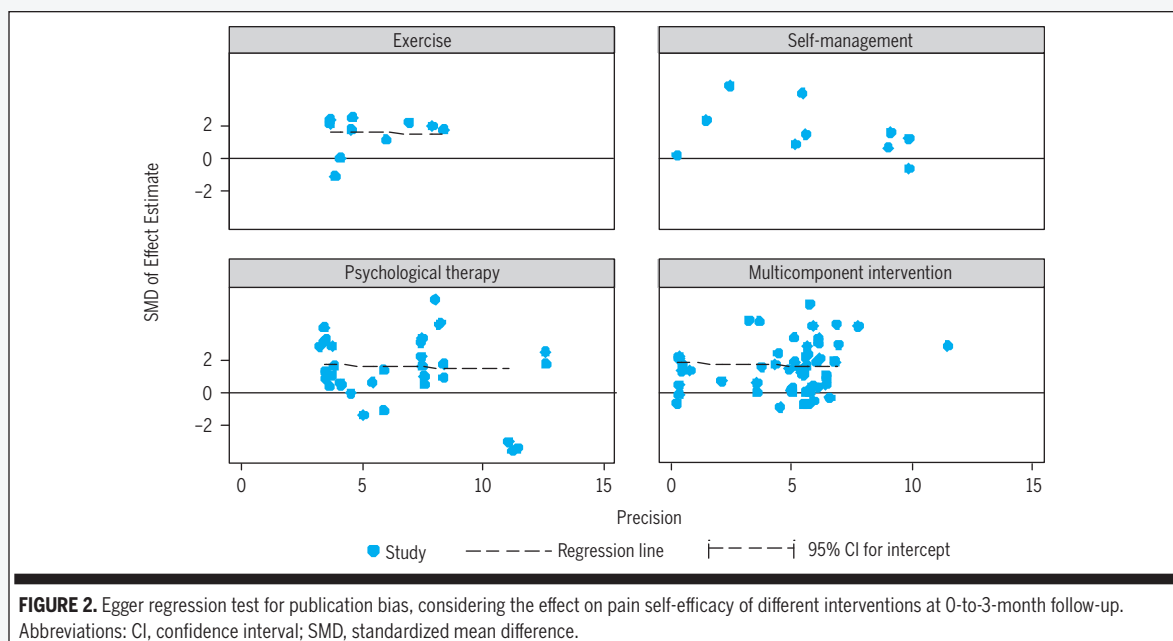
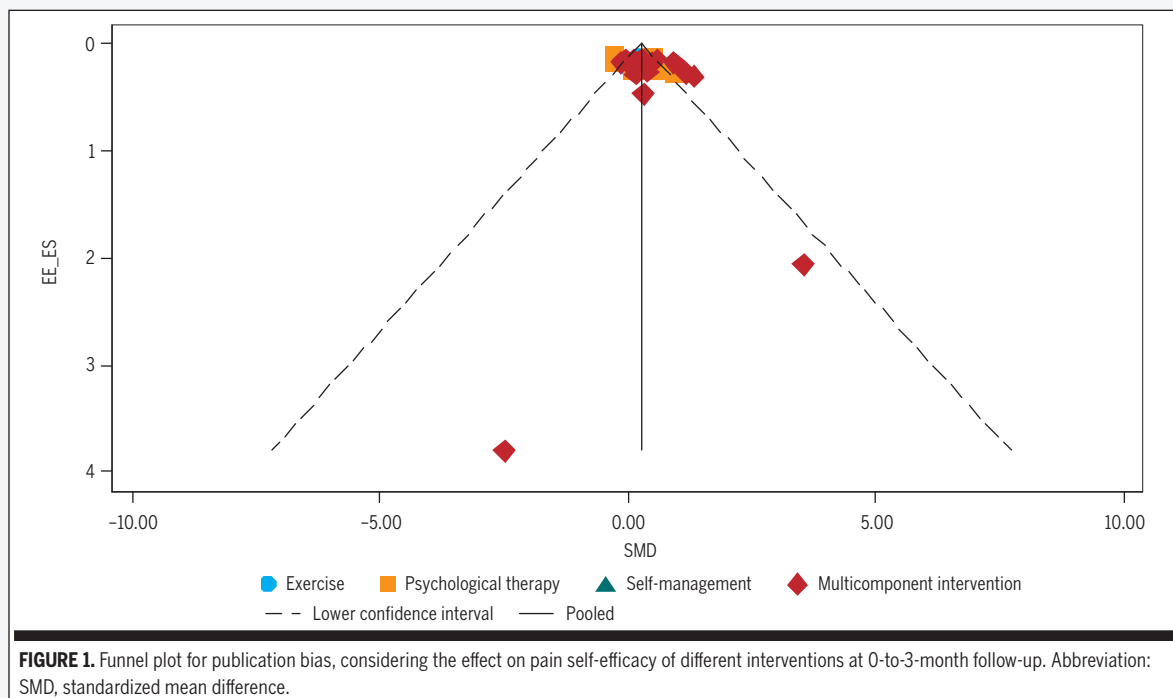
APPENDIX C

Study	Selection Bias		Performance Bias	Detection Bias	Attrition Bias	Reporting Bias		Overall Risk of Bias
	Random Sequence Generation	Allocation Concealment	Blinding of Participants and Personnel	Blinding of Outcome Assessment	Incomplete Outcome Data	Selective Reporting	Other Bias ^a	
Nordin et al ⁶⁸	Low	Low	Low	High	Low	Low	Low	Low
Oliver et al ⁶⁹	High	High	Unclear	High	Low	Unclear	Unclear	High
Primdahl et al ⁷³	Low	Low	Unclear	Unclear	Low	Unclear	Low	Unclear
Riemsma et al ⁷⁵	Unclear	Unclear	Unclear	High	Low	Unclear	Unclear	High
Riemsma et al ⁷⁶	High	High	Unclear	High	Low	Unclear	Unclear	High
Schachter et al ⁷⁷	Low	High	Unclear	Unclear	Low	Unclear	Low	High
Solomon et al ⁸³	Unclear	High	High	High	Unclear	Unclear	Unclear	High
Sullivan et al ⁸⁴	High	High	High	Low	Low	Unclear	Unclear	High
Sweeney et al ⁸⁵	High	High	High	High	High	Unclear	Unclear	High
Taal et al ⁸⁶	Unclear	High	High	High	Low	Unclear	Unclear	High
Taylor et al ⁸⁷	Low	Low	Unclear	High	Low	Low	Low	Unclear
Tilbrook et al ⁸⁸	Low	Low	High	Unclear	Low	Low	Low	High
Turner et al ⁸⁹	Unclear	High	Unclear	High	Low	Unclear	Low	High
Van der Maas et al ⁹¹	Low	Low	Low	High	Low	Low	Low	Low
van der Roer et al ⁹²	Unclear	Low	Low	High	Low	Unclear	Low	Unclear
Verkaik et al ⁹³	Unclear	Low	Unclear	High	Unclear	Low	Low	Unclear
Wajswelner et al ⁹⁴	Low	Low	Low	Low	High	Low	Low	High
Yip et al ⁹⁶	Low	Unclear	High	High	Unclear	Unclear	Low	High
Zadro et al ⁹⁷	Low	Unclear	High	Low	Low	Low	Low	High
Zangi et al ⁹⁸	Low	Low	High	Low	Low	Unclear	Low	High

^aWe judged a study to have an unclear risk of bias when insufficient information to assess an important risk of bias existed or when there was an insufficient rationale or evidence that an identified problem would introduce bias.

APPENDIX D

FUNNEL PLOT AND EGGER REGRESSION TEST FOR PUBLICATION BIAS AT 0-TO-3-MONTH FOLLOW-UP



APPENDIX D

Egger's Test for Small-Study Effects

Regress standard normal deviate of the intervention effect estimate against its standard error.

- Number of studies, 39
- Root-mean-square error, 1.783

Standard Effect	Coefficient ^a	SE	t	P Value
Slope	-0.036 (-0.313, 0.241)	0.137	-0.26	.793
Bias	1.797 (0.241, 3.352)	0.768	2.34	.025

Abbreviation: SE, standard error.

^aValues in parentheses are 95% confidence interval.

APPENDIX E

SENSITIVITY ANALYSIS: EFFECTS ON PAIN SELF-EFFICACY AT 0-TO-3-MONTH FOLLOW-UP

Cochran Q Statistics for Heterogeneity

Intervention	Q Value	df	P Value
Exercise	2.43	3	.488
Self-management	0.00	0	...
Psychological therapy	67.76	12	<.001
Multicomponent	61.30	20	<.001

APPENDIX F

META-REGRESSION ANALYSES: EFFECTS ON PAIN
SELF-EFFICACY AT 0-TO-3-MONTH FOLLOW-UP

Age

Exercise Intervention

- Number of observations, 4
- $r^2 = 0.00375$
- $I^2 = 10.53\%$

	SMD ^a	SE	t	P Value
Age	0.0423 (-0.333, 0.418)	0.087	0.49	.674
_cons	0.069 (-1.486, 1.624)	0.361	0.19	.866

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Self-management Intervention

Insufficient number of studies.

Psychological Therapy

- Number of observations, 13
- $r^2 = 0.1348$
- $I^2 = 83.74\%$
- Adjusted $R^2 = 12.45\%$

	SMD ^a	SE	t	P Value
Age	0.043 (-0.226, 0.311)	0.122	0.35	.734
_cons	0.166 (-0.857, 1.189)	0.465	0.36	.728

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Multicomponent Intervention

- Number of observations, 21
- $r^2 = 0.08186$
- $I^2 = 66.15\%$
- Adjusted $R^2 = 5.05\%$

	SMD ^a	SE	t	P Value
Age	-0.153 (-0.349, 0.043)	0.094	-1.64	.118
_cons	1.002 (0.154, 1.850)	0.405	2.47	.023

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Intervention Dose

Exercise Intervention

- Number of observations, 4
- $r^2 = 0.00$
- $I^2 = 0.00\%$

	SMD ^a	SE	t	P Value
Dose	0.001 (-0.001, 0.003)	0.000	1.47	.280
_cons	-0.437 (-2.449, 1.575)	0.468	-0.93	.449

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

APPENDIX F

Self-management Intervention

Insufficient number of studies.

Psychological Therapy

- Number of observations, 11
- $r^2 = 0.1443$
- $I^2 = 84.88\%$
- Adjusted $R^2 = 9.38\%$

	SMD ^a	SE	t	P Value
Dose	0.000 (0.000, 0.000)	0.000	0.44	.669
_cons	0.260 (-0.143, 0.662)	0.178	1.46	.178

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Multicomponent Intervention

- Number of observations, 14
- $r^2 = 0.1141$
- $I^2 = 68.47\%$
- Adjusted $R^2 = 9.83\%$

	SMD ^a	SE	t	P Value
Dose	0.000 (0.000, 0.000)	0.000	0.64	.533
_cons	0.280 (-0.122, 0.682)	0.184	1.52	.155

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Chronic Musculoskeletal Pain Diagnosis

Exercise Intervention

- Number of observations, 4
- $r^2 = 0.00$
- $I^2 = 15.11\%$

	SMD ^a	SE	t	P Value
Diagnosis	-0.022 (-0.391, 0.348)	0.086	-0.25	.823
_cons	0.302 (-0.818, 1.421)	0.260	1.16	.366

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Self-management Intervention

Insufficient number of studies.

Psychological Therapy

- Number of observations, 13
- $r^2 = 0.1334$
- $I^2 = 83.36\%$
- Adjusted $R^2 = 11.28\%$

	SMD ^a	SE	t	P Value
Diagnosis	0.047 (-0.179, 0.274)	0.103	0.46	.656
_cons	0.175 (-0.579, 0.930)	0.343	0.51	.619

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

APPENDIX F

Multicomponent Intervention

- Number of observations, 21
- $r^2 = 0.08606$
- $I^2 = 66.66\%$
- Adjusted $R^2 = 0.18\%$

	SMD ^a	SE	t	P Value
Diagnosis	-0.110 (-0.296, 0.075)	0.089	-1.24	.229
_cons	0.754 (0.056, 1.453)	0.334	2.26	.036

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Risk of Bias**Exercise Intervention**

Risk of bias dropped because of collinearity.

Self-management Intervention

Insufficient number of studies.

Psychological Therapy

- Number of observations, 13
- $r^2 = 0.118$
- $I^2 = 79.69\%$
- Adjusted $R^2 = 1.57\%$

	SMD ^a	SE	t	P Value
Risk of bias	0.161 (-0.149, 0.471)	0.141	1.14	.278
_cons	-0.078 (-0.884, 0.728)	0.366	-0.21	.835

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Multicomponent Intervention

- Number of observations, 21
- $r^2 = 0.09533$
- $I^2 = 68.88\%$
- Adjusted $R^2 = 10.57\%$

	SMD ^a	SE	t	P Value
Risk of bias	0.001 (-0.272, 0.274)	0.130	0.01	.994
_cons	0.353 (-0.357, 1.063)	0.339	1.04	.311

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Type of Control Group**Exercise Intervention**

- Number of observations, 4
- $r^2 = 0.00$
- $I^2 = 15.11\%$

	SMD ^a	SE	t	P Value
Type of control	-0.044 (-0.783, 0.695)	0.172	-0.25	.823
_cons	0.302 (-0.818, 1.421)	0.260	1.16	.366

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

APPENDIX F

Self-management Intervention

Insufficient number of studies.

Psychological Therapy

- Number of observations, 13
- $r^2 = 0.08204$
- $I^2 = 64.23\%$
- Adjusted $R^2 = 31.57\%$

	SMD ^a	SE	t	P Value
Type of control	-0.197 (-0.440, 0.046)	0.110	-1.79	.101
_cons	0.599 (0.178, 1.020)	0.191	3.13	.009

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Multicomponent Intervention

- Number of observations, 21
- $r^2 = 0.065$
- $I^2 = 61.82\%$
- Adjusted $R^2 = 24.61\%$

	SMD ^a	SE	t	P Value
Type of control	-0.126 (-0.263, 0.011)	0.065	-1.92	.069
_cons	0.578 (0.278, 0.878)	0.143	4.03	.001

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

The Experimental Facilitator

Exercise Intervention

- Number of observations, 4
- $r^2 = 0.00$
- $I^2 = 16.73\%$

	SMD ^a	SE	t	P Value
Facilitator	-0.035 (-0.987, 0.916)	0.221	-0.16	.888
_cons	0.303 (-1.463, 2.068)	0.410	0.74	.537

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Self-management Intervention

Insufficient number of studies.

Psychological Therapy

- Number of observations, 12
- $r^2 = 0.1304$
- $I^2 = 83.35\%$
- Adjusted $R^2 = 10.82\%$

	SMD ^a	SE	t	P Value
Facilitator	-0.108 (-0.550, 0.333)	0.198	-0.55	.597
_cons	0.615 (-0.732, 1.962)	0.604	1.02	.333

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

APPENDIX F

Multicomponent Intervention

- Number of observations, 19
- $r^2 = 0.09534$
- $I^2 = 67.09\%$
- Adjusted $R^2 = 1.26\%$

	SMD ^a	SE	t	P Value
Facilitator	-0.062 (-0.185, 0.060)	0.058	-1.07	.299
_cons	0.523 (0.135, 0.911)	0.184	2.84	.011

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

The Instrument to Assess Pain Self-efficacy**Exercise Intervention**

- Number of observations, 4
- $r^2 = 0.00$
- $I^2 = 15.11\%$

	SMD ^a	SE	t	P Value
Instrument	-0.044 (-0.783, 0.695)	0.172	-0.25	.823
_cons	0.302 (-0.818, 1.421)	0.260	1.16	.366

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Self-management Intervention

Insufficient number of studies.

Psychological Therapy

- Number of observations, 13
- $r^2 = 0.1342$
- $I^2 = 82.39\%$
- Adjusted $R^2 = 11.94\%$

	SMD ^a	SE	t	P Value
Instrument	0.028 (-0.235, 0.290)	0.119	0.23	.821
_cons	0.274 (-0.254, 0.803)	0.240	1.14	.277

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Multicomponent Intervention

- Number of observations, 21
- $r^2 = 0.08778$
- $I^2 = 68.46\%$
- Adjusted $R^2 = 1.81\%$

	SMD ^a	SE	t	P Value
Instrument	0.126 (-0.090, 0.341)	0.103	1.22	.237
_cons	0.090 (-0.397, 0.576)	0.233	0.39	.704

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

APPENDIX G

FUNNEL PLOT AND EGGER REGRESSION TEST FOR PUBLICATION BIAS AT 4-TO-6-MONTH FOLLOW-UP

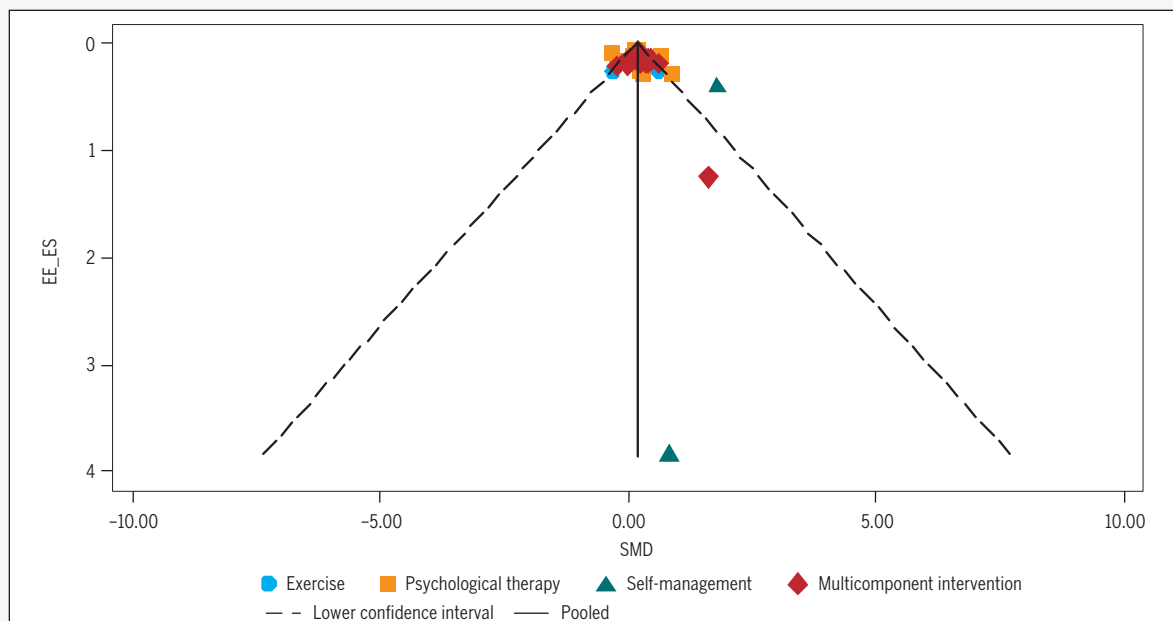


FIGURE 1. Funnel plot for publication bias, considering the effect on pain self-efficacy of different interventions at 4-to-6-month follow-up. Abbreviation: SMD, standardized mean difference.

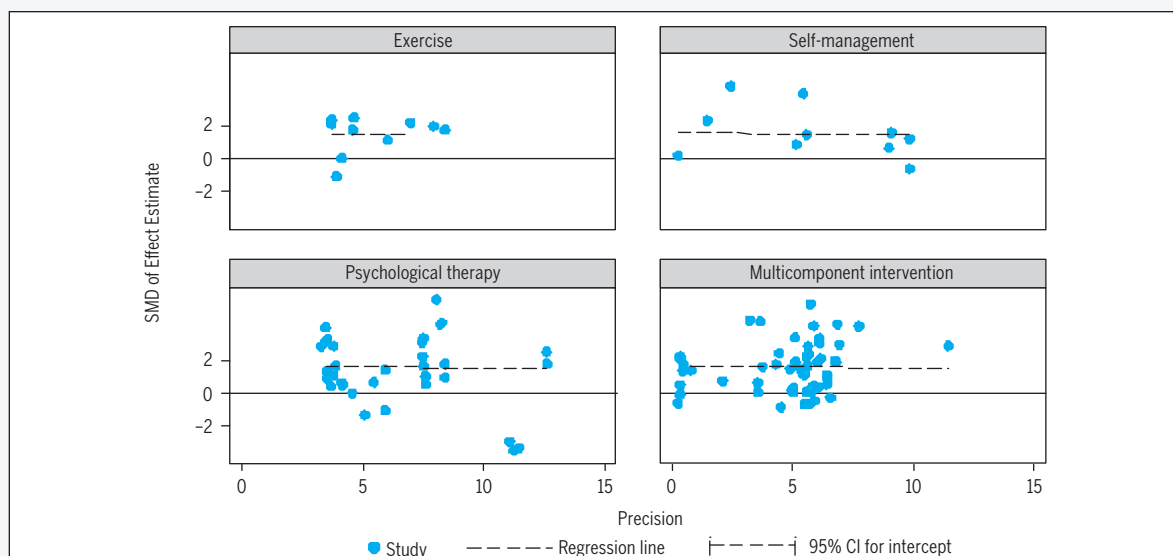


FIGURE 2. Egger regression test for publication bias, considering the effect on pain self-efficacy of different interventions at 4-to-6-month follow-up. Abbreviations: CI, confidence interval; SMD, standardized mean difference.

APPENDIX G

Egger's Test for Small-Study Effects

Regress standard normal deviate of the intervention effect estimate against its standard error.

- Number of studies, 32
- Root-mean-square error, 1.805

Standard Effect	Coefficient ^a	SE	t	P Value
Slope	-0.015 (-0.252, 0.221)	0.116	-0.13	.895
Bias	1.619 (0.085, 3.153)	0.751	2.15	.039

Abbreviation: SE, standard error.

^aValues in parentheses are 95% confidence interval.

APPENDIX H

SENSITIVITY ANALYSES: EFFECTS ON PAIN SELF-EFFICACY AT 4-TO-6-MONTH FOLLOW-UP

When omitted, the following studies modified the total effect and its significance (see **FIGURE 4** for meta-analysis results and **APPENDIX B** for full reference details): Schachter et al.⁵² (short and long bouts), Tilbrook et al.,⁵⁸ Zadro et al.,⁶⁷ and Nicholas et al.⁴⁵

Cochran Q Statistics for Heterogeneity

Intervention	Q Value	df	P Value
Exercise	7.91	4	.095
Self-management	16.38	3	.001
Psychological therapy	58.64	8	<.001
Multicomponent	22.01	13	.055

APPENDIX I

META-REGRESSION ANALYSES: EFFECTS ON PAIN
SELF-EFFICACY AT 4-TO-6-MONTH FOLLOW-UP

Age

Exercise Intervention

- Number of observations, 5
- $r^2 = 0.04808$
- $I^2 = 52.85\%$
- Adjusted $R^2 = 10.54\%$

	SMD ^a	SE	t	P Value
Age	0.190 (-0.469, 0.849)	0.207	0.92	.426
_cons	-0.297 (-2.532, 1.938)	0.702	-0.42	.701

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Self-management Intervention

- Number of observations, 4
- $r^2 = 1.213$
- $I^2 = 87.76\%$
- Adjusted $R^2 = 74.00\%$

	SMD ^a	SE	t	P Value
Age	0.655 (-5.225, 6.536)	1.367	0.48	.679
_cons	-2.354 (-29.934, 25.225)	6.410	-0.37	.749

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Psychological Therapy

- Number of observations, 9
- $r^2 = 0.1208$
- $I^2 = 87.61\%$
- Adjusted $R^2 = 8.19\%$

	SMD ^a	SE	t	P Value
Age	0.099 (-0.232, 0.430)	0.140	0.71	.503
_cons	-0.194 (-1.593, 1.205)	0.592	-0.33	.753

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Multicomponent Intervention

- Number of observations, 14
- $r^2 = 0.01459$
- $I^2 = 39.15\%$
- Adjusted $R^2 = 15.99\%$

	SMD ^a	SE	t	P Value
Age	-0.093 (-0.281, 0.094)	0.086	-1.09	.298
_cons	0.623 (-0.100, 1.347)	0.332	1.88	.085

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

APPENDIX I

Intervention Dose

Exercise Intervention

- Number of observations, 5
- $r^2 = 0.08501$
- $I^2 = 61.98\%$
- Adjusted $R^2 = 95.45\%$

	SMD ^a	SE	t	P Value
Dose	0.000 (-0.001, 0.001)	0.000	0.19	.861
_cons	0.279 (-0.765, 1.323)	0.328	0.85	.457

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Self-management Intervention

Insufficient number of studies.

Psychological Therapy

- Number of observations, 9
- $r^2 = 0.1249$
- $I^2 = 87.79\%$
- Adjusted $R^2 = 11.88\%$

	SMD ^a	SE	t	P Value
Dose	0.000 (0.000, 0.000)	0.000	0.32	.755
_cons	0.178 (-0.234, 0.591)	0.174	1.02	.341

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Multicomponent Intervention

- Number of observations, 12
- $r^2 = 0.02358$
- $I^2 = 45.46\%$
- Adjusted $R^2 = 37.84\%$

	SMD ^a	SE	t	P Value
Dose	0.000 (0.000, 0.000)	0.000	0.75	.473
_cons	0.165 (-0.173, 0.503)	0.152	1.09	.303

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Chronic Musculoskeletal Pain Diagnosis

Exercise Intervention

- Number of observations, 5
- $r^2 = 0.06328$
- $I^2 = 55.51\%$
- Adjusted $R^2 = 45.48\%$

	SMD ^a	SE	t	P Value
Diagnosis	0.229 (-0.811, 1.268)	0.327	0.70	.534
_cons	-0.217 (-2.765, 2.331)	0.801	-0.27	.804

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Self-management Intervention

Dropped because of collinearity.

APPENDIX I

Psychological Therapy

- Number of observations, 9
- $r^2 = 0.1284$
- $I^2 = 88.05\%$
- Adjusted $R^2 = 15.06\%$

	SMD ^a	SE	t	P Value
Diagnosis	-0.038 (-0.252, 0.176)	0.091	-0.42	.687
_cons	0.347 (-0.457, 1.151)	0.340	1.02	.342

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Multicomponent Intervention

- Number of observations, 14
- $r^2 = 0.01582$
- $I^2 = 40.59\%$
- Adjusted $R^2 = 8.92\%$

	SMD ^a	SE	t	P Value
Diagnosis	-0.052 (-0.181, 0.078)	0.059	-0.87	.402
_cons	0.447 (-0.022, 0.917)	0.215	2.07	.060

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Risk of Bias**Exercise Intervention**

Risk of bias dropped because of collinearity.

Self-management Intervention

- Number of observations, 4
- $r^2 = 1.416$
- $I^2 = 86.65\%$
- Adjusted $R^2 = 103.21\%$

	SMD ^a	SE	t	P Value
Risk of bias	-0.066 (-3.639, 3.507)	0.830	-0.08	.944
_cons	0.844 (-7.011, 8.700)	1.826	0.46	.689

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Psychological Therapy

- Number of observations, 9
- $r^2 = 0.08337$
- $I^2 = 83.27\%$
- Adjusted $R^2 = 25.32\%$

	SMD ^a	SE	t	P Value
Risk of bias	0.216 (-0.066, 0.497)	0.119	1.81	.113
_cons	-0.244 (-0.886, 0.399)	0.272	-0.90	.400

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

APPENDIX I

Multicomponent Intervention

- Number of observations, 14
- $r^2 = 0.01883$
- $I^2 = 42.53\%$
- Adjusted $R^2 = 8.43\%$

	SMD ^a	SE	t	P Value
Risk of bias	0.088 (-0.142, 0.317)	0.105	0.83	.421
_cons	0.042 (-0.564, 0.648)	0.278	0.15	.881

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Type of Control Group

Exercise Intervention

- Number of observations, 5
- $r^2 = 0.06328$
- $I^2 = 55.51\%$
- Adjusted $R^2 = 45.48\%$

	SMD ^a	SE	t	P Value
Type of control	0.114 (-0.405, 0.634)	0.163	0.70	.534
_cons	0.126 (-0.940, 1.193)	0.335	0.38	.731

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Self-management Intervention

- Number of observations, 4
- $r^2 = 0.00$
- $I^2 = 0.00\%$
- Adjusted $R^2 = 100.00\%$

	SMD ^a	SE	t	P Value
Type of control	0.557 (-0.045, 1.158)	0.140	3.98	.058
_cons	-0.397 (-1.172, 0.378)	0.180	-2.20	.158

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Psychological Therapy

- Number of observations, 9
- $r^2 = 0.06516$
- $I^2 = 72.38\%$
- Adjusted $R^2 = 41.63\%$

	SMD ^a	SE	t	P Value
Type of control	-0.211 (-0.444, 0.023)	0.099	-2.13	.070
_cons	0.527 (0.089, 0.965)	0.185	2.85	.025

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

APPENDIX I

Multicomponent Intervention

- Number of observations, 13
- $r^2 = 0.02161$
- $I^2 = 44.70\%$
- Adjusted $R^2 = 29.55\%$

	SMD ^a	SE	t	P Value
Type of control	-0.020 (-0.163, 0.123)	0.065	0.31	.765
_cons	0.284 (-0.007, 0.574)	0.132	2.15	.055

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

The Experimental Facilitator**Exercise Intervention**

- Number of observations, 5
- $r^2 = 0.06046$
- $I^2 = 56.26\%$
- Adjusted $R^2 = 39.01\%$

	SMD ^a	SE	t	P Value
Facilitator	0.230 (-0.855, 1.316)	0.341	0.68	.548
_cons	-0.051 (-1.934, 1.831)	0.591	-0.09	.936

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Self-management Intervention

- Number of observations, 3
- $r^2 = 0.00$
- $I^2 = 0.00\%$

	SMD ^a	SE	t	P Value
Facilitator	0.071 (-1.229, 1.372)	0.102	0.70	.613
_cons	-0.089 (-4.762, 4.584)	0.368	-0.24	.849

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Psychological Therapy

- Number of observations, 9
- $r^2 = 0.1142$
- $I^2 = 84.54\%$
- Adjusted $R^2 = 2.34\%$

	SMD ^a	SE	t	P Value
Facilitator	-0.199 (-0.830, 0.433)	0.267	-0.74	.481
_cons	0.735 (-0.952, 2.421)	0.713	1.03	.337

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

APPENDIX I

Multicomponent Intervention

- Number of observations, 13
- $r^2 = 0.01459$
- $I^2 = 38.30\%$
- Adjusted $R^2 = 26.93\%$

	SMD ^a	SE	t	P Value
Facilitator	-0.066 (-0.172, 0.040)	0.048	-1.37	.199
_cons	0.448 (0.104, 0.791)	0.156	2.87	.015

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

The Instrument to Assess Pain Self-efficacy

Exercise Intervention

- Number of observations, 5
- $r^2 = 0.06328$
- $I^2 = 55.51\%$
- Adjusted $R^2 = 45.48\%$

	SMD ^a	SE	t	P Value
Instrument	0.114 (-0.405, 0.634)	0.163	0.70	.534
_cons	0.126 (-0.940, 1.193)	0.335	0.38	.731

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Self-management Intervention

Dropped because of collinearity.

Psychological Therapy

- Number of observations, 9
- $r^2 = 0.07033$
- $I^2 = 80.23\%$
- Adjusted $R^2 = 37.00\%$

	SMD ^a	SE	t	P Value
Instrument	0.257 (-0.047, 0.561)	0.129	2.00	.086
_cons	-0.257 (-0.856, 0.341)	0.253	-1.02	.343

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Multicomponent Intervention

- Number of observations, 14
- $r^2 = 0.0217$
- $I^2 = 44.52\%$
- Adjusted $R^2 = 24.95\%$

	SMD ^a	SE	t	P Value
Instrument	0.046 (-0.179, 0.271)	0.103	0.44	.665
_cons	0.173 (-0.313, 0.659)	0.223	0.78	.453

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

APPENDIX J

FUNNEL PLOT AND EGGER REGRESSION TEST FOR PUBLICATION BIAS AT 7-TO-12-MONTH FOLLOW-UP

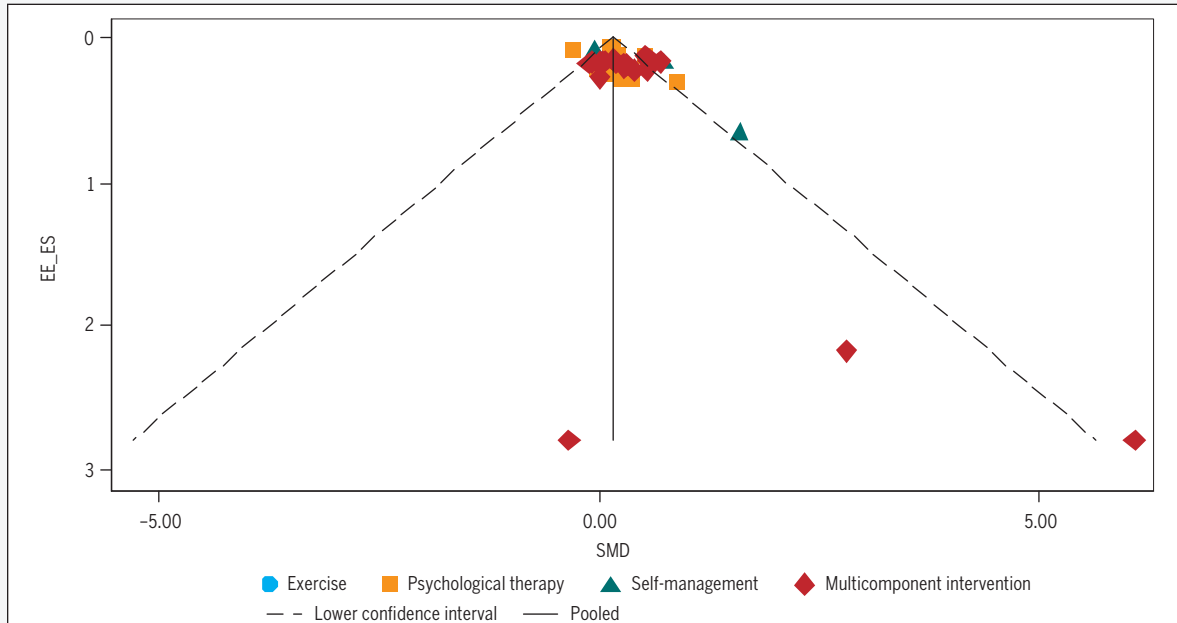


FIGURE 1. Funnel plot for publication bias, considering the effect on pain self-efficacy of different interventions at 7-to-12-month follow-up. Abbreviation: SMD, standardized mean difference.

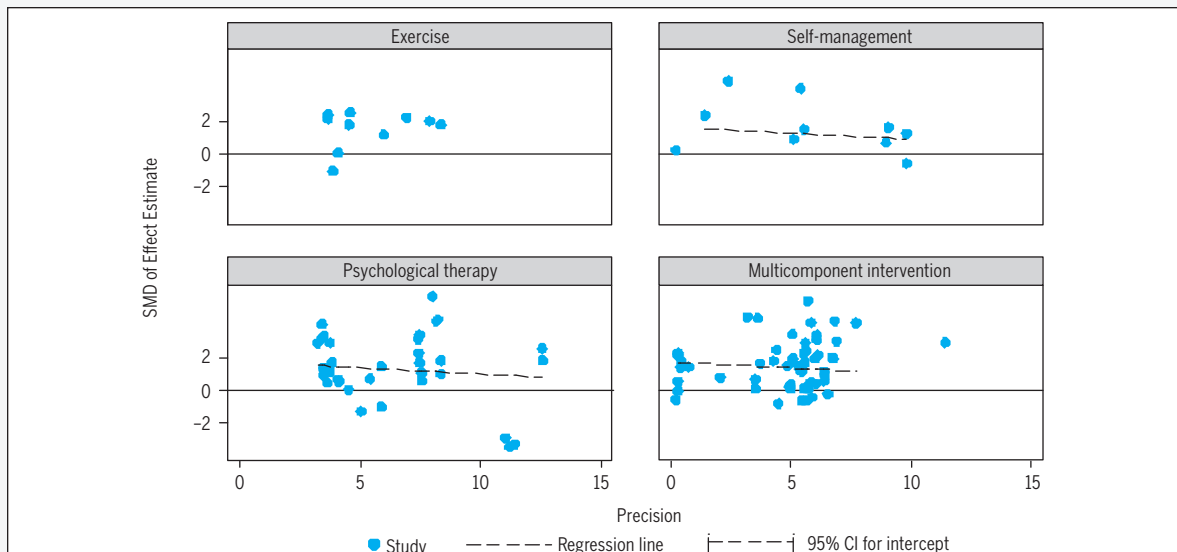


FIGURE 2. Egger regression test for publication bias, considering the effect on pain self-efficacy of different interventions at 7-to-12-month follow-up. Abbreviations: CI, confidence interval; SMD, standardized mean difference.

APPENDIX J

Egger's Test for Small-Study Effects

Regress standard normal deviate of the intervention effect estimate against its standard error.

- Number of studies, 36
- Root-mean-square error, 1.57

Standard Effect	Coefficient ^a	SE	t	P Value
Slope	-0.075 (-0.269, 0.119)	0.095	-0.79	.435
Bias	1.653 (0.440, 2.865)	0.597	2.77	.009

Abbreviation: SE, standard error.

^aValues in parentheses are 95% confidence interval.

APPENDIX K

SENSITIVITY ANALYSES: EFFECTS ON PAIN SELF-EFFICACY AT 7-TO-12-MONTH FOLLOW-UP

When omitted, the following studies modified the total effect and its significance (see **FIGURE 5** for meta-analysis results and **APPENDIX B** for full reference details): Moe et al.⁴⁰ and Lamb et al.³⁴

Cochran Q Statistics for Heterogeneity

Intervention	Q Value	df	P Value
Exercise	0.00	0	...
Self-management	19.38	4	.001
Psychological therapy	40.02	9	<.001
Multicomponent	38.05	19	.006

APPENDIX L

META-REGRESSION ANALYSES: EFFECTS ON PAIN SELF-EFFICACY AT 7-TO-12-MONTH FOLLOW-UP

Age

Exercise Intervention

Insufficient number of studies.

Self-management Intervention

- Number of observations, 5
- $r^2 = 0.2272$
- $I^2 = 80.61\%$
- Adjusted $R^2 = 91.20\%$

	SMD ^a	SE	t	P Value
Age	0.049 (-1.798, 1.897)	0.581	0.08	.938
_cons	0.120 (-7904, 8.144)	2.521	0.05	.965

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Psychological Therapy

- Number of observations, 10
- $r^2 = 0.06469$
- $I^2 = 80.00\%$
- Adjusted $R^2 = 9.59\%$

	SMD ^a	SE	t	P Value
Age	0.111 (-0.182, 0.404)	0.127	0.88	.407
_cons	-0.223 (-1.321, 0.875)	0.476	-0.47	.652

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Multicomponent Intervention

- Number of observations, 20
- $r^2 = 0.03634$
- $I^2 = 52.68\%$
- Adjusted $R^2 = 11.88\%$

	SMD ^a	SE	t	P Value
Age	0.000 (-0.184, 0.183)	0.088	0.00	.996
_cons	0.232 (-0.542, 1.005)	0.368	0.63	.537

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Intervention Dose

Exercise Intervention

Insufficient number of studies.

APPENDIX L

Self-management Intervention

- Number of observations, 3
- $r^2 = 0.00$
- $I^2 = 0.00\%$
- Adjusted $R^2 = 100.00\%$

	SMD ^a	SE	t	P Value
Dose	0.000 (-0.001, 0.002)	0.000	1.58	.360
_cons	-0.090 (-1.520, 1.340)	0.113	0.80	.569

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Psychological Therapy

- Number of observations, 10
- $r^2 = 0.06464$
- $I^2 = 79.53\%$
- Adjusted $R^2 = 9.50\%$

	SMD ^a	SE	t	P Value
Dose	0.000 (0.000, 0.000)	0.000	0.28	.783
_cons	0.159 (-0.149, 0.468)	0.134	1.19	.267

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Multicomponent Intervention

- Number of observations, 12
- $r^2 = 0.03686$
- $I^2 = 53.61\%$
- Adjusted $R^2 = 12.51\%$

	SMD ^a	SE	t	P Value
Dose	0.000 (-0.000, 0.000)	0.000	-0.27	.794
_cons	0.238 (-0.083, 0.558)	0.144	1.65	.129

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Chronic Musculoskeletal Pain Diagnosis**Exercise Intervention**

Insufficient number of studies.

Self-management Intervention

- Number of observations, 5
- $r^2 = 0.1925$
- $I^2 = 84.49\%$
- Adjusted $R^2 = 62.01\%$

	SMD ^a	SE	t	P Value
Diagnosis	0.368 (-1.173, 1.908)	0.484	0.76	.503
_cons	-0.976 (-6.464, 4.512)	1.724	-0.57	.611

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

APPENDIX L

Psychological Therapy

- Number of observations, 10
- $r^2 = 0.07012$
- $I^2 = 79.95\%$
- Adjusted $R^2 = 18.79\%$

	SMD ^a	SE	t	P Value
Diagnosis	0.004 (-0.158, 0.158)	0.069	0.00	1.000
_cons	0.187 (-0.369, 0.743)	0.241	0.77	.461

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Multicomponent Intervention

- Number of observations, 20
- $r^2 = 0.03645$
- $I^2 = 52.45\%$
- Adjusted $R^2 = 12.23\%$

	SMD ^a	SE	t	P Value
Diagnosis	-0.034 (-0.195, 0.128)	0.077	-0.44	.668
_cons	0.360 (-0.281, 1.001)	0.305	1.18	.253

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Risk of Bias

Exercise Intervention

Insufficient number of studies.

Self-management Intervention

- Number of observations, 5
- $r^2 = 0.00438$
- $I^2 = 46.81\%$
- Adjusted $R^2 = 96.31\%$

	SMD ^a	SE	t	P Value
Risk of bias	-0.356 (-0.774, 0.062)	0.131	-2.71	.073
_cons	1.135 (-0.046, 2.317)	0.371	3.06	.055

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Psychological Therapy

- Number of observations, 10
- $r^2 = 0.03261$
- $I^2 = 64.70\%$
- Adjusted $R^2 = 44.77\%$

	SMD ^a	SE	t	P Value
Risk of bias	0.201 (0.002, 0.400)	0.086	2.32	.049
_cons	-0.292 (-0.783, 0.199)	0.213	-1.37	.208

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

APPENDIX L

Multicomponent Intervention

- Number of observations, 20
- $r^2 = 0.03469$
- $I^2 = 51.72\%$
- Adjusted $R^2 = 6.79\%$

	SMD^a	SE	t	P Value
Risk of bias	-0.053 (-0.240, 0.133)	0.089	-0.60	.555
_cons	0.355 (-0.104, 0.814)	0.218	1.63	.121

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Type of Control Group**Exercise Intervention**

Insufficient number of studies.

Self-management Intervention

- Number of observations, 5
- $r^2 = 0.2336$
- $I^2 = 84.41\%$
- Adjusted $R^2 = 96.62\%$

	SMD^a	SE	t	P Value
Type of control	0.099 (-0.664, 0.861)	0.240	0.41	.709
_cons	0.119 (-1.748, 1.987)	0.587	0.20	.852

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Psychological Therapy

- Number of observations, 10
- $r^2 = 0.0138$
- $I^2 = 37.03\%$
- Adjusted $R^2 = 76.62\%$

	SMD^a	SE	t	P Value
Type of control	-0.181 (-0.307, -0.055)	0.055	-3.31	.011
_cons	0.427 (0.182, 0.671)	0.106	4.02	.004

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Multicomponent Intervention

- Number of observations, 20
- $r^2 = 0.02881$
- $I^2 = 47.14\%$
- Adjusted $R^2 = 11.31\%$

	SMD^a	SE	t	P Value
Type of control	-0.067 (-0.174, 0.039)	0.051	-1.32	.203
_cons	0.343 (0.119, 0.567)	0.107	3.22	.005

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

APPENDIX L

The Experimental Facilitator

Exercise Intervention

Insufficient number of studies.

Self-management Intervention

- Number of observations, 4
- $r^2 = 0.005561$
- $I^2 = 32.44\%$
- Adjusted $R^2 = 93.36\%$

	SMD ^a	SE	t	P Value
Facilitator	0.342 (-0.158, 0.841)	0.116	2.94	.099
_cons	-1.158 (-3.088, 0.773)	0.449	-2.58	.123

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Psychological Therapy

- Number of observations, 10
- $r^2 = 0.06667$
- $I^2 = 78.45\%$
- Adjusted $R^2 = 12.94\%$

	SMD ^a	SE	t	P Value
Facilitator	-0.084 (-0.477, 0.309)	0.170	-0.49	.635
_cons	0.428 (-0.726, 1.581)	0.500	0.85	.418

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Multicomponent Intervention

- Number of observations, 19
- $r^2 = 0.03533$
- $I^2 = 51.93\%$
- Adjusted $R^2 = 3.28\%$

	SMD ^a	SE	t	P Value
Facilitator	-0.034 (-0.121, 0.052)	0.041	-0.84	.413
_cons	0.339 (0.056, 0.623)	0.134	2.52	.022

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

The Instrument to Assess Pain Self-efficacy

Exercise Intervention

Insufficient number of studies.

Self-management Intervention

Dropped because of collinearity.

APPENDIX L

Psychological Therapy

- Number of observations, 10
- $r^2 = 0.03244$
- $I^2 = 64.97\%$
- Adjusted $R^2 = 45.05\%$

	SMD ^a	SE	t	P Value
Instrument	0.257 (0.002, 0.513)	0.111	2.32	.049
_cons	-0.201 (-0.610, 0.208)	0.177	-1.13	.289

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Multicomponent Intervention

- Number of observations, 20
- $r^2 = 0.02937$
- $I^2 = 47.93\%$
- Adjusted $R^2 = 9.57\%$

	SMD ^a	SE	t	P Value
Instrument	0.156 (-0.115, 0.427)	0.129	1.21	.243
_cons	-0.102 (-0.695, 0.491)	0.282	-0.36	.722

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

APPENDIX M

FUNNEL PLOT AND EGGER REGRESSION TEST FOR PUBLICATION BIAS AT FOLLOW-UPS GREATER THAN 12 MONTHS

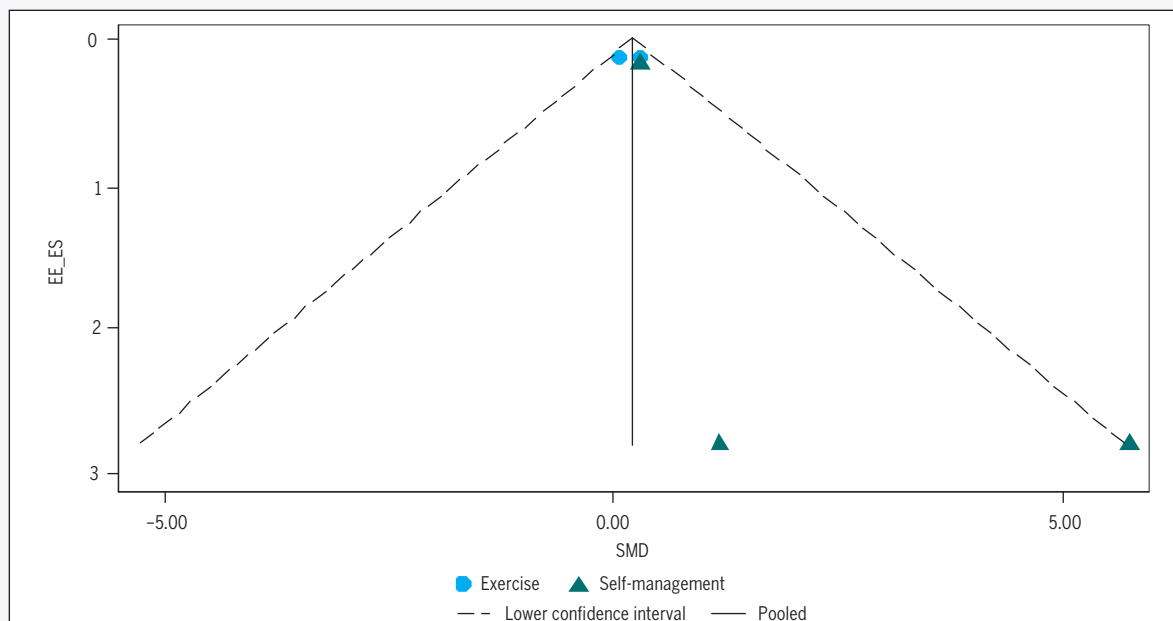


FIGURE 1. Funnel plot for publication bias, considering the effect on pain self-efficacy of different interventions at follow-ups longer than 12 months. Abbreviation: SMD, standardized mean difference.

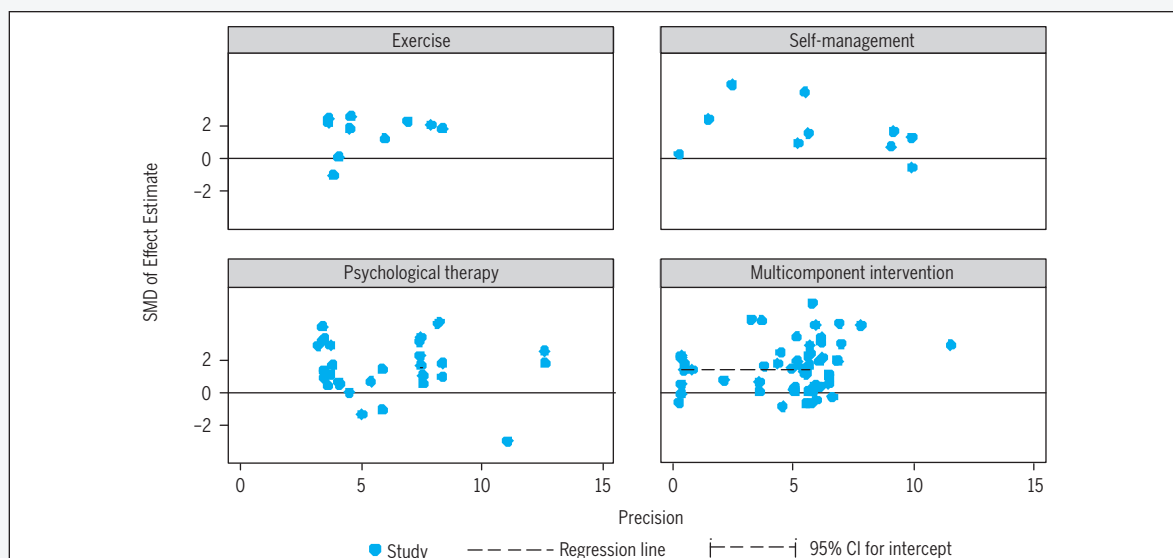


FIGURE 2. Egger regression test for publication bias, considering the effect on pain self-efficacy of different interventions at follow-ups longer than 12 months. Abbreviations: CI, confidence interval; SMD, standardized mean difference.

APPENDIX M

Egger's Test for Small-Study Effects

Regress standard normal deviate of the intervention effect estimate against its standard error.

- Number of studies, 5
- Root-mean-square error, 0.963

Standard Effect	Coefficient ^a	SE	t	P Value
Slope	0.0179 (-0.401, 0.437)	0.132	0.14	.901
Bias	1.264 (-0.992, 3.519)	0.709	1.78	.173

Abbreviation: SE, standard error.

^aValues in parentheses are 95% confidence interval.

APPENDIX N

SENSITIVITY ANALYSES: EFFECTS ON PAIN SELF-EFFICACY AT FOLLOW-UPS GREATER THAN 12 MONTHS

When omitted, the following study modified the total effect and its significance (see **FIGURE 6** for meta-analysis results and **APPENDIX B** for full reference details): Turner et al⁵⁹ (mindfulness group).

Cochran Q Statistics for Heterogeneity

Intervention	Q Value	df	P Value
Psychological therapy	1.41	1	.235
Multicomponent	3.86	2	.145

APPENDIX O

META-REGRESSION ANALYSES: EFFECTS ON PAIN SELF-EFFICACY AT FOLLOW-UPS GREATER THAN 12 MONTHS

Age

Exercise Intervention

No studies.

Self-management Intervention

No studies.

Psychological Therapy

Insufficient number of studies.

Multicomponent Intervention

- Number of observations, 3
- $r^2 = 2.522$
- $I^2 = 24.47\%$
- Adjusted $R^2 = 31.41\%$

	SMD ^a	SE	t	P Value
Age	1.578 (-16.058, 19.214)	1.388	1.14	.459
_cons	-4.450 (-71.143, 62.243)	5.249	-0.85	.552

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Intervention Dose

Exercise Intervention

No studies.

Self-management Intervention

No studies.

Psychological Therapy

Insufficient number of studies.

Multicomponent Intervention

Insufficient number of studies.

Chronic Musculoskeletal Pain Diagnosis

Exercise Intervention

No studies.

Self-management Intervention

No studies.

Psychological Therapy

Insufficient number of studies.

APPENDIX O

Multicomponent Intervention

- Number of observations, 3
- $r^2 = 2.522$
- $I^2 = 24.47\%$
- Adjusted $R^2 = 31.41\%$

	SMD ^a	SE	t	P Value
Diagnosis	1.052 (-10.705, 12.809)	0.925	1.14	.459
_cons	-0.768 (-29.494, 27.958)	2.261	-0.34	.792

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Risk of Bias

Exercise Intervention

No studies.

Self-management Intervention

No studies.

Psychological Therapy

Insufficient number of studies.

Multicomponent Intervention

Dropped because of collinearity.

Type of Control Group

Exercise Intervention

No studies.

Self-management Intervention

No studies.

Psychological Therapy

Insufficient number of studies.

Multicomponent Intervention

Dropped because of collinearity.

The Experimental Facilitator

Exercise Intervention

No studies.

Self-management Intervention

No studies.

Psychological Therapy

Insufficient number of studies.

APPENDIX O

Multicomponent Intervention

- Number of observations, 3
- $r^2 = 2.522$
- $I^2 = 24.47\%$
- Adjusted $R^2 = 31.41\%$

	SMD^a	SE	t	P Value
Facilitator	0.789 (-8.029, 9.607)	0.694	1.14	.459
_cons	-0.505 (-26.887, 25.877)	2.076	-0.24	.848

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

The Instrument to Assess Pain Self-efficacy**Exercise Intervention**

No studies.

Self-management Intervention

No studies.

Psychological Therapy

Insufficient number of studies.

Multicomponent Intervention

- Number of observations, 3
- $r^2 = 2.522$
- $I^2 = 24.47\%$
- Adjusted $R^2 = 31.41\%$

	SMD^a	SE	t	P Value
Instrument	-1.578 (-19.214, 16.058)	1.388	-1.14	.459
_cons	6.596 (-54.558, 67.751)	4.813	1.37	.401

Abbreviations: SE, standard error; SMD, standardized mean difference.

^aValues in parentheses are 95% confidence interval.

Predicting Recurrent Instability of the Shoulder (PRIS): A Valid Tool to Predict Which Patients Will Not Have Repeat Shoulder Instability After First-Time Traumatic Anterior Dislocation

Predicting the likelihood of recurrence following a first-time traumatic anterior shoulder dislocation (FTASD) is difficult. Age, sex, bony Bankart lesions,^{9,31} duration or position of immobilization,²⁸ and hypermobility^{25,27} are risk factors for recurrent instability. A tool that encompasses multiple risk factors for recurrent shoulder instability may improve the accuracy of predicting recurrent shoulder instability. Accurately predicting recurrent shoulder instability may help streamline health care services

and promote efficient, appropriate care for people with an FTASD.

Prediction tools must be valid before being used in clinical practice, to ensure generalizability to different populations,

across different time periods and age groups.¹⁸ A previously developed computer model¹⁶ to predict recurrent shoulder instability after an FTASD^{4,11} had at least 4 limitations.

1. The outcome was derived based only on age and sex. Other risk factors increase risk of recurrent instability,^{19,32} and it is unclear whether sex is a risk factor for recurrent shoulder instability.^{20,30}
2. The effect of treatment (surgical or conservative) on recurrent instability was not considered.
3. The model only examined the outcome of recurrent shoulder instability and did not reflect the loss of function and decreased quality of life evident with recurrent shoulder instability.^{16,29}
4. Computer modeling to predict health outcomes may not reflect what happens in real-life scenarios.

We developed the Predicting Recurrent Instability of the Shoulder (PRIS) tool²⁰ based on a set of risk factors: age, bony Bankart lesions, immobilization after dislocations, dislocation of the dominant-side shoulder, kinesiophobia (fear of

• **OBJECTIVE:** To assess the sensitivity, specificity, and validity of the Predicting Recurrent Instability of the Shoulder (PRIS) tool in people with a first-time traumatic anterior shoulder dislocation.

• **DESIGN:** Prospective cohort study.

• **METHODS:** People with first-time traumatic anterior shoulder dislocation (n = 85), aged 16 to 40 years, were recruited within 12 weeks of their shoulder dislocation and followed prospectively for 1 year post injury. We calculated the sensitivity, specificity, negative predictive value, and positive predictive value of the PRIS tool.

• **RESULTS:** Of the 75 participants available for 1-year follow-up, 57 (76%) did not have recurrent shoulder instability. With the PRIS tool cut point set at 0.895, the tool's sensitivity was 39% (95% confidence interval [CI]: 17.3%, 64.3%) and its

specificity was 95% (95% CI: 85.4%, 98.9%). The area under the curve was 0.69 (95% CI: 0.55, 0.84; $P = .01$). The PRIS tool correctly identified 54 of the 57 (95%) who did not have recurrent instability (accuracy, 81%; 95% CI: 70.7%, 89.4%). Negative and positive predictive values were 83% (95% CI: 77.2%, 87.7%) and 70% (95% CI: 40.2%, 89.0%), respectively.

• **CONCLUSION:** The PRIS tool can predict those who will not have further shoulder instability in the year following first-time traumatic anterior shoulder dislocation. The PRIS tool cannot accurately predict those who will have recurrent shoulder instability. *J Orthop Sports Phys Ther* 2020;50(8):431-437. doi:10.2519/jospt.2020.9284

• **KEY WORDS:** prognostic, recurrent shoulder instability, validation

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movement and reinjury), and perceived pain and disability (TABLE 1). The aim of this study was to assess the validity of the PRIS tool in a cohort of people with an FTASD. We hypothesized that the PRIS tool would have high specificity, sensitivity, and predictive validity.

METHODS

Study Design and Setting

THIS PROSPECTIVE COHORT STUDY was reported according to the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) checklist for cohort studies. Predictive validity was examined in a cohort of people living in New Zealand who had an FTASD. Participants were followed prospectively for 12 months following their FTASD. Participants provided responses to the questionnaires and shared their experience of a shoulder dislocation. They did not participate in the design of the study or contribute in any other way to the study.

Participants

The inclusion and exclusion criteria for participants, along with the recruitment procedures, were identical to those used in the development of the multivariate tool.²⁰ Participants were eligible for inclusion if they were between 16 and 40 years of age, sustained an FTASD in New Zealand, had a shoulder radiograph, had a New Zealand contact address, had registered their shoulder dislocation with the Accident Compensation Corporation between February 2016 and May 2017, and provided verbal informed consent to take part in the study. People were excluded if they reported previous shoulder instability or other shoulder pathology, such as impingement or acromioclavicular joint disruption, at the initial interview or had radiological evidence of previous shoulder instability or other shoulder pathology.

People in New Zealand who have a traumatic injury present to health care professionals who record their injury

with the Accident Compensation Corporation, a government-owned corporation responsible for administering the country's universal no-fault injury scheme. We identified people who had an FTASD via the injury coding system.²⁰ For a detailed description of the sample-size calculation, see APPENDIX A (available at www.jospt.org). Participants were recruited for each age group (5-year intervals) from 16 years to 40 years.²⁵ Sample-size estimates were based on rates of recurrent shoulder instability found during the development of the PRIS tool,²⁰ powered at 0.8, with alpha set at .05, and accounting for 15% loss to follow-up. We required 77 participants for this study.

Eighty-five participants were recruited from 337 people who had an FTASD between February 2016 and May 2017 (FIGURE 1). Data collection ceased for each age group when sufficient participants were recruited to reach a certain power,

as calculated in TABLE 2. Data collection continued until the target for each age group was reached, except for age groups 31 to 35 and 36 to 40 years, which were 1 and 2 participants short of their targets, respectively. We stopped recruitment early because of time and funding restrictions.

Procedures

Following consent and inclusion in the study, participants completed the tool via telephone interview within 12 weeks of the index shoulder dislocation. Bony Bankart lesions were confirmed on X-ray by the lead investigator. We recorded the participant's age, hand dominance, side of dislocation, occupation, immobilization status, and presence of a bony Bankart lesion.²⁰ Baseline kinesiophobia (fear of movement and reinjury) and shoulder pain and disability were measured with the Tampa Scale of Kinesiophobia-11 and

TABLE 1

VARIABLES AND EQUATION OF THE PRIS TOOL^a

Variable	Scoring
Age	16-40 y (16-25 y, 1 point; 26-40 y, 0 points)
Bony Bankart lesion	Yes, 1; no, 0 (verified by X-ray)
Dominant side affected	Yes, 1; no, 0
Immobilization after initial FTASD	Yes, 1; no, 0
SPADI total score	0%-100% (0%, no shoulder pain or disability)
TSK-11 total score	11-44 (higher score indicates greater kinesiophobia)

Abbreviations: FTASD, first-time traumatic anterior shoulder dislocation; PRIS, Predicting Recurrent Instability of the Shoulder; SPADI, Shoulder Pain and Disability Index; TSK-11, Tampa Scale of Kinesiophobia-11.

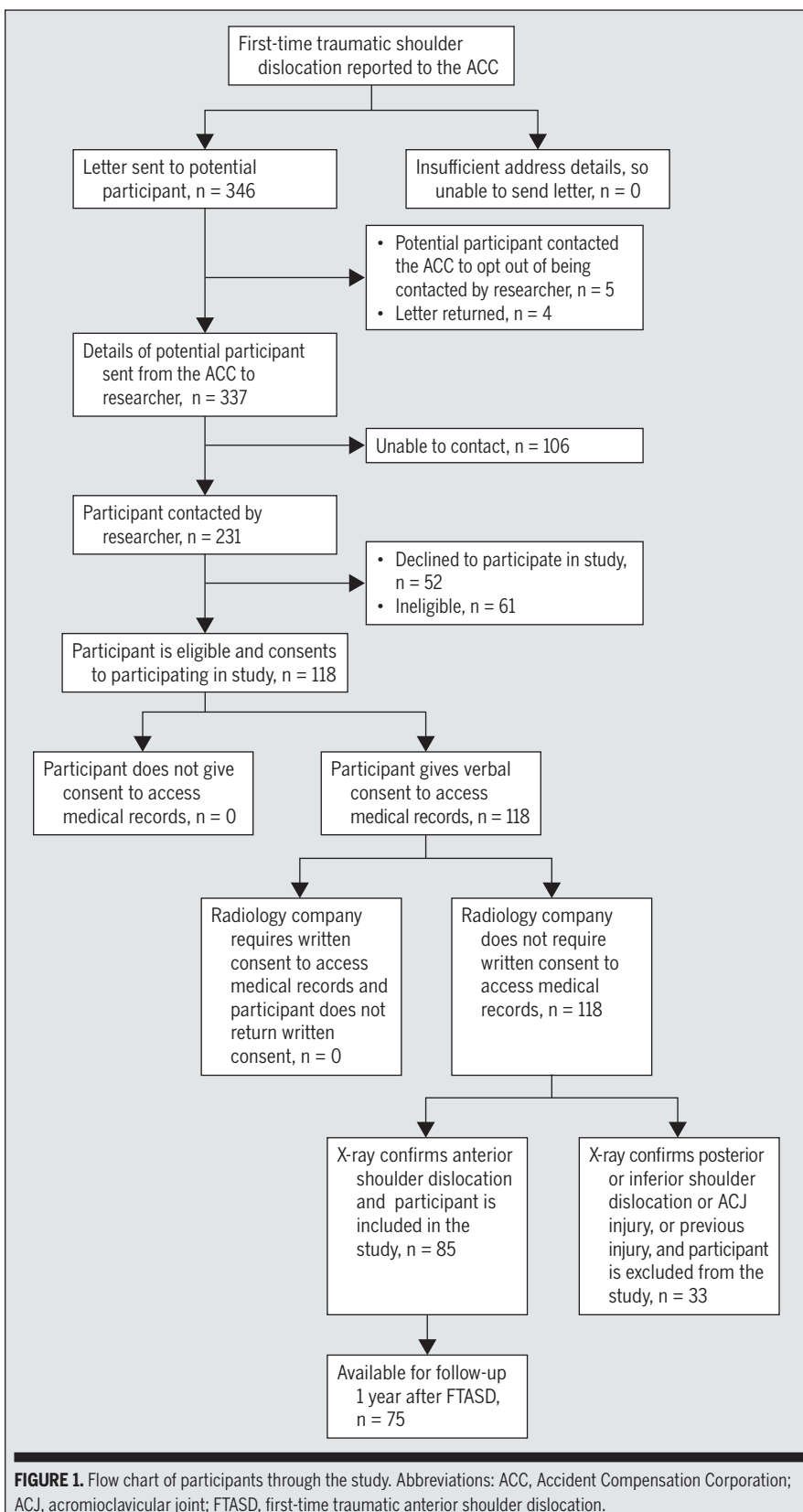
^aRisk of recurrence = $-4.73 + 1.06 \times (\text{ages 16-25 years}) + 1.80 \times (\text{bony Bankart lesions}) + 0.80 \times (\text{dominant side affected}) - 1.27 \times (\text{immobilized}) + 0.03 \times (\text{SPADI total score}) + 0.13 \times (\text{TSK-11 total score})$.

TABLE 2

SAMPLE-SIZE CALCULATION FOR THE VALIDATION COHORT^a

Age Group	Required Sample Size, n	Total Participants Recruited, n
16-20 y	25	25
21-25 y	23	31
26-30 y	9	12
31-35 y	10	9
36-40 y	10	8
Total	77	85

^aBased on a power of 0.80, $\alpha = .05$, and an anticipated loss to follow-up of 15%.



the Shoulder Pain and Disability Index, respectively.²⁰

Data Collection

Research assistants (all health professionals) were trained to identify recurrent shoulder instability events. When there was uncertainty regarding instability events, we discussed the individual cases at regular meetings to reach a consensus (APPENDIX B, available at www.jospt.org). The research assistants were unaware of predictors of recurrent shoulder instability in the baseline data. Follow-up phone calls were made at 3, 6, 9, and 12 months following the date of injury by the research assistants, who were blind to the baseline data collection to limit recall and experimenter bias. If participants preferred to be contacted by e-mail, we sent an e-mail with a link to the online version of the PRIS tool.

The primary outcome was recurrent instability of the previously dislocated shoulder. Recurrent instability was defined as a repeated event of instability: either a subluxation or a dislocation.¹⁹ Some studies have advocated primary surgical intervention in this population of people following an FTASD, which would occur within the 12-month time frame.^{15,23} Additionally, approximately 70% of people who have recurrent instability will experience shoulder instability within 12 months following their initial injury.²⁵ We did not envisage that these variables would change beyond the first year of follow-up. Therefore, we studied the shorter-term impact of recurrent shoulder instability after an FTASD.

Statistical Analysis

The ability of the tool to discriminate between those who did not have any further episodes of instability and those who did have recurrent shoulder instability (ie, predictive validity) was evaluated using receiver operating characteristic (ROC) curve analysis. The ROC curve analysis plots continuous data, including a comprehensive review of all possible cut points, to establish a threshold with

maximal sensitivity and specificity along the curve.¹⁴

The discriminative validity of the tool was measured with the area under the curve (AUC). A larger area under the ROC curve indicated increased accuracy and validity.¹⁴ An AUC of 0.5 or below represents no discriminative validity, values between 0.5 and 0.7 limited validity, between 0.7 and 0.8 acceptable validity, between 0.8 and 0.9 excellent validity, and above 0.9 outstanding validity.¹⁴

Calibration of the tool indicates how well the observed data fit the predicted data, and was measured with the Hosmer-Lemeshow test.¹⁰ Accuracy of the cut point of the predictive tool was measured by the sum of the true positives and true negatives, divided by the total number of tests.¹

Estimates of sensitivity, specificity, and positive predictive value (PPV) and negative predictive value (NPV), with 95% confidence intervals (CIs), were calculated for the scoring system.^{13,24} There is no consensus about which level of sensitivity or specificity is clinically acceptable, partly because these levels change depending on the severity of consequences of the decision making.^{7,8,26} The cut point for the tool was the point on the ROC curve with the highest cumulative sensitivity and specificity (Youden's index).²²

We compared the demographic characteristics of the formation and validation populations to ensure that the demographic make-ups of the respective populations were similar. Statistical analysis was undertaken with SPSS software (Version 24.0; IBM Corporation, Armonk, NY).

RESULTS

Demographics and Description of Study Population

THERE WERE A TOTAL OF 75 PARTICIPANTS, 64 (85%) of whom were male. Participants in the formation²⁰ and validation populations were similar in age, height, and weight (TABLE 3). There was a higher percentage of overhead and

manual workers in the validation population (TABLE 3).

There was 12% loss to follow-up ($n = 10$). There was no significant difference in baseline variables between participants lost to follow-up and those who completed the study. Of the 75 participants followed for 1 year, 18 (24%) had recurrent instability. Over the 12-month study period, the majority of recurrent instability episodes occurred at the 12-month time point (7 episodes, 39%), with 3 episodes at 9 months (17%), 6 at 6 months (33%), 1 at 3 months (5%), and 1 at baseline (5%). Using the PRIS tool, the cut point of 0.895 was used. With a Youden's index value of 0.895, the predictive tool had a sensitivity of 39% (95% CI: 17.3%, 64.3%) and specificity of 95% (95% CI: 85.4%, 98.9%) (FIGURE 2).

The AUC was 0.69 (95% CI: 0.55, 0.84; $P = .01$). The PRIS tool had limited predictive value, given that the 95% CI included the values of 0.5 and 0.7.¹⁴ The PPV (70%; 95% CI: 40.2%, 89.0%) and NPV (83%; 95% CI: 77.2%, 87.7%) can be seen in TABLE 4. The Hosmer-Lemeshow test was 13.30 ($P < .01$), indicating poor goodness of fit between the observed and predicted values. With the cut point set at 0.895, the negative likelihood ratio was 0.65 and the positive likelihood ratio was 7.39.

DISCUSSION

Predictive Ability of the PRIS Tool

THE PRIS TOOL, APPLIED FOLLOWING an FTASD, had high specificity (95%). Out of all participants who

TABLE 3

COMPARISON OF DEMOGRAPHIC DATA BETWEEN THE FORMATION AND VALIDATION POPULATIONS^a

Variable	Formation Population ($n = 110$)	Validation Population ($n = 75$)
Age, y	24.6 ± 7.1	24.2 ± 6.6
Height, cm	180.2 ± 8.5	177.2 ± 8.9
Weight, kg	82.0 ± 15.8	84.0 ± 17.5
Body mass index, kg/m ²	25.5 ± 4.3	26.7 ± 4.9
SPADI ^b	17.02 ± 15.1	24.5 ± 21.8
TSK-11 ^c	36 ± 3.6	24.7 ± 4.8
SAS ^d	11.6 ± 3.5	12.7 ± 4.1
WOSI ^e	758.8 ± 441.9	939.0 ± 470.0
Male, n (%)	97 (88)	64 (85)
Dominant shoulder, n (%)	57 (52)	42 (56)
Manual occupation, n (%)	41 (37)	45 (60)
Overhead occupation, n (%)	29 (26)	31 (41)
Family history of recurrent shoulder instability, n (%)	20 (18)	15 (20)
Hypermobility, n (%)	30 (27)	16 (21)
Immobilized, n (%)	86 (79) ^f	61 (81)
Bony Bankart lesion, n (%)	13 (12)	6 (8)
Greater tuberosity fracture, n (%)	4 (4)	2 (3)
Hill-Sachs lesion, n (%)	31 (28)	18 (24)
Recurrent instability, n (%)	46 (42)	18 (24)

Abbreviations: SAS, Shoulder Activity Scale; SPADI, Shoulder Pain and Disability Index; TSK-11, Tampa Scale of Kinesiophobia-11; WOSI, Western Ontario Shoulder Instability Index.

^aValues are mean ± SD unless otherwise indicated.

^bScores range from 0 to 100, with higher scores denoting worse pain and function.

^cScores range from 11 to 44, with higher scores denoting greater kinesiophobia.

^dScores range from 0 to 20, with higher scores denoting increased activity level.

^eScores range from 0 to 2100, with higher scores denoting worse quality of life.

^f $n = 109$.

did not go on to develop recurrent instability ($n = 57$), the tool accurately predicted 54 people (95%) who did not experience a further episode of recurrent shoulder instability.

The PRIS tool cannot identify those who have subsequent shoulder instability following an FTASD, as it has limited sensitivity (39%). Of the 18 participants who developed recurrent instability, 39% ($n = 7$) were correctly identified by the tool. This means that 61% of people ($n = 11$) who developed recurrence within the 12-month follow-up were incorrectly predicted not to have further recurrence (false negatives). Low sensitivity may be due to the lower prevalence rates of recurrent shoulder instability (24%) in the present participants compared to the initial cohort that was used to develop the tool (42%)²⁰ (TABLE 3). Sensitivity of the PRIS tool may be improved by adding other variables, such as an apprehension test¹⁷ or the presence of labral pathology.²⁷

Clinical Utility of the PRIS Tool

While sensitivity and specificity are useful metrics of a clinical test, clinicians want to know the chances of a positive or negative test result (ie, PPV or NPV) in their patients. Of those people identified as having recurrent shoulder instability, 70% were correctly identified within 12 months (PPV, 0.7). Of all those people identified as not having recurrent shoulder instability, 83% were correctly

identified (NPV, 0.83). Increased PPVs and decreased NPVs of a clinical test are seen when there is a low prevalence rate.⁵ The low prevalence rate in this validation population resulted in lower PPVs and higher NPVs in the study, which might have influenced accurate identification of people who were going to have recurrent shoulder instability. The accuracy value of 95% is the overall probability that a participant will be correctly classified at any given cut point on the ROC curve. Using the single cut point of 0.895, the accuracy was 81%. However, the PRIS tool had limited discriminative validity (AUC = 0.69), and the Hosmer-Lemeshow test indicated that the model was not well calibrated.²¹ Baseline measures of kinesiophobia (Tampa Scale of Kinesiophobia-11) and shoulder pain and disability (Shoulder Pain and Disability Index) provide valuable information for clinicians working with people following an FTASD. The use of predictive tools in clinical practice allows clinicians to predict the outcome of an FTASD. Clinicians might choose to record measures of kinesiophobia and shoulder pain and disability and enter the data into the online clinical tool (www.margieolds.com/pris) to facilitate shared decision making regarding management of shoulder dislocation.

This study showed limited predictive ability of a visual analog scale pain score,

and this was not included in the predictive tool. Therefore, while this may be a useful measure to examine pain, it is not helpful in informing whether or not someone will have a further recurrence.

Improving Care for People With a First-Time Anterior Shoulder Dislocation

The PRIS tool can be used to identify those people who are not likely to have recurrent shoulder instability, with the current level of intervention, and accordingly do not require a different treatment pathway. Using the PRIS tool in clinical practice may improve decision making, promote efficient health care use, and clarify patient expectations after FTASD. In conjunction with shared decision making, predictive tools enable clinicians to be free of clinical bias, which may result inadvertently from their role or position in the health care system.³ This tool allows clinicians to provide objective data for people following an FTASD, and is available online at www.margieolds.com/pris. However, limited accuracy and low rates of sensitivity make it difficult to accurately identify people who will go on to have recurrent shoulder instability following an FTASD.

The rate of recurrent shoulder instability following an FTASD in New Zealand appears to be lower than the rate in other countries, despite the increased

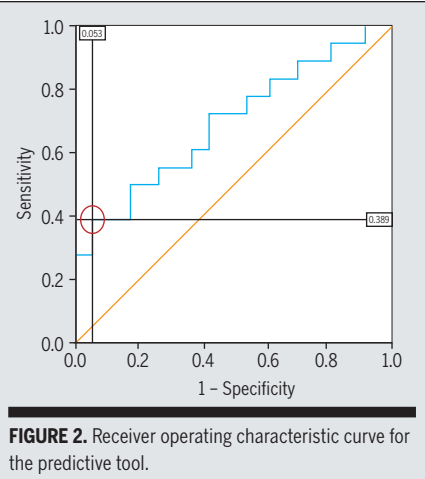


TABLE 4		DIAGNOSTIC VALUES OF THE PRIS TOOL ^a	
		Value ^b	
Prevalence, %		24.00 (14.89, 35.25)	
Sensitivity, %		38.89 (17.30, 64.25)	
Specificity, %		94.74 (85.38, 98.90)	
Area under the curve		0.69 (0.55, 0.84)	
Positive predictive value, %		70.00 (40.20, 89.01)	
Negative predictive value, %		83.08 (77.16, 87.70)	
Positive likelihood ratio		7.39 (2.13, 25.65)	
Negative likelihood ratio		0.65 (0.44, 0.94)	
Accuracy, %		81.34 (70.67, 89.40)	
<i>Abbreviation: PRIS, Predicting Recurrent Instability of the Shoulder.</i>			
<i>^aBased on a cut point of 0.895.</i>			
<i>^bValues in parentheses are 95% confidence interval.</i>			

rates of participation in contact and collision sports. Rates of recurrent instability are 57% in Sweden,¹² 33% in the United States,²⁸ and 67% in Scotland.²⁵ These variations may be due to the accuracy of the injury surveillance system. Additionally, the health care system in New Zealand is heavily subsidized for those people who sustain traumatic injuries.⁶ This enables all New Zealanders to have access to emergency medicine and heavily discounted rates for rehabilitation following traumatic injuries, however mild. Equitable access to health care may be responsible for the lower rate of recurrent instability when compared with rates of recurrent shoulder instability seen globally.

Limitations

This study has at least 3 limitations, which may help explain the poor sensitivity of the PRIS tool. First, participants were followed for 1 year only. Although previous research has shown that around 70% of people who were likely to have another shoulder dislocation had one within 12 months,²⁵ there may be some who sustained a recurrence beyond 12 months and were therefore not captured in this study.

Second, fewer people in the study had recurrent shoulder instability than anticipated. Consequently, this study was underpowered and had an increased chance of reporting no difference when a true difference exists (false-negative finding [type II error]).² Our recurrence rates can be used to inform sample-size calculations for future studies.

Third, there might have been some bias in the recruitment of participants, particularly in those who declined to take part in the study, or in variables not measured at baseline in those who were lost to follow-up.

CONCLUSION

THE PRIS TOOL CAN IDENTIFY THOSE people who are not going to have recurrent shoulder instability after an FTASD. Those identified by the PRIS tool

as not likely to have recurrent shoulder instability can be treated with the current level of intervention, and do not require an alternative treatment pathway. The PRIS tool has limited sensitivity and cannot be used to correctly identify people who will have recurrent shoulder instability. ●

KEY POINTS

FINDINGS: The Predicting Recurrent Instability of the Shoulder (PRIS) tool can help identify people who are less likely to have recurrent shoulder instability following a first-time traumatic anterior shoulder dislocation.

IMPLICATIONS: The online PRIS tool (www.margieolds.com/pris) can facilitate shared decision making regarding best management after a first-time traumatic anterior shoulder dislocation.

CAUTION: The PRIS tool has limited sensitivity and discriminative validity. The PRIS tool cannot predict patients who will have subsequent shoulder instability following a first-time traumatic anterior shoulder dislocation. The validation cohort did not meet the a priori sample-size estimate for participants aged 31 to 40 years. Follow-up beyond 12 months and examination of other risk factors, including physical assessment tests, might improve the validity of the tool.

STUDY DETAILS

AUTHOR CONTRIBUTIONS: Drs Olds and Kersten conceived and designed the work. Dr Olds acquired the data. All authors contributed to the analysis and interpretation of data, drafting and revising the work, and final approval.

DATA SHARING: Data are available on request. Pooled data and data regarding group comparisons, study protocol, and statistical analysis plan are available up to 24 months from study publication date from the corresponding author. Individual patient data are not available.

PATIENT AND PUBLIC INVOLVEMENT: Participants did not participate in the design of the study, or contribute in any other way to the study.

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[RESEARCH REPORT]

APPENDIX A

SAMPLE-SIZE CALCULATIONS FOR PHASE 2, WITH AGE STRATIFICATION BASED ON THE DATA FROM ROBINSON ET AL^{25a}

Age	Recurrence Rate, % ^b	Participants, n	Assumed Recurrence	Sample Size	Adjusted Sample Size ^c
			Rate, %		
16-20 y	52.0 (41.5, 62.5)	92	50	21	25
21-25 y	40.8 (29.6, 52.1)	79	50	20	23
26-30 y	15.9 (5.1, 26.7)	47	25	8	9
31-35 y	21.2 (7.3, 35.3)	34	25	9	10
36-40 y	Unknown	...	25	9	10
Total				67	77

^aBased on a power of 0.80 and $\alpha = .05$ (2 sided).

^bValues in parentheses are 95% confidence interval. Rates are those reported in the Robinson et al²⁵ study.

^cThe sample size was increased by 15% to account for nonresponse rates.

APPENDIX B

FURTHER QUESTIONS TO CATEGORIZE RECURRENT INSTABILITY IF THE INITIAL RESPONSE TO THE RECURRENT INSTABILITY QUESTION WAS NOT CLEAR

Participant Categorized as “No Recurrent Instability”	Participant Categorized as “Recurrent Instability”
• The participant has had no further episodes of shoulder instability • The participant has had pain or felt increased movement in the shoulder, but the shoulder has not come out of its socket	• The shoulder has come out of its socket and was relocated without the application of external force • The shoulder has come out of its socket and required assistance/the application of external force from nonmedical personnel (family or friends) to relocate it • The shoulder has come out of its socket and required assistance of a doctor (or other medical personnel) to relocate it

Purposeful Heading in Youth Soccer: Time to Use Our Heads

Soccer is the most popular participation contact sport in the world across all ages and sexes, with over 265 million registered players, of whom 22 million are under the age of 18 years.⁷ While soccer players are considered much less likely to sustain a significant sport-related head trauma (such as concussion) compared to athletes of other contact or collision sports, soccer is unique in that players are actively encouraged to use their head to strike the ball, called “purposeful heading.”⁷ Purposeful headers in soccer are generally considered to be of low impact (reportedly between 12 and 22 g),⁶ much less than the reported sport-related head trauma threshold of between 80 and 100 g.¹² However, the long-term effect of repeated low-impact forces on the brain is

a topic of increasing global interest for all contact and collision sports.⁷

Despite the absence of a definitive causal relationship between repeated purposeful heading in soccer and neurodegenerative disorders,⁷ discussion has continued to grow on whether heading in soccer should be banned completely for all players (regardless of age) or, at the

very least, in young children and adolescents. Ideally, a clear causal link between an activity and a health outcome would underpin all discussion on the safety of purposeful heading in soccer. But when potential harm is high, taking action with less substantial evidence is considered appropriate, and this is known as the “precautionary principle.”⁵ The increasing pace of research regarding the safety of heading in soccer is likely to yield further insights into minimizing heading-related head impacts.⁵

Given that purposeful heading in soccer is going to continue to be an integral part of the game, at least for the foreseeable future, it is timely to review the current evidence base to reduce heading-related head impact while new research and debate on the safety of heading continue. The purpose of this Viewpoint was to review low-risk strategies that can be implemented now, by technical directors and coaches, to reduce head impact during purposeful heading in soccer, while research and debate continue on this contentious topic.

● **SYNOPSIS:** Repeated purposeful heading in soccer has come under increased scrutiny as concerns surrounding the association with long-term neurodegenerative disorders in retired players continue to grow. Although a causal link between heading and brain health has not been established, the “precautionary principle” supports the notion that soccer governing bodies and associations should consider implementing pragmatic strategies that can reduce head impact during purposeful heading in youth soccer while this relationship

is being investigated. This Viewpoint discusses the current evidence to support low-risk head impact reduction strategies during purposeful heading to protect young, developing players, and how such strategies could be implemented now while research and debate continue on this topic. *J Orthop Sports Phys Ther* 2020;50(8):415-417. doi:10.2519/jospt.2020.0608

● **KEY WORDS:** adolescents, football, heading, injury reduction

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Teaching Correct Heading Technique

In 2015, US Soccer banned heading in children younger than 10 years of age,⁸ with limitations placed on heading practice in players aged 11 to 13 years, to protect developing brains.⁷ More recently, the Football Association (England) released updated heading guidance, which states that heading should not be introduced in training sessions for players under 11 years of age, and that restricted heading practice is encouraged until the age of 18 years.² No restrictions on heading in games are apparent in these guidelines for any age group.² This announcement may increase pressure on soccer associations and governing bodies worldwide to review their own heading practices.

A potential issue with banning headers in one group but allowing them in another, or restricting heading practice in younger age groups but permitting it in games, is that this approach may impede young players from correctly developing this important skill. It might also induce fear or reluctance to head the ball later on, potentially impacting the development of safe heading skills. Training is the time for coaches to teach, correct, or reinforce heading technique.

While the number of purposeful headers completed in soccer is generally acknowledged to increase with increasing age during youth soccer,^{4,10} this is potentially an oversimplification of what has been observed. A recent Canadian study coded heading frequency from match videos of female soccer teams in the under-13, under-14, and under-15 age groups over a 20-week season.⁴ It was reported that although the median and range of headers increased from the under-13 (6 headers; range, 1-42) to the under-15 age groups (23 headers; range, 4-66), the maximum number of headers completed by a single player within 1 game did not (medians ranged from 8 headers in the under-13 age group to 9 headers in both the under-14 and under-15 age groups).⁴ Similar findings have been shown in both male and female

players during an international youth soccer tournament in Norway, where an increasing number of players on a given team were recorded to head the ball as the age group increased.¹⁰ A consistent finding in the literature is that some players (particularly at the youth level) head the ball much more frequently than others.^{4,9,10}

The development of foot-based ball skills and keeping the ball on the ground during the early playing years (as is current practice) will likely reduce the necessity of young players to head the ball during the skill acquisition phase (usually aimed at players under 11 or 12 years of age). Accordingly, once individual players (regardless of age) are observed to start heading the ball in games, it is imperative that they receive instruction and practice in correct heading technique. A study of football players aged 9 to 15 years reported that some players start to head the ball at around 10 years of age, whereas others start much later.⁹ Heading practice can be restricted to shorter, less frequent sessions (as recommended in the new Football Association guidelines²), using only heading drills relevant to player position or game scenario for each individual player, to reduce heading burden in young, developing players. Not teaching young players heading technique in practice would be a disservice to the players who regularly head the ball in games.

Heading a ball is a complex skill, requiring players to develop the ability to predict the flight of the ball and coordinate their body movements accordingly.⁷ Headers can also occur while a player is running, jumping, or standing and in open play or during heading duels, further adding to the complexity. Conventional heading technique encourages players to head the ball from the frontal hairline.¹¹ Failure to isometrically contract the neck musculature, particularly the neck flexors, upon ball-head contact can result in the head being accelerated backward, decreasing the effectiveness of the header and increasing brain movement.¹

Neck Exercises

There is emerging theoretical and scientific evidence suggesting that higher neck strength is important for eliciting lower head accelerations (both linear and rotational accelerations) during purposeful heading in soccer.^{1,3,6} While potentially important for all players, neck strengthening may be particularly beneficial for female and younger players, as these groups of players generally possess weaker neck muscles, smaller neck girth, and a lower effective mass when compared with adult male players.^{1,6} The effective mass of a player is defined as the mass that is able to oppose acceleration of the head when performing a purposeful header; the higher the effective mass, the lower the acceleration of the head during heading.¹ Players can increase their effective mass by having strong, activated neck muscles,¹ with level 1b, 2b, and 4 evidence that higher short-latency isometric neck muscle tension, developed prior to impact, can lower postimpact kinematics of the head.³ This is particularly relevant in soccer, where heading is a fast, dynamic skill. United Soccer Coaches, the soccer coaches' association in the United States, have devised a number of sport-specific neck-strengthening exercises that can be integrated into a warm-up or strength-and-conditioning component of soccer training,¹¹ although further research is required to assess the program's short- and long-term effectiveness.

Ball Properties

The first known ball regulations for circumference (686-711 mm) and mass (368-425 g) were recorded in 1872 by the Football Association in England, with ball mass later increased to 397 to 453 g in 1937.¹⁰ These ball requirements have formed the basis of the current specifications stipulated by the International Football Association Board *Laws of the Game*.¹⁰ The 2019-2020 *Laws of the Game* (<https://thefab.com/document/laws-of-the-game>) state that the adult match ball must be of a pressure equal to 0.6 to 1.1 atmosphere (600-1100 g/cm²) at sea level

and weigh between 410 and 450 g. Although there are different-sized balls recommended for players of different ages, with regulations usually determined by the country's own soccer association, most players aged 14 years and older will have transitioned to the adult size 5 ball.² Ball-pressure reductions of 25% to 50% (to ranges at the lower end of the regulated ball pressure) and ball-mass reductions of 35% have demonstrated lower head acceleration and head impact forces during purposeful heading.¹⁰ Training balls are often found to be on the higher end of the regulated ball mass to increase durability. Heading practice in young players can initially occur with or without a ball, but once a ball is introduced, careful consideration of ball pressure and mass (and/or ball size in younger players who have not transitioned to a size 5 ball) can lead to reduced head impact while the player is learning correct technique.

Summary

Head impact reduction strategies that consider heading technique, neck strength, and ball properties are low cost and can be implemented across all levels of the game worldwide. Although these strategies are aimed toward technical directors and coaches, their adoption requires top-down support. Given that it will take many years to delineate a possible cause-and-effect relationship between repeated purposeful heading in soccer and neurodegenerative changes in the brains of players, it is crucial for the "precautionary principle" to be acknowledged, considered, and adopted. Consideration of the immediate implementation of low-cost, low-risk, and pragmatic head impact reduction strategies during purposeful heading that demonstrate supportive evidence is recommended. The next generation of soccer players will be grateful for the effort.

Key Points

- Currently, there is no definitive causal relationship between repeated purposeful heading in soccer and neurodegenerative disorders, with the necessary evidence to support or refute a causal link likely many years away.

- The "precautionary principle" supports the notion that soccer governing bodies and policy makers should encourage the implementation of pragmatic heading-related head impact reduction practices while this relationship continues to be investigated.
- To ban heading in training but allow heading in games will impede young players from learning correct heading technique at a time when they would benefit from instruction and practice the most.
- Current evidence supports the use of many low-cost, low-risk head impact reduction strategies that can be implemented in the short term.
- Strategies such as reducing ball mass and pressure to the lower end of the International Football Association Board ball regulations, teaching correct heading technique, and implementing neck exercises are recommended for consideration. ●

STUDY DETAILS

AUTHOR CONTRIBUTIONS: All authors made substantial contributions to the conception of this Viewpoint, as well as to drafting and revising the manuscript. All authors have approved the final manuscript for publication and agree to be accountable for all aspects of the work to ensure that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

DATA SHARING: There are no data in this manuscript.

PATIENT AND PUBLIC INVOLVEMENT: There was no patient/public involvement in the development of this Viewpoint.

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MORE INFORMATION
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Patients as Partners in Research: How to Talk About Compensation With Patient Partners

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Imagine you are the only person on a research team who does not work in academia or health care—that is, your participation on the team is not part of your job. Because the team meetings are held during your normal working hours, you must take time off work or make up for missed work to attend. You need hours to prepare for each meeting: to read the agenda and materials, research many of the terms, and look up information. On most project calls, you worry that the questions and comments you have will sound silly, off topic, or irrelevant.

For the annual in-person team meeting, you need an additional day of travel on each side of the meeting due to your medical condition's debilitating fatigue, which is something you need to ask for and justify. The meeting format of 8 AM to 5 PM, along with a dinner off site for 2 days straight, is exhausting. You are passionate about the research and want to contribute the sole patient perspective to the team.

As patient partners, we thank JOSPT for efforts to help readers learn more about patient engagement in research. Through the original call to action¹ for patients as research partners and an editorial⁶ sharing resources to facilitate patient engagement, it is clear the editorial team “walks the talk.”

Our editorial builds on the previous editorials in the patient partnership series, and aims to share practical advice related to compensation for patient research partners. We started writing about this issue in November 2018.⁸ Our paper was written strictly from the patient perspective, without institutional support or funding, is based on the passion of 4 volunteers in different parts of Canada, and is the result of numerous hours of back-and-forth discussion in Google Docs (Alphabet Inc, Mountain View, CA), the same approach used for this editorial. We are pleased that our previous paper has been widely used and shared.^{6,9} We appreciate that more information is sought on this topic, especially because, as patient partners, we are the first to bring up compensation in nearly every project in which we have been involved.

Why Compensating Patient Partners Is Important

Compensation promotes equity, removes barriers, and demonstrates respect for the vulnerability of being a patient partner. Patients and caregivers have a “PhD in Lived Experience,” and compensation acknowledges their perspectives based on these personal experiences, not professional ones.² Expertise is not interchangeable with the notion that patients and caregivers are experts at managing their conditions; rather, they manage their circumstances as best they can and share these experiences. We believe our guidance on how to have a conversation about compensation with patient partners is required to help build expertise in this area—an area in which the research community lacks confidence, evidenced by frequent requests for more concrete guidance, including examples.

How to Have a Conversation About Compensation

The **FIGURE** is intended to guide a conversation with a (potential) patient partner about compensation. As the paid professional, we advise you to take care of as many details as possible in advance and

be prepared for the conversation. Patient partners will appreciate your efforts to make the process seamless for them and your willingness to do additional homework on this topic if required.

Budgeting

Budget for patient partner engagement, including compensation, like you would for any other aspect of your research. Consider whether you need to include costs associated with the patient partner's transport to meetings (eg, transit, mileage, parking, etc), extra days for travel to a meeting or conference (depending on their health condition), considerations for caregiver travel, etc. Covering the expenses associated with a patient partner's involvement is not the same as compensation. Tools are emerging that provide help and excellent templates.^{4,5}

A Culture of Partnership

We have become advocates thanks to our health conditions and circumstances. We will continue to advocate in the field of patient engagement with respect to compensation and other areas. We encourage leaders of organizations and communities to join us in our vision. Let us work together to build capacity in research and health-care environments (including for patient partner compensation), so researchers and patient partners can focus on codeveloping projects rather than on navigating different policies and associated logistics.^{3,10}

Summary

In our first publication on patient partner compensation in research and health care, we presented the “why” and “how.”⁸ Here, we build on the “how” to help alleviate the awkwardness of that conver-

sation. The compensation conversation, as a regular part of this type of partnership, allows teams to codevelop projects and focus on the output and outcomes of their collaborative work. ●

ACKNOWLEDGMENTS: *The authors acknowledge Mr David Tan for developing the figure icons.*

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1. Initiate the conversation. Ask patient partners how they would prefer to discuss compensation (eg, in person, phone, videoconference, e-mail, etc).



2. Be prepared. Find out as much as possible about logistics in advance, including: what is possible, what are the potential implications (eg, additional income, disability payments, etc), when does payment happen, what is required (eg, paperwork, invoice, etc)?



3. Confirm the patient partner's preferences for compensation. It is a patient partner's choice to receive or not receive compensation, and in the manner of his or her choosing. The amount should reflect engagement length and effort.

Monetary considerations:

- Lump sum or hourly rate
- Date(s) of payment, etc

Nonmonetary considerations:

- Gift cards, payment of phone bills/internet bills, attendance for a course/conference of their choosing, etc



Considerations:

- What other forms of recognition are available? For example, authorship or acknowledgment if appropriate?
- Is the patient partner okay with these other forms of recognition? Decisions around acknowledgment should remain with the patient partner (eg, if someone lives with a stigmatized condition, then he or she may have preferences around public acknowledgment)



4. Take care of the details. If you encounter any issues at your institution/organization, be honest with the patient partner about these and be prepared to do required follow-up.

FIGURE. Steps to having a conversation about compensation with a patient partner.

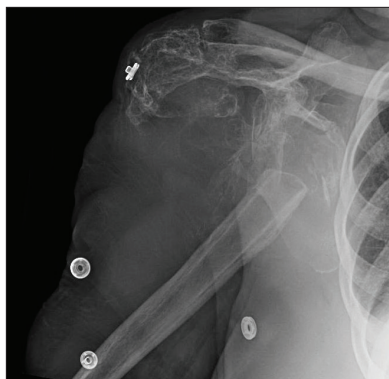


FIGURE 1. Anteroposterior radiograph of the right shoulder depicting destruction of the glenohumeral joint, with absence of the humeral head. Resorption of the humeral head led to the displacement of the humeral shaft, subluxated anteriorly and inferiorly relative to the glenoid. There is a short obliquely oriented lucency involving the medial aspect of the scapula, in the region of the scapular spine (center of image), which may represent an area of nonbridging heterotopic ossification with a nondisplaced fracture, considered less likely. All findings are indicative of a chronic neuropathic joint.

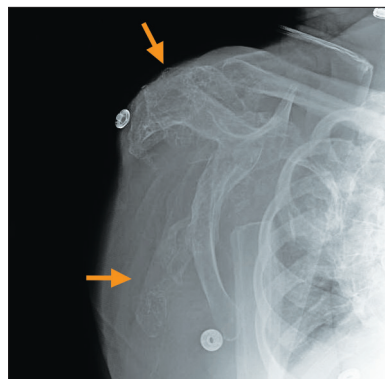


FIGURE 2. The lateral view of the scapula demonstrates areas of heterotopic ossification around the scapula (arrows). There are multiple osseous fragments noted about the glenohumeral joint, with degenerative changes at the acromioclavicular joint. Circular metallic objects in the images are hospital-gown snap closures.

Neuropathic Glenohumeral Joint Resorption

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AN 81-YEAR-OLD, RIGHT-HANDED woman was evaluated by a physical therapist at a skilled nursing facility 3 days post total knee arthroplasty (TKA). Significant medical history included diabetes mellitus. She was ambulatory with a rolling walker, issued postoperatively.

During examination tasks, the patient had difficulty elevating her right arm. She reported a 10-year history of atraumatic functional decline at the shoulder, accompanied by pain only in the first 2 years of onset. She recalled that an orthopaedic surgeon indicated she was not a surgical candidate. Active shoulder range of motion and strength were pain free, but severely limited in all directions. Her humeral head and proximal humerus

could not be palpated, while the contour of the superior right shoulder was hard and protruded abnormally. Light touch was intact throughout the upper extremity, without abnormal temperature or swelling. After consulting the on-call physician, radiographs were ordered.

Radiographs revealed a chronic neuropathic joint with complete resorption of the humeral head and heterotopic ossification at the scapula (**FIGURES 1 and 2**). Physical therapy intervention for the TKA proceeded successfully, utilizing a hemi-walker instead of a standard walker to prevent weight bearing on the right arm.

Common etiologies for the neuropathic joint are acquired syringomyelia, diabetes mellitus, or trauma.¹⁻³ Proposed

mechanisms include neurotraumatic and neurovascular changes that lead to repeated microtrauma, soft tissue breakdown, and hyperemia.^{1,2} This is followed by activation of inflammatory cascades and increased osteoclastic activity, resulting in bone resorption and abnormal bone formation and fusion.^{1,2}

Imaging assisted in decision making to adjust assistive device selection to protect the neuropathic joint, where the absence of pain no longer provided protective feedback, common in this condition. The patient had devised impressive compensatory patterns in the environment of pain cessation, which allowed the shoulder pathology to go undetected. • *J Orthop Sports Phys Ther* 2020;50(8):466. doi:10.2519/jospt.2020.9174

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Dry Needling Combined With Guideline-Based Physical Therapy Provides No Added Benefit in the Management of Chronic Neck Pain: A Randomized Controlled Trial

Neck pain has a lifetime prevalence of nearly 80% and one of the highest disability burdens worldwide.²³ The etiology of neck pain is multifactorial, and several risk factors predispose an individual to develop neck pain, such as poor general health and psychological status, obesity, and sedentary lifestyle.^{15,30}

Treatment guidelines for chronic neck pain recommend a multimodal approach, consisting of manual therapy

(thoracic and cervical manipulation or mobilization) in combination with exercise therapy (ie, strength, endurance,

coordination, proprioception, and postural training).^{4,5,14} However, guidelines provide conflicting recommendations for other treatment modalities, such as dry needling. Canadian¹⁴ and Dutch⁴ guidelines do not recommend dry needling for neck pain; American guidelines⁵ endorse dry needling based on moderate strength of evidence.

Dry needling is superior to sham needling for pain relief up to 12 weeks post randomization.²⁰ Despite evidence of its efficacy from placebo-controlled trials, trials designed to test the effectiveness of dry needling are small, verify only short-term effects, are at high risk of bias, and do not have strong comparators that adequately reflect contemporary clinical practice.^{2,7,9,37} Pragmatic trials, which offer greater flexibility when selecting a therapeutic approach, are therefore needed to better understand the effects of dry needling on neck pain.¹⁶ We aimed to determine the added benefit of combining dry needling with a guideline-based physical therapy treatment program, consisting of exercise and manual therapy, for improving pain and disability in people with chronic neck pain.

• **OBJECTIVE:** To determine the added benefit of combining dry needling with a guideline-based physical therapy treatment program consisting of exercise and manual therapy on pain and disability in people with chronic neck pain.

• **DESIGN:** Randomized controlled trial.

• **METHODS:** Participants were randomized to receive either guideline-based physical therapy or guideline-based physical therapy plus dry needling. The primary outcomes, measured at 1 month post randomization, were average pain intensity in the previous 24 hours and previous week, measured with a numeric pain-rating scale (0-10), and disability, measured with the Neck Disability Index (0-100). The secondary outcomes were pain and disability measured at 3 and 6 months post randomization and global perceived effect, quality of sleep, pain catastrophizing, and self-efficacy measured at 1, 3, and 6 months post randomization.

• **RESULTS:** One hundred sixteen participants

were recruited. At 1 month post randomization, people who received guideline-based physical therapy plus dry needling had a small reduction in average pain intensity in the previous 24 hours (mean difference, 1.56 points; 95% confidence interval [CI]: 1.11, 2.36) and in the previous week (mean difference, 1.20 points; 95% CI: 1.02, 2.21). There was no effect of adding dry needling to guideline-based physical therapy on disability at 1 month post randomization (mean difference, -2.08 points; 95% CI: -3.01, 5.07). There was no effect for any of the secondary outcomes.

• **CONCLUSION:** When combined with guideline-based physical therapy for neck pain, dry needling resulted in small improvements in pain only at 1 month post randomization. There was no effect on disability. *J Orthop Sports Phys Ther* 2020;50(8):447-454. Epub 9 Apr 2020. doi:10.2519/jospt.2020.9389

• **KEY WORDS:** clinical trial, dry needling, neck pain, rehabilitation

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METHODS

WE CONDUCTED A 2-ARM RANDOMIZED controlled trial, with concealed allocation and blind outcome assessment, in Porto Alegre, Brazil. The study was approved by the Federal University of Health Sciences, Porto Alegre Ethics Committee (approval number 1.685.374) and prospectively registered at www.ClinicalTrials.gov (NCT02927977). This trial was reported following the Consolidated Standards of Reporting Trials (CONSORT) statement.³⁴

Participants, Therapists, and Settings

Participants were recruited from the community via advertisements in local newspapers and on social media from October 2016 to March 2018. We included participants who were aged 18 to 65 years and had neck pain lasting for at least 3 months, without signs or symptoms suggestive of major structural pathology (neck pain grades I and II).²¹ Eligible participants also had to report an average neck pain intensity of at least 3/10 on the numeric pain-rating scale (NPRS) and at least 15/100 points on the Neck Disability Index (NDI) questionnaire in the week preceding enrollment. We excluded participants with signs and symptoms of nerve root compression, pregnancy, self-reported diagnosis of tendinopathies in the upper limb, fibromyalgia, and those who had used antidepressant and anticoagulant medications in the week prior to the study. We also excluded those with any contraindication to dry needling, such as infection, fever, hypothyroidism, wounds in the puncture area, metal allergy, cancer or systemic disease, or fear of needles.²⁹

Three physical therapists provided treatment at 3 private physical therapy practices located in the city of Porto Alegre, Brazil. The physical therapists had a mean $\pm$ SD of 6.8 ± 2.8 years of clinical experience. All therapists had postgraduate qualifications in rehabilitation sciences, with emphasis on musculo-

skeletal conditions. The lead investigator provided 6 hours of training to the 2 other therapists prior to study commencement to standardize treatment procedures.

Randomization

A researcher not involved in any other aspect of the study prepared sequentially numbered opaque and sealed envelopes in blocks of 6 and 8 containing the group allocation.¹⁷ Randomization was stratified by baseline pain intensity (0-10 points) into low (3-6) and high (7-10) pain-intensity strata. Participants were allocated at a 1:1 ratio. Researchers involved in outcome assessment and treatment had no access to the envelopes. Participants were randomized to either a guideline-based physical therapy program or a guideline-based physical therapy program plus dry needling. Baseline characteristics were collected prior to randomization.

Assessment Instruments

Participants used Google Forms (Alphabet Inc, Mountain View, CA) to complete outcome assessments online.³¹ A blinded researcher managed all the online forms. Given the nature of the interventions, therapists and participants were not blinded.

Intervention

The intervention was conducted by 1 of 3 physical therapists. Each treatment session lasted approximately 40 minutes in both groups. There were 4 to 6 consultations over 4 weeks. Participant discharge was at the discretion of the physical therapist, in agreement with the participant. No specific criteria were established a priori in order to maintain the pragmatic nature of the trial.

Participants in both groups received a rehabilitation protocol comprising exercise and manual therapy for a period of 1 month. Therapists could use manual treatment²⁸ (neck and thoracic mobilization) and/or exercises¹⁹ (strengthening the neck and upper back muscles against manual resistance). The decision to use 1 or more treatments was pragmatic (ie,

the therapist decided which procedures to use at each session, according to clinical reasoning). The pivotal aims of the interventions were to reduce neck pain, strengthen neck and upper back muscles, increase range of motion, and educate the participant about neck self-care in daily activities.

Participants in the physical therapy plus dry needling group received the dry needling technique on the posterior neck muscles (upper and middle trapezius, cervical multifidi, splenius cervicis, and levator scapulae muscles) at the end of each session. The therapist determined which muscles to treat after assessing for the presence of nodules that were hyperirritable and hyperalgesic to palpation in those muscles.¹⁸ Sterile stainless steel acupuncture needles (0.25 $\times$ 40 mm; Dongbang, Seoul, Republic of Korea) were used. The needle was introduced subcutaneously, penetrating the skin at 10 to 15 mm of depth, and manipulated to elicit a local contraction response. After the first local twitch response was identified, vertical pistoning without rotational needle movement²² was performed to obtain up to 6 additional twitch responses (APPENDIX, available at www.jospt.org).

Outcomes

Primary Outcomes The primary outcomes, measured at 1 month post randomization, were average pain intensity (in the previous 24 hours and in the previous week), measured with the NPRS (0-10; higher score is worse pain), and disability, measured with the NDI (0-100; higher score is more disability).^{11,12}

For pain, we considered a difference between groups of at least 2 points on the NPRS to be clinically important.¹⁰ For disability, we considered a between-group difference of 7.5 points to be clinically important.³⁹

Secondary Outcomes Pain and disability were also recorded at 3 and 6 months post randomization as secondary outcomes. Other secondary outcomes were the global perceived effect of treatment, measured with the Global Perceived Effect (GPE)

scale,¹² quality of sleep, measured with the Pittsburgh Sleep Quality Index (PSQI),³ pain catastrophizing, measured with the Pain Catastrophizing Scale (PCS),³⁵ and self-efficacy, measured with the Pain Self-Efficacy Questionnaire (PSEQ).³³ These outcomes were collected at 1, 3, and 6 months post randomization.

The GPE scale measures perception of recovery following a treatment and ranges from -5 (worst-case scenario) to 0 (no change) to +5 (completely recovered).¹² The PSQI (0-21; higher scores indicate poorer sleep quality) measures sleep quality in the previous 30 days.³ The PCS (0-52; higher scores indicate higher pain-related catastrophizing) measures pain catastrophizing.³⁵ The PSEQ (0-60 points; higher scores indicate higher pain self-efficacy) assesses pain self-efficacy. Scores lower than 15 points (10%) denote substantially reduced self-efficacy.³³

Adverse Events

Participants were asked to report any adverse symptoms that they experienced after the intervention. Adverse events were any sequelae that the participant perceived as distressing and unacceptable and required further treatment.³⁸ Adverse events were classified based on severity as serious (requiring hospital admission, with potential persistent or significant disability or death), significant (requiring medical attention or interfering with daily activities), and mild (short duration, reversible, and not particularly inconveniencing the participant).³⁸

Statistical Analysis

Sample size was estimated a priori using WinPepi software (<http://www.brixtonhealth.com/pepi4windows.html>). A sample of 116 participants was required to ensure 90% power and the ability to detect a mean difference of 2 points on the 0-to-10 NPRS. We assumed an SD of 1.84, a 2-sided alpha of 5%, and a 20% loss to follow-up.

All data were double entered and analyzed by a blinded statistician. Outcomes were analyzed following intention-to-treat

principles (ie, participants were analyzed according to the group they had been initially allocated to). Data normality was verified by visual inspection of histograms.

Continuous variables were reported as mean $\pm$ SD. Categorical or dichotomous data were reported as frequencies and proportions (percent). A repeated-measures linear mixed model that included terms for participant, group, time, and group-by-time interaction was used to assess the effects of treatment on pain, disability, global perceived effect, quality of sleep, pain catastrophizing, and self-efficacy. We used multiple imputation for any missing data. Statistical analyses were performed using SPSS Version 23.0 (IBM Corporation, Armonk, NY) software, and significance was set at $P < .05$.

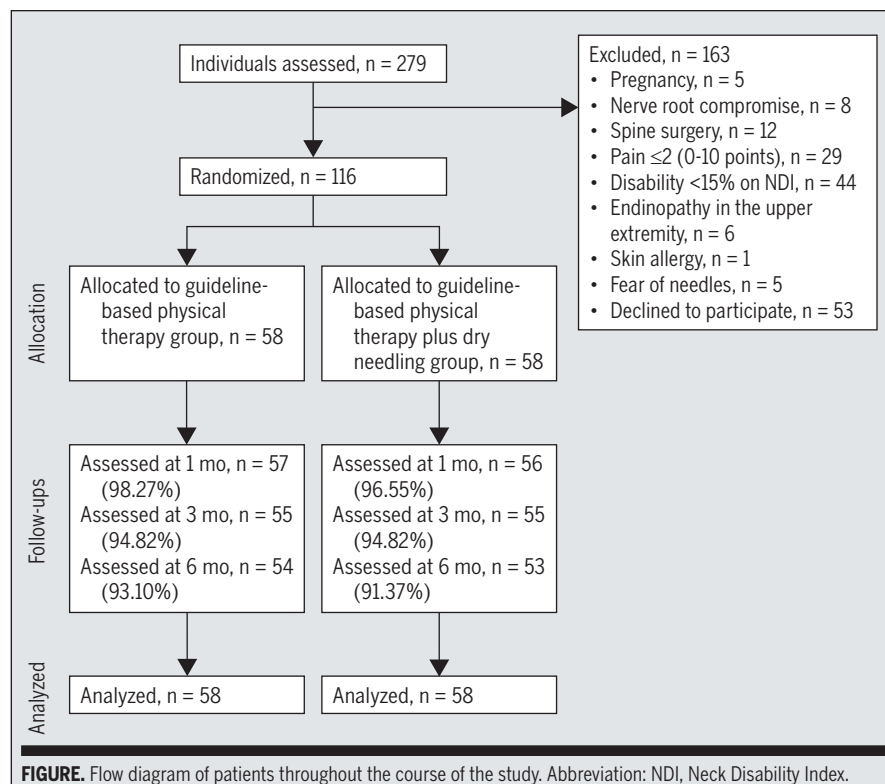
RESULTS

BETWEEN OCTOBER 2016 AND MARCH 2018, 279 participants self-referred to the study, of whom 116 were included. Reasons for prerandomization

exclusions are described in detail in the **FIGURE**. Retention rates were consistently high (greater than 90% at all time points). During the follow-up period, 4 participants from the physical therapy group (2 moved to another city and 2 could not be contacted; 93% participated in follow-up) and 5 participants from the physical therapy plus dry needling group (all due to loss of contact; 91% participated in follow-up) were lost to follow-up.

Most participants were women ($n = 84$, 72%) and reported a moderate level of neck pain in the previous 24 hours (6.6 ± 1.3), neck pain in the previous week (6.2 ± 0.9), and disability (28.3 ± 7.3). Groups were similar at baseline with respect to other characteristics (**TABLE 1**). All participants received the intervention to which they were initially allocated.

The physical therapy and physical therapy plus dry needling groups received a mean number of 4.8 ± 1.3 and 5.1 ± 1.1 treatment sessions, respectively ($P = .21$). No participant was discharged by the physical therapist during the course



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of treatment. Participants who received fewer than 6 sessions did so because of missed appointments.

Effect on Primary Outcomes

There was a significant group-by-time interaction for average pain at 1 month post randomization (average pain intensity in the previous 24 hours, $P = .01$ and average pain intensity in the previous week, $P = .02$). At 1 month, physical therapy plus dry needling provided a small reduction in average pain intensity in the previous 24 hours (mean difference, 1.56; 95% CI: 1.11, 2.36; $P < .001$) and in the previous week (mean difference, 1.20; 95% CI: 1.02, 2.21; $P < .001$) compared to physical therapy alone.

For disability, the group-by-time interaction was not significant ($P = .09$). At 1 month, there was no difference be-

tween physical therapy and physical therapy plus dry needling (mean difference, -2.08 ; 95% CI: -3.01 , 5.07 ; $P = .17$).

Effect on Secondary Outcomes

There were no between-group differences for average pain intensity in the previous 24 hours at 3 months (mean difference, 0.32 ; 95% CI: -1.27 , 0.63 ; $P = .15$) and at 6 months (mean difference, -0.45 ; 95% CI: -1.37 , 2.15 ; $P = .31$). There were no between-group differences for average pain intensity in the previous week at 3 months (mean difference, 0.54 ; 95% CI: -0.66 , 0.80 ; $P = .07$) and 6 months (mean difference, 0.34 ; 95% CI: -0.81 , 1.19 ; $P = .13$). There were no between-group differences for disability at 3 months (mean difference, 0.60 ; 95% CI: -0.92 , 2.29 ; $P = .08$) and 6 months (mean difference, -2.13 ; 95% CI: -2.86 , 1.94 ; $P = .12$).

There were no group-by-time interactions for global perceived effect ($P = .31$), quality of sleep ($P = .31$), pain catastrophizing ($P = .18$), and self-efficacy ($P = .08$) (TABLE 2).

Adverse Events

No serious or significant adverse events were reported. Mild adverse effects were reported for 6 of 58 (10.3%) participants in the physical therapy group and for 8 of 58 (13.7%) participants in the physical therapy plus dry needling group. All adverse events were temporary exacerbations of neck pain and/or headache symptoms. None of the participants withdrew because of adverse events (see TABLE 3).

DISCUSSION

ADDING DRY NEEDLING TO GUIDELINE-based physical therapy resulted in a small, not clinically meaningful reduction in average neck pain intensity at 1 month post randomization, but not at 3 and 6 months, in participants with chronic neck pain. Adding dry needling to guideline-based physical therapy had no added benefit for disability, global perceived effect, quality of sleep, pain catastrophizing, and self-efficacy. Clinicians should not consider dry needling in addition to physical therapy as an approach to managing chronic neck pain.

The small effect on pain at 1 month in our study supports previous research.^{8,9,26,36} Previous systematic reviews reported low- to very low-quality evidence that dry needling was more effective than no treatment, sham, or other treatments in reducing pain in the short term.^{20,26,27} Our study reports more reliable effect estimates than those reported in previous trials. To the best of our knowledge, ours is the first pragmatic trial of dry needling for chronic neck pain to report participant-reported outcomes beyond the short term (we measured outcomes at 6 months post randomization).

The short-term improvements in pain were not accompanied by improve-

TABLE 1

CLINICAL AND DEMOGRAPHIC CHARACTERISTICS AT BASELINE^a

	Guideline-Based Physical Therapy (n = 58)	Guideline-Based Physical Therapy Plus DN (n = 58)
Sex, n (%)		
Female	40 (68.96)	44 (75.86)
Male	18 (31.04)	14 (24.14)
Age, y	36.9 ± 11.5	39.3 ± 9.9
Body mass index, kg/m ²	26.1 ± 5.2	26.4 ± 4.9
Smoker, n (%)	4 (6.89)	9 (15.51)
Education, n (%)		
Primary	9 (15.51)	4 (6.89)
Secondary	6 (10.34)	10 (17.24)
Undergraduate	12 (20.68)	19 (32.75)
Graduate	28 (48.27)	24 (41.37)
Masters degree	3 (5.17)	1 (1.72)
Duration of neck pain, mo	36.1 ± 12.4	41.6 ± 14.1
24-h neck pain intensity (NPRS, 0-10)	6.7 ± 1.3	6.6 ± 0.9
1-wk neck pain intensity (NPRS, 0-10)	6.1 ± 1.0	6.3 ± 0.7
Disability (NDI, 0%-100%)	29.5 ± 9.7	27.1 ± 6.4
Quality of sleep (PSQI, 0-21)	9.2 ± 3.1	9.6 ± 2.7
Pain catastrophizing (PCS, 0-52)	20.9 ± 8.5	23.6 ± 9.5
Self-efficacy (PSEQ, 0-60)	44.1 ± 11.3	39.8 ± 10.6

Abbreviations: DN, dry needling; NDI, Neck Disability Index; NPRS, numeric pain-rating scale; PCS, Pain Catastrophizing Scale; PSEQ, Pain Self-Efficacy Questionnaire; PSQI, Pittsburgh Sleep Quality Index.

^aValues are mean ± SD unless otherwise indicated.

ments in disability. One explanation is that improvements in pain in the group receiving dry needling were too small to be translated to reductions in disability. Short-term reductions of pain that are

not sustained at long-term follow-ups are common across a range of treatments, such as spinal manipulative therapy.³² Booster sessions have been suggested as a means to facilitate long-

term maintenance of beneficial effects of physical therapy treatments.¹ However, we believe dry needling booster sessions would not be beneficial for people with chronic neck pain, as the effects

TABLE 2

PRIMARY AND SECONDARY OUTCOMES AT 1, 3, AND 6 MONTHS AFTER RANDOMIZATION^a

	Treatment Group				
	Guideline-Based Physical Therapy (n = 58)	Guideline-Based Physical Therapy Plus DN (n = 58)	Between-Group Difference ^b	P Value	Group-by-Time P Value
24-h neck pain intensity (NPRS, 0-10)					
Baseline	6.71 ± 1.36	6.64 ± 0.98	0.07 (−0.08, 0.70)	.85	.01
1 mo	3.72 ± 1.11	2.16 ± 0.95	1.56 (1.11, 2.36)	<.001	
3 mo	3.21 ± 0.77	2.89 ± 0.8	0.32 (−1.27, 0.63)	.15	
6 mo	3.41 ± 0.75	3.86 ± 0.99	−0.45 (−1.37, 2.15)	.31	
1-wk neck pain intensity (NPRS, 0-10)					
Baseline	6.18 ± 1.07	6.31 ± 0.72	−0.13 (−0.46, 0.72)	.57	.02
1 mo	3.37 ± 1.22	2.17 ± 0.81	1.20 (1.02, 2.21)	<.001	
3 mo	3.52 ± 0.95	2.98 ± 0.63	0.54 (−0.66, 0.80)	.07	
6 mo	3.60 ± 0.56	3.26 ± 0.74	0.34 (−0.81, 1.19)	.13	
Disability (NDI, 0%-100%)					
Baseline	26.52 ± 9.72	27.13 ± 6.42	−0.61 (−1.46, 0.25)	.14	.09
1 mo	20.94 ± 10.4	22.94 ± 8.90	−2.08 (−3.01, 5.07)	.17	
3 mo	23.66 ± 8.91	23.08 ± 11.1	−0.58 (−0.92, 2.29)	.08	
6 mo	22.86 ± 7.28	24.99 ± 9.04	−2.13 (−2.86, 1.94)	.12	
Global perceived effect (GPE, −5 to +5) ^c					
Baseline	NA	NA	NA	NA	.31
1 mo	2.43 ± 1.21	3.01 ± 1.01	−0.58 (−1.34, 0.71)	.29	
3 mo	2.01 ± 0.96	2.89 ± 0.69	−0.88 (−1.21, 0.34)	.55	
6 mo	2.05 ± 0.91	2.86 ± 1.43	−0.81 (−1.03, 1.10)	.15	
Quality of sleep (PSQI, 0-21)					
Baseline	9.27 ± 3.13	9.65 ± 2.75	−0.38 (−0.76, 1.12)	.49	.31
1 mo	8.94 ± 5.12	7.99 ± 3.16	0.96 (−0.29, 1.58)	.28	
3 mo	7.88 ± 2.88	7.99 ± 2.09	−0.11 (−1.00, 0.87)	.41	
6 mo	8.17 ± 3.12	7.47 ± 2.17	0.70 (0.09, 1.97)	.19	
Pain catastrophizing (PCS, 0-52)					
Baseline	20.97 ± 8.56	23.67 ± 9.51	−2.71 (−4.26, 1.44)	.87	.18
1 mo	21.08 ± 8.83	22.17 ± 6.04	−1.09 (−1.96, 0.88)	.76	
3 mo	21.26 ± 9.41	19.07 ± 7.89	2.20 (−3.02, 5.41)	.68	
6 mo	18.94 ± 8.06	19.18 ± 6.47	−0.24 (−3.26, 0.25)	.57	
Self-efficacy (PSEQ, 0-60)					
Baseline	44.14 ± 11.37	41.81 ± 9.61	2.33 (−1.46, 3.22)	.26	.08
1 mo	46.69 ± 16.27	48.45 ± 15.51	−1.76 (−2.44, 6.71)	.60	
3 mo	43.72 ± 9.91	42.14 ± 12.46	1.58 (−1.98, 2.59)	.29	
6 mo	46.91 ± 16.21	42.11 ± 11.80	4.80 (−3.21, 6.09)	.70	

Abbreviations: DN, dry needling; GPE, Global Perceived Effect scale; NA, not applicable; NDI, Neck Disability Index; NPRS, numeric pain-rating scale; PCS, Pain Catastrophizing Scale; PSEQ, Pain Self-Efficacy Questionnaire; PSQI, Pittsburgh Sleep Quality Index.

^aValues are mean ± SD unless otherwise indicated.

^bValues are mean (95% confidence interval).

^cDue to the nature of this outcome, data were collected only at follow-ups, not at baseline.

observed in the short term were not clinically important.

Previous randomized controlled trials recruiting participants with neck pain either focused solely on reporting serious adverse events²⁵ or did not report adverse events.^{2,24} Some trials of dry needling for other musculoskeletal conditions, such as plantar heel pain, had shown a proportion of adverse events as high as 32%,¹³ and a survey study conducted with physical therapists reported that about 20% of dry needling treatments had an adverse event.⁶ We collected data on mild, significant, and serious adverse events. The proportion of adverse events reported in our sample was lower than previous research, and similar to that reported in the control group, suggesting that patients who received dry needling were not at greater risk of harm than were patients who did not receive dry needling. The intensity of treatment, including the depth of needle penetration, the number of twitch responses elicited, and the time of treatment, might explain differences across studies. Monitoring safety of physical therapy treatments needs to be an ongoing effort, and future trials of dry needling should report adverse events more consistently.

We prospectively registered this trial, used adequate methods of randomization, concealed allocation, and used intention-to-treat principles to analyze data. We had high retention rates (great-

er than 90%). Our study was also adequately powered, which increases our confidence in the results. Participants in the control group received guideline-based care, which, to the best of our knowledge, had not been done in a large randomized controlled trial testing the effectiveness of dry needling in people with neck pain. Clinicians in our study used a pragmatic approach to treating participants in the study, mimicking the clinical decision-making process seen in daily practice.

This study also has limitations. Blinding was not possible due to the nature of the intervention. That includes blinding of outcome assessment, given that outcomes were self-reported and participants were not blinded to group allocation. However, researchers responsible for collecting outcome measures data and conducting analyses were blinded to group allocation, in an attempt to minimize bias associated with blinding. Interventions in this study were provided by 3 physical therapists from the study team. It is unclear whether results would have been different had treatment been delivered by the participants' health care providers.

CONCLUSION

WHEN ADDED TO GUIDELINE-BASED physical therapy for chronic neck pain, dry needling resulted in

small, not clinically meaningful improvements in pain in the short term, but not in the long term, and did not improve disability, global perceived effect, quality of sleep, pain catastrophizing, and self-efficacy at any time point. ●

KEY POINTS

FINDINGS: One month of guideline-based physical therapy plus dry needling improved pain in the short term (1 month), but not in the long term (6 months).

There was no effect on disability in people with chronic neck pain.

IMPLICATIONS: Owing to the small, clinically unimportant reduction in pain only in the short term, clinicians should not consider dry needling in addition to physical therapy as a treatment for chronic neck pain.

CAUTION: Only 3 therapists delivered interventions in both groups, which may limit the potential to generalize results. Improvements observed in both groups could be explained by the natural course of neck pain.

STUDY DETAILS

AUTHOR CONTRIBUTIONS: The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted. Fábio Franciscatto Stieven, Giovanni Esteves Ferreira, Luis Henrique Telles da Rosa, and Marcelo Faria Silva conceived and designed the study. Fábio Franciscatto Stieven, Francisco Xavier de Araújo, and Marcelo Faria Silva collected the data. Fábio Franciscatto Stieven, Giovanni Esteves Ferreira, Marcelo Faria Silva, and Matheus Wiebusch contributed data and analysis tools. Luis Henrique Telles da Rosa and Marcelo Faria Silva performed the analyses. Fábio Franciscatto Stieven, Giovanni Esteves Ferreira, and Francisco Xavier de Araújo wrote the paper.

DATA SHARING: Data are available on request.

PATIENT AND PUBLIC INVOLVEMENT: Patients and public partners were not involved in the conception and design of this study.

TABLE 3

ADVERSE EVENTS EXPERIENCED BY PATIENTS

Event	Guideline-Based Physical Therapy (n = 58)		Guideline-Based Physical Therapy Plus DN (n = 58)		P Value
	Patients, n (%)	Events, n	Patients, n (%)	Events, n	
Serious adverse events	...	...	...	...	...
Moderate adverse events	...	...	...	...	...
Mild adverse events	6 (10.34)		8 (13.79)		.609
Temporary posterior neck pain exacerbation	4 (6.89)	4	2 (3.44)	2	
Temporary neck-shoulder pain exacerbation	2 (3.44)	3	5 (8.62)	2	
Temporary headache	0	0	1 (1.72)	1	

Abbreviation: DN, dry needling.

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APPENDIX

DESCRIPTION OF MANUAL THERAPY EXERCISES AND DRY NEEDLING PROCEDURES

Procedure	Description	Dose
Posteroanterior mobilization in the cervical and upper thoracic spine (T1-T3)	Mobilizations were applied by passive movements in the vertebral spinous process, according to pragmatically determined parameters of intervention	3 series of 30 mobilizations, according to parameters of intervention determined pragmatically by the treating clinician and based on an individualized evaluation
Neck flexor muscle exercise	Exercise to strengthen the capacity of the neck flexor muscles. The exercise was applied with the participant in a seated position and manually resisted by the clinician, according to participant tolerance	3 series of 10 repetitions. The resistance was applied according to participant tolerance, with an interval of 30 seconds between each series
Neck extensor muscle exercise	Exercise to strengthen the capacity of the neck extensor muscles. The exercise was applied with the participant in a seated position and manually resisted by the clinician, according to participant tolerance	3 series of 10 repetitions. The resistance was applied according to participant tolerance, with an interval of 30 seconds between each series
Retraining of the scapular muscles	Exercise to strengthen the capacity of the scapular stabilizers. The exercise was applied in the prone position, with dynamic elevation of the upper limb sustaining against gravity for 5 to 10 seconds, according to participant tolerance	3 series of 10 repetitions. The resistance was applied according to participant tolerance, with an interval of 30 seconds between each series
Dry needling technique	The dry needling technique was performed as determined pragmatically by the treating clinician and based on an individualized evaluation of the upper and middle trapezius, cervical multifidi, splenius cervicis, or levator scapulae muscles The needle was introduced subcutaneously, penetrating the skin at 10 to 15 mm of depth, and manipulated in order to elicit a local contraction response. After identifying the first local twitch response, vertical pistoning of the needle was performed in order to obtain 6 additional twitch responses (or fewer, depending on a participant's tolerance of needle insertion), without rotational needle movement	The needle remained in the muscle for as long as it took to produce an appropriate response and was tolerated by the participant; the needle was then left in situ for approximately 30 seconds to 1 minute