

## Systematic Review

# Mind-Body Interventions for Depressive Symptoms in Chronic Pain: A Systematic Review of Meta-Analyses

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**Background:** Psychological comorbidities in chronic pain (CP) are common and contribute to adverse health outcomes and poor quality of life. Evidence-based guidance for the management of depressive symptoms in CP is limited, particularly for mind-body interventions.

**Objectives:** To investigate the effectiveness of mind-body interventions for the management of depressive symptoms in people with CP.

**Study Design:** Systematic review (SR) of SRs.

**Setting:** SRs with meta-analyses of clinical interventions for the management of depressive symptoms in people with CP.

**Methods:** This SR was reported following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Electronic searches were performed for MEDLINE, EMBASE, PsycINFO, CINAHL, AMED, the Cochrane Database of Systematic Reviews, and the Joanna Briggs Institute Database of Systematic Reviews and Implementation Reports from inception to March 14, 2019. Reference lists and overviews were also hand-searched. SRs of mind-body interventions for CP were included if they conducted a meta-analysis of depression outcomes in people with any CP type not including headache. Two independent reviewers screened, extracted, and evaluated the quality of articles found. Quality was assessed using the AMSTAR 2 criteria and data were summarized narratively with standardized mean differences and 95% confidence intervals of the depression outcome.

**Results:** Eleven SRs with 20 distinct meta-analyses demonstrated a small to moderate beneficial effect for mind-body interventions (effect sizes: -0.05 to -0.63).

**Limitations:** Depressive symptomatology was a subordinate concern compared with other outcomes. The primary literature base was reasonably broad with 33 primary studies, but small when compared with the number of meta-analyses.

**Conclusions:** Mind-body interventions show consistent small to moderate effects in reducing depressive symptoms in CP. The literature in this area demonstrates understudy and oversynthesis. There is a need for more clinical trials focusing on people with axial pain, people with comorbid major depressive disorder, and with depression as the primary outcome of interest. Full SR registered on PROSPERO: CRD42019131871.

**Key words:** Mind-body, meditation, yoga, depression, chronic pain, umbrella review

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**T**he prevalence of chronic pain (CP) in North American adults is approximately 20% (1,2), and depression is disproportionately common in people with CP with rates as high as 60% in specialized

treatment centers (3), and ranging between 18% and 85% in population-based settings and dental clinics, respectively (4). This compares to a 12-month prevalence of major depressive disorder (MDD) in the United States

population of between 8% and 10% (5,6). The CP and depression comorbidity is associated with higher rates of health care utilization, problematic opioid prescribing and use, opioid overdose, and suicide (3,7-10). Despite this high prevalence, the evidence-base for CP with depression has not been well summarized for clinical practice. For example, a recent guideline cited only one randomized control trial for its single recommendation regarding depression in CP (11).

A substantial body of evidence suggests mind-body interventions as relevant for people with CP. Mind-body interventions “focus on the relationships among the brain, mind, body, and behavior, and their effect on health and disease” and include interventions such as meditation and yoga (12). A recent systematic review (SR) demonstrated moderate effects for meditation and pain (effect size [ES]: 0.33, 4 trials, 410 patients), and, independently, moderate effects for depression (ES: 0.30, 11 trials, 986 patients) and anxiety (ES: 0.38, 10 trials, 691 patients) (13). Likewise, these interventions are commonly sought out by diverse people living with depression and CP and are well received in these populations (14-16). As patient and health provider interest in these interventions have grown, there has been a proliferation of meta-analyses, umbrella reviews, and evidence maps examining mind-body interventions for managing CP (17-19), some of which also report on depression outcomes. However, these have tended to focus on specific CP types (20,21) or specific interventions (22,23). To our knowledge, none of these overviews have focused specifically on mind-body interventions for depression symptomatology in all kinds of CP.

## OBJECTIVES

We aim to answer the following questions:

1. What mind-body interventions have been demonstrated to have an effect on depressive symptoms in CP?
2. What is the effectiveness of mind-body interventions for depressive symptoms in CP and how does the effectiveness vary across different mind-body interventions?
3. What is the breadth of the underlying primary literature on mind-body interventions for depressive symptoms in CP?

To answer these questions, we conducted an SR of meta-analyses (24) reporting on mind-body interventions for CP with a depression outcome against any kind of control.

## METHODS

A protocol for the review was developed prior to beginning this study and followed the Joanna Briggs Institute (JBI) recommendations for umbrella reviews (25). This work was also registered with the PROSPERO database, registration number: CRD42019131871. The protocol was developed for an SR of meta-analyses of all clinical interventions, including but not limited to pharmacologic, psychological, and physical therapies. We report here the review of the mind-body intervention subgroup.

## Eligibility Criteria

### Population

We included records examining adults with CP, namely pain of any etiology and involving any body part, that lasts 3 or more months and being present 15 or more days per month (26). Likewise, we included only diseases for which pain is a primary and necessary symptom, for example, arthritis and not chronic fatigue. We excluded reviews that included exclusively a pediatric (< 18 years) population but included reviews for which the majority of patients were adults (> 50% are ≥ 18 years). We excluded reviews focused entirely on cancer or end-of-life pain considering that treatment approaches and outcomes can be dissimilar (27). Formal diagnoses of MDD in the studied population was not used as a selection criterion. Thus reviews could include patients with MDD, without MDD, or mixed populations with and without MDD.

### Interventions and Comparators

We included SRs examining any kind of mind-body intervention intended to address CP, or a related aspect of CP, and any kind of comparator. We considered tai chi, qi gong, yoga, and meditation as the primary interventions of interest as per other recent reviews (28). We excluded SRs of interventions that were not patient-level, for example those focused on health policy. Expected comparators were placebo, usual care, and active interventions, such as educational programs.

### Outcomes

We focused on depressive symptom outcomes and included only studies that reported aggregates of depressive symptom outcomes using validated scales. Although there is no accepted definition of a validated scale for depressive symptomatology in CP, expected depression rating scales included, but were

not limited to, the Beck Depression Inventory (BDI), the Hamilton Depression Rating Scale (HAM-D), and the Montgomery-Asberg Depression Rating Scale (MADRS). SRs that reported only on mood, overall mental health, or quality of life and with no depression-specific outcomes were excluded, as were SRs that only reported on surrogate (e.g., physiological) outcomes.

## STUDY DESIGNS

We included completed, published SRs (as per the Cochrane definition [29]) of efficacy or effectiveness studies using experimental designs (usually in the form of randomized controlled trials) that included a meta-analysis. We excluded SRs that focused on other areas, such as diagnostic measures, or SRs that only included a narrative synthesis. In cases in which there were multiple records for a single SR, we retained only the most up-to-date and comprehensive review.

### Timing, Context, Setting, and Language

We set no limits in terms of timeframe, context, or setting of the SRs or their included primary studies. Due to resource constraints, we only included English language SRs.

### Information Sources

We searched the following electronic bibliographic databases: MEDLINE, EMBASE, PsycINFO, CINAHL, AMED, the Cochrane Database of Systematic Reviews, and the JBI Database of Systematic Reviews and Implementation Reports from inception to March 14, 2019.

To identify any additional records, we hand-searched the references of 10 overviews of SRs (20-23,30-35) and we also reviewed the references of the included SRs.

### Search Strategy

The search was designed as a combination of a “chronic pain” and a “depression” concept. Each concept was searched using a combination of controlled vocabulary and keywords. The CP and depression concepts were combined and then limited to a validated “systematic review” filter (36).

This strategy was initially developed for MEDLINE and was iteratively validated against a set of relevant studies previously identified for inclusion in the SR. Please see Appendix 1 for the MEDLINE search strategy.

The search strategy was peer-reviewed by an independent information specialist following the Peer Review of Electronic Search Strategies guidelines (37)

and then adapted appropriately for the remaining databases.

### Study Selection

Database and hand-search results were compiled, duplicates were removed in EndNote version X9 (Clarivate Analytics, Boston, MA) and the remaining records were uploaded to Covidence (Veritas Health Innovation, Melbourne, Australia), an online data management platform. An additional set of duplicates were detected and removed within Covidence.

Title and abstracts were independently screened by 2 authors (AS, KL, CC, OP, and DR) in Covidence. Records with uncertainty were screened in full text. Conflicts between screeners were resolved by consensus between the 2 authors and by a third screener if conflicts persisted (AS, KL, CC, OP, or DR).

Full-text records were independently reviewed by 2 authors (AS, KL, CC, OP, and DR) in Covidence. Conflicts were resolved by consensus and by a third author (AS, KL, CC, OP, or DR) if conflicts persisted. Study authors were contacted to clarify information about the reviews to aid in resolving conflicts. Reasons for exclusion were tracked using Covidence and independently in a spreadsheet.

### Data Collection Process

A data extraction form was developed using Excel software (Microsoft Corporation, Redmond, WA) and piloted independently by 2 authors on 2 SRs. Data from the remaining studies were extracted from the original SRs independently and in duplicate (AS, KL, DC, CC, OP, and DR). The collected data were then collated in a single spreadsheet and reviewed for missing data and conflicts. Inconsistencies and conflicts in the data extraction were resolved by discussion with extracting authors or by a third reviewer (AS or DC). SR authors were contacted to gather missing information from reports for important data (e.g., ES and numbers of patients).

### Data Items

The following data items were collected from each SR: review details (citation, objectives, type of review, funding source, lead author country), population (CP type, age, gender), number of patients (total, intervention, and control), intervention and comparator, primary study types, settings and contexts, search dates, nondepression outcomes reported, primary study quality assessment and the instrument used to assess quality, primary study details specific to the depression

outcome (number of studies, types of studies, depression symptom outcome scale, date ranges, full study citation), depression synthesis outcome (ES, confidence interval, measure of heterogeneity, *P* value of overall effect), methods of synthesis, and any additional comments.

### Risk of Bias in Individual Studies

We used the AMSTAR 2 quality appraisal tool to assess for risk of bias in the SRs. This tool is widely used, comprehensive, has clear guidance on appropriate use, and is designed specifically for SRs of health care interventions (38). It includes a checklist of 16 items ranging from the availability of a protocol to appropriate meta-analysis procedures. The checklist was completed independently and in duplicate using the online form provided by the tool developers (39). Disagreements were resolved by consensus between the 2 raters or adjudication by a third appraiser.

As recommended by the developers, we did not calculate an overall quality score but instead reported an overall confidence in the SR results as high, moderate, low, or critically low, which is determined by the matrix of responses to the 16 appraisal questions. Likewise, the results were not used as inclusion or exclusion criteria.

### Summary Measures and Synthesis of Results

The principal summary measure was the synthesized ES with the 95% confidence interval for the depression outcome. It was not possible, nor meaningful, to further quantitatively synthesize these data. As such, we described, compared, and contrasted using a narrative approach. We compared the data across studies particularly in terms of the quality of the studies, CP types, interventions, comparators, and the included underlying primary studies. We calculated a ratio of the cumulative number of randomized controlled trials (RCTs) included to date to the cumulative number of meta-analyses to determine if this body of literature demonstrated oversynthesis (40).

## RESULTS

The database search yielded 9,804 records, and hand-searching yielded 5 unique records. After deduplication, 6,966 titles and abstracts were screened, of which 6,566 were deemed irrelevant to this study. Four hundred full-text records were screened and in total 16 SRs were initially included. Another 5 SRs were excluded at the data extraction stage: 2

included nonvalidated depression outcome measures (41,42), one did not report quantitative results (43). One included anxiety scales in a mood outcome rather than depression outcome (44), and one did not assess risk of bias (45). See Fig. 1 for PRISMA flow diagram.

The 11 SRs (17,46-55) included 20 distinct depression meta-analyses (Table 1). These SRs were published from 2013 to 2019. Five (45%) of the reviews focused on general CP, 4 (36%) on fibromyalgia, and 2 (18%) on axial pain. There were a variety of outcome timeframes that were meta-analyzed, ranging from immediately after completion of the intervention (short-term) to up to 6 months postintervention (medium-term) to greater than 6 months postintervention (long-term). However, this coding was inconsistent across the primary trials, and thus also in the SRs. Hence Table 1 attempts to characterize the outcome timeframe as closely as possible to the earlier described categorization. Three (27%) reviews were conducted by researchers in Germany, 2 (18%) in the United States, 2 (18%) in the United Kingdom, and one (9%) each in Belgium, Canada, China, and the Netherlands. The most recent review (52) was from China (56).

Two distinct kinds of interventions were synthesized, namely meditation and mindful movement (yoga, qi gong, and tai chi). The population largely included middle-aged women. Several SRs included primary studies that exclusively enrolled women (45,51,55). The number of primary studies included in the SRs ranged from 6 to 38, and the total population included ranged from 362 to 3,536. None of these SRs had depression as the primary outcome of interest. In all cases, the depression synthesis included fewer studies and fewer patients than the primary outcome, which was usually pain severity and quality of life. The breadth of depression meta-analyses ranged from 2 studies with a total of 86 patients to 12 studies including 1,178 patients.

The studies included a variety of validated depression scales with the most common being the BDI and the Centre for Epidemiological Studies Depression Scale (CES-D). The studies were of variable quality by AMSTAR 2 criteria, with 2 high-quality reviews and 4 critically low-quality reviews. Most of the SRs rated low or critically low quality were due to poor reporting of prespecified protocols and poor reporting of studies excluded during full-text screening, both of which are critical domains by AMSTAR 2 criteria. One SR in the mindful

movement group did not account for risk of bias of the primary studies when interpreting the results of the review (52).

All meta-analyses used random effects models and reported a synthesized ES using standardized mean differences (SMD) with 95% confidence intervals. Where required, we converted SMDs from positive to negative to represent a reduction in depressive symptoms. For 14 out of 20 analyses (70%), the 95% confidence interval did not include the null value (solid border in Fig. 2). By Cohen's criteria (57), all of the syntheses found a small to moderate beneficial effects ranging from  $-0.05$  to  $-0.63$  (Fig. 2). None of the studies included estimates of small study effects specifically for the depression meta-analyses. None of the SRs were funded by industry.

There was a clear clustering of ES for the meditation interventions between approximately  $-0.1$  and  $-0.3$ . These effects were seen consistently from analyses from SRs of critically low to high quality (Table 1, Fig. 2). These effects were consistent across general CP and fibromyalgia populations. The mindful movement ES estimates were generally larger (ranging from  $-0.15$  to  $-0.63$ ), but these estimates were synthesized from a smaller number of studies and smaller overall populations with similar variability in

the SR quality. There were no clear trends of larger ES in analyses examining inactive comparators or shorter outcome measurement time.

### Characteristics of the Primary Studies Vis-a-Vis Syntheses

In total, 33 primary studies (58-91), ranging in publication date from 2003 to 2016, were included in the 20 meta-analyses. Ten of these studies were considered

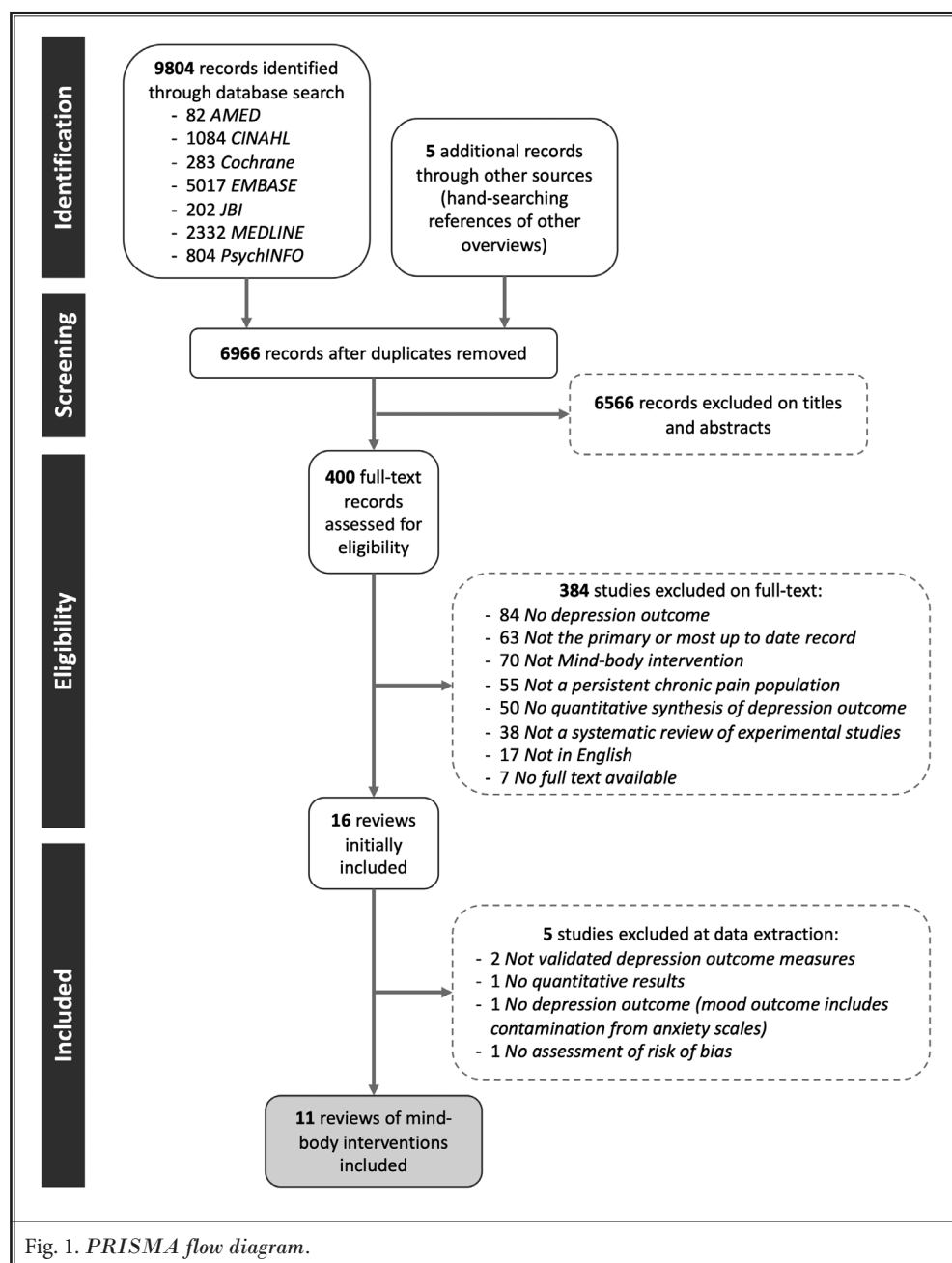


Fig. 1. PRISMA flow diagram.

Table 1. Summary of extracted data for 20 meta-analyses.

Meta-Analysis	Pain Type	Intervention(s) Analyzed	Comparator	Outcome Timeframe	Funding Source	Total Included RCTs; Total Patients	Depression Subanalysis: Total RCTs; Total Patients	Depression Outcome Scale(s)	AMSTAR 2 Critical Appraisal	SMD with 95% CI (negative favors intervention)
<b>Meditation</b>										
Courtois 2015	FM	Meditation	Any	NR	NR	18; 1,279	4; 322	1, 2, 3	Crit Low	-0.25
Bawa 2015	CP	MBI	Any	Short	Govt	11; 889	6; 593	1, 2, 8, 9	Crit Low	-0.12
Bawa 2015			Active				4; 407	1, 2, 8		
Bawa 2015			Inactive				3; 239	1, 9		
Lauche 2013b			Usual Care				3; 291	1, 2, 4		
Lauche 2013b	FM	MBSR	Active	Short	Pvt Fdn	6; 579	3; 225	1, 2, 3	Low	-0.13
Lauche 2013b			Usual Care				3; 278	1, 2, 4		
Lauche 2013b			Active				2; 173	1, 2		
Veehof 2016			Any				9; 622	1, 2, 8, 9, 11		
Ball 2017	CP	Meditation	Any	NR	Pvt Fdn	13; 862	3; 368	1, 2, 3	Crit Low	-0.31
Hilton 2017	CP	MBI	Any	NR	Govt	38; 3,536	12; 1,178	1-3, 5-8	Low	-0.15
Khoo 2019	CP	MBSR	Any	NR	None	21; 1,981	6; 658	1-3, 6, 9	Moderate	-0.49
<b>Mindful Movement</b>										
Langhorst 2013	FM	All	Any	Short	NR	7; 362	6; 306	1, 2, 8, 10	Low	-0.49
Langhorst 2013		All	Active	Short			3; 162	1, 2, 10		
Langhorst 2013		Tai Chi	Any	Short			2; 132	1, 2		
Langhorst 2013		Tai Chi	Any	Med (3-6 m)			2; 132	1, 2		
Langhorst 2013		Qi Gong	Any	Short			2; 86	1, 10		
Langhorst 2013		Qi Gong	Active	Short			3; 188	1, 2, 10		
Wieland 2017	LB	Yoga	Any	Med (3m)	Govt	12; 1,080	2; 107	1, 2	High	-0.15
Li 2019	Neck	Yoga	Active	Short	Govt	10; 647	3; 202	1, 2	Crit Low	-0.63

NB: meta-analyses are arranged by intervention type, then date of literature search. Abbreviations: RCTs, randomized controlled trials; SMD, standard mean difference; CI, confidence interval; NR, not reported; FM, fibromyalgia; CP, general chronic pain; LB, low back; MBI, Mindfulness Based Interventions; MBSR, Mindfulness Based Stress Reduction; Govt, government; Pvt Fdn, private foundation; Crit Low, critically low. Depression outcome scales: 1 = Beck Depression Inventory; 2 = Centre for Epidemiological Studies-Depression Index; 3 = Hamilton Anxiety and Depression Scale; 4 = Symptoms Check List-8; 5 = Montgomery-Asberg Depression Rating Scale; 6 = Patient Health Questionnaire; 7 = Brief Symptom Inventory; 8 = Depressive symptoms/Visual Analog Scale; 9 = Symptoms Checklist-90-R; 10 = Children's Depression Inventory; 11 = Calgary Symptoms of Stress Inventory; 12 = structured clinical interview.

## Mind-Body Interventions for Depressive Chronic Pain

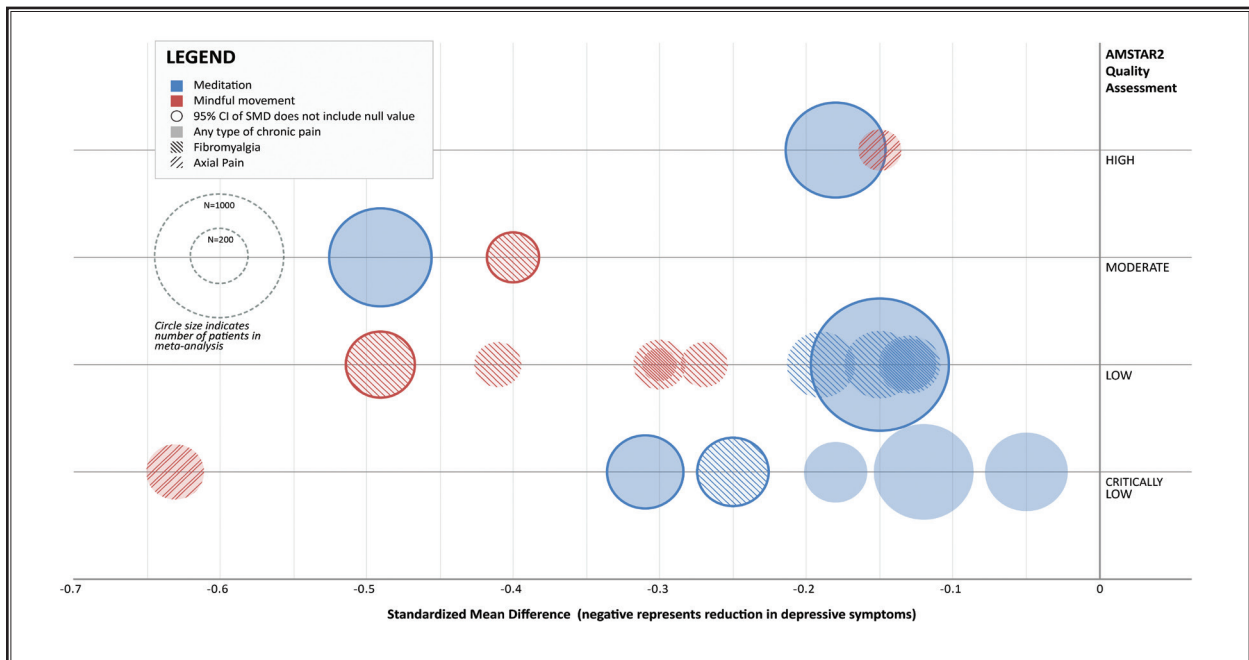


Fig. 2. Evidence map: SMD versus quality rating (n = 20 meta-analyses). CI = confidence interval.

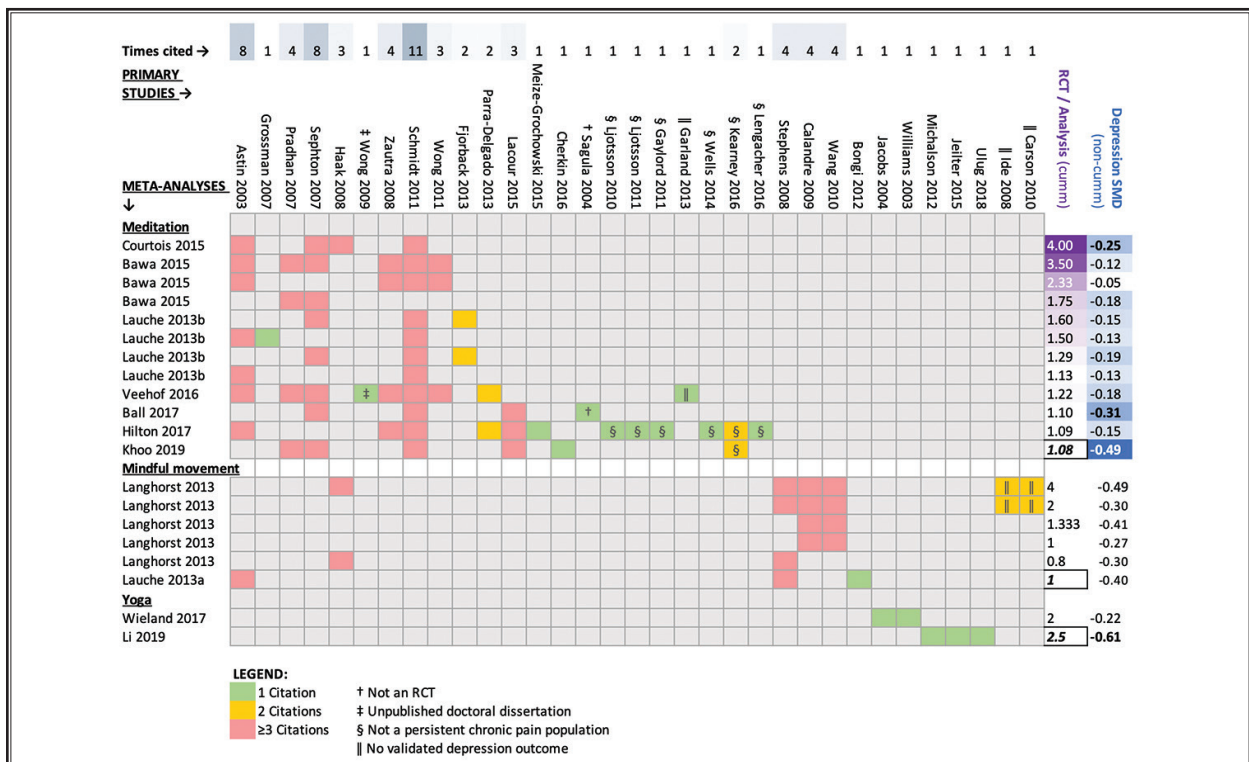


Fig. 3. Array of primary studies versus meta-analyses. NB: primary studies are arranged by intervention type, then by date of publication; meta-analyses are ordered by intervention type (meditation, mindful movement, yoga), then by date of literature search.

irrelevant: one was not a RCT (79), even though it was considered as such by the critically low quality SR that included it; 6 did not include a persistent CP population as per the criteria for this review (63,69,71-73,85); and 3 did not use validated depression outcomes (60,66,90). Another study to note was an unpublished doctoral dissertation, which was thus likely not captured in the search strategies of the other reviews (91).

Most of the underlying primary studies were included multiple times in multiple syntheses (Fig. 3). In this figure, meta-analyses are shown along the y-axis and are ordered by intervention type and then their date of final database search. The primary studies are arranged along the x-axis ordered by intervention type and then date of publication. In the meditation group, one primary study was synthesized in 11 distinct meta-analyses (80), one study in 8 meta-analyses (81), and another primary study in 7 meta-analyses (58). Only 4 relevant primary studies were synthesized once (61,64,75,91), and 2 studies were synthesized twice (62,77). There was similar redundancy in the primary studies in the mindful movement and yoga groups, although overall this was a smaller and sparser experimental literature. The mindful movement studies overlapped marginally with the meditation group (58,65). Because the yoga literature showed no overlap, we have separated these meta-analyses as a distinct group in this table. The ratio of cumulative RCTs to cumulative meta-analyses starts at a maximum of 4.0 RCTs per synthesis and ends at 1.1 RCTs per synthesis (Fig. 3). These numbers are calculated excluding the 10 irrelevant primary studies outlined earlier. If this ratio were to be calculated to determine the maximum possible ratio, including all RCTs (relevant and irrelevant) in the numerator and the cumulative number of SRs (rather than meta-analyses) in the denominator, then the ratio would decrease from a maximum of 4 to a minimum of 3.1, indicating that there are between 1.08 to 3.1 underlying RCTs for every meta-analysis or SR in this area, depending on the method of calculation. Despite this redundancy in the underlying primary studies, there is variability in the synthesized ES, which range from  $-0.05$  to  $-0.49$  (Table 1 and Fig. 2). The mindful movement and yoga groups demonstrate similarly low ratios.

## DISCUSSION

### Summary of Evidence

Overall, mind-body interventions show a consistent,

small to moderate beneficial effect for depressive symptoms in CP. Other research has demonstrated that these interventions are generally safe (92) and can be commonly utilized by people living with CP (14,15). In the included meta-analyses, these beneficial effects were seen across diverse populations. However, there was overrepresentation of fibromyalgia representing 55.0% of the meta-analyses despite being a much smaller minority of the CP population (93). Likewise, there was poor representation of people with axial pain (only 10.0% of meta-analyses) despite these being among the most common kinds of CP (94,95). This may be because depression is more clearly recognized as part of fibromyalgia, and thus depressive symptoms are more commonly studied in this literature. However, the depressive burden in axial pain may be just as high (96). Thus this review suggests that either mind-body interventions have not been adequately studied in people with chronic axial pain, or there may be underrecognition of the burden of depressive symptoms in this population. There was overrepresentation of middle-aged women in the included primary studies, limiting generalizability of the findings to other populations. This may be a reflection, however, of higher rates of CP (2,97) and comorbid depression (98) among women, and the greater likelihood of women with pain and depression utilizing health services as compared with men (99).

Mindful movement practices appear to have larger estimated ES than meditation interventions. However, the meta-analyses included a smaller number of studies and smaller overall populations, which may diminish confidence in these findings.

Mind-body interventions have been reported to have an attenuation of effects over time (100). However, no such trend could be discerned here likely owing to the variability of how outcome timeframe data were synthesized and due to overall paucity of these data.

There was significant variability in the overall quality of the reviews, as per AMSTAR2 criteria. Of the 2 high-quality reviews, one was the only Cochrane review in this group, which is in keeping with general trends that Cochrane reviews tend to have higher quality ratings (101), although ES was small for both. Two studies examining meditation for CP (46,47) that were judged as critically low quality did not include an adequate investigation of publication bias and their findings should be considered with caution. However, these reviews are essentially entirely redundant when their included primary studies are considered against those of the other SRs (Fig. 3).



It is also notable that there are currently no SRs of mind-body interventions that have synthesized depressive symptoms, or even psychological symptomatology, as the primary outcome of interest. Likewise, all the depressive symptom meta-analyses were of a smaller number of studies (and thus a smaller population) than the meta-analysis of the primary outcome, which was usually pain severity and quality of life. This suggests that depressive symptomatology in CP has not been a research priority in this area of mind-body interventions.

As a result, the research community also appears to be drawing from this same pool repeatedly in its attempts to synthesize the existing literature and improve clinical practice and policy. Only one review (17) demonstrated substantial expansion of the primary literature base, but this was mostly due to a broader inclusion criteria for CP types. Thus mind-body interventions for depressive symptoms in CP are understudied and oversynthesized. As Ioannidis (56) has articulated, this is a problem that is symptomatic of the medical literature globally. Here we have attempted to quantify this problem by introducing a ratio of primary studies to syntheses, revealing that there is barely more than one RCT per synthesis in this area of study. This is even lower than what was found for syntheses of statins for atrial fibrillation after cardiac surgery, whereas by 2012 there were 11 meta-analyses of only 22 primary studies (40), or a ratio of 2.0.

### LIMITATIONS

This review provides partial insight into the topical primary literature. In particular, we elected to include only those reviews that reported a quantitative synthesis of depressive outcomes. This was done to facilitate standardized and meaningful comparisons across SRs. It is possible that the strict inclusion criteria for meta-analyses limits the view on the extant primary literature and thus drives the redundancy in the cited primary literature.

As discussed earlier, a limitation of the collected literature is that it is not representative of the real-world

prevalence of various pain conditions. There is a need to further investigate mind-body interventions for conditions such as chronic axial pain, which are comparatively understudied in this set of reviews.

Furthermore, given the selection criteria for the included SRs, we only have a view of the impacts of mind-body interventions on depressive symptoms but not on MDD. Owing to the limitation of reporting in the included SRs, it is unclear to what extent outcomes for study patients with MDD were captured by these reviews. Indeed, other studies demonstrated that many trials of interventions in CP often exclude patients with comorbid MDD (102,103). Thus this review cannot meaningfully contribute to the knowledge of the management of MDD in CP. A separate systematic analysis of the primary literature with a focus only on studies conducted with patients with comorbid CP and MDD will be required to assess this.

### CONCLUSIONS

The sum of evidence suggests that mind-body interventions have small to moderate effects for depressive symptoms in a variety of CP conditions. However, there is need for more primary study, especially for mindful movement interventions and any kind of mind-body intervention for people living with axial pain. Further syntheses of the existing data are of little value until there is substantial expansion of the primary data.

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Author contributions: AS had full access to all the data in the study and takes responsibility for the integrity of the data. AS designed the study protocol with input from KL, OP, DR, and CC. AS wrote the first draft of the manuscript. DC, KL, OP, DR, and CC provided revision for intellectual content and final approval of the manuscript.

Appendix table available at [painphysicianjournal.com](http://painphysicianjournal.com)

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Appendix 1. Ovid Medline Search Strategy

Database: Ovid MEDLINE: Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE Daily and Ovid MEDLINE <1946-Present>

- 
- 1 exp PAIN/ (369996)
  - 2 exp Complex Regional Pain Syndromes/ (5337)
  - 3 exp Headache Disorders/ (32344)
  - 4 exp Musculoskeletal Pain/ (4017)
  - 5 Fibromyalgia/ (7882)
  - 6 exp Neuralgia/ (18714)
  - 7 Pain Measurement/ (79982)
  - 8 (pain or headache\* or migrain\* or fibromyalgia or neuralgia or myalgia or sciatica).tw,kf. (660457)
  - 9 or/1-8 [pain concept] (803956)
  - 10 depression/ (106651)
  - 11 exp Mental Disorders/ (1158636)
  - 12 exp Antidepressive Agents/ (143373)
  - 13 ((depressi\* or psycholog\* or affectiv\*) adj3 (therap\* or disorder\* or symptom\* or patient\* or neuro\* or treatment\*)).tw,kf. (190083)
  - 14 (depression or dysthymi\* or mood or mental health or antidepress\* or anti-depress\*).tw,kf. (486550)
  - 15 or/10-14 [depression concept] (1554996)
  - 16 9 and 15 [pain and depression concepts] (76659)
  - 17 exp meta-analysis as topic/ (17385)
  - 18 meta analy\$.tw,kf. (142562)
  - 19 metaanaly\$.tw,kf. (1959)
  - 20 Meta-Analysis/ (97386)
  - 21 (systematic adj (review\$1 or overview\$1)).tw,kf. (137756)
  - 22 exp Review Literature as Topic/ (11945)
  - 23 or/17-22 (253897)
  - 24 (cochrane or embase or psychlit or psyclit or psychinfo or psycinfo or cinahl or cinhal or science citation index or scopus or bids or cancerlit).ab. (125469)
  - 25 reference list\$.ab. (16114)
  - 26 bibliograph\$.ab. (16464)
  - 27 (hand-search\$ or handsearch\$).ab. (8366)
  - 28 relevant journals.ab. (1082)
  - 29 manual search\$.ab. (3974)
  - 30 or/25-29 (40065)
  - 31 selection criteria.ab. (27974)
  - 32 data extraction.ab. (17634)
  - 33 31 or 32 (43464)
  - 34 Review/ (2481714)
  - 35 33 and 34 (28425)
  - 36 Comment/ (753535)
  - 37 Letter/ (1016383)
  - 38 Editorial/ (482388)
  - 39 animal/ (6352750)
  - 40 human/ (17557036)
  - 41 39 not (39 and 40) (4516275)
  - 42 or/36-38,41 (6150447)
  - 43 23 or 24 or 30 or 35 (307612)

- 44 43 not 42 [systematic review filter] (291864)
- 45 16 and 44 [pain and depression filtered to systematic reviews] (2746)
- 46 45 not (Animals/ not (Animals/ and Humans/)) (2746)