Original Article

Mindfulness intervention in the management of chronic pain and psychological comorbidity: A meta-analysis

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ABSTRACT

Objective: To review trials on mindfulness intervention for chronic pain in primary care to clarify the evidence base and establish whether mindfulness is an important intervention for relieving pain and improving psychological comorbidity.

Methods: We performed a literature search using PubMed, the Cochrane Database, EBSCOhost, Elsevier, Wiley, Springer, and the references of retrieved articles. We included articles written in English and that were published up to January 2012. We found 428 empirical studies, but only eight were included as randomized controlled trials of mindfulness intervention for chronic pain in our meta-analysis. After extracting and synthesizing data from these eight trials, we analyzed the data extracted and synthesized from these eight trials.

Results: Compared with control intervention, mindfulness intervention had no specific effect on reducing pain intensity (weighted mean difference 3.24, 95% confidence interval [CI]: −8.92 to 2.45). Mindfulness intervention led to greater improvement in psychological comorbidity with chronic pain, such as depression (weighted mean difference −3.91, 95% CI −5.94 to −2.32) and trait anxiety (weighted mean difference −4.07, 95% CI −4.48 to −3.65).

Conclusion: There is insufficient evidence that mindfulness intervention relieves pain intensity. However, it improves depression and trait anxiety in patients with chronic pain. Further research in larger, properly powered, and better-designed studies is warranted.

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1. Introduction

Chronic pain develops from numerous conditions and is one of the most widespread and disabling health problems today [1]; it seriously affects the lives of those who have it, leading to significant suffering in patients and their families and significant cost to communities and healthcare systems [2,3]. About 20–30% of the adult population in the Western countries suffers from chronic pain [4]. An investigation of the prevalence and characteristics of chronic pain in the general population of Hong Kong reported overall pain (34.9%) lasting >3 months (chronic pain), with an average of 1.5 pain sites [5]. In addition, epidemiological studies indicate that depression is a common comorbidity associated with chronic pain states [6]. Some studies [7,8] have also shown that patients with chronic pain are significantly more likely to have higher levels of anxiety symptoms.

Pain medications, including nonselective, nonsteroidal anti-inflammatory drugs, cyclooxygenase 2 inhibitors, and weak or strong opioids, are significant interventions for improving chronic pain. However, Gore and colleagues demonstrated that therapy switching and discontinuation of certain pain medications due to inadequate pain relief or undesirable side effects were common among patients with osteoarthritis and chronic low back pain (CLBP) in the United Kingdom [9]. Other than pain medication, surgery can also relieve pain significantly, but it is suitable for only a subset of patients [10,11]. Regarding psychological approaches for chronic pain, the focus in recent work has shifted from cognitive behavior therapy (CBT) to acceptance and commitment therapy (ACT) due to the lack of a coherent and consistent theoretical model in CBT [12]. Currently, ACT is the most widely researched approach to relieving pain, where the focus is less on controlling or fighting pain, but accepting it [13].

Mindfulness intervention, one of the processes described in the ACT model, is currently the most widely implemented meditation interventions when examining pain outcomes [14]. Mindfulness intervention has been defined as "awareness that emerges by way of paying attention on purpose, in the present moment, and non-judgmentally to the unfolding of experience moment by moment" [15]. It was initially introduced as a clinical intervention for patients with chronic pain and disease [16]. A number of studies support the efficacy of mindfulness intervention for chronic pain [17–19]. For psychological comorbidities with chronic pain, Hofmann and colleagues suggested that mindfulness-based therapy is a promising intervention for treating anxiety and mood problems in patients with chronic pain [20], and it accounted for significant variance in measures of depression and pain-related anxiety [21]. However, other studies found no statistical significance in mindfulness intervention on chronic pain [22,23]. Given these positive and negative outcomes and the question of whether mindfulness intervention improves chronic pain, we investigated previous trials for evidence of the efficacy of mindfulness intervention through systematic review.

2. Aim and objectives

We searched the literature in six data sources as well as the references of retrieved articles to select randomized controlled trials (RCTs) of mindfulness intervention for chronic pain. We performed the above to identify the evidence base to fulfill the purpose of this meta-analysis, which was to evaluate the efficacy of mindfulness intervention in relieving chronic pain and improving depression and anxiety associated with chronic pain states.

3. Methods

3.1. Search strategy

We searched the published literature for RCTs that used mindfulness as intervention for relieving chronic pain and improving psychological state, and searched keywords such as "intervention with mindfulness", "mindfulness meditation", "mindfulness-based interventions" (MBIs), and "mindfulness-based stress reduction" (MBSR). The inclusion criteria were as follows: population of interest comprising adults aged ≥18 years with pain for a minimum of three months or diseases with chronic pain symptoms; primary outcome measures were pain symptoms, including pain intensity, pain acceptance, and so on; secondary outcomes were psychological symptoms, including depression and anxiety.

3.2. Data sources and extraction

First, we searched evidence-based data sources: the Cochrane Database and Registered Nurses Association of Ontario guidelines, and then we searched PubMed, EBSCOhost, Elsevier, Wiley, Springer, and the references of the retrieved articles. We searched for RCTs originally published in English before January 2012. We attempted to obtain potential missed information through general web searches, requesting articles via the shared databases of our respective institutions, and corresponding directly with authors to identify missed citations. However, some articles were unavailable or were an incorrect match.

We selected potentially relevant studies independently by screening retrieved citations and abstracts. We retrieved trials assessed as definite or uncertain for inclusion as full papers. We resolved differences by discussion; arbitration by a third author (CHL) was planned but not required. Details of the studies and data were extracted using a standardized electronic form; differences were resolved by discussion. Risks of bias in terms of random sequence production, allocation concealment, and blind method were assessed as adequate, unclear, or inadequate; withdrawal was assessed as description and undescribed using the revised Jadad Scale [24]. One author (SY) checked the reference lists of all included studies for further potentially relevant citations, and two authors (SY, LHX) reviewed this list and agreed on further potentially relevant papers to be retrieved in full. We performed the searches in November 2011 and repeated them in January 2012 before the final analysis.

3.3. Statistical analysis

Data were pooled and analyzed using RevMan v5.1. We carried out separate analysis for each intervention and outcome measure as compared with control intervention. Intervention effects were calculated as relative risks with 95% confidence intervals for dichotomous data. For continuous data, we used a conservative random effects meta-analysis model to calculate mean differences and weighted mean differences with 95% confidence intervals. Heterogeneity was quantified using the I^2 statistic and the χ^2 test of heterogeneity, and we reported pooled data only when heterogeneity was not significant ($P \geq 0.05$). We explored heterogeneity by excluding single outlying results or restricting analysis to good-quality studies by using sensitivity analysis. Two authors (SY, LHX) reviewed cluster random controlled trial data and pooled data, respectively, and then compared their findings. If opinions differed, the authors held discussions until they reached consensus before the data were analyzed.

4. Results

4.1. Included studies

Our search identified 372 potential citations; we identified a further 56 potential studies from citations in the retrieved papers. After initial screening of the titles and abstracts, we assessed 34 full studies for possible inclusion in the review; eight studies met the inclusion criteria (Fig. 1).

Table 1 summarizes the characteristics of the included studies. Three studies had three arms: One compared MBSR and CBT with an attention–placebo group [25]; we extracted only mindfulness intervention and attention–placebo outcomes. One compared MBSR and an active control with a wait list; we extracted only mindfulness intervention and wait list outcomes [26]. The third study compared 20-min and 45-min mindfulness intervention meditation with a comparison group; we extracted outcomes as separate groups [27]. The remaining RCTs were 2-armed studies.

Interventions included MBSR, mindfulness-based meditation, and MBIs. Loving-kindness meditation is an intervention that encompasses all of these methods, using mindfulness meditation techniques to develop love and transform anger into compassion [23]. Most interventions were implemented for eight weeks (seven studies); the remaining trial involved a 6-week intervention [28]. Some trials mentioned that some participants used compact discs (CDs) for guidance in daily practice [22,25,29,30], and others embarked on a "retreat" session [22,26,29].

Although most of the studies recruited patients with chronic pain, five recruited participants with a specific disease associated with chronic pain: two with CLBP [23,30], one with breast cancer [28], and two with fibromyalgia [26,29].

4.2. Risk of bias in included studies

The overall study quality was high. Of the studies included, there was an adequate random sequence generation in 62.5% (5/8), allocation concealment in 62.5% (5/8), and data collection blinding in 62.5% (5/8), and description of withdrawal in 62.5% (5/8). We used the revised Jadad Scale to evaluate risk of bias, viewing 1–3 points as bad quality and 4–7 points as good quality. Six studies were defined as "good quality" and were used for sensitivity analysis by study quality (Table 2).
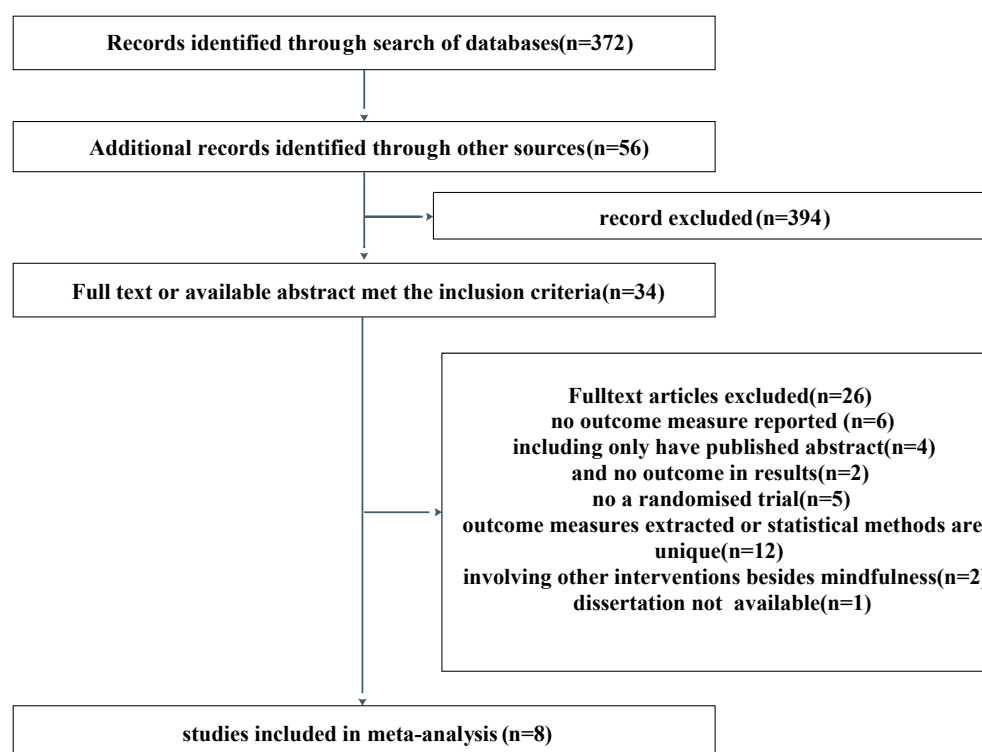

Fig. 1 – Flowchart of identification of papers in the study.

Table 1 – Characteristics of included studies.

Study and location	Study type (duration)	Participants	Sample (I/C)	Interventions	Quality judgment	Outcome measures extracted	Results
Wong et al. [22], Hong Kong	RCT (8 weeks, including 6-month post-treatment follow-up)	Patients aged 24–64 years with pain for a minimum of 3 months	99 (51/48)	MBSR: 8 weekly group sessions, 2.5 h each, a 7-h "retreat" session, a booklet on the MBSR program and CDs; MPI: educational instructions on chronic pain management based on *Managing Pain Before It Manages You* for 8 weekly 2.5-h group sessions	Random sequence production, allocation concealment, blind method: adequate; withdrawal: undescribed	Depressive symptoms: CES-D; anxiety: STAI	No significant improvement to depression and anxiety in the past 3 months
Carson et al. [23], USA	RCT (8 weeks, including 3 months' follow-up)	Adults with CLBP	43 (18/25)	Loving-kindness meditation: 8 weekly 90-min group sessions. Usual care: routine care provided through medical outpatient programs	Random sequence production, allocation concealment, blind method: adequate; withdrawal: undescribed	Pain intensity: MPQ	Pre–post-tests: pain intensity (MPQ), P = 0.03
Bruckstein [25], USA.	RCT (8 weeks)	Patients with chronic pain disorder (duration ≥ 6 months)	64 (CBT: 24/ MBSR: 22/attention–placebo: 18)	MBSR: 1.5 training sessions in a class like-setting in the daily discipline of mindfulness meditation; CBT: organizing and implementing a structured, time-limited pain management program; attention–placebo: discussing the problems of living with chronic pain with others	Random sequence production, allocation concealment, blind method: adequate; withdrawal: description	Pain intensity: MPQ; depression: BDI	No significant change in pain intensity following MBSR but significant increase of functional capacity and psychological status
Schmidt et al. [26], Germany	RCT (8 weeks, and short follow-up)	Women aged 18–70 years currently with fibromyalgia	177 (59/59/59)	MBSR: Weekly 2.5-h sessions for 8 weeks, additional 7-h all-day session on a weekend day, daily homework assignments of 45–60-min; active control procedure: nonspecific effects of MBSR; wait list	Random sequence production, allocation concealment, blind method: adequate; withdrawal: described	Depression: CES-D	Changes in depression from baseline to short-term follow-up, P = 0.012
Sagula [27], USA.	RCT (8 weeks)	Patients with chronic pain	71 (53.17/22/18)	20-min mindfulness meditation group: 20 min/day for 8 weeks; 45-min mindfulness meditation group: 20 min/day for 8 weeks; comparison group: seeking or receiving medical assistance, or who were on a wait list for psychological assistance in response to their chronic pain condition	Random sequence production: unclear; allocation concealment and blind method: inadequate	Depression: BDI; anxiety: STAI	Depression: significant mean difference between 20-min group and comparison group (P < 0.001), between 45-min group and comparison group (P < 0.003); anxiety revealed that the difference was not significant (P < 0.15); For significant differences between the 20 min and the comparison (P < 0.02), the 45 min and the comparison (P < 0.07)

Lengacher et al. [28], USA	RCT (6 weeks)	Female breast cancer survivors (Stages 0–III) aged ≥21 years	84 (41/43)	MBSR: weekly 2-h sessions conducted by a psychologist certified and trained in MBSR for 6 weeks; control group: usual care	Random sequence production: unclear; allocation concealment: inadequate; blind method: adequate; withdrawal: description	Depressive: CES-D; anxiety: STAI	Compared with usual care, MBSR had significantly lower adjusted mean levels of depression (6.3 vs. 9.6, $P = 0.03$), state anxiety (28.3 vs. 33.0, $P = 0.03$), trait anxiety (30.4 vs. 34.5, $P = 0.004$)
Sephton et al. [29], USA	RCT (8 weeks)	Patients at least 18 years old with fibromyalgia	91 (51/40)	MBSR: 8 weekly 2.5-h sessions; day-long meditation retreat held between weeks 6 and 7, home practice assignments guided by a workbook and audiotapes, daily home practice of 30–45-min duration, 6 days/week was encouraged; control: wait-list group; participants were offered MBSR program only after conclusion of the study	Random sequence production: unclear; allocation concealment and blind method inadequate; withdrawal: description	Depression: BDI	Depressive symptoms improved significantly in treatment vs. control participants over 3 assessments
Morone et al. [30], USA	RCT (8 weeks, including 3-month follow-up)	Adults aged ≥65 years with moderate-intensity CLBP occurring daily or almost daily	37 (19/18)	Mindfulness-based meditation group: 8 weekly 90-min mindfulness meditation sessions and meditation homework assignments; control: wait list group	Random sequence production, allocation concealment: adequate; blind method: inadequate; withdrawal: description	Pain intensity: MPQ	Mindfulness-based meditation group in CPAQ total Score and Activities Engagement subscale ($P = 0.008$, $P = 0.004$) and SF-36 physical function ($P = 0.03$) compared to control group. There was no statistically difference for the other outcome measures compare to control group

Table 2 – Risk of bias in included studies.				
Study	Random sequence production	Allocation concealment	Blind method	Withdrawal	Total score
Wong et al. [22]	2	2	2	0	6
Carson et al. [23]	2	2	2	0	6
Bruckstein [25]	2	2	2	1	7
Schmidt et al. [26]	2	2	2	1	7
Sagula et al. [27]	1	0	0	0	1
Lengacher et al. [28]	1	0	2	1	4
Sephton et al. [29]	1	0	0	1	2
Morone et al. [30]	2	2	0	1	5

Random sequence production: 2 = adequate; 1 = unclear; 0 = inadequate; allocation concealment: 2 = adequate; 1 = unclear; 0 = inadequate; blind method: 2 = adequate; 1 = unclear; 0 = inadequate; withdrawal: 1 = description; 0 = undescribed.
MPQ-SF: McGill Pain Questionnaire–Short Form; BDI: Beck Depression Inventory; CES-D: Center for Epidemiological Studies Depression Scale; STAI: 20-item Trait Subscale of the State–Trait Anxiety Inventory.
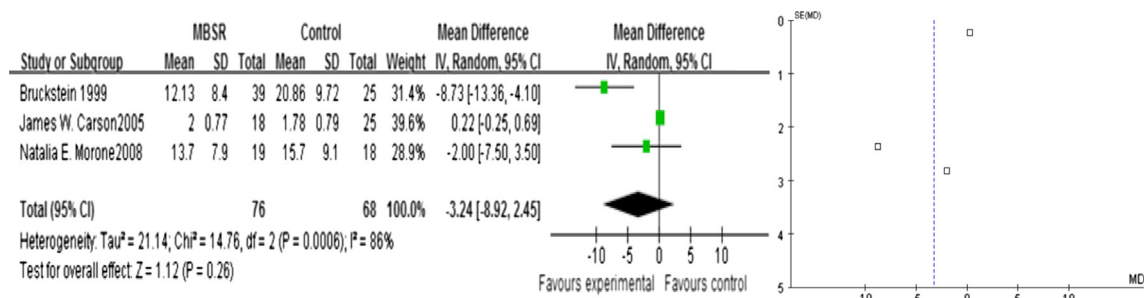

Fig. 2 – Change in pain intensity following mindfulness intervention compared with control intervention.

4.3. Effects of intervention

4.3.1. Pain intensity
Three studies [23,25,30] used the McGill Pain Questionnaire–Short Form to measure the extent of pain intensity. Three good-quality studies reported no significant reduction in pain intensity for MBSR compared with attention–placebo, usual care, and wait list (weighted mean difference −3.24, 95% confidence interval −8.92 to 2.45; z = 1.12, P = 0.26), and there was no significant heterogeneity between them (I^2 = 0%, P = 0.43) (Fig. 2).

4.3.2. Depression
Six studies [22,25−29] focused on depression and used two questionnaires. Three studies [25,27,29] used the Beck

Depression Inventory to measure the level of depression, the others [22,26,28] used the Center for Epidemiological Studies Depression Scale (CES-D). Meta-analysis of four groups from three studies revealed lower magnitudes of depression in favor of MBSR compared with the control intervention, i.e., wait list and attention–placebo (weighted mean difference −3.91, 95% confidence interval −5.94 to −2.32) (Fig. 3). A good-quality study reported similar results (weighted mean difference −5.07, 95% confidence interval −7.49 to −2.65). Three studies [22,26,28] used the CES-D to measure the extent of depression. The pooled data of three good-quality studies revealed a significant reduction following MBSR compared with usual care, educational instruction, and wait list (weighted mean difference −3.21, 95% confidence interval −3.65 to −2.77) (Fig. 4).
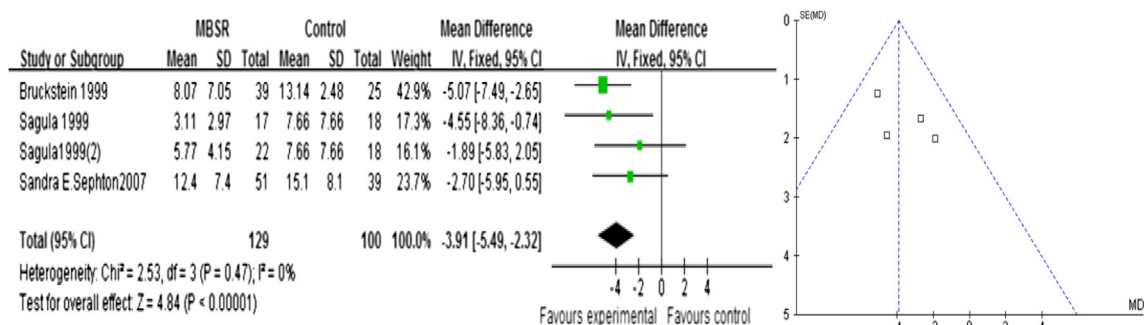

Fig. 3 – Change in depression according to the BDI following mindfulness intervention compared with control intervention.
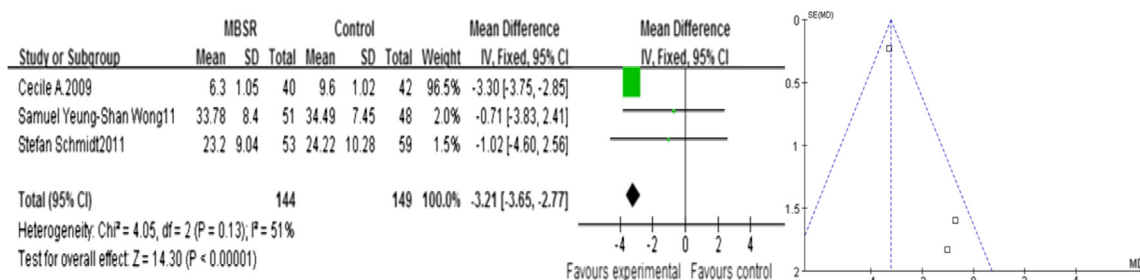
Fig. 4 – Change in depression according to the CES-D following mindfulness intervention compared with control intervention.

4.3.3. Anxiety

Three studies [22,27,28] included trait and state anxiety. Meta-analysis of four groups from three studies revealed a significant difference in favor of MBSR compared to educational instruction, wait list, and usual care for trait anxiety (weighted mean difference −4.07, 95% confidence interval −4.48 to −3.65, P < 0.00001) (Fig. 5). Two good-quality studies [22,28] reported the same results (weighted mean difference −4.07, 95% confidence interval −4.49 to −3.65, P < 0.00001). However, there was no difference for state anxiety (weighted mean difference −2.11, 95% confidence interval −6.40 to 2.17, P = 0.33) (Fig. 6). There was also no difference between the MBSR and control group in the pooled data from two good-quality studies (weighted mean difference −2.83, 95% confidence interval −7.43 to 1.76).

5. Discussion

We aimed to determine whether mindfulness intervention is an effective means of managing patients with chronic pain. We made two findings: First, in comparison with the controls, mindfulness intervention did not reduce pain intensity significantly. Chiesa and colleagues reported similar results in that MBI had nonspecific effects for reducing pain symptoms in patients with chronic pain [31]. One possible reason for the nonspecific effects of mindfulness intervention is the sample size, where the largest sample size in three reports [23,25,30] was 22/18 (intervention/control, I/C); another possible reason is the heterogeneous patient samples, which included populations with different sites or types of pain, as well as different ages. However, we were unable to find sufficiently

robust evidence in the three reports proving that mindfulness intervention was effective for relieving pain.

Chronic pain interacted with psychological and social factors [32], and the strength of interaction was stronger for depression and anxiety than for other mental disorders [33]. Our second finding was that mindfulness intervention reduced depression and trait anxiety significantly in patients with chronic pain. Our results are the same as that of Chiesa and colleagues [31], who reported that MBIs could be useful for reducing depressive symptoms associated with chronic pain. However, the magnitude of such benefits appeared comparable to that of other nonspecific interventions and did not suggest a possible advantage for MBIs in comparison to interventions such as educational support groups. In fact, the results were not consistent with that of Chiesa et al. The control groups in this meta-analysis received active treatments, including attention–placebo and educational instruction, and four reports compared mindfulness intervention to usual care and wait lists. These six studies all reported significant improvement following mindfulness intervention compared with the control groups regardless of nonspecific interventions or active treatments. Notably, our findings indicate that mindfulness intervention is effective for reducing trait anxiety and does not suggest a possible effect for improving state anxiety; however, some studies mentioned the effect of mindfulness intervention for reducing anxiety in passing only, and did not describe the impact of mindfulness intervention on state and trait anxiety separately.

Our study has some limitations. The most obvious and important is the limited number of pooled articles, especially when analyzing pain intensity. A possible reason for this is that outcome measures of chronic pain and its concomitant
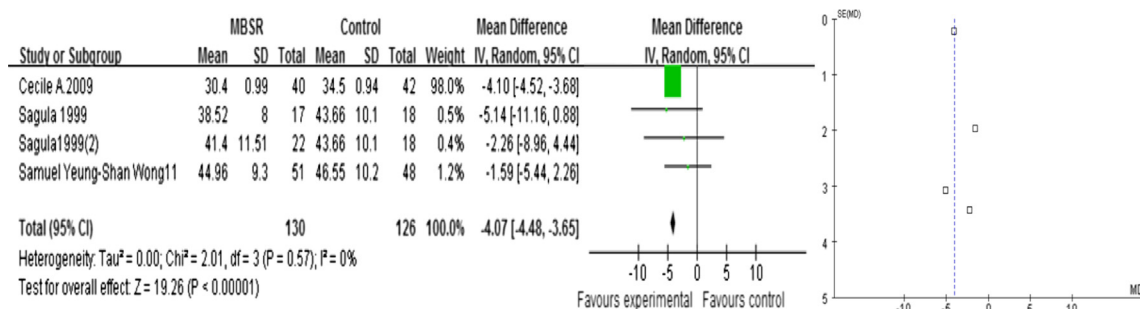

Fig. 5 – Change in trait anxiety following mindfulness intervention compared with control intervention.
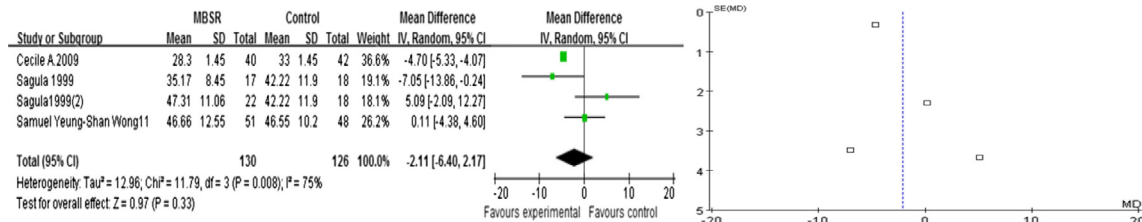
Fig. 6 — Change in state anxiety following mindfulness intervention compared with control intervention.

symptoms are all subjective, which might have led to the authors using different questionnaires to evaluate these outcome measures, hence the limited number of articles available for pooling.

The heterogeneity of types of chronic pain, the comparative control groups, and the difference of mindfulness intervention duration, especially the duration of evaluation for post-intervention follow-up, might partially explain the heterogeneity observed in the reviewed findings. As stated earlier, chronic pain includes CLBP, fibromyalgia, and the like; the controls involved educational instruction, usual care, and wait list; and the duration of evaluation was three and six months.

Of 34 RCTs identified initially, only eight met our quality criteria. Most of the studies were from the USA; only two were from elsewhere, namely Hong Kong in China [22], and Germany [26]. Therefore, evidence of whether mindfulness intervention has specific effects on reducing chronic pain relies on the generalization of findings from American studies, thus limiting the generalizability to non-Caucasians and Eastern populations. We also restricted our search to articles in English, which may have excluded potential data; however, it is highly likely that most good-quality and useful information would have been published in English.

Mindfulness intervention and outcome measures of pain and psychological comorbidities are rather subjective and would not be evaluated with objective measures; therefore, it is important and necessary to use the blind method. Generally, it was impossible for participants to achieve adequate blind method for any intervention study, particularly because all patients had to complete informed consent forms before enrollment. Thus, when statistician or data collector blinding was reported in an article, we coded this criterion as adequate blind method; five of the eight studies met this criterion.

In addition to the above, there are other limitations to our study. Most trials evaluated outcome measures after eight weeks post-intervention; only two studies [22,25] followed participants for a maximum six months post-intervention; thus, these studies could not demonstrate any potential between-group differences in long-term outcome measures. Additionally, the sample size of the most articles in our meta-analysis might not have been large enough to demonstrate significant differences in outcome measures.

6. Conclusions

There is insufficient evidence to determine whether mindfulness intervention is effective for reducing pain intensity.

However, there is evidence that mindfulness intervention improves depression and trait anxiety in patients with chronic pain. Our meta-analysis findings provide preliminary support for nurses and other healthcare professionals to integrate the use of mindfulness intervention into the treatment of patients with chronic pain, especially those with psychological comorbidities. Overall, we found evidence of the benefits conferred by mindfulness intervention in managing depression and trait anxiety in patients with chronic pain.

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Conflicts of interest statement

The authors declare that they have no conflict of interest.

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