



The Effectiveness of School-Based Mindfulness and Cognitive Behavioural Programmes to Improve Emotional Regulation in 7–12-Year-Olds: A Systematic Review and Meta-Analysis

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Abstract

Objectives Though findings have been mixed, some primary or elementary school-based mindfulness and cognitive behavioural interventions have been shown to improve aspects of emotion regulation. Age is suggested as a potential mediator but previous reviews have not addressed this comprehensively, making evaluation of impact unclear. The current review brought together the evidence surrounding the impact of mindfulness-based interventions (MBIs) or cognitive behavioural interventions (CBIs) on emotion regulation in children aged between 7 and 12 years.

Method Databases (British Education Index, Child Development and Adolescent Studies, CINAHL, Education Source, ERIC, MEDLINE, PsycINFO, PubMed, SAGE, Web of Science) were searched for published and unpublished randomised controlled trials evaluating the effect of primary school-based MBIs ($n = 18$) or CBIs ($n = 12$) on measures of emotional awareness, modulation and expression.

Results Analysis of the MBIs in this review indicated a significant improvement in emotional awareness, an increase in positive emotions and a reduction in depression. Sub-analyses found an effect of age, duration and universal delivery for MBIs. Analysis of the CBIs indicated significant improvement in child negative expressive behaviours as reported by parents. Risk of bias was low across domains of incomplete outcome data and selective outcome reporting but was unclear in other domains.

Conclusions Evidence from the MBI studies suggested that universal interventions with a shorter duration had more significant effects, particularly for 10–12-year-old participants. Future research should investigate programme design features and the suitability of content and skill-focus for different age groups, employing qualitative techniques for analysis. This could lead to reconsideration of typical intervention formats for primary school children.

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Keywords Emotion regulation · CBT · Mindfulness · Well-being · School-based interventions

In 2022, 15.2% of children aged 7–10 years old were identified as having a probable mental disorder in England (NHS digital, 2022) and it is likely that less than two-thirds will have accessed professional help (Radez et al., 2021). School-based support for mental health could help address this significant gap. One-to-one services, collective discussions of emotions and well-being in a classroom setting have been

shown to create a more inclusive, non-stigmatising environment which may make it easier for children with more serious mental health problems to seek help (Weare & Nind, 2011). School-based interventions can also be a welcome resource for schools, easing the requirement of specialist knowledge and lesson planning (Davies & Matley, 2020; Weare, 2015).

Metacognitive approaches, getting children to think about their thinking (Flavell, 1979), offer a way to generate curiosity of cognitive processes that can bring about greater understanding of evaluation and self-reflection (Larkin, 2010). Metacognitive insight and strategies can be taught to primary age pupils (Perry et al., 2019) and can be integrated into the curriculum, as evidenced with interventions such as the growth mindset (Blackwell et al., 2007; Dweck,

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2006). Two of the most prevalent school-based metacognitive approaches are cognitive behaviour interventions (CBIs) and mindfulness-based interventions (MBIs). Creating an objective awareness and understanding of cognitions is a fundamental characteristic of both types of intervention (Crane et al., 2017; Fenn & Byrne, 2013).

A key difference between CBIs and MBIs is the theoretical basis of change. CBIs work from the principle of reappraisal: that if an individual gains control of dysfunctional cognitions, they (the individual) can change them to reduce emotional distress and maladaptive behaviours (Daunic et al., 2012). In MBIs, rather than giving values to thoughts (e.g. functional or dysfunctional), the aim is to facilitate non-judgemental awareness (Kabat-Zinn, 2003). As such, there is no attempt to change thoughts (e.g. from negative to positive), but rather to learn to observe without judgement, changing the relationship rather than the context (Roeser et al., 2022; Teasdale, 1999).

Although comparisons of these interventions have been conducted in previous reviews (e.g. Caldwell et al., 2019; Dray et al., 2017; Mackenzie & Williams, 2018), the precedence has been to compare CBIs with a range of other interventions. However, the similarity in the application of CBIs and MBIs justifies a more direct comparison. Both can be integrated relatively easily into the school curriculum and delivered in a universal classroom setting. Teachers often need minimal training because the interventions are either delivered by external practitioners, or teachers are given relevant resources/manuals (see reviews, e.g. Calear & Christensen, 2010; Felver et al., 2016). However, the theoretical assumptions that underpin these approaches may lead to differences in several applied factors in a school setting such as the problem-focus of the intervention, appropriate participant group or the allocation of time and financial resources. Understanding these differences can help schools to make an informed choice regarding relevant programmes. In a comprehensive review of school-based interventions, Klingbeil et al. (2017) recognised the need for a comparison between well-established interventions to establish the effects of these differences in theory and application.

An important consideration when exploring the effects of school-based interventions is the age and cognitive ability of the participants (Porter et al., 2022). Significant neurological changes in both the limbic system (the emotion centre of the brain) and the pre-frontal cortex occur during the pre-adolescent period, from around 7–8 to 11–12 years (Bunge et al., 2002; Urbain et al., 2017). At this stage in brain development, executive functions such as goal-setting, inhibiting impulses and cognitive flexibility are still in the process of maturation (Ridderinkhof et al., 1999) and the application of controlled regulation strategies makes additional demands on cognitive capacity (Best et al., 2009; Grave & Blissett, 2004). Cognitive ability

could differentially impact the efficacy of CBIs and MBIs with CBIs often emphasising controlled regulation and application of executive functions to control and change behaviour (Daunic et al., 2006; Diamond, 2013). This contrasts with MBIs where there is a focus on the application of executive functions to help create a pause between the response to emotional stimuli and the appraisal of that stimuli, which reduces the necessity for controlled regulation strategies (Farb et al., 2013; Hölzel et al., 2011; Vago & Silbersweig, 2012). However, the level and focus of awareness that MBIs require could prove challenging for some children, especially those under the age of 7 years (Maynard et al., 2017).

Although a review of school-based depression and anxiety prevention programmes for 5–19 year olds, where 84% of the interventions were CBIs, found no effect of age (Werner-Seidler et al., 2017), others have reported that child age significantly influences mental health outcomes related to emotion regulation (Caldwell et al., 2019; Carsley et al., 2017; Dray et al., 2017; Porter et al., 2022). Dray et al. (2017) reported small but significant effects of CBIs on anxiety, depression and general psychological distress for children aged 5–18 years. A sub-group analysis for age indicated that anxiety and psychological distress were improved for children 5–10 years old but in adolescents aged 11–18 years improvement was seen for non-anxiety internalising problems only, such as self-regulation, coping, empathy and problem-solving. Similarly, Caldwell et al. (2019) found a small but significant beneficial impact of CBIs on anxiety for primary school children (4–11 years) but not for adolescents supporting the growing evidence for the use of CBIs in younger age groups. These findings suggest that CBIs have a positive impact on anxiety in younger children and should be implemented prior to adolescence.

More MBI-focused reviews also suggest a greater impact for younger children than for adolescents. Porter et al. (2022) reported a significantly greater effect of MBIs on mental health symptoms for 3–10-year-olds in comparison with adolescents. Carsley et al. (2017) found improvements in measures of emotional health and well-being for late adolescents (15–18 years) and middle childhood (6–10 years) but no effects for early adolescents (11–14 years). This indicates that there may be an interaction between the type of outcome that is investigated and the age of participants. Finally, Dunning et al. (2019) found that MBIs had larger effect sizes for improvements in negative behaviours associated with younger ages when compared to adolescents. Collectively, this evidence suggests that metacognitive interventions may be most effective for primary schoolchildren. However, all the reviews mentioned identified different age ranges to represent younger children and none fully aligns with a specified educational stage such as upper primary/elementary school.

In terms of differential effects on aspects of emotion regulation, mindfulness programmes, although often showing a more general approach to outcomes, are considered to have a moderate effect on the increase of emotional awareness as evaluated using measures of attention and awareness (Dunning et al., 2019; Klingbeil et al., 2017; Zoogman et al., 2014). Emotional modulation outcomes, such as anxiety and depression, have been shown to have small but significant reductions following both school-based CBIs (Caldwell et al., 2019; Calear & Christensen, 2010; Dray et al., 2017; Mackenzie & Williams, 2018; Werner-Seidler et al., 2017) and MBIs (Dunning et al., 2019; Klingbeil et al., 2017; Zoogman et al., 2014), though in the latter the effect was greater in the clinical population groups than in general classroom based groups. Other reviews have found no effect of MBIs in these outcomes (Ruiz-Íñiguez et al., 2019; Zenner et al., 2014).

Regarding expression-based emotion regulation measures, CBIs have been shown to reduce anti-social and improve pro-social expressive behaviours (Dray, et al., 2017) but may not be effective in reducing negative expressive behaviours in pre-adolescent populations (Dray et al., 2017; Mackenzie & Williams, 2018). Although MBIs have been found not to significantly impact behaviour in school settings (Maynard et al., 2017), the positive effects of MBIs on negative behaviours have been shown in reviews by Klingbeil et al. (2017) and Dunning et al. (2019). However, it should be noted that both these reviews cover a broad age range of participants, from 3 to 17 years and 4 to 17 years, respectively.

Collectively, the findings from previous reviews, in terms of the impact of MBIs and CBIs in the areas of emotional awareness, modulation and expression, demonstrate the lack of consistency in reporting and an inability to draw any clear conclusion on the effectiveness of interventions for aged groups of particular development stages such as 7–12-year-olds. Due to the inconsistent evidence, researchers have urged caution in the adoption of both CBIs (Caldwell et al., 2019) and MBIs (Carsley et al., 2017; Maynard et al., 2017) as a method of addressing emotion-related well-being. However, it is often the broad range of outcomes, participant age ranges and intervention types in each review which may be contributing to the lack of clarity; therefore, more focused research is needed to inform future practice in this area.

Although comparison of interventions has been conducted (e.g. Caldwell et al., 2019; Dray et al., 2017; Mackenzie & Williams, 2018), there has been no direct comparison between CBIs and MBIs for primary age participants in terms of their effects on emotion regulation, or previous review focusing on the educational stage of upper primary/elementary school. The stage of education is an important factor when comparing the effects of school-based programmes as it impacts the content and delivery of the

intervention (Porter et al., 2022). It is possible that some interventions respond more effectively to the educational requirements of this age group by teaching appropriate skills and knowledge. Therefore, this systematic review sought to provide a meta-analysis of interventions designed specifically for upper primary/elementary pupils through the following: (1) synthesising evidence regarding the effectiveness of school-based CBIs on emotion regulation outcomes of awareness, modulation and expression in typically developing children aged 7–12 years old; (2) synthesising evidence for the effectiveness of school-based MBIs on emotion regulation outcomes of awareness, modulation and expression in typically developing children aged 7–12 years old; and (3) providing a comparative evaluation of the differences between these two approaches.

Method

This review was reported in accordance with the Preferred Reporting Items for Systematic review and Meta-Analysis (PRISMA) guidelines; see Supplementary Material: S1 PRISMA Checklist. The inclusion criteria and methods of analysis were pre-specified and documented in a protocol (ID: CRD42019139283) which is available on the International Prospective Register of Systematic Reviews (<http://www.crd.york.ac.uk/PROSPERO>). Ethical approval for this study was granted by the University of Lincoln Research Ethics committee via the Lincoln Ethics Application System (LEAS), approval code: 2020–2322.

Eligibility Criteria

Studies were included if they were randomised controlled trials (RCTs), quasi-RCTs and non-randomised controlled trials, with 7–12-year-old children in primary or elementary mainstream schools. Interventions designed specifically for children in key stage 2 or upper elementary education were the main focus of this systematic review. Studies with 12-year-old participants were excluded if they had graduated from primary/elementary level education. Studies were excluded if the majority of participants had special educational needs, clinical mental health disorders or if the intervention had been delivered in a behavioural school. CBIs were included if they were identified by the original authors as being based on cognitive behavioural therapy (e.g. CBT-informed, or developed from CBT practices). CBIs had no elements of mindfulness practice. Mindfulness programmes were included if they were identified by the original authors as being MBIs and they included mindfulness meditations, body scans and/or breath awareness. MBIs were excluded if they involved yoga. For inclusion, the intervention had to be school-based and delivered in a group setting by school

staff or external practitioners. All studies had a component of emotion regulation as an outcome measure. All journal publications were included, published in English language with no restrictions on date or country of publication.

Information Sources and Search Strategy

A total of 10 databases were searched from inception to August 2022 (British Education Index, Child Development and Adolescent Studies, CINAHL, Education Source, ERIC, MEDLINE, psycINFO, PubMed, SAGE, Web of Science). Database searching was supplemented with internet searching (e.g. Google Scholar), and forward and backward citation tracking from systematic reviews and included studies. Key search terms for database searching included the following: (cbt OR “cognitive behav* therapy” OR “contemplative education” OR mindfulness AND “elementary education” OR “primary education” OR classroom OR school).

Study Selection

Search results were downloaded to EndNote where duplicate citations were removed. Titles and abstracts were screened independently by four reviewers (LP, FC, CC, KM) against the inclusion criteria, with all references being screened by at least two reviewers. Where studies could not be excluded based on title and abstract, full texts were retrieved. The full texts were then assessed for eligibility by three reviewers (LP, FC, CC) independently with reasons for exclusion recorded. Any discrepancies were resolved through discussion with the wider review team.

Data Extraction

A data extraction form was developed and tested. The extracted data included information about the following: intervention characteristics and design (title, author, aim of study, country, design, inclusion/exclusion criteria, recruitment, randomisation, blinding of participants and study team, allocation concealment), participants (sample size, age, gender, and ethnicity), intervention components (description, type of intervention, comparator, screening of participants, mode of delivery, dose, time to follow up), and key findings (primary and secondary outcomes). The outcome measures used in this review were categorised within the emotion regulation processes of *awareness*, i.e. creating awareness of thoughts, feelings or behaviour; *modulation*, i.e. change or reappraisal of thoughts and feelings; and *expression*, i.e. reducing negative/anti-social behaviours or increasing positive/pro-social behaviours (Gross & Thompson, 2007).

Risk of Bias Assessment

Three reviewers independently assessed risk of bias using the Cochrane Risk of Bias assessment tool on key criteria to include random sequence generation, allocation concealment, blinding and incomplete outcome data. Each domain was classified as adequate (low risk of bias), inadequate (high risk of bias) or unclear (not possible to determine risk of bias). An overall study risk of bias was not assessed and data for each domain are presented for readers to interpret in context with review findings. Risk of bias was not a reason for exclusion.

Data Analysis and Synthesis

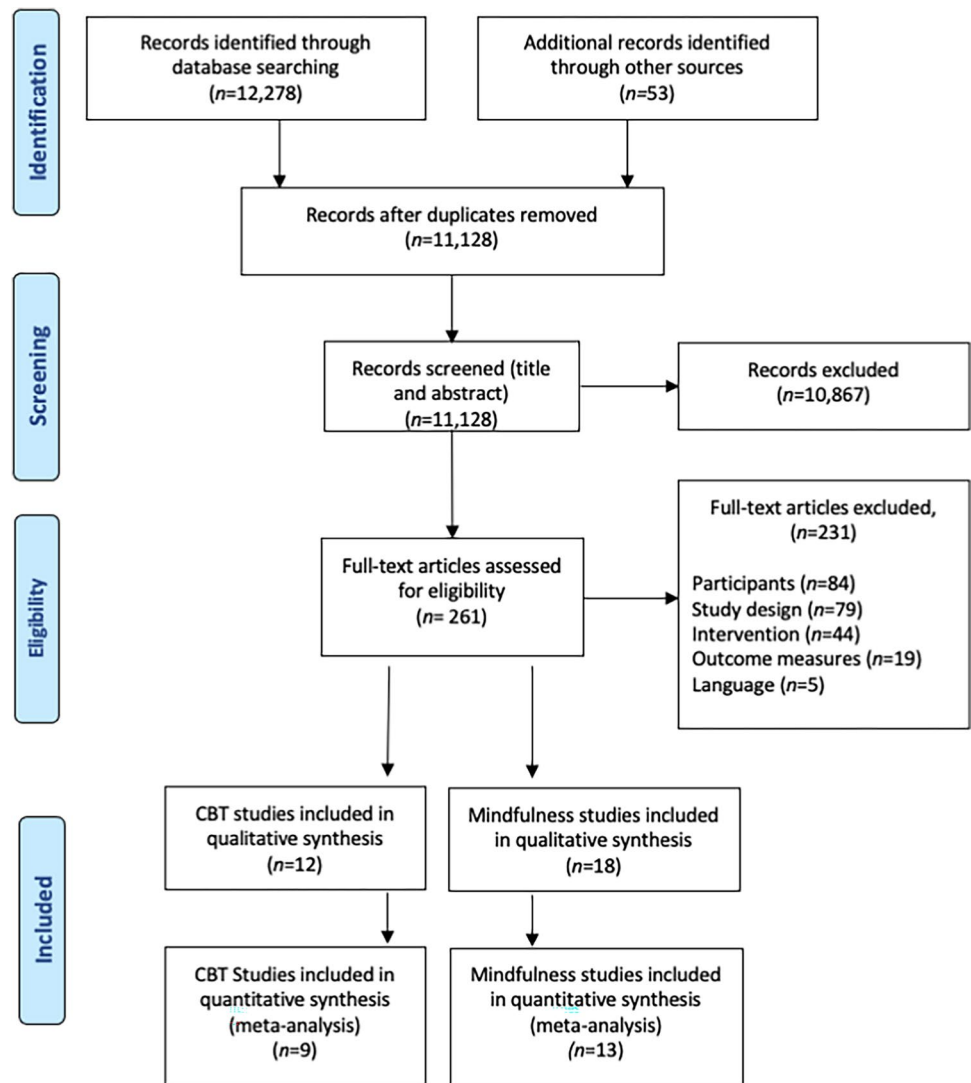
All analyses were conducted using Review Manager version 5.3. The primary outcome was emotion regulation. The summary measure of treatment effect was the between-groups difference in the post-intervention emotion regulation scores expressed as mean difference (MD). Random-effect models were used in all meta-analyses because they are more conservative than the fixed-effects models, as they incorporate both within- and between-study variances, resulting in confidence intervals for the summary effect. Statistical heterogeneity was assessed using the I^2 test, which described the percentage of variability among effect estimates beyond that expected by chance. Potential sources of clinical and methodological heterogeneity were investigated through sub-group analyses where I^2 values $\geq 40\%$.

Interventions were categorised into two groups: CBIs vs comparison control, and MBIs vs comparison control. Meta-analyses were performed using a random-effects model in Review Manager version 5.3 (Review Manager, 2014) with a significance level of 0.05. Sub-group analyses were conducted based on participant (age), intervention duration, teacher vs external delivery and targeted vs universal participant group.

Results

The search strategy identified a total of 12,278 citations. The removal of duplicates left 11,128 distinct citations, of which, 10,867 were excluded during the initial screening phase (Fig. 1). For the remaining 256 citations, full-text papers were obtained. Thirty studies met the inclusion criteria (Tables 1 and 2). Twelve of these were CBI-based (i.e. Bernstein et al., 2005; Daunic et al., 2006; Kato & Shimizu, 2017; Liber et al., 2013; Loevaas et al., 2019; Miller et al., 2010; Miller et al., 2011; Pophillat et al., 2016; Rose et al., 2009; Stallard et al., 2015; Yamamoto et al., 2017; Yeo et al., 2015) and eighteen of these were mindfulness-based studies (i.e. Alampay et al., 2020; Amundsen et al., 2020; Charest, 2015; de Carvalho et al., 2017; Folch et al., 2021; Harpin et al., 2016; Jalón et al., 2022;

Fig. 1 PRISMA flow diagram of study selection. PRISMA Preferred Reporting Items for Systematic Reviews and Meta-analyses (Moher et al., 2009)



Keller et al., 2017, Meyer & Eklund 2020; Müller et al., 2021; Parker et al., 2014, Poli et al., 2022; Santos & Langill, 2018; Schonert-Reichl et al., 2015; Suárez-García et al., 2020; van de Weijer-Bergsma et al., 2014; Vickery & Dorjee, 2016; Wright et al., 2019). The reasons for exclusion are described in Fig. 1.

Characteristics of Included Studies

The twelve included CBI studies (see Table 1) were published between 2005 and 2019. These were conducted in Canada (Miller et al., 2010, 2011; Rose et al., 2009), the USA (Bernstein et al., 2005; Daunic et al., 2006), Japan (Kato & Shimizu, 2017; Yamamoto et al., 2017), UK (Stallard et al., 2015), Netherlands (Liber et al., 2013), Norway (Loevaas et al., 2019), Australia (Pophillat et al., 2016) and Singapore (Yeo et al., 2015). The twelve studies randomised 3406 participants with intervention group sample sizes ranging between 61 and 1392 participants. The

reported mean age of study populations ranged from 9.75 to 10.2 years, with a range of 8–12 years old.

The eighteen included MBI studies (see Table 2) were published between 2014 and 2022. These were conducted in the USA (Charest, 2015; Harpin et al., 2016; Keller et al., 2017; Meyer & Eklund, 2020; Parker et al., 2014), Canada (Santos & Langill, 2018; Schonert-Reichl et al., 2015), Spain (Folch et al., 2021; Jalón et al., 2022; Suárez-García et al., 2020), UK (Amundsen et al., 2020; Vickery & Dorjee, 2016), Australia (Wright et al., 2019), Germany (Müller et al., 2021), Italy (Poli et al., 2022), Netherlands (van de Weijer-Bergsma et al., 2014), Portugal (de Carvalho et al., 2017) and Philippines (Alampay et al., 2020). The study by Wright et al. (2019) was excluded from the meta-analysis as it delivered a CBI as a control condition.

The eighteen studies included 2247 participants with intervention group sample sizes ranging between 28 and 454 participants. The reported mean age of study populations ranged from

Table 1 Characteristics of included CBI studies

Study ID	Sample size; age (years); sex	Control group	Facilitator	Awareness measures	Modulation measures	Expression measures	Dosage	Intervention name; structure; focus	Target group	Original study outcomes
Bernstein et al., 2005	IG: 15, CG: 24; †9; 65% fem	‡No treatment	External		MASC; MASC-P; SCARED-P		10 sessions, 9 weeks, 60 min	FRIENDS; manualised; resilience	Most anxious	Anxiety
Daunic et al., 2006	IG:38; no age, 18% fem. CG:27; no age, 37% fem	No treatment	Teacher	KQ		R/P; PAES-3; CAB-T BRIEF-T	21 sessions; 7–10 weeks	Tools of Getting Along; manualised; social problem solving	Most aggressive/disruptive	Managing anger
Kato & Shimizu, 2017	IG: 37, CG: 37, †8–9; 43% fem	TAU	External		SCAS; DSRs; SCAS-P	SDQ-P	10 sessions, 3 months, 45 min	FRIENDS; manualised; resilience	Universal	Anxiety
Liber et al., 2013	IG: 70; M = 10.35; 54% male, CG: 103; M = 10.21; 82% male	WL	Teacher			SDQ-P; TRF; DBDRS-T; PMIEB	10 sessions	“Keep cool... start at school”; manualised; social information processing	Most disruptive	Disruptive behaviour
Loevaas et al., 2019	IG: 272; M = 10.18; 62.5% fem. CG: 319; M = 10.01; 55.2% fem	TAU	External		ERC (parent report)		20 sessions, 10 weeks, 45–60 min	EMOTION; manualised; coping with anxiety and depression	Anxiety and depression	Anxiety or depression
Miller et al., 2010	IG: 73, CG: 43 †M = 9.75; 50% fem	WL	Teacher		MASC; BASC-PRS-IC	BASC-PRS-IC	8 weeks	Taming Worry Dragons; manualised; coping with anxiety	Universal	Anxiety
Miller et al., 2011	IG: 175, CG: 178 †M = 9.77; 50% fem	WL	Teacher		MASC		9 sessions, 9 weeks	FRIENDS; manualised; coping and resilience	Universal	Anxiety
Pophillat et al., 2016	IG: 103; 6–9 [§] ; 53.9% fem.; CG: 91; 6–9 [§] ; 57.5% fem	TAU	Teacher		CDI; SCAS		10 sessions, 10 weeks	Aussie Optimism Feeling and Friends programme; manualised; anxiety and depression	Universal	Social and emotional skills

Table 1 (continued)

Study ID	Sample size; age (years), sex	Control group	Facilitator	Awareness measures	Modulation measures	Expression measures	Dosage	Intervention name; structure; focus	Target group	Original study outcomes
Rose et al., 2009	IG: 26, CG: 26 ‡8–9; no sex reported	WL	Teacher	MASC			8 sessions, 8 weeks, 60 min	FRIENDS for life; manualised; resilience and anxiety reducing	Universal	Anxiety reduction
Stallard, 2015	IG: 472; 9–10; 50% male CG: 401; 9–10; 42% male	‡TAU	Teacher and external	RCADS; PSWQ	SDQ-P; SDQ-T		9 sessions, 9 weeks, 60 min	FRIENDS; manualised; coping and resilience	Universal	Anxiety
Yamamoto et al., 2017	IG: 61; 9–10; 42.6% fem CG: 33; 9–10; 51.5% fem	WL	External	SCAS, RESC			8 sessions, 8 weeks, 45 min	You Can Do It!; manualised, resilience	Universal	Promote resilience
Yeo et al., 2015	IG: 58; $M=10.01$; 39.7% fem.; CG: 57; $M=10.01$; 38.6% fem	TAU	External	CTAS, CBSC			4 sessions, 4 weeks, 30 min	No name; structured lessons; dealing with test anxiety	Universal	Test anxiety prevention

IG intervention group, CG control group, TAU treatment as usual, WL waitlist

Outcome measures: Multidimensional Anxiety Scale for Children (MASC), Multidimensional Anxiety Scale for Children -parent report (MASC-P), Screen for Child Anxiety Related Emotional Disorders—parent report (SCARED-P), Problem-solving Knowledge Questionnaire (KQ), Reactive/Proactive Anger Expression Scale (RP), Pediatric Anger Expression Scale (PAES-3), Clinical Assessments of Behavior – teacher rating form (CAB-T), Behavior Rating Inventory of Executive Function – teacher report (BRIEF-T), Strength and Difficulties Questionnaire – parent rating (SDQ-P), Strength and Difficulties Questionnaire – teacher rating (SDQ-T), Spence Children's Anxiety Scale (SCAS), Depression Self Rating Scale for Children (DSRS), Spence Children's Anxiety Scale – parent report (SCAS-P), Teacher Report Form (TRF), Disruptive Behaviour Disorders Rating Scale – teacher report (DBDRS-T), Peer Measure of Internalising and Externalising Behavior (PMIEB), Emotion Regulation Checklist (ERC), Behavior Assessment System for Children – Parent Rating Scales-Internalising Composite (BASC-PRS-IC), Child Depression Inventory (CDI), Revised Child's Anxiety and Depression Scale (RCADS), Penn State Worry Questionnaire (PSWQ), Resilience in Elementary School Children Scale (RESC), Children's Test Anxiety Scale (CTAS), Cognitive-Behavioural Skills Checklist (CBSC)

‡ Participant characteristics were not differentiated between control and intervention groups

‡ More than one comparison group

§ Only 8–9-year-olds completed the emotion outcome measures included in this review

Table 2 Characteristics of included MBI studies

Study	Sample size; age (years); sex no sex reported	Control group	Facilitator	Awareness measures	Modulation measures	Expression measures	Dosage	Intervention name; structure; skills focus	Target group	Original study outcomes
Alampay et al., 2020	IG: 42; CG: 50; ¹ 9–12 years; no sex reported	Handicraft	Teachers and guidance counsellors		SMFQ; STAIC	DERS	8 sessions, 8 weeks, 75 min	Kamlayan; manualised; awareness and emotion regulation	Behaviour problems	Feasibility and acceptability of the programme
Amundsen et al., 2020	IG: 64; M = 10.13; 50% fem CG: 25; M = 10.40; 48% fem	³ WL	Teacher	CAMM	SCWBS; PANAS; SLSS; ERQ-CA		6 sessions, 6 weeks, 60 min	Living Mindfully Primary Programme; manualised; awareness	Universal	Well-being and emotion regulation
Charest, 2015	IG: 115; ¹ M = 9.98, 48.7% fem CG: 113; ¹ M = 9.98, 50.4% fem	CAU	External		CHS	BERS-2; BERS-2-T; BERS-2-P	6 sessions, 6 weeks, 45 min	InnerU; structured sessions; attention and inner exploration	Universal	General well-being
de Carvalho et al., 2017	IG: 223; M = 8.5; 43.9% fem CG: 231; M = 8.5; 49.8% fem	WL	Teacher	MAAS-C	PANAS; ERQ-CA		15 s, 15 w, 45–60 min, 3 × 3 min meditation each day	MindUp; manualised; self regulation and social skills	Universal	Social and emotional competence
Folch et al., 2021	IG: 15; CG: 18; ¹ M = 10.37; 64% fem	³ TAU	Teacher using pre-recorded audio		IECI; SPECI		5–10 min, daily, 13 weeks	No name; pre-recorded mindful awareness exercises	Universal	Cognitive/executive functions and well-being
Harpin et al., 2016	IG: 18; CG: 12 ¹ 9–10 years; no sex reported	CAU	External	CAMM		FTSC	20 sessions, 10 weeks, 20–30 min	Amalgam of MindUp and Mindful Schools; structured sessions; social skills	Universal	Social and emotional competence
Jalón et al., 2022	IG: 25; M = 11; 36% fem; CG: 25; M = 11.12; 28% fem	TAU	Teacher	CAMM	IRI		5 min, 3 times p.w., 4 months	No name, manualised; mindful awareness	Universal	Mindfulness and pro-environmental attitudes
Keller et al., 2017	IG: 15; CG: 13 ¹ 4th grade, 64% fem	10-min quiet time	External and teacher	CAMM; EAQ	SCAS		27 sessions, 10 weeks, 10 min + home work	No title; mindful meditation; mindful attention and awareness	Universal	General impact of programme
Meyer & Eklund, 2020	IG: 138; CG: 158; ¹ M = 9.3; 53.4% fem	CAU	Teachers	CAMM		MCI-S; MCI-T	3 × 2 min session each day for 10 weeks	Mindful Moments: structured and scripted	Universal	Classroom climate and reading
Müller et al., 2021	IG: 42; M = 137.83 months; 47.62% female CG: 37; M = 135.41; 48.65% fem	Listened to a podcast	External using pre-recorded audio		RSE		Daily 10-min sessions for 2 weeks	No title; taught content and pre-recorded mindful awareness exercises; mindful attention and reading comprehension	Universal	Attention, self-esteem and reading
Parker et al., 2014	IG: 71; ¹ M = 10.09; 57.7% fem CG: 40; ³ M = 10.09; 57.5% fem	WL	Teacher		SCRS (teacher report)	C-TRF	20 sessions, 4 weeks, 15 min	Master Mind; manualised; mindful awareness	Universal	General impact of mindfulness

Table 2 (continued)

Study	Sample size; age (years); sex	Control group	Facilitator	Awareness measures	Modulation measures	Expression measures	Dosage	Intervention name; structure; skills focus	Target group	Original study outcomes
Poli et al., 2022	IG: 23; 43.48% fem CG: 18; 22.22% fem [†] Mean age = 10.78	CAU	External		QUIT; TAD		8 weeks, 8 sessions, 60 min	No title, structured programme, mindful awareness	Universal	Internalising difficulties
Santos & Langill, 2018	IG: 49; <i>M</i> = 7.98; 53.1% fem.; CG: 49; <i>M</i> = 8; 57.1% fem	TAU	Teacher	ACES		CO-T; PBC-T	~36 sessions, 3 months, 5–15 min	MindMasters2; manualised; coping strategies	Universal	Social and emotional competence
Schonert-Reichl et al., 2015	IG: 48; <i>M</i> = 10.16; 46% fem CG: 51; <i>M</i> = 10.31; 42% fem	BAU	Teacher	MAAS-C	IRI; SPQ-C; RI		12 sessions, 12 weeks, 40–50 m, 3 × 3 min meditation each day	MindUp; manualised; self-regulation and social skills	Universal	Social and emotional competence
Suárez-García et al., 2020	IG: 40; <i>M</i> = 8.18; CG: 38; <i>M</i> = 7.97; no sex reported	WL	External and teacher			SENA	8 sessions, 8 weeks, 60 min + 10 min each other day for 8 weeks	Mindkeys; structured sessions; mindful attention and self-regulation	Universal	Social and emotional competence
van de Weijer-Bergsma et al., 2014	IG: 95; CG: 104 [‡] <i>M</i> = 9.92; 55% fem	WL	External	EAO	SCARED-P; NPDK; SHS	SCBE-30-P	12 sessions, 6 weeks, 30 min	Mindful Kids; manualised; emotion regulation skills	Universal	Dealing with stress
Vickery & Dorjee 2016	IG: 33; <i>M</i> = 8; 42.4% fem CG: 38; <i>M</i> = 7.82; 55.3% fem	EAU	Teacher	CAMM; EESC (awareness)	SCWBS; PANAS	EESC (expression)	12 sessions, 6 weeks, 30 min	Paws.b; adaptable lesson plans; mindful attention and awareness	Universal	General well-being
Wright et al., 2019	IG: 45; <i>M</i> = 10.6; 53.3% fem CG: 44; <i>M</i> = 10.6; 47.7% fem	CBI; FRIENDS	External	CAMM	RCADS	SDQ	10 session, 10 weeks, 90 min	Amended MBCT-C (Semple & Lee, 2011), manualised, internalising symptoms	Universal	Internalising difficulties

CAU classroom as usual, WL waitlist, TAU treatment as usual, EAU education as usual, CBI cognitive behavioural intervention

Outcome measures: Short Mood and Feelings Questionnaire (SMFQ), State-Trait Anxiety Inventory for Children (STAIC); Difficulties in Emotion Regulation Scale (DERS) Sterling Children's Wellbeing Scale (SCWBS), Positive and Negative Affect Scale (PANAS), Students Life Satisfaction Scale (SLSS), Emotion Regulation Questionnaire – Children and Adolescents (ERQ-CA), Behavioural and Emotional Rating Scale – 2nd edition (BERS-2), Behavioural and Emotional Rating Scale – 2- Teacher rating (BERS-2-T), Behavioural and Emotional Rating Scale – 2- Parent rating (BERS-2-P), Children's Happiness Scale (CHS), Mindful Attention Awareness Scale for Children (MAAS-C), Children's Daily Stress Inventory (ECI), Screening of Children's Emotional and Behavioural Problems (SPECB), Child and Adolescent Mindfulness Measure (CAMM), Fast-track Teacher Social Competency scale (FTSC), Emotion Awareness Questionnaire (EAO), Spence Children's Anxiety Scale (SCAS), My Class Inventory (classroom climate) – student report (MCI-S); My Class Inventory (classroom climate) – Teacher report (MCI-T) Rosenberg Self Esteem Scale (RSE) Self Control Rating Scale (SCRS), Child Behaviour Checklist—Teacher rating (C-TRF), Italian Questionnaire of Teachers (QUIT), Test of Anxiety and Depression (TAD), Assessment of Children's Emotional Skills (ACES), Concern for Others—Teacher rating scale (CO-T), Prosocial Behaviour of Children—Teachers' perceptions (PBC-T), Interpersonal Reactivity Index (IRI), Seattle Personality Questionnaire for Children (SPQ-C), Resiliency inventory (RI), Evaluation system for children and adolescents (SENA) Social Competence and Behaviour Evaluation—parent report (SCBE-30-P), Screen for Child Anxiety Related Emotional Disorders—parent report (SCARED-P), Non-Productive Thoughts Questionnaire for Children (NPTDK), Subjective Happiness Scale (SHS), Emotion Expression Scale for Children (EESC), Revised Child's Anxiety and Depression Scale (RCADS), Strength and Difficulties Questionnaire – self-report (SDQ)

[†]Participant characteristics were not differentiated between control and intervention groups

[‡]More than one comparison group

7.9 to 11.12 years, with a range of 7–12 years old. It should be noted that the study by Wright et al. (2019) included a 13-year-old participant but this participant was a pupil in elementary education. Common participant exclusion criteria for both intervention types included participant age (not within 7–12 range) or serious medical or mental health conditions.

Participants within all the included studies were required to be from universal, typically developing classroom settings. One study was excluded (Cole et al., 2013) as the majority of participants (70%) had special educational needs. The CBIs targeted specific populations in four studies. Target populations were anxiety (Bernstein et al., 2005; Loevaas et al., 2019) and disruptive behaviours (Daunic et al., 2006; Liber et al., 2013). From the MBIs, only one study (Alampay et al., 2020) had a targeted population of children ‘at risk or probability for clinical diagnosis’ in the strengths and difficulties questionnaire screening measure.

Delivery of CBIs varied across the different studies. In five of the studies, the programme was led by external deliverers (Bernstein et al., 2005; Kato & Shimizu, 2017; Loevaas et al., 2019; Yamamoto et al., 2017; Yeo et al., 2015), in six studies the programme was teacher led (Daunic et al., 2006; Liber et al., 2013; Miller et al., 2010, 2011; Pophillat et al., 2016; Rose et al., 2009) and one study had a combination of teacher and external delivery (Stallard et al., 2015). All but one (Yeo et al., 2015) were manualised programmes. The programmes ranged from 4 weeks to 3 months with a delivery rate of one (Bernstein et al., 2005; Kato & Shimizu, 2017; Liber et al., 2013; Miller et al., 2010; Miller et al., 2011; Pophillat et al., 2016; Rose et al., 2009; Stallard et al., 2015; Yamamoto et al., 2017; Yeo et al., 2015), two (Loevaas et al., 2019) or three (Daunic et al., 2006) sessions per week. Sessions lasted between 30 and 60 min. The lowest total intervention dosage was approximately 2 hr (Yeo et al., 2015) and the highest was approximately 17 hr (Loevaas et al., 2019).

Delivery of MBIs also varied across the different studies. In six of the studies, the programme was led by external deliverers (Charest, 2015; Harpin et al., 2016; Müller et al., 2021; Poli et al., 2022; van de Weijer-Bergsma et al., 2014; Wright et al., 2019); in eight studies, the programme was teacher led (Amundsen et al., 2020; de Carvalho et al., 2017; Jalón et al., 2022; Meyer & Eklund, 2020; Parker et al., 2014; Santos & Langill, 2018; Schonert-Reichl et al., 2015; Vickery & Dorjee, 2016); three studies had a combination of teacher and external delivery (Alampay et al., 2020; Keller et al., 2017; Suárez-García et al., 2020); and one study provided an audio recording of the exercises (Folch et al., 2021). Seven of the mindfulness programmes were manualised (Alampay et al., 2020; Amundsen et al., 2020; de Carvalho et al., 2017; Parker et al., 2014; Santos & Langill, 2018; Schonert-Reichl et al., 2015; van de Weijer-Bergsma et al., 2014); three of the studies included separate mindfulness meditations (de Carvalho et al., 2017; Schonert-Reichl et al., 2015; Suárez-García et al.,

2020); and seven studies used mindful meditation as the main intervention element (Folch et al., 2021; Jalón et al., 2022; Keller et al., 2017; Meyer & Eklund, 2020; Müller et al., 2021; Poli et al., 2022; Wright et al., 2019). The programmes ranged from 2 weeks to 4 months. Delivery schedules tended to provide more sessions than CBIs but these were shorter in duration, for example, 36 sessions of between 5- and 15-min duration (Santos & Langill, 2018). The lowest total intervention dosage was approximately 1.5 hr (Müller et al., 2021) and the highest was approximately 15 hr (de Carvalho et al., 2017; Wright et al., 2019).

The CBIs were targeted for specific emotion regulation issues. Eight studies were mood disorder focused (Bernstein et al., 2005; Kato & Shimizu, 2017; Miller et al., 2010; Miller et al., 2011; Loevaas et al., 2019; Rose et al., 2009; Stallard et al., 2015; Yeo et al., 2015). Two CBIs targeted anger and disruptive behaviour management (Daunic et al., 2006; Liber et al., 2013). One study focused on social and emotional competence (Pophillat et al., 2016) and one on promoting resilience (Yamamoto et al., 2017). The MBIs had more general outcomes. Five studies focused on social and emotional competence (de Carvalho et al., 2017; Harpin et al., 2016; Santos & Langill, 2018; Schonert-Reichl et al., 2015; Suárez-García et al., 2020). Four studies targeted general well-being and emotion regulation (Amundsen et al., 2020; Charest, 2015; Folch et al., 2021; Vickery & Dorjee, 2016). Three explored the impact and feasibility of the intervention (Alampay et al., 2020; Keller et al., 2017; Parker et al., 2014). Two studies targeted internalising difficulties (Poli et al., 2022; Wright et al., 2019) and two explored elements of academic achievement (Meyer & Eklund, 2020; Müller et al., 2021). One study focused on stress (van de Weijer-Bergsma et al., 2014) and one study promoted pro-environmental attitudes (Jalón et al., 2022).

Meta-analysis of CBIs

Analysis of awareness outcome data could not be carried out for CBIs as only one study reported awareness measures (Daunic et al., 2006). Modulation outcomes included separate analyses of anxiety measures and depression measures. Analysis of self-reported anxiety outcomes favoured the control condition, but this was not statistically significant (0.02, 95% CI [−0.08, 0.11], $p=0.76$, $I^2=0\%$) (see Fig. 2). Analysis of self-reported depression was not statistically significant (−0.04, 95% CI [−0.17, 0.09], $p=0.55$, $I^2=0\%$) post CBI (see Fig. 3) with no indication of statistical heterogeneity.

Expression outcomes were grouped into teacher-reported measures and parent-reported measures. Teacher-reported measures were not significant (0.20, 95% CI [−0.44, 0.84], $p=0.54$, $I^2=98\%$) and substantial heterogeneity was evident (see Supplementary Material:S2). Sources of heterogeneity were explored and removing the Stallard et al. (2015) study

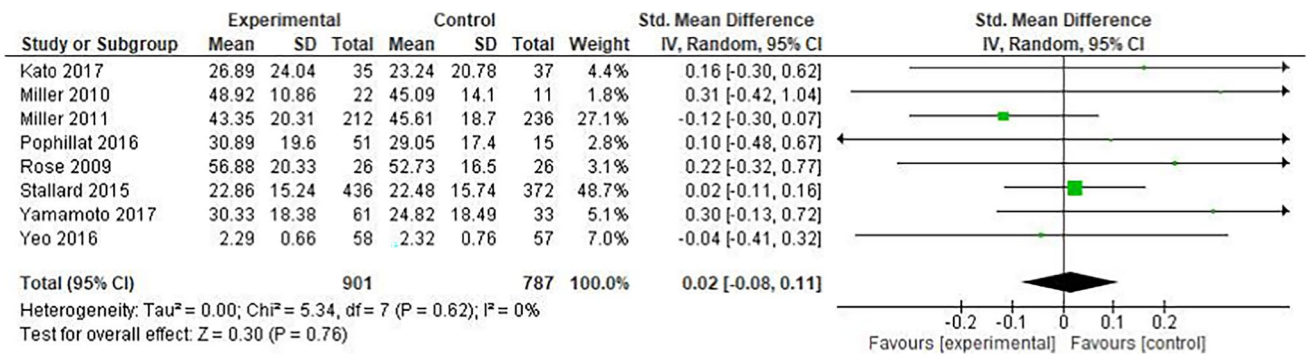


Fig. 2 Forest plot showing meta-analysis of self-report anxiety measures in CBI studies. Measures include Multidimensional Anxiety Scale for Children (MASC), Spence Children’s Anxiety Scale

(SCAS), Revised Child’s Anxiety and Depression Scale RCADS (anxiety subscale) and Children’s Test Anxiety Scale (CTAS)

reduced the heterogeneity (-0.07 , 95% CI $[-0.24, 0.10]$, $p=0.43$, $I^2=33%$) though it was not possible to identify the potential cause (Fig. 4). Neither the initial analysis nor sensitivity analysis indicated a significant effect of the CBIs on emotional expression as reported by teachers. Parent-reported measures (all Strength and Difficulties Questionnaire) showed a significant between-groups difference (Fig. 5) favouring the experimental condition post CBI (-1.69 , 95% CI $[-3.08, -0.30]$, $p=0.02$, $I^2=0%$). This suggests that CBIs had a small, significant positive effect on participant emotion expression as reported by parents. Sub-analyses were conducted based on participant age, intervention duration, teacher vs external delivery and targeted vs universal participant group. They did not affect the outcome of the analyses.

Meta-analysis of MBIs

An initial analysis of awareness outcomes identified substantial, significant heterogeneity ($I^2=52%$, $p=0.036$; see Supplementary Materials: S3). Sub-analyses were conducted based on participant age, intervention duration, teacher vs external delivery and targeted vs universal participant group. The sub-group analysis of intervention duration reduced heterogeneity among the remaining studies and showed a small, significant, positive effect of MBIs on emotional awareness for studies that ran for 12 weeks or less (0.17 , 95% CI $[0.03,$

$0.32]$, $p=0.02$, $I^2=0%$) (Fig. 6). The studies that were removed in this sub-group analysis were de Carvalho et al., (2017; 15 weeks’ duration) and Jalón et al., 2022; 4 months’ duration) (Table 2).

Effects on modulation outcomes were clustered as positive modulation measures (in which higher scores suggest better modulation), anxiety and negative modulation measures (in which higher scores suggest worse modulation), and measures of depression. An initial analysis of positive modulation outcomes identified substantial, significant heterogeneity ($I^2=68%$, $p=0.01$; see Supplementary Materials: S4). Sub-group analyses were conducted based on participant age, intervention duration, teacher vs external delivery and targeted vs universal participant group. The sub-group analysis of age reduced heterogeneity among the remaining studies and showed a moderate, significant, positive effect of MBIs on positive modulation outcomes for participants with an average age of 10 years and above (0.48 , 95% CI $[0.22, 0.7]$, $p<0.001$, $I^2=0%$) (Fig. 7). The studies that were removed in this analysis were de Carvalho et al., (2017; $M=8.5$ years) and Vickery and Dorjee (2016; $M=7.8-8$ years) (Table 2). Analysis of anxiety and negative modulation indicated that there was no significant effect of MBIs on these outcome measures (-0.02 , 95% CI $[-0.16, 0.12]$, $p=0.80$, $I^2=0%$) (see Fig. 8). Sub-group analyses were conducted based on participant age, intervention duration, teacher vs external

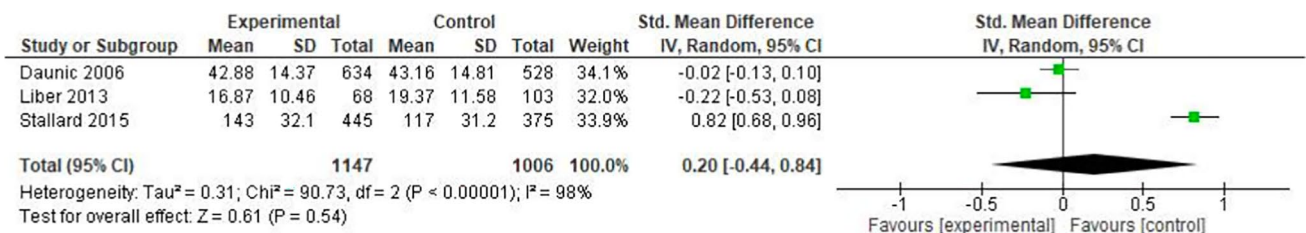


Fig. 3 Forest plot showing meta-analysis of self-report depression measures in CBI studies. Measures include Depression Self Rating Scale for Children (DSRS), Child Depression Inventory (CDI) and RCADS (depression subscale)

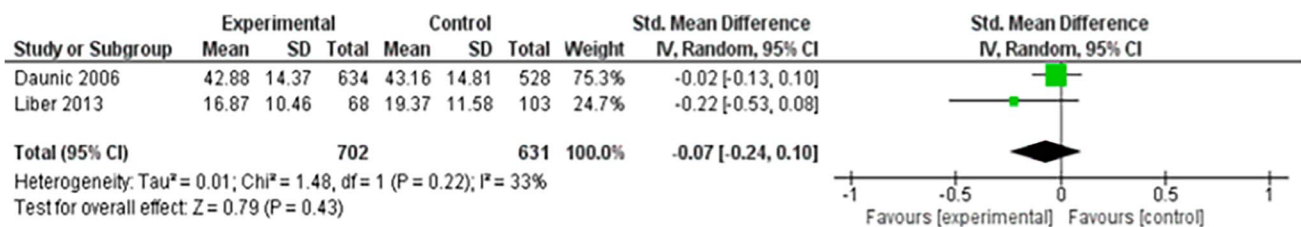


Fig. 4 Forest plot showing selective analysis of teacher-report negative expressive behaviour measures in CBI studies, removing Stallard (2015) due to high levels of heterogeneity. Measures include Behav-

ior Rating Inventory of Executive Function – teacher report (BRIEF-T); Teacher Report Form (TRF)

delivery and targeted vs universal participant group. They did not affect the significance of the outcome.

Analysis of depression measures identified considerable, significant heterogeneity ($I^2 = 75\%$, $p = 0.008$; see Supplementary Materials: S5). The sub-group analysis of targeted vs universal participant group reduced heterogeneity among the remaining studies and showed a small, significant, positive effect of MBIs on depression outcomes for universal interventions (-0.29 , 95% CI $[-0.57, -0.02]$, $p = 0.04$, $I^2 = 0\%$) (see Fig. 9). The study removed in this sub-group analysis was Alampay et al. (2020), which was the only study to include a targeted participant group (see Table 2).

Only one measure of expression outcomes could be analysed, those of teacher-reported measures. An initial analysis identified considerable, significant heterogeneity ($I^2 = 98\%$, $p < 0.001$) (Fig. 10). Sources of heterogeneity were explored but sensitivity analyses did not sufficiently reduce heterogeneity to allow confidence in the results ($I^2 = 67\%$, $p = 0.08$). Neither the initial analysis nor sub-group analyses indicated a significant effect of the MBI on emotional expression as reported by teachers.

Risk of Bias

Risk of bias for the domain random sequence generation was rated as unclear if randomisation was indicated in the study, but no detail was provided (Tables 3 and 4). Two CBIs (Daunic et al., 2006; Liber et al., 2013) and four MBIs (Alampay et al., 2020; Poli et al., 2022; Schonert-Reichl et al., 2015; Wright et al.,

2019) outlined specific randomisation processes. Four CBI studies (Kato & Shimizu, 2017; Rose et al., 2009; Yamamoto et al., 2017; Yeo et al., 2015) and one MBI study (Müller et al., 2021) had only quasi-randomisation. The remaining studies identified either no randomisation or did not report a randomisation process. Allocation concealment was not mentioned in all but one study (Wright et al., 2019) and therefore rated as unclear. The blinding of personnel was described in three MBI studies (Poli et al., 2022; Schonert-Reichl et al., 2015; Wright et al., 2019) but not in any of the CBI studies. Three studies had low bias in the blinding of the outcome assessment (Bernstein et al., 2005; Poli et al., 2022; Schonert-Reichl et al., 2015). All studies were considered to have low risk of bias for incomplete data reporting ($\geq 80\%$). Again, all studies had a low rating for risk of bias in selective outcome reporting (Tables 3 and 4) except Jalón et al. (2022) which was rated as unclear.

Discussion

The aim of this systematic review was to synthesise evidence regarding the effectiveness of school-based CBIs and school-based MBIs on emotion regulation in terms of awareness, modulation and expression of emotion in typically developing children aged 7–12 years old. Thirty school-based studies evaluating different domains of emotion regulation were retrieved, twelve of these were CBI-based and eighteen of these were MBI studies. Synthesised

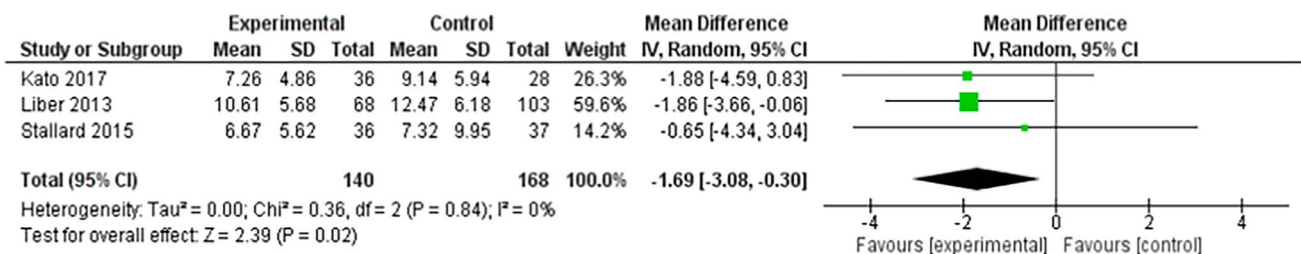


Fig. 5 Forest plot of meta-analysis of parent-report negative expressive behaviour measures in CBI studies. Measures include Strength and Difficulties Questionnaire-Parent report (SDQ-P)

data suggests that school-based CBIs do not have an effect on self-reported anxiety and depression levels. There was a statistically significant effect of CBIs in reducing the negative expressive behaviours of participants as reported by parents (-1.69 , 95% CI $[-3.08, -0.30]$, $p=0.02$, $I^2=0\%$) but teacher-reported measures showed no effect on expressive behaviours. Analysis of the MBIs showed a small but significant effect of interventions that ran for 12 weeks or less in increasing self-reported levels of emotional awareness (0.17 , 95% CI $[0.03, 0.32]$, $p=0.02$, $I^2=0\%$). MBIs had a moderate, significant effect on positive emotion modulation for participants with an average age of 10 years and above (0.48 , 95% CI $[0.22, 0.74]$, $p<0.001$, $I^2=0\%$). There was also a small, significant effect on depression outcomes for universal interventions (-0.29 , 95% CI $[-0.57, -0.02]$, $p<0.04$, $I^2=0\%$). There was no effect of MBIs on anxiety and negative emotion modulation measures, or on measures of emotion expression.

The formats of the programmes in both the CBIs and MBIs were similar, providing either structured or manualised programmes, and a mix of both teacher and external facilitator delivery. CBIs targeted precise issues such as anxiety or disruptive behaviour by focusing on coping and resilience skills. In contrast, MBI studies tend to explore a range of outcomes, such as happiness (e.g. Charest, 2015), affect (e.g. de Carvalho et al., 2017) and general well-being (e.g. Vickery & Dorjee, 2016). All studies had a low risk of bias for incomplete outcome data. All studies except Jalón et al. (2022) had a low risk of bias for selective outcome reporting, with risk of bias predominantly assessed as unclear in relation to randomisation, allocation and blinding criteria.

There was no analysis of emotion awareness measures in CBI studies as only one study (Daunic et al., 2006) included a relevant measure. The results of the meta-analysis of awareness measures in mindfulness studies reflected previous review findings (Dunning et al., 2019; Klingbeil et al., 2017; Zoogman et al., 2014), indicating that MBIs are an effective way to improve emotional awareness in children. Sub-group analysis of awareness measures identified that

this small effect was only seen in interventions of 12 weeks or less. This contrasts findings from adult populations of the importance of sustained practice to improve mindful awareness. Experienced meditators have a greater ability to achieve mindful states than novice meditators (Keng et al., 2011). While a high level of bias was evident for Amundsen et al. (2020), it was not possible to perform a sensitivity analysis to explore how this would change the results due to the low number of studies in the analysis.

It is unclear whether this effect of duration on levels of awareness in school-based studies can be supported by previous literature. The reviews of Dunning et al. (2019) and Zoogman et al. (2014) each include only one study with an intervention longer than 12 weeks. Klingbeil et al. (2017) reported dosage and number of sessions but not duration. Waters et al. (2015) found that interventions with durations of less than 6 weeks had a lower percentage of significant findings across a range of ER measures than interventions that lasted between 6 and 24 weeks. They did not report on interventions longer than 24 weeks. In the current review, the studies of longer duration (de Carvalho et al., 2017; Jalón et al., 2022) did not carry out follow-up measures so it is also unclear whether these studies may have had longer term effects that were not observed immediately after programme completion.

It is possible that children's levels of motivation to sustain practice are limited and programmes of longer duration may lead to demotivation, as disengagement increases over time (Skinner et al., 2008). In a recent, comprehensive randomised controlled trial of a secondary school-based MBI (Montero-Marin et al., 2022), the issue of participant disengagement was considered a factor which negatively affected outcomes for participants. An alternative explanation is that interventions that exceed the boundaries of school term-times (e.g. 12 weeks) may be impacted by discontinuity in teaching. More research is needed to understand optimal duration in school-based interventions.

Initial analysis indicated that there was no significant effect of CBIs on student anxiety or depression. This finding

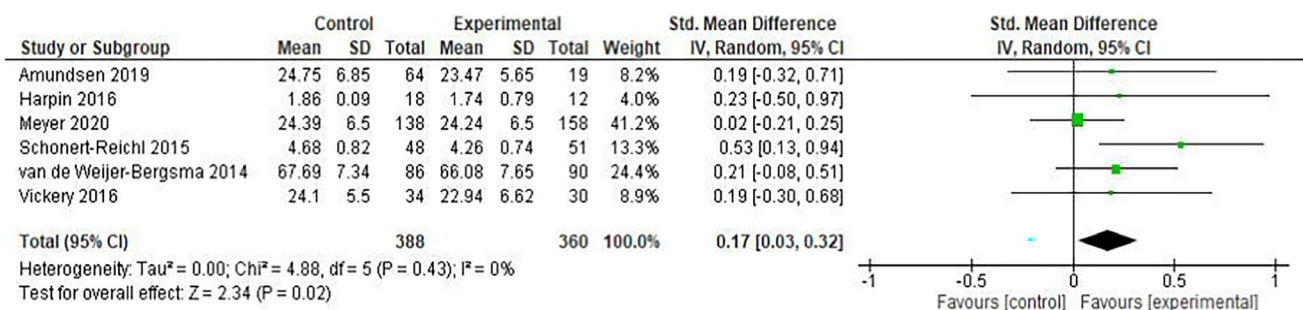


Fig. 6 Forest plot of self-report emotion awareness measures in MBI studies, showing sub-group analysis of intervention duration of 12 weeks or less, removing de Carvalho (2017) and Jalón (2022).

Measures include Child and Adolescent Mindfulness Measure (CAMM), Mindful Attention Awareness Scale for Children (MAASC) and Emotion Awareness Questionnaire (EAQ)

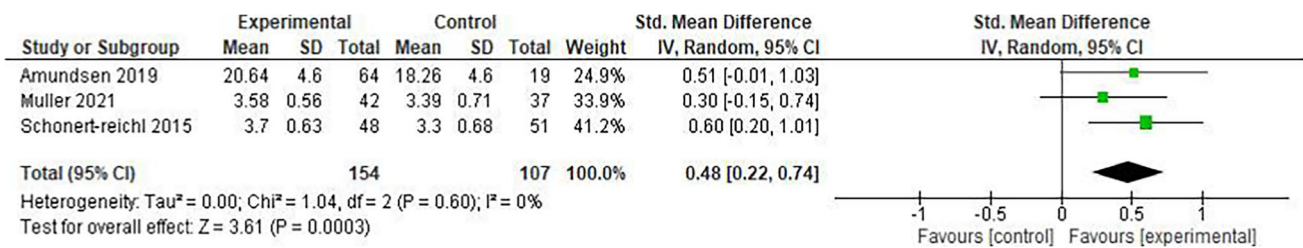


Fig. 7 Forest plot self-report positive emotion measures in MBI studies, showing sub-group analysis of studies with participants with a mean age of 10–12 years removing de Carvalho (2017) and Vickery

(2016). Measures include Emotion Regulation Questionnaire – Children and Adolescents (ERQ-CA); Rosenberg Self-esteem Scale (RSE); and Resiliency inventory (RI)

contrasts with the systematic review by Dray et al. (2017) which found that school-based interventions had a small effect on anxiety levels in children up to 11 years old. MacKenzie and Williams (2018) also found that primary school students significantly reduced anxiety levels following CBIs. However, both these reviews included participants from 5 years old and 4 years old respectively. It is possible that the contrasting findings in the current review are due to the exclusion of younger participants. Werner-Seidler et al. (2017) included both CBIs and MBIs in their review of school-based prevention programmes. They found that programmes had small effects on anxiety and depression with no effect of age. However, their sub-analyses of age categories should be treated with some caution as heterogeneity ranged from $I^2 = 32\%$ to $I^2 = 73\%$.

In the current review, an effect of age was found in the sub-group analysis of MBIs. Studies that included participants with a mean age of 10 years and older found improved levels of positive emotion modulation and reduced levels of depression. The age-related effect may explain the mixed results found in previous studies. Some reviews suggest there is no effect of mindfulness on depression in children (Ruiz-Íñiguez et al., 2019; Zenner et al., 2014) but Zoogman et al. (2014) did find a significant effect on depression with a mix of clinical and non-clinical populations. Werner-Seidler et al. (2017) also found that targeted interventions had

a larger effect than universal programmes on measures of depression. This is in direct contrast to the current findings as a sub-group analysis indicated that only universal MBIs showed a significant effect. The targeted study in the current review (Alampay et al., 2020) included children with behavioural problems as the target group and these participants may not have experienced elevated levels of depression.

It is interesting that MBIs showed a small effect on positive affect and levels of depression but no effect on anxiety and negative affect. This contrasts previous reviews (Dunning et al., 2019; Klingbeil et al., 2017) which suggest that MBIs do improve outcomes such as internalising problems, negative emotions and subjective distress. The broad age ranges analysed in these previous reviews with no sub-group analysis of age may impact on these findings. In addition, only the MBI studies, in the current review, that had participants with a mean age of 10+ years saw significant improvements in both awareness and modulation measures. Vickery and Dorjee (2016) included younger participants and they found a significant improvement in raising emotional awareness but not in emotion modulation. This suggests that younger children may not have the ability to develop more complex emotional appraisal skills. This complements developmental perspectives of intervention design (e.g. Porter et al., 2022; Vekety et al., 2022) which argue that the skills being taught should be adapted for different age groups.

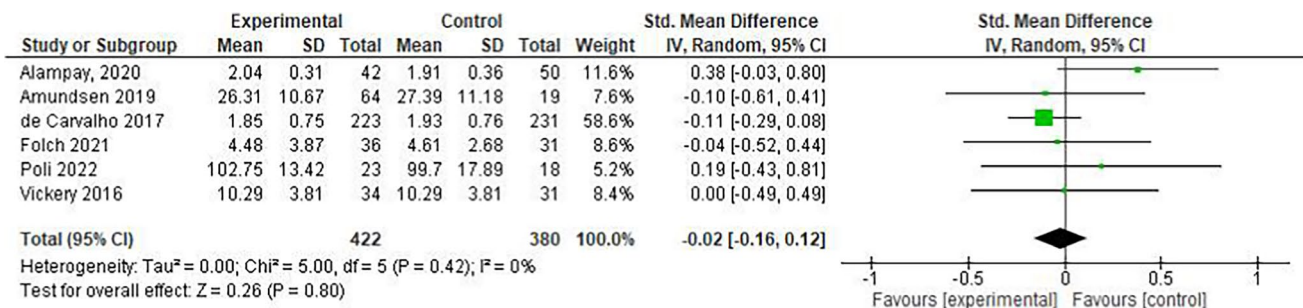


Fig. 8 Forest plot of meta-analysis of self-report anxiety and negative emotion measures in MBI studies. Measures include State-Trait Anxiety Inventory for Children (STAIC); Positive and Negative Affect

Scale (PANAS); Children's Daily Stress Inventory (IECI); and Test of Anxiety and Depression (TAD)

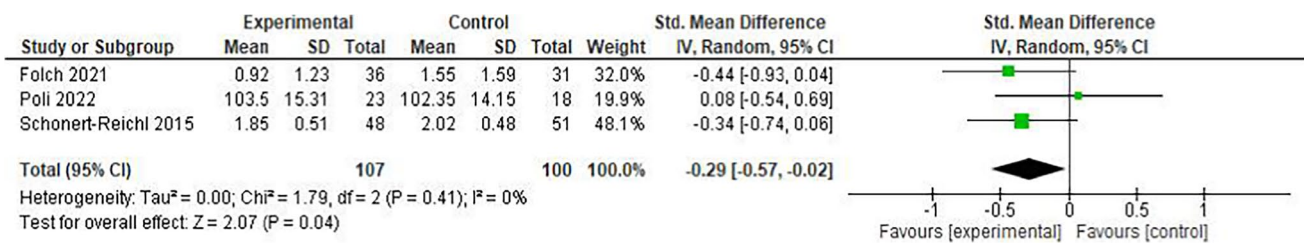


Fig. 9 Forest plot of sub-group analysis of self-report depression measures in MBI studies, showing only universal studies, removing Alampay (2020). Measures include Screening of Children’s

Emotional and Behavioural Problems (SPECI); Test of Anxiety and Depression (TAD); and Seattle Personality Questionnaire for Children (SPQ-C)

Two of the studies in the sub-analysis of positive emotion measures had a high risk of randomisation bias (Amundsen et al., 2020; Müller et al., 2021). It was not possible to perform a sensitivity analysis to explore how bias would change the results due to the low number of studies in the analysis.

The results in the current review regarding emotional expression found that CBIs can reduce negative expressive behaviours in pre-adolescents, as reported by parents. These findings were not observed in the analysis of teacher-report. The difference in parent and teacher reports could be explained by parents observing different behaviours in the participants when they were at home compared to behaviours at school. Also, parents complete questionnaires for just one participant, whereas teachers consider numerous participants. The positive findings contrast with previous reviews (Dray et al., 2017; Mackenzie & Williams, 2018) which suggest that CBIs do not effectively reduce expressive behaviours for pre-adolescents. It is unclear which conduct/ expressive behaviour measures were used in the review by Dray et al. (2017), so parent, teacher and self-reports could have been combined in the analysis and thus explain the difference in findings in our current review of this area. Meta-analysis was not carried out in the review by Mackenzie and Williams (2018) due to heterogeneity of the studies; however, their narrative review suggested no effect as reported by parents.

No expression measures could be analysed for the MBI studies, due to high levels of variation in study

characteristics. The cause of this heterogeneity could be differences in intervention duration, which varied from a 2-min session delivered 3 times each day (Meyer, 2020); a 15-min session delivered approximately 3 times per week (Santos & Langill 2018); and a 30-min session delivered twice a week (Harpin et al., 2016). Klingbeil et al. (2017) suggest that mindfulness interventions can reduce negative expressive behaviours and improve pro-social behaviours. In support of this, five of the studies in this current review showed significant improvements in expressive behaviours (Harpin et al., 2016; Parker et al., 2014; Santos & Langill, 2018; Suárez-García et al., 2020; Wright et al., 2019), though five showed no effect (Alampay et al., 2020; Charest, 2015; Meyer & Eklund, 2020; van de Weijer-Bergsma et al., 2014; Vickery & Dorjee, 2016). A qualitative exploration of these studies did not reveal any discernible differences between the characteristics of significant and non-significant studies.

Limitations and Future Research

The measures used in the studies were categorised within the regulation processes of emotional awareness, modulation of emotion and expression of emotion (Gross & Thompson, 2007). The original studies included in the current review did not necessarily define their outcome specifically as emotion regulation. The potential for inaccurate categorisation of regulation outcomes was addressed by reviewing existing literature and reaching consensus among the review team. The

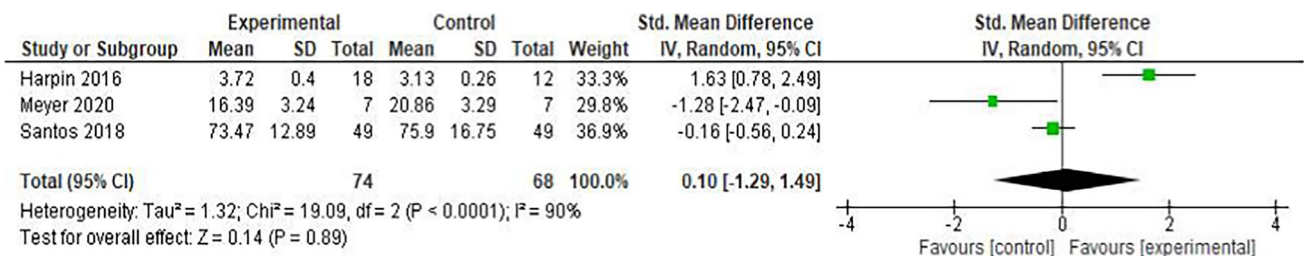


Fig. 10 Forest plot of meta-analysis of teacher-report emotion expression measures in MBI studies. Measures include Fast-track Teacher Social Competency scale (FTSC); My Class Inventory (classroom cli-

mate) – Teacher report (MCI-T); and Prosocial Behaviour of Children – Teachers’ perceptions (PBC-T)

Table 3 Risk of bias in CBI studies

Study ID	Random sequence generation	Allocation concealment	Blinding of participants and personnel	Blinding of outcome assessment	Incomplete outcome data	Selective outcome reporting
Bernstein et al., 2005	Unclear	Unclear	Unclear	Low	Low	Low
Daunic et al., 2006	Low	Unclear	Unclear	Unclear	Low	Low
Kato & Shimizu, 2017	High	Unclear	Unclear	Unclear	Low	Low
Liber et al., 2013	Low	Unclear	Unclear	Unclear	Low	Low
Miller et al., 2010	Unclear	Unclear	Unclear	Unclear	Low	Low
Miller et al., 2011	Unclear	Unclear	Unclear	Unclear	Low	Low
Loevaas et al., 2019	Unclear	Unclear	Unclear	Unclear	Low	Low
Pophillat et al., 2016	Unclear	Unclear	Unclear	Unclear	Low	Low
Rose et al., 2009	High	Unclear	High	Unclear	Low	Low
Stallard et al., 2015	Unclear	Unclear	High	Unclear	Low	Low
Yamamoto et al., 2017	High	Unclear	Unclear	Unclear	Low	Low
Yeo et al., 2015	High	Unclear	Unclear	Unclear	Low	Low

pooling of data based on these categorisations is limited due to the small number of studies providing data for inclusion within sub-group analyses. However, a strength of clustering the measures in this way has reduced issues of heterogeneity and therefore increases confidence in the findings. Due to the broad range of outcomes included in this review, the quality of evidence for each outcome was not evaluated. It would be recommended that the quality of evidence for each paper is evaluated in future reviews.

By including CBIs and MBIs, which are common school-based interventions, this review provides a broad overview for effectiveness of these frequently used interventions, across the different domains of emotion regulation. A limitation is the lack of comparative meta-analysis of CBIs and MBIs in outcome goals and measures. However, this highlights an important distinction in the way that the interventions address emotion regulation. CBIs appeared to precisely target the evaluation of modulation and expression

Table 4 Risk of bias in MBI studies

Study ID	Random sequence generation	Allocation concealment	Blinding of participants and personnel	Blinding of outcome assessment	Incomplete outcome data	Selective outcome reporting
Alampay et al., 2020	Low	Unclear	Unclear	Unclear	Low	Low
Amundsen et al., 2020	High	Unclear	Unclear	Unclear	Low	Low
Charest, 2015	Unclear	Unclear	Unclear	Unclear	Low	Low
de Carvalho et al., 2017	Unclear	Unclear	Unclear	Unclear	Low	Low
Folch et al., 2021	High	Unclear	Unclear	Unclear	Low	Low
Harpin et al., 2016	Unclear	Unclear	Unclear	Unclear	Low	Low
Jalón et al., 2022	High	Unclear	Unclear	Unclear	Low	Unclear
Keller et al., 2017	Unclear	Unclear	Unclear	Unclear	Low	Low
Meyer & Eklund 2020	Unclear	Unclear	Unclear	Unclear	Low	Low
Müller et al., 2021	High	Unclear	Unclear	Unclear	Low	Low
Parker et al., 2014	Unclear	Unclear	High	Unclear	Low	Low
Poli et al., 2022	Low	Unclear	Low	Low	Low	Low
Santos & Langill 2018	Unclear	Unclear	Unclear	Unclear	Low	Low
Schonert-Reichl et al., 2015	Low	Unclear	Low	Low	Low	Low
Suárez-García et al., 2020	High	Unclear	Unclear	Unclear	Low	Low
van de Weijer-Bergsma et al., 2014	Unclear	Unclear	Unclear	Unclear	Low	Low
Vickery & Dorjee 2016	Unclear	Unclear	Unclear	Unclear	Low	Low
Wright et al., 2019	Low	High	Low	Unclear	Low	Low

components of emotion regulation without perhaps appreciating the importance of improved awareness. Conversely, MBIs tend to focus on awareness outcomes, with much more diversity in the measures of modulation and expression. In addition, it is evident in this review that CBIs are more likely to target mental health outcomes (such as anxiety and depression), whereas MBIs tend to target more general aspects of well-being. This is reflected in measures of emotion regulation strategies: MBIs include positively framed measures (such as happiness or concern for others), whereas CBIs have a clinical framework and more often measure negative or disorder-based outcomes (such as anxiety or disruptive behaviours). This differentiation could be an important factor for schools when deciding which style of intervention to include in their curriculum.

The results of the current review and meta-analysis indicate age-related differences even with the limited bracket of 7–12-year-olds. Participants younger than 10 years may only be able to change their levels of emotional awareness but participants aged 10–12 show significant improvement in both awareness and modulation of positive and negative emotional states. Such a specific age bracket has not been explored in previous systematic review and demonstrates the need to research effects on precise populations rather than a broad-spectrum approach.

Finally, the findings indicate shorter programmes that run within one school term (a maximum of 12 weeks) are more effective. This may be because longer programmes lead to demotivation and disengagement, or it may be due to vacation periods causing a break in the routine of teaching. Future research could investigate this further through the incorporation of longitudinal designs into studies of this type and/or considering the impact that school breaks may have on continuity of practice. Furthermore, qualitative data would provide insight from the children into factors that may affect their participation in the interventions. This could lead to reconsideration of typical intervention formats for primary school children.

Author Contributions

LEP: conceptualised the review, conducted initial database searches, screened and selected studies, extracted and analysed data, assessed bias and wrote the initial draft of the manuscript. FC: conducted initial database searches, screened and selected studies, extracted data, assessed bias and collaborated with the initial draft of the manuscript. KP: extracted data, screened and selected studies and collaborated with the initial draft of the manuscript. CC: extracted data and assessed bias. KAM: extracted data and collaborated with the initial draft of the manuscript. All the

authors contributed to editing the final manuscript and all the authors read and approved the final version of the manuscript for submission.

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Data Availability The data that support the findings of this study are available from the corresponding author upon reasonable request.

Declarations

Ethics Approval Ethical approval was granted by the University of Lincoln Research Ethics Committee: UoL2020_2322. The manuscript does not contain clinical studies or patient data. No informed consent was required.

Conflict of Interest KP has received research funding from The Mindfulness Association.

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