



How do mindfulness-based cognitive therapy and mindfulness-based stress reduction improve mental health and wellbeing? A systematic review and meta-analysis of mediation studies



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HIGHLIGHTS

- We systematically review mediation studies on mechanisms of MBCT and MBSR.
- We statistically integrate mediation data using two-stage structural equation modelling.
- Strong consistent evidence for reactivity as a mechanism of MBCT and MBSR
- Moderate consistent evidence for mindfulness, rumination and worry as mechanisms
- Mindfulness, rumination and worry are significant mediators for clinical outcomes.

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ABSTRACT

Given the extensive evidence base for the efficacy of mindfulness-based stress reduction (MBSR) and mindfulness-based cognitive therapy (MBCT), researchers have started to explore the mechanisms underlying their therapeutic effects on psychological outcomes, using methods of mediation analysis. No known studies have systematically reviewed and statistically integrated mediation studies in this field. The present study aimed to systematically review mediation studies in the literature on mindfulness-based interventions (MBIs), to identify potential psychological mechanisms underlying MBCT and MBSR's effects on psychological functioning and wellbeing, and evaluate the strength and consistency of evidence for each mechanism. For the identified mechanisms with sufficient evidence, quantitative synthesis using two-stage meta-analytic structural equation modelling (TSSEM) was used to examine whether these mechanisms mediate the impact of MBIs on clinical outcomes. This review identified strong, consistent evidence for cognitive and emotional reactivity, moderate and consistent evidence for mindfulness, rumination, and worry, and preliminary but insufficient evidence for self-compassion and psychological flexibility as mechanisms underlying MBIs. TSSEM demonstrated evidence for mindfulness, rumination and worry as significant mediators of the effects of MBIs on mental health outcomes. Most reviewed mediation studies have several key methodological shortcomings which preclude robust conclusions regarding mediation. However, they provide important groundwork on which future studies could build.

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Contents

1. Introduction	2
2. Hypothesised mechanisms underlying mindfulness-based interventions	2
3. Methods of studying the mechanisms underlying mindfulness-based interventions	3
4. The current study	4

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5.	Methods	4
5.1.	Identification and selection of studies	4
5.2.	Inclusion and exclusion criteria	4
5.3.	Quality assessment	4
5.4.	Levels of scientific evidence	4
5.5.	Data extraction, synthesis and statistical analysis	4
6.	Results	5
6.1.	Study flow and characteristics	5
6.2.	Summaries of identified mechanisms	5
6.3.	Mechanism 1: mindfulness	5
6.4.	TSSEM results with mindfulness as a mediator	6
6.5.	Mechanism 2: repetitive negative thinking	7
6.6.	TSSEM results with RNT as a mediator	7
6.7.	Mechanism 3: self-compassion	7
6.8.	Mechanism 4: cognitive and emotional reactivity	8
6.9.	Other mechanisms: psychological flexibility and autobiographical memory specificity	8
7.	Discussion	8
7.1.	Strengths and limitations of the current review	9
8.	Conclusions	10
	Role of funding sources	10
	Contributors	10
	Conflict of interest	10
	Acknowledgements	10
	References	10

1. Introduction

Although there are diverse definitions of mindfulness, it is commonly and operationally defined as the quality of consciousness or awareness that arises through intentionally attending to present moment experience in a non-judgemental and accepting way (Kabat-Zinn, 1994). Mindfulness originates from Eastern traditions and its recent popularity in Western psychology is largely due to the development and wide-spread application of standardised mindfulness-based interventions (MBIs), which integrate the essence of traditional mindfulness practice with contemporary psychological practice, in order to improve psychological functioning and wellbeing. The two most extensively employed and evaluated MBIs are mindfulness-based stress reduction (MBSR; Kabat-Zinn, 1982) and mindfulness-based cognitive therapy (MBCT; Segal, Williams, & Teasdale, 2002; 2013), both of which are eight-week group-based therapies which teach mindfulness skills through a range of formal and informal mindfulness practices. These include mindfulness of breath, thoughts, bodily sensations, sounds, and everyday activities. A growing body of robust evidence from randomised controlled trials (RCTs) has demonstrated that MBIs are effective in improving a range of clinical and non-clinical psychological outcomes in comparison to control conditions, including anxiety (Green & Bieling, 2012; Hofmann, Sawyer, Witt, & Oh, 2010), risk of relapse for depression (Kuyken et al., 2008; Teasdale et al., 2000), current depressive symptoms (Strauss, Cavanagh, Oliver, & Pettman, 2014), stress (Chiesa & Serretti, 2009), chronic pain (Grossman, Tiefenthaler-Gilmer, Raysz, & Kesper, 2007), quality of life (Godfrin & van Heeringen, 2010; Kuyken et al., 2008), psychological symptoms in patients with cancer (Ledesma & Kumano, 2009) and retrieval of specific autobiographical memories (Williams, Teasdale, Segal, & Soulsby, 2000), a reliable cognitive marker of depression (e.g. Brittlebank, Scott, Williams, & Ferrier, 1993).

Other notable interventions which involve mindfulness principles alongside other components include acceptance and commitment therapy (ACT; Hayes & Wilson, 1994) and dialectical behavioural therapy (DBT; Linehan, 1993). A consensus has not yet been reached regarding the similarity between MBSR and MBCT and these alternative interventions (Chiesa & Malinowski, 2011). However it is clear that alternative interventions differ considerably from MBSR and MBCT and each other in the duration and frequency of mindfulness practice involved, and the inclusion of mindfulness psychoeducation and non-mindfulness therapeutic ingredients. Therefore, the current review will focus solely on MBCT and MBSR to ensure consistency across

studies and will use the term MBI to refer to these two interventions. These interventions have much in common in their core elements, have published therapy protocols that are adhered to in research trials and have generated the large body of evidence.

2. Hypothesised mechanisms underlying mindfulness-based interventions

Compared to the extensive evidence base for the effectiveness of MBSR and MBCT, relatively few studies have tested the mechanisms of action which causally connect changes that occur during MBIs with psychological outcomes. Kazdin (2007) emphasises several clinically relevant reasons why establishing the mechanisms of psychotherapies is crucial. These include being able to optimise therapeutic effects through enhancing active components of interventions, distinguishing between the specific and broader, non-specific effects of treatment, facilitating the identification of treatment moderators and matching of therapies to individuals, and informing theory development and interpretation of results. Moreover, Brown, Ryan, and Creswell (2007) state that developing a deeper understanding of mindfulness, including how it works, is a worthy venture as it has the potential to reveal insights into the age-old mystery of the nature of consciousness.

Studies which have examined the mechanisms of MBIs have typically based their investigation on the theoretical underpinnings of MBSR and MBCT. A theoretical premise of MBCT and MBSR is that the development of mindfulness skills leads to non-judgemental and non-reactive acceptance of all experience, which in turn results in positive psychological outcomes (Kabat-Zinn, 1982; Segal et al., 2002). Additionally, MBCT, originally developed with the intention of treating recurrent depression, is theorised to decrease depressive recurrence by enhancing awareness of and disengagement from repetitive negative thinking about one's depressive symptoms (Segal et al., 2002). A further cognitive process proposed and found to be implicated in the relationship between MBCT and depression (Williams et al., 2000) and closely linked to ruminative analytic thinking (Raes et al., 2006; Watkins & Teasdale, 2001, 2004) is autobiographical memory specificity (AMS), which refers to the ability to retrieve memories of specific personal events that happened at particular times and locations. MBCT, which encourages participants to notice specific details of their environment and accept all experiences without judging or avoiding them, is likely to improve AMS through reducing overgeneric encoding of situations and suppression of unpleasant memory retrieval (Williams et al., 2000). Therefore,

we might expect MBSR and MBCT to improve psychological outcomes through increasing levels of mindfulness and non-judgemental acceptance, and through decreasing negative reactivity, repetitive negative thinking and overgeneral autobiographical memory retrieval.

Additionally, through integrating knowledge from empirical studies of MBIs, several researchers have developed theoretical models or summaries that include a wider range of potential mechanisms of mindfulness and MBIs. For instance, Shapiro, Carlson, Astin, and Freedman's (2006) model proposes that mindfulness, composed of attention, intention and attitude, leads to re-perceiving and changes in the following four mechanisms: 1) self-regulation, 2) emotional, cognitive and behavioural flexibility, 3) values clarification and 4) exposure. Hölzel et al. (2011) theoretical review integrated neuroscientific findings with self-report and experimental data to propose four mechanisms through which mindfulness works: 1) attention regulation, 2) body awareness, 3) emotion regulation, and 4) change in perspective on a 'static' self. They also draw similarities between emotion regulation and change in perspective on the self with self-compassion, a construct conceptualised by Neff (2003) as being closely linked to mindfulness and consisting of three components: self-kindness in the face of suffering, seeing one's experience as part of larger human experience, and 'mindfulness', defined as "holding one's painful thoughts and feelings in balanced awareness rather than over-identifying with them" (p. 223). Vago and Silbersweig's (2012) framework and neurobiological model describes three mechanisms through which mindfulness promotes positive mental health and reduces biases related to self-processing: 1) self-awareness, 2) self-regulation, and 3) self-transcendence. Brown et al. (2007) also describe several processes underlying the therapeutic effects of mindfulness, including insight, exposure, nonattachment, enhanced mind-body functioning and integrated functioning. Similarly, Baer (2003) identified exposure, cognitive change, self-management, relaxation and acceptance as key mechanisms. A further model of the mechanisms of mindfulness is the Buddhist psychological model (Grabovac, Lau, & Willett, 2011). This model, based on Buddhist texts, proposes acceptance/compassion, attention regulation, ethical practices, nonattachment and nonaversion, and decreased mental proliferation as mechanisms underlying the effects of mindfulness practice on clinical symptom reduction and wellbeing. The proposed mechanisms of mindfulness and MBIs in these theoretical models are presented in Table 1.

Taken together, based on the theoretical underpinnings of MBIs and models of how they work, possible mechanisms connecting MBSR and MBCT with their beneficial effects include improvements in a number of variables including mindfulness, repetitive negative thinking, AMS, re-perceiving, reactivity, nonattachment, nonaversion, self-awareness, self-regulation, self-transcendence, psychological flexibility, clarification of inner values, exposure, attentional control and regulation, body awareness, mind-body and integrated functioning, emotion regulation, self-compassion, compassion, insight, acceptance, relaxation and ethical practices.

3. Methods of studying the mechanisms underlying mindfulness-based interventions

To understand how change occurs during interventions, conducting mediation analyses to study the indirect influence of a treatment (X) on an outcome (Y) through a mediator (M), or intervening variable, is an essential first step (Kazdin, 2007). There are over a dozen methods of mediation analysis, most of them testing the statistical significance of a sequence of linear regression models (Baron & Kenny, 1986), or using structural equation modelling (SEM), which allows simultaneous examination of direct and indirect relationships among constructs represented by multiple items (Kline, 2011). Researchers have advocated the use of SEM techniques for assessing mediation (e.g. Preacher & Hayes, 2004) and empirically demonstrated their superiority over regression procedures (Iacobucci, Saldanha, & Deng, 2007). Nevertheless the most popular method of mediation analysis, the Baron and Kenny (1986) causal-steps test, uses a regression framework. Under this approach, mediation is said to occur if four conditions are fulfilled through conducting a series of regression analyses: 1) there is a significant linear relationship between X and M (path *a*), 2) there is a relationship between X and Y (path *c*), 3) there is a relationship between M and Y, after accounting for X (path *b*), and 4) after controlling for M, the relationship between X and Y decreases in size relative to the size of the regression coefficient for path *c* (path *c'*). Full mediation refers to when the regression coefficient for path *c'* is not significantly different from zero and partial mediation is said to occur if this coefficient has decreased in size relative to the coefficient for path *c* but remains significant (Baron & Kenny, 1986).

Following the causal-steps approach, the most common methods of mediation analysis and testing the significance of indirect effects, based on regression or SEM frameworks, are the Sobel test, or product of coefficients approach (Sobel, 1982), the distribution of the product approach (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002), and the bootstrapping method (Preacher & Hayes, 2004). Of the most popular methods, MacKinnon and colleagues recommended bootstrapping or the distribution of the product approach over the Sobel test or causal steps approach, based on the former having greater statistical power and the most accurate type I error rates (see MacKinnon et al. (2002) for a detailed evaluation of different methods of mediation analysis). Additionally, Kraemer, Wilson, Fairburn, and Agras (2002) recommended an analytic framework for testing mediation in RCTs when outcomes are dimensional. The framework shares the regression basis with the causal steps approach but differs in that a variable is demonstrated to be a mediator when it is correlated with the treatment and has either a main effect on the outcome or an interactive effect with treatment on the outcome.

In addition to there being a wide range of methods for testing mediational hypotheses, some recommended over others, drawing inferences about a mediator also involves several design requirements. Kazdin (2007) postulated that ideally, to establish mediation, there

Table 1
Theoretical models and proposed mechanisms of mindfulness and mindfulness-based interventions.

Baer (2003)	Brown et al. (2007)	Grabovac et al. (2011)	Hölzel et al. (2011)	Shapiro et al. (2006)	Vago and Silbersweig (2012)
Exposure, cognitive change (decentering), self-management (increased adaptive coping skills), relaxation, and acceptance.	Insight (decentering), exposure, nonattachment (non-aversion and non-craving), enhanced mind-body functioning, and integrated functioning (behaving in more purposeful ways).	Acceptance/compassion, attention regulation, ethical practices, nonattachment and nonaversion, and mental proliferation (narrative thought processes).	Attention regulation, body awareness, emotion regulation (reappraisal, exposure, extinction and reconsolidation), and change in perspective on the self.	Re-perceiving (decentering), self-regulation (stability of functioning and adaptability to change), emotional, cognitive and behavioural flexibility, value clarification, and exposure.	Self-awareness, self-regulation, and self-transcendence (self-other connection)

Note. Clarifications of meanings are given in parentheses.

should be a strong theoretical basis for the study of certain variables as mediators, studies should compare the intervention to a control group to make a strong case for specificity of effects to treatment, measure change in mediators during the intervention and before outcomes, and show consistency by replicating evidence for mediation across studies. Inconsistency however, does not necessarily mean that a mediator is not involved, due to the potential presence of unmeasured moderator variables affecting the mediated relationship. Lastly, studies should analyse data from only participants who receive a sufficient dose of the intervention (Kazdin, 2007), commonly defined in the MBI literature (e.g. Kuyken et al., 2008; Teasdale et al., 2000) as participation in more than four out of eight weekly sessions. Not adhering to such methodological requirements results in conclusions about mediation which are premature and tentative at best. Only after studies meeting all or most of these criteria have consistently demonstrated that a particular variable accounts for the effects of a MBI on an outcome can this variable be established as a mechanism.

4. The current study

Despite systematic reviews long being advocated as a method for investigating the mediators attributed to interventions (Shadish, 1996), as interpretation of what explains a phenomenon cannot emerge from a single study (Kazdin, 2007), there are no known systematic reviews of the mechanisms of MBIs reviewing only mediation studies. Researchers have also advocated integrating meta-analytic techniques with SEM to statistically evaluate and synthesise evidence for mediation across multiple studies (e.g. Cheung, 2008; Shadish, 1996). Cheung and Chan (2005) proposed a two-stage SEM (TSSEM) method to unify meta-analysis and SEM in a fixed or random-effects model, by first synthesising correlation matrices between X, M and Y across studies and second fitting structural mediational models on the pooled correlation matrix.

Thus, the present study's aims are threefold. First, it aims to systematically review mediation studies in the literature on MBIs, and to identify the mechanisms underlying MBCT's and MBSR's effects on psychological outcomes. Second, it aims to provide narrative summaries of the strength and consistency of evidence for each identified mechanism. Third, it aims to conduct separate TSSEM analyses for each identified mechanism of the effects of MBIs on mental health outcomes which have been supported by a substantial pool of evidence. There is currently no consensus in the multivariate meta-analysis literature on the minimum number of studies needed to conduct TSSEM. Thus, it was decided that three would be the minimum number of studies needed for a TSSEM analysis in order for synthesised evidence to be meaningful. Mental health outcomes such as global psychopathological, depressive and anxiety symptoms, stress, and negative affectivity were chosen as the target psychological outcome to be used in TSSEM meta-analyses. Combining statistical synthesis with narrative summaries of mediation findings across studies will allow us to make stronger and more compelling conclusions regarding how MBIs improve psychological functioning and wellbeing, compared to using either of these techniques in isolation.

5. Methods

5.1. Identification and selection of studies

A comprehensive search of published studies up to 10/01/2014 was conducted using the following electronic databases: PsycInfo, Scopus, Web of Knowledge, PsycArticles, ASSIA and Science Direct. The search term was: ("mindfulness based cognitive therapy" OR "mindfulness based stress reduction" OR MBSR OR MBCT) AND (mechanism* OR mediat* OR predict* OR process* OR "structural equation modelling" OR caus* OR path* OR correlat* OR relationship OR associat*).

5.2. Inclusion and exclusion criteria

Any study published in English which used 1) an adult sample (> 18 years), 2) a RCT or quasi-experimental design measuring pre- to post-MBI change in variables, 3) a well-established method of mediation analysis with group (i.e. MBI versus control) as the independent variable, 4) MBSR or MBCT in the mediation analysis, 5) quantitative assessment (self- or other-report) of pre-post-change in mental health and wellbeing outcomes (clinical and non-clinical) or related constructs, and 6) quantitative assessment of pre-post-change in hypothesised psychological mediators, were included in the review. Studies which used adapted versions of MBSR and MBCT were included if the intervention followed the basic structure of MBSR and MBCT and involved both formal and informal mindfulness practice (meditation during sessions and for homework). The exclusion criteria were as follows: 1) uncontrolled studies, 2) reviews, 3) qualitative studies, 4) studies in which the MBI was not delivered in person (i.e. self-help format, internet-delivered MBIs), and 5) studies which tested mediators without a strong theoretical basis, or mediators not previously hypothesised in theoretical models and summaries of the mechanisms of mindfulness and MBIs. A strong theoretical basis for the study of variables as mediators is proposed by Kazdin (2007) to be a design requirement to establish mediation.

5.3. Quality assessment

Mediation studies meeting the inclusion criteria were assessed for methodological quality and potential for bias using an appraisal framework adapted from Lubans, Foster, and Biddle (2008), the CONSORT checklist (Schulz, Altman, & Moher, 2010) and the Jadad checklist (Jadad et al., 1996) and informed by Kazdin (2007)'s design requirements for mediation. A score for each study was computed by assigning a value of 0 (no) or 1 (yes) to the 16 questions detailed in the tables in Appendix A. If a study did not explicitly report information related to a certain question or if a question did not apply to a study, it was assigned 0 for that question. If a study with missing information explicitly reported that it was embedded in a larger trial, information provided in the original paper was also consulted to grade the study. Studies which scored 0–5 were classified as low-quality with a high risk of bias, 6–11 indicated a moderate risk of bias and 12–16 high-quality with a low risk of bias.

5.4. Levels of scientific evidence

To draw narrative conclusions across included studies regarding the strength of evidence for identified mediators of MBIs, similar to previous reviews, a best evidence synthesis rating system (BESRS) was applied (Hoogendoorn, van Poppel, Bongers, Koes, & Bouter, 2000; Singh, Mulder, Twisk, van Mechelen, & Chinapaw, 2008; van Stralen et al., 2011). Under this system, a body of evidence was considered strong if it involved consistent findings in two or more high-quality studies. Moderate evidence referred to consistent findings in one high-quality study and at least one low-quality study, or consistent findings in multiple low-quality studies and insufficient evidence referred to when only one study was available or findings were inconsistent across two or more studies. Consistency was defined as at least 75% of studies demonstrating results in the same direction.

5.5. Data extraction, synthesis and statistical analysis

The following data were extracted for narrative summaries of the mechanisms identified from included studies: study authors, year, sample characteristics, design, intervention, measurement times, measures, mediator(s), outcome(s) and type of mediation analysis. Additionally, in order to conduct TSSEM analyses for identified mechanisms tested with mental health outcomes, bivariate correlations

between X (MBI versus control), pre–post-intervention change in M and pre–post-change in Y (clinical outcome) were extracted from each relevant study. Corresponding study sample sizes were also extracted. If a study did not explicitly report bivariate correlation coefficients, means, standard deviations, *t*-statistics, *F*-statistics and effect sizes were used to calculate bivariate correlations (Lipsey & Wilson, 2001). If a study provided insufficient data to calculate correlations, it was omitted from the TSSEM analyses. A systematic approach was devised to select which mental health outcome to use from each relevant study, where studies measured more than one mental health outcome. The outcome used in the first instance was a global measure of psychopathology, then anxiety or depression. For studies which tested both anxiety and depression as outcomes, the outcome selected was the one which matched the study sample. For samples which did not match either anxiety or depression, the outcome used depended on whether baseline anxiety or depression levels in the sample were higher. If a study did not measure anxiety or depression, stress was chosen as the mental health outcome and failing that, negative affect. Finally, if two or more measures of the same outcome were used, the one with the stronger psychometric properties was selected. If a study did not include a mental health outcome, it was excluded from TSSEM. Only one mental health outcome was selected from each study to enable bivariate correlations to be extracted. Although it would be possible to calculate mean correlations across multiple outcomes in a single study, it would not be straightforward to determine the appropriate sampling variance of averaged correlations. Thus, it was deemed more appropriate to select one mental health outcome per study.

The metaSEM package (Cheung, 2013) in R (R Development Core Team, 2013) was used to perform the TSSEM analyses. The first stage tested the homogeneity of correlation matrices across studies and if these were not significantly different from each other, a pooled correlation matrix was produced. The second stage involved treating the pooled matrix as the observed correlation matrix and fitting a structural mediational model to the matrix to test the fit of model to the data. As samples, design and effect sizes were expected to differ across studies, conducting random-effects models was deemed more appropriate than fixed-effects. Unstandardised regression coefficients and standard errors from the pooled matrix were then used to conduct Sobel tests, to determine the significance of the indirect pathway from participation in a MBI versus control to the mental health outcome, via particular mediators.

6. Results

6.1. Study flow and characteristics

The search identified 1547 articles, 533 of which were duplicates. Of the remaining 1014 papers, 845 were excluded based on the title or abstract, thus the number of full-text articles assessed for eligibility was 169. The final number of studies meeting the inclusion criteria and included in the systematic review was 20. One RCT (Batink, Peeters, Geschwind, van Os, & Wichers, 2013) conducted two separate mediation analyses on subgroups in their sample and were included as two separated comparisons. Reference lists of full texts were examined for further studies meeting the inclusion criteria. Fig. 1 illustrates the flow of studies through the review.

The tables in Appendix B present summary data from the 20 included studies. Of these, 15 were RCTs, which compared MBCT to a non-active control ($n = 6$), active control ($n = 2$) or both ($n = 1$), or MBSR to a non-active control ($n = 6$), and 5 were quasi-experimental studies, which compared MBCT to a non-active control ($n = 2$), or MBSR to a non-active control ($n = 2$) or active control ($n = 1$). Study sample sizes ranged from 27 to 205 participants. Eight studies were conducted with adults with depressive symptoms, four used cancer patients or survivors, three used non-clinical samples, two used adults with heterogeneous anxiety disorders, two used adults with distress

symptoms and one used an unselected sample. Mental health outcomes (depression, anxiety, stress, distress, negative affectivity) were the most commonly assessed across studies ($n = 18$), with many studies including more than one mental health measure. Other outcomes assessed include mood states ($n = 3$), quality of life ($n = 1$), goal attainment ($n = 1$) and anger expression ($n = 1$). The most commonly tested mechanism across studies was mindfulness ($n = 16$), followed by rumination ($n = 7$), worry and concerns ($n = 5$), self-compassion ($n = 3$), psychological flexibility ($n = 1$), emotional reactivity ($n = 1$), cognitive reactivity ($n = 1$), and AMS ($n = 1$). Most studies performed more than one method of mediation analysis. 12 studies applied the causal-steps test, 9 used bootstrapping, 6 reported the Sobel test and 3 used Kraemer et al.'s (2002) framework for RCTs. Quality scores for included studies ranged from 5 (low quality) to 14 (high quality). Three studies were classified as low-quality, 15 were deemed to have a moderate risk of bias and two studies were high-quality.

6.2. Summaries of identified mechanisms

This section gives narrative summaries of and evaluates the strength of evidence for each identified mechanism. Similar mechanisms (e.g. rumination and worry) are grouped together, as are mechanisms only tested in one study. This section also reports the results from TSSEM analyses for mediators tested by a substantial body of included studies (three or more) as mechanisms underlying the effects of MBIs on clinical outcomes.

6.3. Mechanism 1: mindfulness

Perhaps the most important question about how MBIs work concerns whether or not their effects on psychological outcomes are mediated by increases in mindfulness, as theoretically asserted by proponents of MBCT and MBSR (Kabat-Zinn, 1982; Segal et al., 2002). In the 12 RCTs and 4 quasi-experimental studies which examined mindfulness as a mediator, most studies measured levels of depression ($n = 9$) as the main psychological outcome, followed by stress ($n = 3$), anxiety ($n = 3$), mood states ($n = 3$), quality of life ($n = 1$), and anger expression ($n = 1$), with many studies measuring more than one outcome. Samples included adults with depressive symptoms ($n = 6$), cancer ($n = 3$), distress symptoms ($n = 2$) and anxiety disorders or symptoms ($n = 2$). Non-clinical samples ($n = 2$) and an unselected sample ($n = 1$) were also used. Twelve studies examined mindfulness as a mechanism in simple mediator analyses and four analysed its effects in multiple mediator models, of which two reported both simple and multivariate mediation analyses. Multiple mediation involves simultaneously testing multiple variables as mediators in a single model.

Generally, findings showed support for mindfulness as a mediator, regardless of heterogeneity in measures of mindfulness, sample characteristics and outcomes. As evidence for mindfulness as a mechanism was found in both simple and multiple mediator analyses, this suggests its mediating effects were present over and above the effects of other tested mediators, which included worry, rumination and psychological flexibility. However, Labelle, Campbell, and Carlson's (2010) low-quality quasi-experimental study did not find mindfulness to mediate the impact of MBSR on depressive symptoms. This could be due to design limitations acknowledged by the authors, such as lack of randomisation of participants to conditions and not testing only participants who received an adequate dose of MBSR and are thus sufficiently familiar with the principles of the intervention. Additionally, Keng, Smoski, Robins, Ekblad, and Brantley (2012) did not find evidence for mindfulness as a mediator of MBSR's effects on anger expression, in their multiple mediation analysis of both self-compassion and mindfulness using bootstrapping. This may have been due to mindfulness and self-compassion scores being significantly correlated and thus not

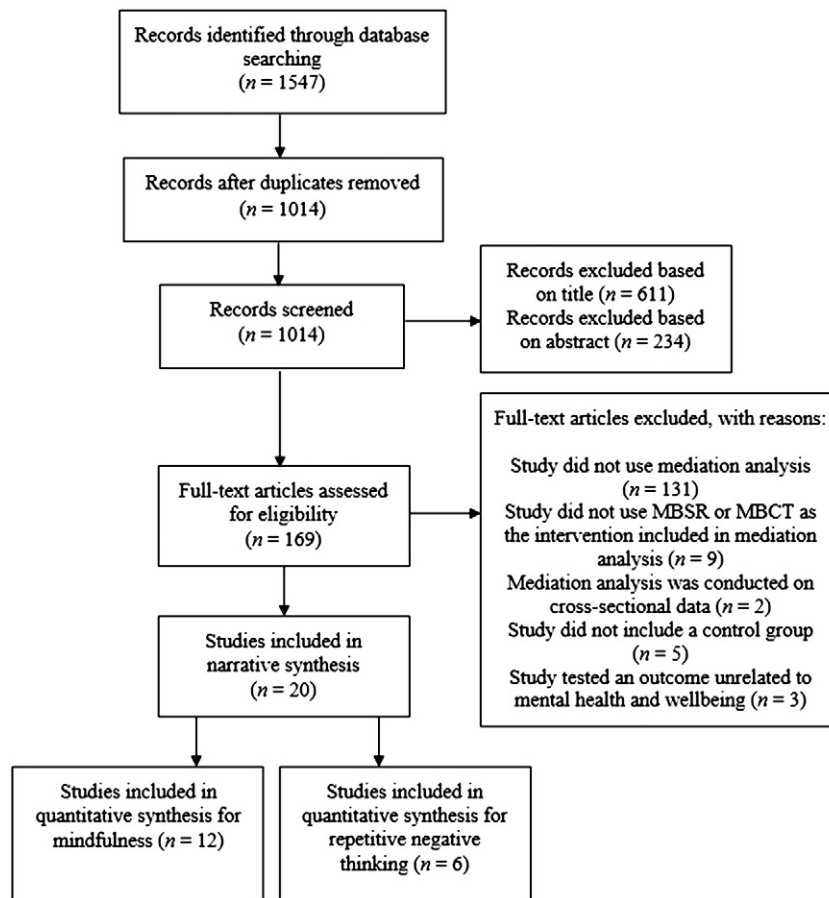


Fig. 1. Diagram depicting the flow of studies through the review process.

empirically distinct constructs. Preacher and Hayes (2008) cautioned against testing overlapping constructs in multiple mediator models, as this compromises the significance of indirect effects.

Despite this, of the studies which found evidence for mindfulness as a mediator, one was high-quality, eleven medium-quality and two low-quality, which constitutes moderate, consistent evidence for mindfulness as a mediator, according to the BESRS (e.g. Hoogendoorn et al., 2000). However, many studies have methodological limitations which future research should improve upon in order to provide strong evidence for mindfulness as a mediator. For example, only three studies compared a MBI to an active control group, one measured change in mediator before the outcome, none measured change in mediator during treatment, nine conducted mediation analysis only on participants who received an adequate dose of the intervention and eleven used the most appropriate method of mediation analysis given study design and recommendations (e.g. MacKinnon et al., 2002).

6.4. TSSEM results with mindfulness as a mediator

Of the 16 included studies which tested mindfulness as a mediator, 13 included a measure of a mental health outcome and sufficient information to calculate bivariate correlations. Two of these studies (Nyklicek, Beugen, & Denollet, 2013; Nyklicek & Kuyjpers, 2008) used overlapping samples for their mediation analyses involving separate variables. Therefore, although both were included in the narrative synthesis, only the one with the higher quality score (Nyklicek et al., 2013) was included in the TSSEM. Thus, correlation matrices were extracted and synthesised from 12 studies testing mindfulness for the first stage of the TSSEM (Batink et al., 2013; Bränström, Kvillemo, Brandberg, & Moskowitz, 2010; Kuyken et al., 2010; Labelle, 2012; Labelle et al., 2010; McManus, Surawy, Muse, Vazquez-Montes, &

Williams, 2012; Nyklicek et al., 2013; Raes, Dewulf, Van Heeringen, & Williams, 2009; Shahar, Britton, Sbarra, Figueredo, & Bootzin, 2010; van Aalderen et al., 2012; Vøllestad, Sivertsen, & Nielsen, 2011). One study (Batink et al., 2013) conducted two separate mediation analyses on subgroups in their sample and were included as two comparisons. The most common mental health outcome across studies selected for TSSEM was depression ($n = 7$), followed by stress ($n = 2$), anxiety ($n = 2$) and negative affect ($n = 1$). The total pooled sample size was 1109. Table 2, which presents the pooled correlation coefficients for X, M and Y, shows that all three correlations are highly significant. The Q statistic for the homogeneity of effect sizes was also non-significant ($Q(24) = 27.09, p = .30$), indicating that the 12 correlation matrices were relatively similar and justifying their synthesis. Fig. 2 displays the path diagram of the mediational model fitted to the data for stage two of the TSSEM analysis. Although the regression coefficient for path c' remains significant, it has reduced in size compared to the value of path c , which is indicative of partial mediation (Baron & Kenny, 1986). A Sobel test using correlation estimates for X and M, and M and Y and their standard errors demonstrated that mindfulness significantly mediated the effects of MBIs on mental health outcomes ($z = 4.99, SE = 0.02, p < .001$).

Table 2

Pooled correlation coefficients ($k = 12$) for X (participation in MBIs vs control), M (changes in mindfulness) and Y (changes in mental health outcome). Standard errors are displayed in parentheses.

	X	M	Y
X	1		
M	0.34 (0.03)*	1	
Y	0.27 (0.03)*	0.36 (0.06)*	1

* $p < .001$.

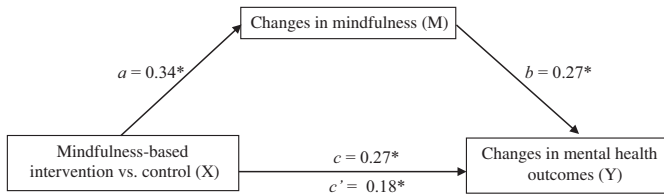


Fig. 2. Path diagram depicting the stage two mediational model of the TSSEM, with changes in mindfulness as the mediator. Values are path coefficients. Note. * $p < .001$.

6.5. Mechanism 2: repetitive negative thinking

RNT is a style of repetitive thinking about negative experiences which is difficult to disengage from and at least partly intrusive (Ehring et al., 2011). Two commonly examined forms of RNT include worry, and rumination, which are typically highly correlated with each other (e.g. Fresco, Frankel, Mennin, Turk, & Heimberg, 2002) and implicated in a range of psychopathologies (Ehring & Watkins, 2008). The only difference between worry and rumination is argued to be temporal orientation (Watkins, 2008), with worry relating more to the future and rumination more to the past (Papageorgiou & Wells, 1999). However, theory and evidence concerning the degree of overlap versus distinction between these constructs are inconsistent (e.g. Hoyer, Gloster, & Herzberg, 2009). For the purposes of this review, as findings generally suggest that rumination and worry appear to be closely related constructs (e.g. Watkins, Moulds, & Mackintosh, 2005), and there is a paucity of studies examining rumination and worry separately, both mechanisms are captured under RNT.

In the five RCTs and three quasi-experimental studies which have tested RNT constructs as mediators of MBIs, the most frequently assessed outcome was levels of depression ($n = 5$), followed by stress ($n = 2$), anxiety ($n = 1$) and global psychopathological symptoms ($n = 1$), with one study including measures of both stress and anxiety (Lengacher et al., 2014). Most studies recruited participants with depressive symptoms ($n = 4$), three used cancer patients or survivors and one used a non-clinical sample. Out of the eight studies, five examined RNT in simple mediation analyses and three in multiple mediator models, of which two reported both simple and multivariate mediator analyses. Other mediators included in multivariate analyses were mindfulness and psychological flexibility.

Despite differences in questionnaires, samples and methods of mediation analysis conducted across studies, findings from all studies generally demonstrated that RNT constructs were significant and unique mediators of the effects of MBIs on clinical outcomes. Seven studies were deemed medium-quality, with a moderate risk of bias, and one study was low-quality with a high risk of bias, constituting consistent moderate evidence for RNT as a mediator, according to the BESRS (e.g. Hoogendoorn et al., 2000). Only Shahar et al. (2010) found equivocal evidence for rumination as a mediator of MBCT's effects on depression, in their multiple mediation analysis of both rumination and mindfulness using bootstrapping. They found that mindfulness and the brooding aspect of rumination, which refers to the tendency to dwell on negative thoughts related to one's condition, were significant mediators, but no evidence for the reflective pondering component, which is concerned with constructively thinking about one's condition in order to better understand and improve it (Trenor, Gonzalez, & Nolen-Hoeksema, 2003). This may be due to brooding being the key maladaptive component in rumination rather than reflection, consistent with findings from research which showed that brooding but not reflection mediated the relationship between negative thinking and depression (Lo, Ho, & Hollon, 2008) and self-criticism and suicidal ideation (O'Connor & Noyce, 2008).

Although there appears to be a consistent body of evidence for RNT as a unique mechanism underlying the effects of MBIs, included studies contain numerous methodological limitations which preclude strong

conclusions regarding mediation and specificity of improvements to MBIs. For example, none of the eight studies compared a MBI with an active control group and measured change in mediator before the outcome or during treatment, three conducted mediation analysis only on participants who received an adequate dose of the intervention and four used the most appropriate method of mediation analysis. Future research examining RNT constructs as mediators would be enhanced by taking such limitations into account.

6.6. TSSEM results with RNT as a mediator

Six of the eight included studies which tested RNT constructs as a mediator included a measure of a mental health outcome and sufficient information to calculate bivariate correlations and were included in the second TSSEM analysis (Heeren & Philippot, 2011; Labelle, 2012; Labelle et al., 2010; Lengacher et al., 2014; Shahar et al., 2010; van Aalderen et al., 2012). The most common mental health outcome across studies selected for TSSEM was depression ($n = 3$), followed by stress ($n = 1$), anxiety ($n = 1$) and global psychopathological symptoms ($n = 1$). The total pooled sample size was 586. All three pooled coefficients were significant (see Table 3) and the Q statistic was non-significant, indicating homogeneity of correlation matrices, $Q(11) = 18.79, p = .07$. As depicted in Fig. 3, after accounting for M, the unstandardized coefficient for path c' has reduced in size compared to the value for path c but remains significant, indicating partial mediation (Baron & Kenny, 1986). A Sobel test showed that RNT significantly mediated the effects of MBIs on mental health outcomes, ($z = 4.88, SE = 0.02, p < .001$).

6.7. Mechanism 3: self-compassion

Two RCTs and one quasi-experimental study tested self-compassion as a mediator of MBIs. One study assessed self-compassion as a mediator of a MBI's effect on depression in a sample of adults with recurrent depression (Kuyken et al., 2010) and the other two, on trait anxiety (Bergen-Cico & Cheon, 2013) and anger expression (Keng et al., 2012) in non-clinical samples. Keng and colleagues' study examined self-compassion in a multivariate mediation analysis, controlling for mindfulness; the other two studies reported simple mediation analyses.

Despite differences in samples and types of mediation analysis conducted, findings from Kuyken et al.'s (2010) study, with a low risk of bias, supported self-compassion as a mediator of MBCT's effects. However, Keng et al.'s (2012) study, with a moderate risk of bias, and Bergen-Cico and Cheon's (2013) quasi-experimental study, which had a moderate risk of bias, found that although MBSR participation significantly increased self-compassion, this increase did not mediate MBSR's effects on anger expression or anxiety. This could be due to reasons such as Keng et al.'s study only examining self-compassion in a multiple mediator analysis, the cultivation of self-compassion to improve anger expression and anxiety requiring a longer period of mindfulness practice compared to other outcomes, methodological limitations of the study, and the presence of moderated mediation effects (Preacher, Rucker, & Hayes, 2007), or unmeasured moderators affecting the strength of the mediated relationship.

Table 3

Pooled correlation coefficients ($k = 6$) for X (participation in MBIs vs control), M (changes in repetitive negative thinking) and Y (changes in mental health outcome). Standard errors are displayed in parentheses.

	X	M	Y
X	1		
M	0.31 (0.04)*	1	
Y	0.31 (0.06)*	0.33 (0.05)*	1

* $p < .001$.

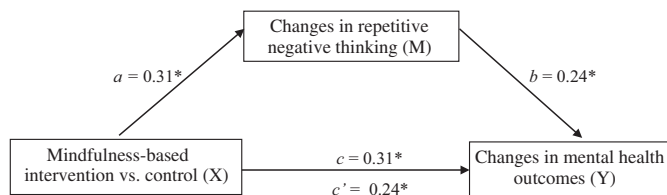


Fig. 3. Path diagram depicting the stage two mediational model of the TSSEM, with improvements in repetitive negative thinking (worry and rumination) as the mediator. Values are path coefficients. Note. $*p < .001$.

As evidence for self-compassion was found in just one high-quality study, this constitutes preliminary but inconsistent evidence for self-compassion as a mediator of the impact of MBIs on psychological outcomes (e.g. Hoogendoorn et al., 2000). This modest body of evidence could be extended and improved upon by including more studies which measured change in mediator before the outcome and during treatment, an active control group, conducted mediation analysis only on participants who received an adequate dose of the intervention and used the most appropriate method of mediation analysis. Methodological limitations, coupled with the small number of studies which supported self-compassion as a mediator, means that we are unable to conclusively establish self-compassion as a mechanism of MBIs. Furthermore, as only two of the three mediation studies which tested self-compassion as a mediator included a measure of a mental health outcome, combining findings using TSSEM was deemed inappropriate at this time.

6.8. Mechanism 4: cognitive and emotional reactivity

Two high-quality RCTs, with a low risk of bias, studied cognitive and emotional reactivity as mediators of MBCT's effects on depressive symptoms, using samples of adults with recurrent depression. Cognitive and emotional reactivity refer to the extent to which a mild state of distress coupled with stress reactivates negative thinking and emotional patterns, putting individuals at risk of a depressive episode (Scher, Ingram, & Segal, 2005). Both studies found consistent, strong evidence for reactivity as a mediator in simple mediation analyses, according to the BESRS (e.g. Hoogendoorn et al., 2000). Future research should extend this small body of evidence for cognitive and emotional reactivity as mechanisms, by examining whether they also mediate MBSR, can be generalised to other samples and outcomes and their degree of overlap with other mechanisms such as self-compassion, RNT and mindfulness, by testing their effects in multivariate mediator models.

6.9. Other mechanisms: psychological flexibility and autobiographical memory specificity

Psychological flexibility refers to the ability to fully embrace thoughts, feelings and experiences in the present moment without avoidance and persisting or altering behaviour to be consistent with goals and values (Hayes, Luoma, Bond, Masuda, & Lillis, 2006). A medium-quality quasi-experimental study which used a sample of cancer patients (Labelle, 2012) found psychological flexibility to be a significant mediator of MBSR's effects on stress and mood states in both simple and multiple mediator models, with RNT taken into account. According to the BESRS (e.g. Hoogendoorn et al., 2000), this constitutes preliminary but insufficient evidence for psychological flexibility as a mechanism. AMS was not found to be a significant mediator of MBCT's effects on likelihood of goal attainment in a low-quality RCT (Crane, Winder, Hargus, Amarasinghe, & Barnhofer, 2012) using a sample of adults with residual depressive symptoms. This non-significant finding may have been due to the high risk of bias associated with Crane et al.'s study and methodological limitations,

such as not measuring change in mediators during the intervention and before outcomes, not conducting mediation analysis on only participants who received an adequate dose of MBCT, and not using the most appropriate method of mediation analysis.

7. Discussion

This paper's aims were threefold. First, it aimed to systematically review mediation studies in the literature on MBIs, in order to identify the mechanisms underlying MBCT and MBSR's effects on psychological functioning and wellbeing. Second, it aimed to evaluate and provide narrative summaries of the strength of evidence for each identified mechanism. Third, it aimed to conduct TSSEM analyses, to statistically synthesise evidence for mechanisms of the effects of MBIs on mental health outcomes which were supported by five or more mediation studies. In the 20 included studies, the following psychological constructs were identified and tested as mediators of MBIs: mindfulness, repetitive negative thinking (rumination, worry and concerns), self-compassion, psychological flexibility, emotional reactivity, cognitive reactivity, and AMS. The narrative synthesis described strong and consistent evidence for cognitive and emotional reactivity, consistent and moderate evidence for mindfulness and RNT, and preliminary but insufficient evidence for self-compassion and psychological flexibility as mechanisms of the effects of MBIs on clinical and non-clinical psychological outcomes. The Sobel tests in two separate TSSEM analyses demonstrated that both mindfulness and RNT significantly mediated the effect of MBIs on mental health outcomes such as anxiety, depression, global psychopathological symptoms, stress and negative affect. Although in both TSSEM analyses the causal-steps test indicated partial mediation, several researchers have criticised the distinction between full and partial mediation as being trivial and emphasised the importance of avoiding these concepts when interpreting mediation (e.g. Rucker, Preacher, Tormala, & Petty, 2011). Additionally, unlike the causal-steps method, the Sobel test is able to assess whether or not the indirect, mediated effect is statistically significant (MacKinnon et al., 2002). Therefore, current TSSEM findings are better interpreted using Sobel test over causal-steps results.

These findings are largely consistent with the theoretical underpinnings of MBSR and MBCT. Evidence for mindfulness, cognitive reactivity and emotional reactivity as mechanisms support the key theoretical premises underlying MBSR and MBCT that the cultivation of mindfulness skills leads to insight and non-reactive acceptance of one's experience (Kabat-Zinn, 1982; Segal et al., 2002) which in turn lead to positive outcomes. Findings from this review also support theoretical models or summaries of the mechanisms of mindfulness and MBIs proposed by Baer (2003), Brown et al. (2007), Grabovac et al. (2011), Hölzel et al. (2011) and Shapiro et al. (2006), all of which include non-reactivity or acceptance as mechanisms. Evidence for rumination and worry as mechanisms is also reflected in the underlying theory of MBCT, participation in which is postulated to decrease depressive recurrence through increasing insight into and disengagement from recurrent maladaptive thinking about one's depressive symptoms (Segal et al., 2002). In addition, consistent with current findings, Shapiro and colleagues' model highlights emotional, cognitive and behavioural flexibility as a mechanism that contributes to beneficial outcomes.

Current findings also offer suggestions for theory development. For instance, models explaining how mindfulness and MBIs work could incorporate self-compassion more explicitly as a mechanism. Theoretical accounts of mindfulness and MBIs in combination with this systematic review also highlight gaps in the literature and inform future research assessing the mediators of MBIs. For example, although theories propose attentional control and regulation (e.g. Hölzel et al., 2011; Shapiro et al., 2006), bodily awareness (Hölzel et al., 2011), self-awareness, -regulation and -transcendence (Vago & Silbersweig, 2012) as key mechanisms which work alongside empirically-tested

mechanisms, this review did not identify any studies which have tested these variables as mediators of MBIs. As well as informing theory and future research, current findings also have implications for clinical practice. For instance, they suggest that we may be able to develop MBIs to maximise their therapeutic effects, through emphasising components of these interventions related to mindfulness, rumination, worry, cognitive and emotional reactivity, self-compassion, and psychological flexibility.

Although integrating the findings across the mediation studies in this review advance our understanding of the causal pathways between MBIs and psychological outcomes and guide future research, theoretical developments and clinical practice, most included studies had a moderate risk of bias and at least one of several key methodological shortcomings. For example, although temporal ordering of mediator and outcome variables is crucial to establish mediation (Kazdin, 2007), most studies did not conduct mediational analyses that took temporality into account, thus weakening conclusions about causality. Most studies also lacked active control conditions and did not conduct mediation analysis only on participants who received an adequate dose of the MBI, meaning that change cannot be readily attributed to the MBI rather than to non-specific factors (e.g. participant expectation of benefit, attention from research team, group support). Therefore despite their worth, in the presence of these design flaws, the current body of evidence is likely to be subject to biases and insufficient to provide compelling support for the identified mechanisms. Once future research improving on these limitations has established the mechanisms of MBIs, a next step could be to examine each mechanism in depth, to explore the temporal ordering of its effects in relation to other mechanisms in a multiple mediator model, the degree of overlap between mechanisms in multiple mediator models, the impact of moderator variables on the mediated relationship and whether experimental manipulation of the mechanism affects levels of the outcome.

7.1. Strengths and limitations of the current review

As no known studies have systematically reviewed and provided narrative and statistical syntheses of findings from mediation studies exploring the mechanisms underlying MBIs, the main strength of the current study lies in addressing this gap in the literature. Although Chiesa, Anselmi, and Serretti (2014) recently published a narrative review of the literature on psychological mechanisms of MBIs, their review did not document a systematic, replicable literature search strategy, examined case control and uncontrolled studies alongside RCTs, the former of which do not allow us to infer causality, did not specifically examine mediation studies, a crucial analytic method for establishing a variable as a mediator, and did not conduct statistical syntheses of findings across studies. Another strength of this systematic review is that for the purposes of the narrative synthesis, it did not confine its search to studies with specific samples and outcomes, reflecting the perspective supported by many proponents of mindfulness, that the underlying mechanisms of its effects are the same across different intensities of suffering in all people (e.g. Teasdale & Chaskalson, 2011). The non-significant homogeneity statistics associated with TSSEM analyses, which indicate that the roles of mindfulness and rumination and worry as mechanisms did not significantly differ across different samples, appear to support this approach. However, it is possible that some mechanisms are unique to particular populations or play a larger role in explaining therapeutic change for certain populations than others. Due to the dearth of mediation studies of MBIs, the current review did not examine population-specific mechanisms as this would have further restricted the inclusion criteria. As the number and quality of mediation studies increase, it would be worthwhile for future reviews to address population-specific mechanisms of MBIs.

A further strength of this review is that it only included studies which used MBCT or MBSR as the MBI, as other interventions which

include teachings in mindfulness such as ACT (Hayes & Wilson, 1994) and DBT (Linehan, 1993) differ from MBCT and MBSR and each other in the duration and frequency of mindfulness practice involved, the inclusion of mindfulness psychoeducation and non-mindfulness therapeutic components, and a consensus has not yet been reached regarding the similarity between MBCT and MBSR and these alternative interventions (Chiesa & Malinowski, 2011). Inclusion of multicomponent interventions could inflate effect sizes and make it unclear whether mindfulness or other components lead to positive changes. Thus, including only MBSR and MBCT minimises methodological heterogeneity across studies, allowing meaningful narrative summaries to be constructed and justifying integration of studies using TSSEM. However, it is worth noting that some of the identified mechanisms in this review may also account for the therapeutic effects of alternative interventions. In particular, psychological flexibility has been explored in relation to ACT and found to mediate the effects of ACT on a range of outcomes such as emotional exhaustion (Lloyd, Bond, & Flaxman, 2013), pain-related disability and life satisfaction (Wicksell, Olsson, & Hayes, 2010). Thus, by excluding mediation studies of alternative interventions which include mindfulness teachings, as well as studies of other closely related therapies (e.g. mindfulness-based relapse prevention; Bowen, Chawla, & Marlatt, 2010), this review may have underemphasised the role processes such as psychological flexibility play in implementing therapeutic change. A separate systematic review of mediation studies of alternative interventions would shed light on whether underlying processes are similar across different interventions with mindfulness components.

A limitation of this systematic review is that its conclusions may be affected by between-study differences in design. As the number of publications on mediation studies increases, it will be useful to examine only RCTs, in order to base conclusions on more rigorously designed studies and decrease heterogeneity in methods and quality across studies. As the number of mediation studies increases, other potential limitations, such as rumination and worry being subsumed under RNT rather than assessed separately can also be addressed. Included studies also used a range of measures of mechanisms and outcomes, exposing the review to measurement heterogeneity. However, all included studies were published in peer-reviewed journals and all measures had good psychometric properties, indicating that questionnaires were conceptually and empirically similar. An additional limitation of this review pertains to its strict inclusion criteria, which excluded studies examining mechanisms without a strong theoretical basis, in line with Kazdin's (2007) design requirement to establish mediation. In doing so, it may have overlooked some mechanisms of MBSR and MBCT which have the potential to inform theoretical developments, such as positive and negative affect (Batink et al., 2013). Future reviews could improve on this limitation by instead including Kazdin's design requirement as a quality criterion.

Furthermore, it is possible that the findings from this review are subject to the influence of publication bias. This applies to meta-analyses more generally (Turner, 2013). Although a few included studies reported non-significant indirect effects from their mediation analyses, it is possible that current findings overestimate the effects of the identified mechanisms in mediating the relationship between MBIs and outcomes. For example, some RCTs of MBCT or MBSR may have included rumination as a measure but not published mediation analyses. This may be due to mediation analyses being conducted post-hoc and thus only being reported when there is evidence of mediation. If this is the case, there may be a greater risk of publication bias for mediation studies from RCTs than for RCT outcome studies, and this should be taken into account when interpreting the findings of this review.

Nevertheless, our review presents a valid synthesis of publicly available findings in the field and the aggregated data (AD) meta-analytic approach taken for the TSSEM analyses is typically used to inform practice and policy. Although an individual participant data

(IPD) approach, in which raw data for each participant from each study are used for synthesis, has been advocated as a less biased method (Stewart & Parmar, 1993), currently the best strategy would be to conduct AD synthesis of findings before IPD meta-analysis due to the greater cost of IPD analysis and lack of available IPD datasets (Cooper & Patall, 2009). As the current review was the first to narratively and statistically synthesise findings from mediation studies exploring the mechanisms underlying MBCT and MBSR, the AD approach was taken using published results. However, future systematic reviews of this kind should consider the merits of implementing the IPD meta-analytic approach. Additionally, good practice for future RCTs aiming to conduct mediation analyses would be to publish their full trial protocol and analytic plan prior to analysing their data. Lastly, it is worth noting that current conclusions are not informed merely by the number of significant findings across studies and significant TSSEM results. They are based to a larger extent on whether or not individual studies are adequately designed to establish mediation, the importance of which is reiterated throughout this paper. Therefore, the cautious approach to evaluation taken in this review should minimise the impact publication bias has on the validity of its conclusions.

8. Conclusions

The empirical investigation of the mechanisms of change underlying the effects of MBIs on psychological functioning and wellbeing is a complex yet crucial path on which to embark in order to improve the quality, delivery and effectiveness of the interventions, develop the theoretical underpinnings of mindfulness and MBIs and inform the direction of future research. The current study is the first to systematically review mediation studies to identify and evaluate the strength and consistency of evidence for mechanisms underlying the effects of MBIs. It was also the first to use TSSEM analyses and accompanying Sobel tests to statistically synthesise evidence across mediation studies testing the effects of MBIs on mental health outcomes. It found strong, consistent evidence for cognitive and emotional reactivity, moderate, consistent evidence for mindfulness and RNT, and preliminary but insufficient evidence for self-compassion and psychological flexibility as mechanisms. Moreover, TSSEM analyses and Sobel tests demonstrated evidence for mindfulness and RNT as significant mediators of the impact of MBIs on clinical outcomes. Although included studies using mediation analysis have key methodological shortcomings which preclude strong conclusions regarding mediation, they provide valuable insights into the potential causal pathways connecting MBIs with improved psychological outcomes and construct important groundwork on which future theories and research could build.

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Contributors

JG designed the study, developed the search strategies, conducted the literature searches and wrote the first draft of the manuscript, under the supervision of CS and KC. JG conducted the two-stage structural equation modelling analyses in collaboration with RB. All authors contributed to and have approved the final manuscript.

Conflict of interest

All authors declare that they have no conflict of interest.

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