Mindfulness

Brief mindfulness-based interventions in laboratory context: A systematic review of randomized controlled trials

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Abstract:	Objectives: Brief mindfulness-based interventions conducted in laboratory context have increased in recent years as a novel form of intervention. However, there are no reports of their association with improved psychological health. The main objective of the present study was to systematically review the evidence from randomised controlled trials in a laboratory context of the relationship between brief mindfulness interventions and psychological outcomes. Methods: MEDLINE, Scopus, Open Grey, Psycinfo, Web of Science, Proquest, and the Cochrane Database were searched for relevant publications from inception to March 2019. Search terms included (a) brief mindfulness, and (b) laboratory setting. Results: A total of 4799 studies were reviewed, 19 of which were finally included, only three conducted in a clinical population. All the included studies were from the last decade. A total of 19 psychological variables were included, among which are anxiety, positive affect or distress. The studies differ in the type of intervention, the duration of the intervention and the type of variable studied. Conclusions: Brief mindfulness interventions need to be examined with greater rigor in their application. In order to reach relevant conclusions regarding their implementation, consensus must be reached regarding the type of intervention, settings, timing and target population.
Response to Reviewers:	We have attached every change proposed by the Editor. However, we decided to maintain the concept "mindfulness-based interventions" following the definition provided by Howarth et al., 2019

Brief mindfulness-based interventions in a laboratory context: A systematic review of randomized controlled trials

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Brief mindfulness-based interventions in a laboratory context: A systematic review of randomized controlled trials

Abstract

Objectives: Brief mindfulness-based interventions conducted in laboratory context have increased in recent years as a novel form of intervention. However, there are no reports of their association with improved psychological health. The main objective of the present study was to systematically review the evidence from randomised controlled trials in a laboratory context of the relationship between brief mindfulness interventions and psychological outcomes.

Methods: MEDLINE, Scopus, Open Grey, Psycinfo, Web of Science, Proquest, and the Cochrane Database were searched for relevant publications from inception to March 2019. Search terms included (a) brief mindfulness, and (b) laboratory setting.

Results: A total of 4799 studies were reviewed, 19 of which were finally included, only three conducted in a clinical population. All the included studies were from the last decade. A total of 19 psychological variables were included, among which are anxiety, positive affect or distress. The studies differ in the type of intervention, the duration of the intervention and the type of variable studied.

Conclusions: Brief mindfulness interventions need to be examined with greater rigor in their application. In order to reach relevant conclusions regarding their implementation, consensus must be reached regarding the type of intervention, settings, timing and target population.

Mindfulness has been described as non-judgmental awareness focussed on the present moment (Kabat-Zinn, 1990; Segal et al., 2002; Shapiro & Schwartz, 1999). Mindfulness can be developed through different methods, such as: explicit meditation training (Kabat-Zinn, 1990; Marlatt & Donovan, 2005); as a technique through behavioural practice without meditation (Hayes et al., 2009; Linehan, 1993); or as a brief intervention (Creswell, 2017). Following recent reviews (Creswell, 2017; Schumer et al., 2018), brief mindfulness interventions have taken several forms, ranging from 2-3 week programs; laboratory-based 3- to 4-day interventions; at-home daily practice; to single-session laboratory-based experimental inductions. In this line, Howarth et al. (2019, p. 2) considered a brief mindfulness-based intervention (MBI) to be a unique intervention of "a duration of 30 minutes or less on any one occasion, totalling no more than 100 minutes per week, and lasting up to 4 weeks".

In the last decade, substantial clinical evidence has related mindfulness to psychological well-being. Several meta-analyses and systematic reviews have highlighted the association between mindfulness and diverse psychological outcomes such as decreased stress, anxiety and depressive symptoms (Hofmann et al., 2010; Khoury et al., 2013), and enhanced coping (Grossman et al., 2004). Specifically, recent systematic reviews have found that brief MBI has a positive effect on recovery from dysphoric mood (Howarth et al., 2019; Keng et al., 2011) and are associated with improvements in anxiety and stress symptoms (Gilmartin et al., 2017; Goyal et al., 2014). In this regard, studies suggest that brief MBI buffer negative affect and pain after training, but the effect is small (Creswell, 2017; Schumer et al., 2018). A recent review found mixed results in several variables such as in pain tasks, craving, or emotional regulation strategies (Howarth et al., 2019). These controversial results may be explained by the inclusion of different study designs or types of MBI.

Because of the growing evidence of the benefits of brief MBI and certain psychological variables, it has become necessary to update reviews on the specific relationships between these variables

and brief MBI in laboratory-settings. Although several reviews have studied the association between brief MBI and psychological variables, these reviews have some limitations: a) previous reviews have included different mindfulness approaches; b) the design of the studies included cross-sectional and cohort studies, which cannot offer a considerable experimental control; c) no previous systematic review has specifically focused on the association between brief MBI in a laboratory context and psychological outcomes. The present study, therefore, aimed to systematically review randomized controlled trials available in the literature by examining psychological variables associated with brief MBI in laboratory settings.

Methods

We followed the PRISMA guidelines for reporting systematic reviews (Moher et al., 2009). The protocol was registered in the International Prospective Register of Systematic Reviews (PROSPERO, registration No.: CRD42018091440) on March 21, 2018. Comprehensive literature searches of Scopus, MedLine (through Ovid and Pubmed), the Cochrane Database, Web of Science, Psycinfo, and Open Grey Repository databases were conducted, from inception to December 2018 with no restrictions and were last updated in March 2019. Databases were searched by two reviewers separately (OJJ and AGM). The search strategy incorporated variations and combinations of two different concepts: (1) brief mindfulness; and (2) laboratory setting. Searches were piloted in Ovid and then adapted to run across the other databases. Expert authors were contacted to identify additional records and citations from recent meta-analyses and reviews, and the reference lists of the included studies were checked.

Study selection.

During the study selection, duplicate studies were removed. Based on the screening of the title and abstract, potentially relevant articles were selected. After reading the full text of the articles, a final selection was made. The selection process was completed in duplicate (OJJ and AGM), and

a third reviewer participated in cases of disagreement (DMR). The Kappa inter-agreement statistic was good (κ: 0.63, 95% CI: 0.05-0.48).

Included studies met the inclusion criteria presented in Table 1. The inclusion criteria were considered for various reasons. We only selected studies with an adult population, therefore excluding those focusing on children and adolescents because differences in psychopathology and clinical characteristics between populations would make it difficult to draw conclusions. We included only randomized controlled trials which give the highest level of evidence. In this line, the laboratory setting was included due to the fact that a controlled environment enables a more precise measure of the intervention on the outcome. For this purpose, only one brief MBI session with a maximum duration of 60 minutes was included because the objective was to assess whether the mindfulness instruction had an immediate effect on psychological outcomes. Finally, all languages were considered for inclusion.

- Insert Table 1 -

Summary measures.

The summary measures included in the studies selected were effect size measure (Cohen's d), means, standard deviation, and other reported statistics (e.g. *F*, *t, p*).

Data synthesis.

A data extraction sheet was developed and tested on four randomly selected included studies and refined accordingly. The main characteristics of these studies were rigorously extracted by AGM and verified by a second reviewer (OJJ). Any discrepancies were resolved by discussion between the two reviewers, and a third reviewer (DMR) decided in the event of disagreement. For each study, information was collected about the author(s), year of publication, study country, purpose of the study, sample size, mean age and standard deviation, inclusion criteria,

conditions, duration of intervention, type of delivery, outcome variable, procedure for data collection, task, and main results.

Risk of bias in individual studies.

Quality assessment was performed independently in duplicate (DMR and OJJ), and a third reviewer participated in cases of disagreement (NSR). The quality of the studies was assessed using The Cochrane Collaboration's tool for assessing risk of bias (Higgins et al., 2011), which assesses six domains: sequence generation, allocation concealment, blinding, incomplete outcome data, selective outcome reporting, and other sources of bias; rating quality as low, unclear or high risk of bias.

Results

Search results.

The search strategy produced 4799 potentially relevant studies (see Fig. 1 PRISMA flow diagram), and one further study was also identified from selected references from the articles. Of the total, 1224 were duplicates. After reviewing the title and abstract, 1180 were excluded. Of those remaining, 26 were excluded after reviewing the full text for the following main reasons: 16 were not brief MBIs, five studies were carried out in other settings, and four did not evaluate psychological variables. Finally, 19 articles were included.

- Insert Figure 1 -

Data from the included studies were summarised and presented in Table 2. The vast majority of the studies included were from the last decade (Broderick, 2005; Cruess et al., 2015; Feldman et al., 2010; Garland et al., 2017; Huffziger & Kuehner, 2009; Keng et al., 2016; Kuehner et al., 2009; Lancaster et al., 2016; Liu et al., 2013; Marek et al., 2013; McClintock & Anderson, 2015; McKie et al., 2017; Paz et al., 2017; Pepping et al., 2015; Ramos et al., 2014; Sharpe, et al., 2013; Swain & Trevena, 2014; Villa & Hilt, 2014; Vinci et al., 2014). Nine articles were from the United States (Broderick, 2005; Cruess et al., 2015; Feldman et al., 2010; Garland et al., 2017; Lancaster et al.,

2016; Marek et al., 2013; McClintock & Anderson, 2015; Villa & Hilt, 2014; Vinci et al., 2014). The main tasks employed were mood induction, a manipulation that evokes changes in subjective feelings or affect (Broderick, 2005); cold pressor, which involves immersing the hand in cold water provoking pain of mild to moderate intensity (Liu et al., 2013); and rumination and distraction, in which a spiral-bound booklet is presented and instructions are given either to self-focus or to distract (Broderick, 2005).

- Insert Table 2 -

Study quality.

The results of the quality assessment of the included studies are presented in Table 3. Six studies reported a low-risk sequence generation (Cruess et al., 2015; Garland et al., 2017; Huzzfiger & Kuehner, 2009; McClintock & Anderson, 2015; Sharpe et al., 2013; Vinci et al., 2014), and four studies reported low risk in the blinding domain (Broderick, 2005; Cruess et al., 2015; Garland et al., 2017; Liu et al., 2013). Only one study had a previously published protocol (Garland et al., 2017). Other sources of bias were the use a predominantly female or undergraduate sample (Broderick, 2005; Huzzfiger & Kuehner, 2009; Lancaster et al., 2016; Marek et al., 2013; McClintock & Anderson, 2015; Pepping et al., 2015; Sharpe et al., 2013; Vinci et al., 2014).

- Insert Table 3 -

Synthesis of results.

The studies included a total sample of 2164 participants, with a mean age of 24.19 years. Fifteen studies used an undergraduate sample (78.94%) (Broderick, 2005; Cruess et al., 2015; Feldman et al., 2010; Keng et al., 2016; Kuehner et al., 2009; Lancaster et al., 2016; McClintock & Anderson, 2015; McKie et al., 2017; Liu, et al., 2013; Pepping et al., 2015; Ramos et al., 2014; Sharpe et al., 2013; Swain & Trevena, 2014; Villa & Hilt, 2014; Vinci et al., 2014), and three studies used a clinical sample (Garland et al., 2017; Huffziger & Kuehner, 2009; Marek et al., 2013).

From the 19 articles included, four employed a sample of women only (Feldman et al., 2010; Liu et al., 2013; Marek et al., 2013; Ramos et al., 2014). In the studies that included both men and women participants, the percentage of women in the sample ranged between 50.42% and 90% (Broderick, 2005; Cruess et al., 2015; Garland et al., 2017; Huffziger & Kuehner, 2009; Keng et al., 2016; Kuehner et al., 2009; Lancaster et al., 2016; McClintock & Anderson, 2015; McKie et al., 2017; Pepping et al., 2015; Sharpe et al., 2013; Swain & Trevena, 2014; Villa & Hilt, 2014; Vinci et al., 2014).

Six studies compared a brief MBI group with an active control group (Cruess et al., 2015; Feldman et al., 2010; Garland et al., 2017; Sharpe et al., 2013; Swain & Trevena, 2014; Villa & Hilt, 2014) and the rest compared the intervention with a non-specific control group (Broderick, 2005; Huffziger & Kuehner, 2009; Keng et al., 2016; Kuehner et al., 2009; Lancaster et al., 2016; Liu et al., 2013; Marek et al., 2013; McClintock & Anderson, 2015; McKie et al., 2017; Paz et al., 2017; Pepping et al., 2015; Ramos et al., 2014; Vinci et al., 2014). Regarding the task, eight (42.1%) employed a mood induction task (Broderick, 2005; Huffziger & Kuehner, 2009; Kuehner et al., 2009; McClintock & Anderson, 2015; Pepping et al., 2015; Ramos et al., 2014; Villa & Hilt, 2014; Vinci et al., 2014), three (15.78%) employed a cold pressor task (Liu et al., 2013; Sharpe et al., 2013; Swain & Trevena, 2014), and two (10.52%) employed a stress task (Cruess et al., 2015; Feldman et al., 2010).

Twelve studies (63.15%) provided an audio-recorded intervention (Broderick, 2005; Feldman et al., 2010; Keng et al., 2016; Lancaster et al., 2016; Liu et al., 2013; Marek et al., 2013; McClintock & Anderson, 2015; McKie et al., 2017; Paz et al., 2017; Sharpe et al., 2013; Villa & Hilt, 2014; Vinci et al., 2014), four studies (21.05%) had a therapist as the provider of the intervention (Garland et al., 2017; Pepping et al., 2015; Ramos et al., 2014; Swain & Trevena, 2014), and one study employed a DVD (Swain & Trevena, 2014).

Psychological outcomes.

From the 19 studies, nine studies assessed either positive or negative affect. Different studies found that a brief MBI reduced negative affect in comparison with rumination control groups and distraction control groups in undergraduate samples (Broderick, 2005; McClintock & Anderson, 2015; McKie et al., 2017). In line with these results, Vinci et al. (2014) found that after a mood induction, a brief MBI was as effective as progressive muscle relaxation and more effective than an active control condition in reducing negative affect. Employing clinical samples with major depression, two studies found that a brief MBI was as effective as distraction and more effective than rumination in reducing negative affect after a mood induction (Huffziger & Kuehner, 2009; Kuehner et al., 2009). In women diagnosed with an eating disorder, Marek et al. (2013) found that after exposure to food, negative affect was higher in the brief MBI group than in the distraction group. However, in the non-clinical sample, the brief MBI reduced negative affect. In contrast with these studies, other authors found no differences in negative affect after mood induction in a brief MBI (Kuehner et al., 2009; Lancaster et al., 2016; Ramos et al., 2014).

Results concerning positive affect are contradictory. Positive affect was higher in the brief MBI group after a mood induction in comparison with a control group in undergraduates (Ramos et al., 2014) and in clinical samples (Huffziger & Kuehner, 2009). However, other studies found that positive affect was reduced (Vinci et al., 2014) or there were no significant differences (Broderick, 2005; Kuehner et al., 2009).

Anxiety symptoms were assessed in six studies. In undergraduate samples, anxiety symptoms were reduced after a mood induction in the brief MBI group (McClintock & Anderson, 2015), and with no induction (Lancaster et al., 2016). However, two studies found no significant differences in either undergraduate or clinical samples (Garland et al., 2017; Pepping et al., 2015). After a cold pressor task, Swain & Trevena (2014) found that a brief MBI was less effective than hypnosis in reducing anxiety symptoms. Employing a hyperventilation stressor with deprived smokers, Paz et al. (2017) found that a brief MBI moderated the anxiogenic effect of distress intolerance. Regarding

distress symptoms in undergraduates, one study found that after a cold pressor task, a brief MBI was more effective than a distraction strategy or a spontaneous strategy (Liu et al., 2013). Employing a social stress task, Cruess et al. (2015) found that acute distress was reduced after a brief MBI compared with a control group.

With respect to cognitive outcomes, Kuehner et al. (2009) found that after a mood induction, dysfunctional attitudes increased in the rumination group compared with the brief MBI group. However, another study found no differences in this variable after a computerized cognitive task (Keng et al., 2016). Regarding repetitive thought, one study found that this increased after a stress management task in comparison to progressive muscle relaxation (Feldman et al., 2010). Compared with a control group, women reported higher levels of rumination in the brief mindfulness condition whereas men reported lower levels of rumination after a mood induction (Villa & Hilt, 2014). Related to intrusive thoughts, Ramos et al. (2014) found no differences after a mood induction in the brief MBI. One study compared the differences between a brief MBI, loving-kindness meditation and relaxation in a women-only sample (Feldman et al., 2010). The authors found that repetitive thoughts and decentering increased in the brief MBI group compared with the other groups. McKie et al. (2017) found that paranoid ideation was reduced in the brief MBI group in comparison with the rumination group after a paranoia induction in undergraduates. Concerning pain tolerance after a cold pressor task, whereas one study found no differences in the brief MBI group (Sharpe et al., 2013), another found that pain tolerance was higher in both the brief MBI and the distraction groups (Liu et al., 2013). Finally, a recent study found no causal relationship between a brief MBI and anxiety, avoidance and security, after a mood induction (Pepping et al., 2015).

Discussion

This systematic review provides a comprehensive overview of the association between brief MBI in laboratory-based MBIs and psychological variables. The present systematic review highlighted

the vast diversity in the duration of brief MBI, from 3 to 20 minutes, and in the tasks presented for assessment (Gilmartin et al., 2017).

Consistent with previous reviews (Gilmartin et al. 2017; Keng et al., 2011; Schumer et al., 2018), several outcomes improved after a brief MBI, such as negative affect, distress, and anxiety. These results could be interesting within clinical practice as a brief MBI can be included as a complement in therapeutic processes for reducing negative affect in response to distress or promoting recovery from distress (Schumer et al., 2018). To this effect, a brief MBI could be implemented with participants with no previous experience in mindfulness (Keng et al., 2011). In addition, a brief MBI could be implemented in therapy as an intervention technique through repeated application.

However, we also found variables that have not appeared in previous reviews such as positive affect (Broderick, 2005; Huffziger & Kuehner, 2009; Kuehner et al., 2008; Ramos et al., 2014; Vinci et al., 2014); dysfunctional attitudes (Keng et al., 2017; Khuener et al., 2008); rumination (Villa & Hilt, 2014); decentering, pain tolerance or paranoid ideation (Feldman et al., 2010; Liu et al., 2013; McKie et al., 2017); repetitive thoughts (Feldman et al., 2010); and avoidance, security, or intrusive thoughts (Pepping et al., 2015; Ramos et al., 2014; Sharpe et al., 2013). The differences in variables could be due to previous systematic reviews including several study designs and different mindfulness interventions, or focusing on specific variables (Schumer et al., 2018).

One of the key findings of the present review highlights that several outcomes showed controversial evidence concerning their relationship with a brief MBI. Despite the similarities among the studies (e.g. similar samples, mood induction tasks, duration of the brief MBI ranging from 8 to 10 minutes), the association between positive affect and a brief MBI remains unclear. In this line, anxiety and dysfunctional attitudes also presented controversial results, which could be explained due to the use of different population samples, such as clinical samples (Garland et al., 2017), or smokers (Paz et al., 2017), and the presentation of different tasks such as stress management,

computerized cognitive mood, hyperventilation, or cold pressor (Feldman et al., 2010; Keng et al., 2016; Liu et al., 2013; Paz et al., 2017; Sharpe et al., 2013; Swain & Trevena, 2014). More randomized controlled trials are needed to clarify the association between these variables and brief MBIs.

Literature on mindfulness and specifically about brief interventions has increased in recent decades (Keng et al., 2011). The findings of the present systematic review highlight the need for a standardization of brief MBI, the tasks presented to the participants, and the duration of the interventions. In addition, several studies employed undergraduate samples and were mainly of women. Further studies with different samples, including clinical samples, are needed in order to gain deeper knowledge about brief MBI and their relationship with psychological variables.

Previous studies found that depression was a variable associated with mindfulness (Grossman et al., 2004; Hofman et al., 2010; Khoury et al., 2013; Miró et al., 2011). However, no study was found which assessed depression in a laboratory context after a brief MBI. It is possible that because of their particular characteristics, brief MBI involves psychological processes more than psychological states (Campos et al., 2015). In this line, brief MBI could be implemented to assess changes in psychological states. In addition, in order to ascertain these changes, future studies should assess the variables after a given follow-up period.

Finally, it would be interesting to test whether there is any difference between audio-recorded instructions or the presence of a therapist and whether the type of delivery of the brief MBI has an influence on the psychological variables assessed. Knowing whether it is more effective to employ an audio recording or a therapist could improve the application of brief MBI.

Limitations and future research.

The present systematic review analysed several outcomes associated different psychological variables and brief laboratory-based MBIs. This review has generated further evidence

concerning the importance of each of these outcomes. By including only randomized controlled trials, we minimized the risk of effect bias. In addition, most of the studies included were conducted within the past decade, showing a new trend in mindfulness and, more specifically, in brief interventions.

Nonetheless, our review has several limitations that should be taken into account. First, the quality of the studies included in this systematic review was low. Second, since most of the articles included women-only samples, these results should be interpreted with caution. Third, almost 80% of the studies employed an undergraduate sample, limiting the generalizability of the results. Finally, as there is no common definition of brief MBI in the literature, the authors' definition has been adopted.

Ethics statement

The authors report no relationships that could be construed as a conflict of interest. All authors take responsibility for all aspects of the reliability and freedom from bias of the data presented and their discussed interpretation. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Author contributions

OJJ: designed the study, assisted with the data analyses, and wrote the paper. NSR: collaborated with the design and writing of the study. AG-M: analyzed the data. DMR: collaborated in the design, writing of the study and editing of the final manuscript. All authors approved the final version of the manuscript for submission.

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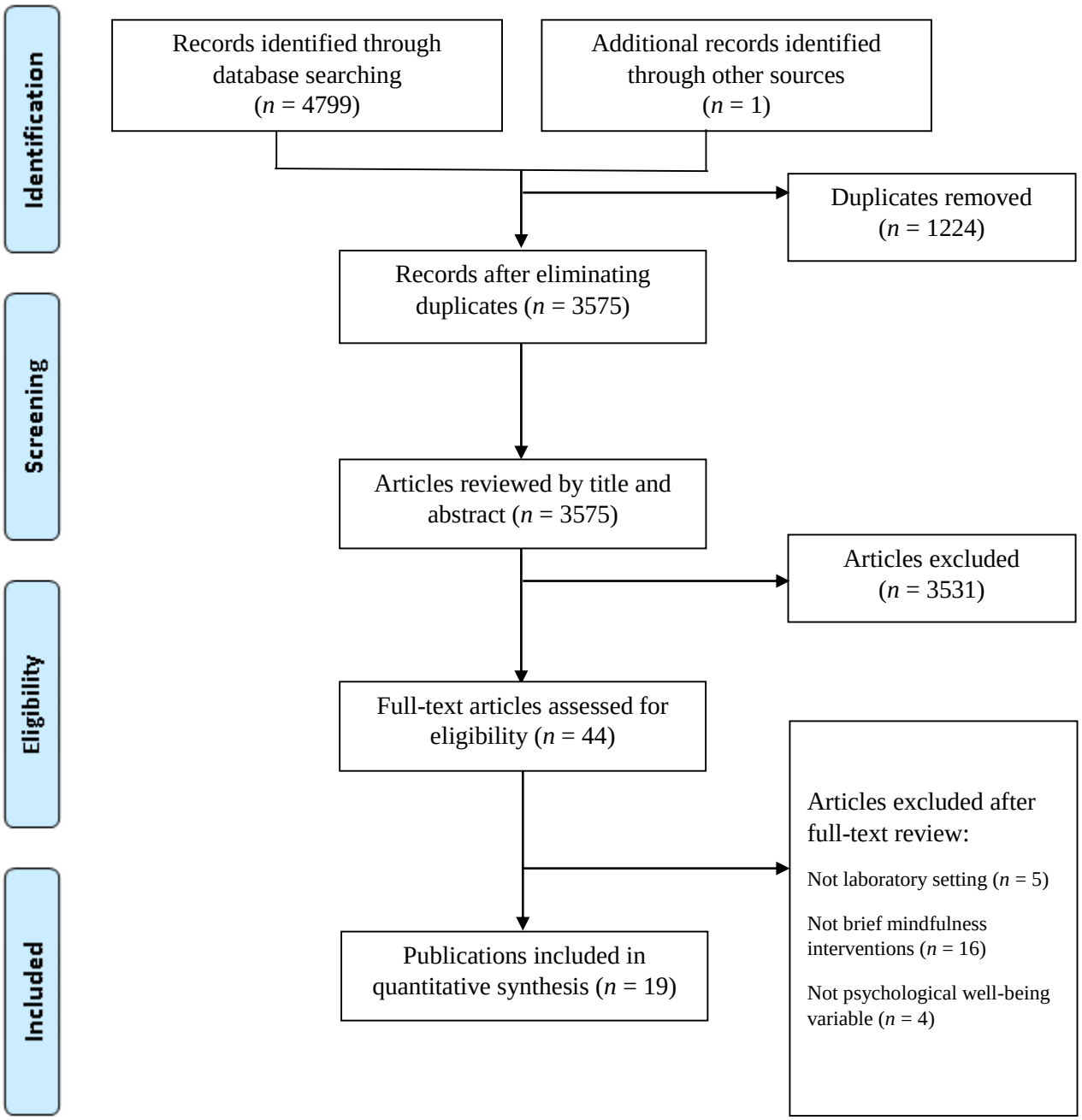

Figure 1. Flow chart of articles included and excluded after the systematic review

Table 1. Inclusion and exclusion criteria for the studies included in the review.

Aspects considered	Inclusion criteria	Exclusion criteria
Population	Clinical and nonclinical adults	Children, adolescents
Outcome	Psychological variables related to wellbeing (e.g. rumination, depressive symptoms, anxiety symptoms, affect)	Non-wellbeing variables
Design	Randomized controlled trials	Cross-sectional, cohort studies, qualitative studies, systematic reviews and/or meta-analysis, protocols, clinical cases, and editors' letters.
Type of intervention	Brief mindfulness intervention (5 to 60 minutes)	Training, meditation programs, behavioral practice without meditation
Language	All languages	None
Setting	Laboratory	School, community, non-laboratory settings

Table 2. Description of the studies included in the present systematic review

Study, Country study[a]	Purpose of the study	Sample size, women % (control / intervention)	Mean age (*SD*)	Inclusion /exclusion criteria	Conditions (control/intervention)	Duration of intervention/ Provider	Outcome variable(s)	Procedure for data collection/task	Main results[1]
Broderick 2005 (US)	To examine whether the practice of mindfulness meditation could reduce dysphoric mood even more effectively than distraction	177, 78.53% (55/61/61)	20.9 (no data provided)	Inclusion: undergraduate students without previous meditation experience.	Rumination; distraction; mindfulness meditation	8 minutes/ audiotaped	Positive and negative affect	Questionnaire / Mood Induction	ANCOVA F(2,171)= 21.49, *partial* η^2 = .20*** ● Positive Affect: F(2,171)= 3.35, *partial* η^2= .03** Rumination Vs. Distraction** 23.6 (7.71) / 26.28 (7.78) ● Negative Affect: F(2,171)= 20.47, *partial* η^2= .19*** Rumination Vs. Distraction** 18.98 (6.06) / 15.39 (4.60) Mindfulness Vs. Rumination*** 14.04 (4.67) / 18.98 (6.60) Mindfulness Vs. Distraction** 14.04 (4.67) / 15.39 (4.60)
Cruess et al., 2015 (US)	To examine whether brief enhanced mindfulness and somatic-relaxation stress management interventions can reduce acute distress levels and buffer the physiological response to social stress in the laboratory.	120, 66.6% (40/40/40)	19.08 (1.02)	Between 18 and 25 years, not reporting an elevated depression risk profile.	Attention-only control group; somatic- relaxation intervention; brief enhanced-mindfulness intervention	15-20 minutes / Script	Acute distress	Questionnaire / Social stress task	ANOVA ● Acute Distress: F(2, 114)= 3.63** Somatic Relaxation Vs. Control -3.72 / 30.81, SE = .14** Mindfulness Vs. Control -4.00 / 30. 81, SE = .14**
Feldman et al., 2010 (US)	To test if mindful breathing has a unique effect on decentering (especially from repetitive thoughts) compared to two other popular stress-management approaches.	190, 100% (63/59/68)	19.83 (1.34)	Inclusion criteria: Being women, non-clinical symptoms, being novice meditators.	Progressive muscle relaxation; loving-kindness meditation; mindfulness breathing	15 minutes / Audio-recorded	Repetitive thought, Decentering	Questionnaires / Stress management tasks	ANOVA ● Repetitive Thought (higuer in Mindfulness) Contrast= -3.09, *SE*= 1.56, *t*= -1.98, *df*= 18, *d*= .31** ● Decentering (higher in Mindfulness) Contrast= -3.60, *SE*= 1.53, *t*= -2.36, *df*= 182, *d*= .36**

									● Negative reaction to thoughts Contrast= .29, *SE*= .74, *t*= .39, *df*= 186, *d*= -.03*
Garland et al., 2017 (US)	To test if a single session of mindfulness or hypnotic suggestion would significantly reduce acute pain intensity and unpleasantness compared to a psychoeducation control condition.	244, 57.4% (85/73/86)	51.1 (16.6)	Inclusion criteria: being older than 18 years; english-speaking inpatients at a public hospital reporting intolerable pain or inadequate pain control; not altered status due to delirium, psychosis, or pharmacological sedation.	Psychoeducation; hypnotic suggestion; mindfulness training	15 minutes / Clinical social workers	Anxiety	Questionnaire /	ANCOVA ● Anxiety (between groups): *partial* η^2= 0.02*** ● Anxiety: Mindful training: *t*= 4.46 *d*= 0.98* 3.93 (3.37) / 2.74 (2.90)
Huffziger & Kuehner, 2009 (DEN)	To assess the effects of experimentally induced rumination, distraction, and mindful self-focus on the course of mood after negative mood induction in a clinical sample of depressed patients 3.5 years after discharge from inpatient treatment.	76, 50% (24/27/25)	47.39 (11.72)	Inclusion criteria: major depression (single or recurrent episode), and dysthymic disorder; depressed patients 3.5 years after discharge from index inpatient treatment.	Rumination; distraction; mindful self-focus	8 minutes / Main author	Positive and negative affect	Questionnaires / Mood induction	ANOVA ● Increased Positive Affect (Mindfulness) F(1,23)= 27.87*** ● Decreased Negative Affect (Mindfulness) F(1,23)= 24.67*** ● Increased Positive Affect (Distraction) F(1,26)= 21.70*** ● Decreased Negative Affect (Distraction) F(1,26)= 17.67*** ● Positive Affect (Rumination) F(1,23)= 1.47* ● Negative Affect (Rumination) F(1,23)= .58*

Keng et al., 2016 (SGP)	To examine whether a brief mindfulness induction would result in improvements in implicit dysfunctional attitudes, as compared to an active control condition.	79, 73% (39/40)	21 (1.92)	Inclusion criteria: Having a score between 10 and 29 on the Beck depression inventory, being between 18 and 55 years, having no color vision deficiency.	Thought wandering condition; mindfulness training condition	15 minutes / Audio-recorded	Dysfunctional attitudes	Questionnaire / Computerized cognitive	Linear regression ● Unchanged in Dysfunctional Attitudes β= .15, *t(54)*= 1.28**
Kuehner et al., 2008 (DEN)	To assess the effects of induced rumination, distraction and mindful self-focus on the course of mood and levels of dysfunctional attitudes.	60, 50% (20/20/20)	22.3 (3.0)	Inclusion criteria: non-clinical young adults.	Rumination, distraction; mindful self-focus	8 minutes / NR	Dysfunctional attitudes, positive and negative affect	Questionnaires /Mood induction	ANCOVA ● Negative Affect: F(2,56)= 5.47** Rumination Vs. Distraction F(1,37)= 24.84*** 14.25 (4.14) / 11.15 (1.39) Rumination Vs. Mindful self-focus F(1, 37)= 2.88* 14.25 (4.14) / 12.95 (5.8) Distraction Vs. Mindful self-focus [F(1, 37)=2.32* 11.15 (1.39) / 12.95 (5.8) ● Positive Affect: F(2,56)= 2,87* ● Dysfunctional Attitudes Scale: F(2,54)= 6,72** Rumination Vs. Distraction F(1,35)= 6,40** 122.05 (17.18) / 105.25 (20.19) Rumination Vs. Mindful self-focus F(1,35)= 16,69*** 122.05 (17.18) / 110.50 (36.46) Distraction Vs, Mindful self-focus F(1,35)= .74* 105.25 (20.19) / 110.50 (36.46)
Lancaster et al., 2016 (US)	To test whether mindfulness meditation provides additional benefits beyond a standard relaxation intervention.	194, 64% (96/98)	19.03 (1.25)	Inclusion criteria: undergraduate students.	Relaxation; mindfulness	15 minutes / Audio-recorded	Cognitive and somatic anxiety, positive and negative affect	Questionnaire / Relaxation	ANOVA ● Cognitive and Somatic Anxiety F(1,184)= 6.26** Relaxation Vs. Mindfulness 13.86 / 16.06 ● Somatic Anxiety (woman) F(1,121)= 3.88, *partial* η^2= .03** Relaxation Vs. Mindfulness 13.96 / 15.34 ● Somatic Anxiety (men) F(1,63)= 2,84, *partial* η^2= .04* ● Positive and Negative Affect (no data provided)*

Liu et al., 2012 (CHN)	To explore the effect of brief mindfulness intervention using pre-recorded instruction on pain experimentally induced by the cold-pressor task.	60, 100% (20/20/20)	20.48 (1.47)	Exclusion criteria: An existing pain condition, history of heart disease, high blood pressure or Reynaud's disease, having previous meditation experience.	Distraction condition; spontaneous condition; mindfulness condition	15 minutes / Audio-recorded	Pain tolerance and distress	Questionnaire / Cold pressor	ANOVA ● Distress: F(2,53)= 4.20** Mindfulness *t*(19) = 2.27** 4.5 (2.24) / 3 (1.86) Distraction *t*(17)= 1.8* Spontaneous *t*(17)= 1.77* ● Pain Tolerance: F (2,53) = 3.70** Mindfulness *t*(19)= -3.32** 51.95 (25.87) / 138.05 (116.55) Distraction *t*(17)= -3.91** 52.61 (17.10) / 128.39 (83.32) Spontaneous *t*(17)= -1.94*
Marek et al., 2013 (US)	To compare mindfulness vs. thought suppression invention during a food exposure in both clinical and non-clinical samples.	40, 100% (40/40)*	29.29 (11.96)	Inclusion: All met criteria for an eating disorder and non clinical sample.	Distracción / mindful eating exercise	15 minutes/ Audio recorded	Positive and negative affect	Questionaire / Food exposure	ANOVA F(1,36)= 8.42, *partial* η^2= .20** ● Negative affect (Control): Mindfulness Eating Exercise Vs. Distraction 14.44 (11.99) / 18.59 (15.87) ● Negative affect (Eating Disorder): Mindfulness Eating Exercise Vs. Distraction 51.29 (26.89) / 48.82 (23.95)
McClintock & Anderson, 2015 (US)	To examine the efficacy of a brief mindfulness intervention for alleviating the affective consequences of interpersonal dependency.	70, 90% (35/35)	19.1 (1.2)	Inclusion criteria: having high levels of interpersonal dependency.	Distraction/Mindfulness	20 minutes / Audio-recorded	Anxiety, negative affect	Questionnaires/ Mood induction	Regression analyses ● Anxiety: β= -0.24), *t*(67)= -2.63** Mindfulness Vs. Distraction 34.09 (11.34) / 35.77 (13.37) ● Negative Affect: *β*= -0.20, *t*(67)= -2.13** Mindfulness Vs. Distraction 12.43 (4.21) / 12.54 (4.53)
McKie et al., 2017 (UK)	To explore whether inducing ruminative self-focus maintains paranoid ideation whilst inducing mindful self-focus reduces paranoid ideation in non-clinical sample.	32, 71.87% (32/32)*	19.25 (1.22)	Inclusion criteria: Score > 60th percentile in a measure of paranoid ideation Exclusion criteria: Reporting past and/or current mental health problems.	Ruminative induction Mindful self-focus induction	8 minutes / Audio file	Negative affect, level of paranoid ideation	Questionnaire (with a visual analogue scale)/ Paranoia induction	ANOVA ● Paranoid ideation: *t*(31)= 7.49, *d* = 1.70*** Mindfulness self-focus Vs. Ruminative 175.45) / 477.56 (210.53) ● Negative Affect: *t*(31)= 5.28, *d*= 1.07*** ● Mindfulness self-focus Vs. Ruminative ● 82.40 (53.38) / 119.34 (90.34)

Paz et al., 2017 (ISR)	To test whether mindfulness de-couples the expected anxiogenic effects of distress intolerance on psychological and physiological reactivity to and recovery from an anxiogenic stressor among participants experimentally sensitized to experience distress.	94, 45.2% (94/94)*	26.02 (5.36)	Between 18 and 65 years of age; smoked regularly for at least one year; currently smoke an average of at least 10 cigarettes per day; exhaled carbon monoxide > 10 ppm; have not reduced number of cigarettes smoked per day by more than half in the past six months; reported Hebrew-language fluency; and reported normal or glasses vision.	Control condition; present moment attention and awareness (PMAA)	7 minutes / Audio-recording	Distress Tolerance, Subjetive anxious arousal (SAA)	Laboratory task experience samples / Hyperventilation	ANOVA ● Association between distress intolerance and degree of SAA in response to stressor: F(4,74)= 2.95** Distress intolerance predicted elevation in SAA: Control Vs. PMAA β= 1.06** / β= .83* Recovery post-stressor, distress intolerance predicted slower recovery and elevation in SAA: Control Vs. PMAA β= .95*** β= .86*** / β= .5* β= .65*
Pepping et al., 2015 (AU)	To examine whether there is a causal relationship between state attachment and state mindfulness.	86, 71.64% (45/41)	20.40 (4.92)	Inclusion criteria: Undergraduate	Control condition; mindfulness induction condition	15 minutes / Experimenter	Anxiety, avoidance, security	Questionnaire/ Mood induction	ANOVA ● Security: F(1,81)= .54, *parcial* η^2= .007* ● Anxiety: F(1,80)= 1.10, *partial* η^2= .014* ● Avoidance: F(1,81)= .54, *parcial* η^2= .007*
Ramos et al., 2014 (SPA)	To examine the effects of trait mindfulness and experimentally induced mindfulness in cognitive and emotional responses to the recollection of an acute stressor.	76, 100% (27/22/27)	23.1 (3.7)	Inclusion criteria: Undergraduate.	Control, analytical, mindfulness	10 minutes / Research assistant	Positive and negative affect, Intrusive thoughts	Questionnaire /Mood induction	ANOVA ● Positive Affect: F(2,76)= 4.93, η^2= .12** Control Vs. Mindfulness 2.14 (0.53) / 2.74 (0.69) ● Negative Affect: F(2,76)= 2.39, η^2= .06* ● Intrusive Thoughts: F(2,76)= 1.62, η^2= .04*

Sharpe et al., 2013 (AU)	To investigate the efficacy of mindfulness training in comparison with relaxation training on pain, threshold and tolerance during the cold pressor task.	140, 72.14% (68/72)	20.05 (3.67)	Exclusion criteria: Having a chronic pain condition; any other current medical or psychological condition; recent use of analgesics; current pain >0 on visual analogue scale; excessive caffeine or alcohol intake in the preceding 24 h; inability to read or comprehend English.	Progressive muscle relaxation; Mindfulness meditation	12 minutes / Audio file	Tolerance	Questionnaire/ Cold pressor	● Tolerance (main effect): Threat: F(1,136)= .006* Training: F(1,136)= .15* ● Tolerance (interaction effect): F(1,136)= 1.86*
Swain & Trevena, 2014 (NZ)	To test if mindfulness and hypnosis interventions are effective acute pain reduction strategies in the laboratory setting.	240, 50.42% (120/120)	21 (2.98)	Exclusion criteria: Having circulatory problems, skin problems, painful conditions serious health problems, being left-handed.	Hypnosis face to face; hypnosis on DVD; mindfulness face to face; mindfulness on DVD	3 minutes / Therapist and DVD	Enjoyment, anxiety	Questionnaire/ Cold pressor	ANOVA ● Enjoyment: F(1.236)= 7.91** Face to Face Vs DVD 5.00, 95% CI 4.83-5.18 / 4.64, 95% CI 4.46-4.82 ● Anxiety: F(1,236)= 4.22** Hypnosis Vs Mindfulness 2.89 / 3.22
Villa & Hilt, 2014 (US)	To compare mindfulness and somatic relaxation in their ability to remediate a negative self-focused ruminative state	114, 61% (36/37/38)	20.25 (N/R)	Non-clinical symptoms	No-treatment control; somatic relaxation; mindfulness:	8 minutes / Audio-recording	State rumination	Questionnaires / Mood induction	ANCOVA ● State Rumination: F(2,102)= 6.98, η^2= .12*** Mindfulness Vs. No-treatment control (women) -2.53, SE= .95** Relaxation Vs. Mindfulness Vs. No-treatment control (men) -2.93, SE= 1.09** / -4.57, SE= 1.11***

Vinci et al., 2014 (US)	To examine the direct effects of mindfulness on negative affect and urge.	207, 76.3% (66/74/67)	20.13 (1.89)	Inclusion criteria: Being college students reporting at-risk drinking (defined as a <6 score on the Alcohol Use Disorders Identification Test (AUDIT), and having and elevated score on the Drinking s Questionaire-Revised (DMQ-R) subscale.	Control group; relaxation intervention, mindfulness intervention.	10 minutes / Audio-recorded	Positive and negative affect	Questionnaire / Mood manipulation	ANOVA ● Negative Effect: F(1,108)= 177.55*** Mindfulness: *t*(38)= .68. 11.37 (.35) / 19.66 (1.13)*** Relaxation: *t*(34)= 8.59. 10.51 (.37) / 19.74 (1.17)*** Control: *t*(38)= 6.41. 13.11 (.35) / 20.82 (1.13)*** ● Groups all significantly decreased in level of Positive Affect: F(2,112)= 6.23** Mindfulness: *t*(38)= 5.33*** Relaxation: *t*(34)= 2.72** Control: *t*(38)= 4.62***

[a] AU: Australia; CHN: China; DEN: Denmark; ISR: Israel; NZ: New Zealand; SGP: Singapour; SPA: Spain; UK: United Kingdom; US: United States
[b] (All participants were in both conditions)
[1] Mean and standard deviation are reported
*** $p \leq .001$ ** $p \leq .05$ * ns

Table 3. Quality of included studies

Study	Sequence generation	Allocation concealment	Blinding of participants personnel and outcome assessors	Incomplete outcome data addressed	Selective outcome reporting	Other sources of bias (e.g. small sample; female sample)
Broderick, 2005	-	?	+	+	-	-
Cruess et al., 2015	+	-	+	+	-	+
Feldman et al., 2010	?	?	?	+	-	+
Garland et al., 2017	+	+	+	+	+	+
Huffziger & Kuehner, 2009	+	?	?	+	-	-
Keng et al., 2016	?	?	-	+	-	?
Kuehner et al., 2009	?	?	?	+	-	+
Lancaster et al., 2016	?	?	-	+	-	+
Liu et al., 2012	?	+	+	+	-	-
Marek et al., 2013	-	?	?	+	-	-
McClintock & Anderson, 2015	+	?	?	+	-	-
McKie et al., 2017	?	?	?	+	-	+
Paz et al., 2017	?	?	?	+	-	+

Pepping et al., 2015	?	?	?	+	-	-
Ramos et al., 2014	?	?	?	+	-	+
Sharpe et al., 2013	+	?	?	+	-	-
Swain & Trevena, 2014	?	?	?	+	-	+
Villa & Hilt, 2014	?	?	-	+	-	+
Vinci et al., 2014	+	?	-	+	-	-

+ Represents low risk; - represents high risk; ? represents unclear risk which means that not evidence was found.