The Effects of Mindfulness-Based Interventions on Suicide Outcomes: A Meta-Analysis

Abstract

Although mindfulness-based interventions (MBIs) have been shown to be effective in treating several psychological difficulties, to date, no review has systematically examined their effectiveness in treating or preventing suicide. The goals of the present study were to (1) evaluate the effectiveness of MBIs in treating suicide and (2) understand how individual characteristics and characteristics of MBIs influence treatment outcomes through a systematic meta-analysis. A search of PubMed, MEDLINE, PsychINFO, and ProQuest Dissertations and Theses was conducted in February 2019. A total of 12 publications (13 studies, $n = 627$) were included. MBIs demonstrated significant moderate effects on suicidal ideation in pre-post studies and small effects in controlled studies. In addition, MBIs demonstrated significant moderate effects in both samples of individuals with histories of depression and histories of suicidal ideation or attempts. Moreover, MBIs led to clinically significant reductions in suicidal ideation and depression. Female participants, older samples, and longer treatments showed greater treatment effects, although these relationships were weak. Results suggest that MBIs may be promising treatments for suicidal ideation; however, more research is needed to establish the effects of these treatments as well as the mechanisms through which MBIs reduce suicide.

INTRODUCTION

Suicide is a significant global public health concern and is the 9th leading cause of death in Canada (Statistics Canada, 2011) and 10th in the United States (Kochanek, Murphy, Xu, & Tejada-Vera, 2016). Despite being a pressing public health concern, there are few existing treatments that target suicide (Office of the US Surgeon General & National Action Alliance for

Suicide Prevention, 2012), and reviews of such treatments indicate a dearth of evidence for their efficacy (World Health Organization, 2010). An investigation of interventions aimed at targeting the positive components of mental health, such as mindfulness-based interventions (MBIs), to offset the risks of suicide is warranted for more effective prevention and intervention.

Mindfulness-Based Interventions

Kabat-Zinn (1994) defines mindfulness as the practice of paying attention to one's experiences in the present moment (e.g., thoughts, feelings, physical sensations) and orienting oneself toward those experiences with an attitude of curiosity, openness, and acceptance. MBIs, such as mindfulness-based stress reduction (MBSR; Kabat-Zinn, 1990), mindfulness-based cognitive therapy (MBCT; Teasdale et al., 2000), and mindfulness-based relapse prevention (Bowen, Chawla, & Marlatt, 2011), are interventions in which mindfulness practice is the primary focus of treatment. MBIs incorporate practices such as guided meditation, mindful practice of daily activities (e.g., mindful eating), body scanning, or breathing exercises with the goal of fostering mindfulness. MBIs have been demonstrated to be effective treatments for a variety of psychological problems, including anxiety and depression (e.g., Khoury et al., 2013).

Individuals who have attempted suicide frequently report doing so in an effort to escape intense emotional pain (Hjelmeland et al., 2002; Holden & DeLisle, 2006; May & Klonsky, 2013; May, O'Brien, Liu, & Klonsky, 2016; Klonsky, May, & Saffer, 2016), which suggests that MBIs may be an effective means of reducing risk of suicide. Whereas suicidal behaviors function as method of escaping emotional pain, mindfulness is the practice of accepting experiences in the present moment, whether pleasant or painful, and can thus be conceptualized as contrary to these behaviors. Studies have found positive associations between mindfulness training and emotion regulation skills (Goldin & Gross, 2010; Hill & Updegraff, 2012; Leahey,

Crowther, & Irwin, 2008;). Conversely, mindfulness has been demonstrated to decrease depressive symptoms which are associated with an increased risk of suicidal ideation (Arria et al., 2009; Hofmann, Sawyer, Witt, & Oh, 2010; Lamis & Lester, 2012). A recent narrative review of MBIs by Chesin, Interian, et al. (2016) found that individuals with a history of suicide attempts demonstrate improvement in attentional control, problem-solving abilities, and a regulated stress response with MBIs. Chesin, Interian et al. (2016) identified these factors as potential mechanisms of action in MBIs.

Although a relatively large number of recent systematic and nonsystematic reviews have examined suicide interventions (e.g., Pirkis et al., 2015; Tarrier, Taylor, & Gooding, 2008; Torok et al., 2020), research on interventions that target the positive components of mental health for suicide remains limited. Given that evidence suggests that deficits in mindfulness may be related to suicidal ideation, a systematic, meta-analytic review investigating the effectiveness of MBIs in treating these difficulties is warranted. Moreover, current understanding of how MBIs may confer their benefits on suicidal outcomes and for higher-risk samples (i.e., individuals with depression) remains limited. Building on the gaps in the existing literature, this is the first meta-analysis to investigates the impact of MBIs on suicidal outcomes. The objectives of the present study are as follows: (1) examine the effectiveness of MBIs on suicide and related outcomes (anxiety, depression, and mindfulness) in pre-post, control, and follow-up studies; (2) explore the impact of MBIs on suicidal ideation, specifically with individuals who have a history of suicide (participants with a history of suicide attempts or ideation) and depression (participants with diagnosed depressive disorder); (3) examine the impact of intervention type and key moderator variables (age, proportion of females, and hours spent in treatment); and (4) examine the clinical significance of MBIs. This meta-analysis aims to provide new insight into the role of specific

intervention characteristics and individual differences in the effectiveness of MBIs for suicidal outcomes. A protocol for the present review was registered with PROSPERO [CRD42019126082].

METHOD

Search Strategy

A comprehensive search of the following databases was conducted in February 2019: PubMed, MEDLINE, PsychINFO, and ProQuest Dissertations and Theses (See Figure 1 for a complete description of search terms used for each database). The reference sections of review papers found in these databases were searched for additional relevant studies. No limits were placed on the searches in terms of date of publication. Theses and dissertations were included in an effort to decrease publication bias and increase the total sample size of studies used in the analysis, given the relatively small number of studies that were expected to meet inclusion criteria.

The retrieved articles were saved in EndNote (version X8.0.1), and duplicate articles were removed. The first and second authors of this study examined 15% of the articles collected from the searches to assess their eligibility for inclusion. Discrepancies were resolved through discussion between reviewers. The authors then divided the remaining articles and independently assessed their eligibility for inclusion.

Methodological quality was assessed by calculating Jadad scores for pre-post and controlled studies (Jadad et al., 1996). Scores for each study were calculated based on several criteria, including whether treatment followed a standardized protocol, whether outcome measures were given at follow-up, the level of clinical training of therapists, and whether

therapists had received formal training in validated mindfulness meditation protocols. Scores for controlled studies were calculated using additional items evaluating the rigor of their blinding and randomization procedures as well as the study's attrition rate. Ratings were completed by the first and second authors, and discrepancies were resolved though discussion.

Eligibility Criteria

Both pre-post and controlled treatment studies that examined the effects of MBIs were included. The goal of the meta-analysis was to understand the effects of mindfulness on suicide-related thoughts and/or behaviors. Thus, studies that used mindfulness as a component of a larger treatment program, such as dialectical behavior therapy or acceptance and commitment therapy (ACT), were excluded. Additionally, studies were excluded if (1) they did not include a quantitative measure of at least one suicide-related variable; (2) they did not report sufficient data to compute effect sizes; (3) they were published in a language other than English; (4) they were published in a format other than a peer-reviewed journal article or dissertation; or (5) the reported data overlapped with existing data that was previously included in another study. In cases where papers did not provide sufficient data to calculate effect sizes, authors were contacted to obtain the relevant information.

Data Extracted

Data collection occurred in March 2019. The following data were extracted from each study: (1) whether the study included a control group, (2) the type of treatment provided, (3) the mean age of participants, (4) the proportion of females in the sample, (5) the attrition rate, (6) type of participant (e.g., people with major depressive disorder, incarcerated youth), and (7) the

number of hours participants spent in treatment. Effect size data were extracted for suicide-related outcomes, outcomes that are associated with suicide, and mindfulness outcomes.

Statistical Analyses

Summary measures

Summary effect sizes were computed using standardized mean differences. All analyses were completed using Microsoft Excel or Comprehensive Meta-Analysis, Version 2 (Borenstein, Hedges, Higgins, & Rothstein, 2005). Analyses were conducted using effect size data all of the studies (i.e., data from the pre-post design studies as well as pre-post data from the treatment groups of controlled studies) and for effect size data from controlled studies only.

Synthesis of results

When possible, effect sizes were calculated using means and standard deviations (SDs). When means and SDs were not available, effect sizes were calculated using other statistics (e.g., *t*). Hedge's *g* was calculated as an effect size measure for all studies, as well as a 95% confidence interval (CI) and the associated *z* and *p* values. A 95% precision interval was calculated, which describes the distribution of true effect size (unlike a confidence interval, which describes the precision of the estimate of the mean effect size). Given the differences between individual studies in terms of design, target population, and outcome variable measured, individual effect sizes were pooled using a random-effects model. Heterogeneity between studies was measured by calculating *Q*, which tests the significance of the variability between studies, as well as I^2, which reflects the proportion of true dispersion in study effect sizes. I^2 has the benefit of being unaffected by scale nor the total number of studies. Higgins, Thompson, Deeks, and Altman's

(2003) cutoffs for I2 were used, where 25% was considered low, 50% was considered moderate, and 75% was considered high.

Subgroup analyses and meta-regressions

Subgroup analyses were conducted for suicide-related outcomes, as well as other psychological outcomes that are associated with suicide risk (depression, anxiety) and mindfulness outcomes. Subgroup analyses were also conducted to compare the mean effect sizes of studies using different treatment modalities (e.g., MBCT vs. MBSR vs. other treatments). Comparisons were made using a *z* test and a pooled estimate of T^2. A meta-regression analysis was conducted with the goal of assessing the impact of the following moderators: length of treatment, study quality (i.e., Jadad score), mean age of participants, and the proportion of females in the studies' samples.

Bias across and within studies

The risk of bias across studies was assessed by computing the fail-safe *N* (Orwin, 1983) and creating a funnel plot. Risk of bias in controlled studies was calculated using the Cochrane Collaboration's tool for assessing risk of bias (Higgins & Altman, 2008). Each study was rated independently by both the first and second author, and discrepancies were resolved though discussion.

Clinical significance

Clinical significance was assessed with the goal of understanding the clinical relevance of the findings of the analysis. There was a large degree of variability between studies in terms of the measures that were used to assess different outcome variables. For this reason, only two outcome measures could be used to assess clinical significance: the Beck Depression Inventory

(BDI-II; Beck, Steer, & Brown, 1996) and the Beck Scale for Suicidal Ideation (BSS; Beck, Kovacs, & Weissman, 1979).

Beck Scale for Suicidal Ideation

The BSS was used as a measure of suicidal ideation in two studies. Weighted means were calculated for average scores on the BSS at pre- and post-testing. Scores of 6 or higher were classified as clinically significant. Although the test creators have not established clinical cutoff scores for the BSS, previous studies have categorized scores of 6 or greater as clinically significant (e.g., Sokero, 2006).

Beck Depression Inventory-II

Of the 13 studies included in the analysis, 7 reported scores from the BDI-II. Weighted means were calculated for these studies at pre- and post-testing. BDI-II scores of 0 to 13 are considered minimal, scores of 14 to 19 are considered mild, scores of 20 to 28 are considered moderate, and scores from 29 to 63 are considered severe (Beck et al., 1996).

RESULTS

Study Selection

The initial search conducted on February 14, 2019, resulted in 378 publications. After thorough examination and application of the inclusion and exclusion criteria described above, 12 publications were included in the analysis—one of which presented the results of two studies—resulting in a total of 13 studies in the final sample (see flowchart in Figure 1 for a detailed description of the search outcomes). An additional paper identified in the search met inclusion criteria for the study (Raj et al., 2019); however, the effect sizes calculated based on the means

and SDs of outcome measures reported in the paper were unusually high, ranging from Hedge's $g = 3.19$ to Hedge's $g = 11.37$. The authors of the paper were contacted to verify the reported SDs, but at the time of submission of this study, verification had not been provided. The decision was made to exclude this study from the analyses to avoid inflating effect sizes. Nineteen publications included either a suicide outcome or data from a questionnaire with a suicide item or subscale without adequate information to calculate an effect size. The authors of these 19 publications were contacted, and two provided data so that effect sizes could be calculated.

Study Characteristics

All of the included studies provided outcome data from measures that assessed suicidal ideation. None of the included studies provided outcome data for suicidal behaviors (e.g., frequency of suicide attempts). Of the 13 studies included, 10 used self-report measures of suicidal ideation, 2 used clinician-administered interviews, and 1 assessed suicidal ideation using both self-report questionnaires and interviews. See Tables 1 and 2 for more characteristics of individual studies. Six of the included studies used a pre-post design, and the remaining seven used a controlled design. Specific characteristics of individual studies are presented in Tables 1 and 2. Table 3 presents the effects (Hedge's g) of individual studies for all outcome measures. Effects on all outcome measures for pre-post data from all studies ($k = 13$) were moderate, Hedge's $g = .46$ (95% CI, [.31, .62], $p < .001$). Overall effects for studies with control groups ($k = 7$) were moderate, Hedge's $g = .39$ (95% CI [.26, .52], $p < .001$) (Table 4).

Effects Grouped by Outcome Measures

All studies

MBIs had significant, moderate effects on suicidal ideation ($k = 13$), Hedge's $g = .45$ (95% CI [.27, .63], $p < .001$), with high heterogeneity ($I^2 = 81.21\%$, $Q = 63.91$). Significant moderate effects were also found for depression ($k = 11$), Hedge's $g = .47$ (95% CI [.28, .67], $p < .001$), and mindfulness outcomes ($k = 3$), Hedge's $g = .81$ (95% CI [.59, 1.04], $p < .001$), with high heterogeneity for depression outcomes ($I^2 = 73.12\%$, $Q = 37.30$) and low heterogeneity for mindfulness outcomes ($I^2 = 10.87\%$, $Q = 2.24$). A moderate-to-low, but nonsignificant effect was found for anxiety outcomes ($k = 3$), Hedge's $g = .39$ (95% CI [−.10, .88], $p = .12$, ns), with high levels of heterogeneity ($I^2 = 87.80\%$, $Q = 16.39$). A complete list of effect sizes grouped by outcome measure for pre-post data is presented in Table 5.

Follow-up data

Of the 13 studies included in the analysis, only 3 included follow-up data for outcome measures. Only one of the studies that included follow-up data used a control group. Thus, follow-up effect sizes were not calculated separately for controlled data. Though nonsignificant, large effects were found across all outcome measures at follow-up, Hedge's $g = .99$ (95% CI [−.20, 2.02], $p = .09$, ns). Large but nonsignificant effects were also found at follow-up for suicidal ideation, Hedge's $g = .91$ (95% CI [−.20, 2.02], $p = .11$, ns).

Controlled studies

Data from studies with control groups ($k = 7$) demonstrated weaker effects on suicide outcomes, compared to those found in the analysis of pre-post data, Hedge's $g = .36$ (95% CI [.20, .53], $p < .001$), and were less heterogeneous ($I^2 = 20.52\%$, $Q = 7.55$). Effects on depression were also found to be weaker, but in the moderate range, Hedge's $g = .43$ (95% CI [.24, .63], $p < .001$), with no heterogeneity ($I^2 = 0.00\%$, $Q = 2.60$). Mindfulness outcome measures were used in

only one controlled study, which showed a significant large effect size, Hedge's g = .73 (95% CI [.38, 1.08], p < .001). This effect was smaller, however, than the effect found for mindfulness in pre-post studies (see above). Anxiety outcomes were also only measured in one controlled study, in which a significant moderate effect was found, Hedge's g = .52 (95% CI [.17, .87], p < .01). A complete list of effect sizes grouped by outcome measure for controlled studies is presented in Table 6.

Effects Grouped by History of Suicide or Depression

Pre-post studies

In pre-post studies, MBIs were found to have significant moderate effects on all outcomes among studies that had samples with histories of suicide (k = 3), Hedge's g = .48 (95% CI [.92, .76], p < .001), with no heterogeneity (I^2 = 0.00%, Q =.10). In studies that used samples of individuals with depressive disorders (k = 5), MBIs were also found to have a significant moderate effect, Hedge's g = .45 (95% CI [.28, .62], p < .001). Significant moderate effects were also found in studies that used other samples (e.g., university students, juvenile correctional samples; k = 3), Hedge's g = .48 (95% CI [.16, .80], p < .001).

Controlled studies

Only one controlled study included exclusively participants with a history of suicide and had significant moderate effects (k = 1), Hedge's g = .58 (95% CI [.14, 1.01], p < .01). In controlled studies, MBIs were found to have significant moderate effects in studies with depressive samples (k = 4), Hedge's g = .44 (95% CI [.20, .68], p < .001) with no heterogeneity (I^2 = 0.00%, Q = .61). MBIs demonstrated significant low-to-moderate effects in studies

categorized as other (e.g., university student sample; $k = 2$), Hedge's g = .33 (95% CI [.16, .50], p <.001) with no heterogeneity (I^2 = 0.00%, Q = .42).

Risk of Bias Within Studies

Controlled studies ($k = 7$) were evaluated using the Cochrane Collaboration's tool for assessing risk of bias (Higgins et al., 2011). All of the included controlled studies were rated high on performance bias, while the risk of selection bias was low across most studies. See Figures 2 and 3 for a complete description of Cochrane biases ratings.

Risk of Bias Across Studies

The effect sizes of pre-post data from all studies across all outcomes corresponded to a z value of 10.55 (p < .001). This indicated that a minimum of 364 studies with null results would be needed in order to nullify the results of the present study. Using the trim and fill method, no studies would need to be imputed to the left of the mean effect size to make the funnel plot for all studies symmetrical, which suggests that the average effect size obtained for pre-post data in the present study may reflect the true effect of MBIs.

The effect sizes of controlled studies corresponded to a z value of 5.62 (p < .001). This indicated that a minimum of 51 studies with null results would be necessary to nullify the findings of the current study. Using the trim and fill method, three studies would need to be imputed to left of the mean effect size to make the funnel plot for controlled studies symmetrical. Based on a random effects model, the new imputed mean would decrease the mean effect size for controlled studies to Hedge's g = .35, 95% CI [.23, .48]. This indicates that the average effect size obtained in the present study may overestimate the actual effect of MBIs.

Additional Analyses

Meta-regression

Meta-regression analyses were conducted on effect results from pre-post studies. The effect of MBIs on all outcomes was positively moderated by the mean age of the sample ($k = 12$; $\beta = .01$, $SE = .00$, $p < .001$), the percentage of females in the sample ($k = 12$; $\beta = .001$, $SE = .00$, p < .001), and the number of hours spent in treatment ($k = 10$; $\beta = .02$, $SE = .00$, $p < .001$), although the strength of these relationships was weak. Thus, effects were greater for older samples, samples with more female participants, and samples that spent more time in treatment. Effects were also positively moderated by study quality (i.e., Jadad scores; $k = 13$; $\beta = .07$, $SE = .02$, $p < .001$), although the effect of this association was small, indicating that higher-quality studies had stronger treatment effects. Finally, mindfulness effects positively moderated the effects of all other outcome scores ($k = 3$; $\beta = .65$, $SE = .11$, $p < .001$) and the effect of this relationship was large, suggesting that improvements in mindfulness account for about 42.3% of the variance in treatment outcomes.

Clinical Significance

BSS

The BSS was used as a measure of suicidal ideation in two studies. At pretreatment, weighted mean BSS scores were in the clinically significant range ($k = 2$, $M = 6.20$). At post-treatment, the average score decreased ($M = 3.52$) and was below the clinical threshold.

BDI-II

Of the 13 studies included in the analysis, 6 reported scores from the BDI-II. At pretreatment, the weighted mean BDI-II score across all six studies was in the moderate range ($M = 23.05$). At post-treatment, the average BDI-II score fell to the mild range ($M = 17.33$).

Studies in which participants had mean scores in the severe range at pretesting on the BDI-II ($k = 4$, $M = 31.41$) fell to the moderate range at post-testing ($M = 23.30$). Studies with average scores in the mild range at pretesting ($k = 1$, $M = 16.5$) fell to the minimal range at post-testing ($M = 8.40$). Studies with average scores in the minimal range at pretesting ($k = 1$, $M = 9.20$) decreased slightly and remained in the minimal range at post-testing ($M = 9.00$).

DISCUSSION

This meta-analysis examined a total of 13 studies ($n = 627$) that measured suicide outcomes following an MBI. This meta-analysis is the first of its kind to assess the effectiveness of MBIs on suicidal ideation. The results of the pre-post study data in present study provide support for MBIs as effective treatments for suicide ideation; however, smaller effect sizes were found in studies with control groups. Although this provides some preliminary evidence for the effectiveness of MBIs in treating suicide, further research with randomized controlled trials is needed to clarify these findings. Results also revealed that MBIs were found to have significant moderate effects on all outcomes among studies that had samples with histories of suicide and depression. Additionally, MBIs seem to promote clinically significant reductions in suicidal ideation and depressive symptoms, as demonstrated by the changes seen in participants' scores on the BDI-II and BSS; however, only a small number of studies measured these outcomes. The results of this study provide support for previous research which has demonstrated the efficacy of MBIs for depression (Hofmann et al., 2010; Khoury et al., 2013).

Results from the meta-regression revealed that studies with older participants, more female participants, and more total hours of treatment were most effective, although the strength of these relationships is weak. Previous meta-analyses examining the MBIs found similar moderating effects (e.g., Per et al., 2020). Effects were also positively moderated by study

quality. Research regarding the association between study quality and the effectiveness of MBIs has been mixed. Similarly to the present study, some have found that study quality positively moderates the effectiveness of MBIs (e.g., Hofmann et al., 2010; Klainin-Yobas, Cho, & Creedy, 2012; Piet & Hougaard, 2011). Other researchers, however, have found a negative relationship between study quality and clinical outcomes (e.g., Khoury et al., 2013; Wykes, Steel, Everitt, & Tarrier et al., 2008). Although a growing body of research is examining the effects of MBIs through high-quality studies (e.g., RCTs), MBI research is still in its infancy, and it is likely that the relationship between study quality and the effects of MBIs will remain unclear until more high-quality clinical trials are conducted.

One of the goals of the present study was to understand the effects of MBIs on suicide-related outcomes. Although significant changes were seen in suicidal ideation measures, it is worth investigating whether these interventions impact mindfulness outcomes. Only four of the included studies collected outcome data related to mindfulness. Despite this, MBIs demonstrated moderate effects on mindfulness outcomes. Furthermore, improved mindfulness outcomes positively and strongly predicted the effects of all other outcome measures included in the study. These findings indicate that mindfulness may be a mechanism through which MBIs confer their benefits. Further research is needed to confirm this association and understand the potential causal relationship between changes in mindfulness and changes in other relevant outcomes.

Limitations

The primary limitation of the present study was the relatively small number of publications ($k = 13$), with relatively small treatment group sample sizes ($M = 43.85$), that met inclusion criteria for the analysis. The small number of studies included may have led to

insufficient power, which in turn may have led to the nonsignificant results seen in some sub-analyses.

All of the included studies reported outcome data for suicidal ideation; however, none reported outcome data for suicidal behavior (e.g., suicide attempts). Thus, while it seems that MBIs may be effective in reducing suicidal ideation, it is unclear what effect MBIs may have on suicide attempts. Furthermore, there was a wide degree of variability in the measures that studies used to assess suicidal ideation. In the 13 studies included in the analysis; six different measures of suicidal ideation were used. This may have contributed to the heterogeneity observed in effect sizes.

Finally, the included studies' sample characteristics were somewhat heterogeneous. Only four of the studies that met inclusion criteria for the review excluded participants with no history of suicide attempts or ideation. The remaining studies assessed suicidal ideation in samples of individuals with depressive disorders or from other populations (e.g., incarcerated youth) who may or may not have had histories of suicide prior to treatment. Although MBIs appeared to be effective in studies that did target individuals with histories of suicide, further research is needed to establish this finding.

Despite the limitations noted above, the results of this meta-analysis have several important implications. First, findings suggest that MBIs may be a viable treatment option for individuals struggling with suicidal ideations. Clinicians may want to consider adopting treatment approaches that focus on mindfulness when working with clients who express suicidal ideation. Second, results suggest that mindfulness-based treatments for suicidal ideation may be a promising area for future research, especially considering the relatively small number of studies that met inclusion criteria for the analysis. Future studies could focus on clarifying the

effect of mindfulness-based interventions on suicidal ideation. Further research using randomized controlled trials could be of particular importance.

CONCLUSIONS

The results of this meta-analysis indicated that MBIs have significant effects on suicidal ideation, as well as psychological outcomes associated with suicide (e.g., depression). Although MBIs seem to cause significant increases in mindfulness, more research is needed to understand the mechanisms though which MBIs lead to decreases in suicidal ideation as well as other related clinical outcomes.

References

Arria, A. M., O'Grady, K. E., Caldeira, K. M., Vincent, K. B., Wilcox, H. C., & Wish, E. D. (2009). Suicide ideation among college students: A multivariate analysis. Archives of Suicide Research: Official Journal of the International Academy for Suicide Research, 13(3), 230–246. doi:10.1080/13811110903044351

Barber-Lomax, L. (2011). Attitudes and change in suicidality and self-harm (Global database) (ProQuest Dissertations & Theses). Ann Arbor: University of Birmingham (United Kingdom). Retrieved from http://etheses.bham.ac.uk/id/eprint/3203/1/BarberLomax_11_ClinPsyD.pdf.

Barnhofer, T., Crane, C., Brennan, K., Duggan, D. S., Crane, R. S., Eames, C., … Williams, J. M. G. (2015). Mindfulness-based cognitive therapy (MBCT) reduces the association between depressive symptoms and suicidal cognitions in patients with a history of suicidal depression. Journal of Consulting and Clinical Psychology, 83(6), 1013–1020. doi:10.1037/ccp0000027

Barnhofer, T., Crane, C., Hargus, E., Amarasinghe, M., Winder, R., & Williams, J. M. (2009). Mindfulness-based cognitive therapy as a treatment for chronic depression: A preliminary study. Behaviour Research and Therapy, 47(5), 366–373. doi:10.1016/j.brat.2009.01.019

Beck, A. T., Kovacs, M., & Weissman, A. (1979). Assessment of suicidal intention: The Scale for Suicide Ideation. Journal of Consulting and Clinical Psychology, 47(2), 343–352. doi:10.1037/ 0022-006X.47.2.343

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). Beck depression inventory-II. San Antonio, TX: Psychology Corporation.

Borenstein, M., Hedges, L. V., Higgins, J. P., & Rothstein, H. R. (2005). Comprehensive meta-analysis (Version 2). Englewood, NJ: Biostat.

Chesin, M., Interian, A., Kline, A., Benjamin-Phillips, C., Latorre, M., & Stanley, B. (2016). Reviewing mindfulness-based interventions for suicidal behavior. Archives of Suicide Research: Official Journal of the International Academy for Suicide Research, 20(4), 507–527. doi:10.1080/ 13811118.2016.1162244

Chesin, M. S., Benjamin-Phillips, C. A., Keilp, J., Fertuck, E. A., Brodsky, B. S., & Stanley, B. (2016). Improvements in executive attention, rumination, cognitive reactivity, and mindfulness among high-suicide risk patients participating in adjunct mindfulness-based cognitive therapy: Preliminary findings. The Journal of Alternative and Complementary Medicine, 22(8), 642–649. doi:10.1089/acm.2015.0351

Chesin, M. S., Sonmez, C. C., Benjamin-Phillips, C. A., Beeler, B., Brodsky, B. S., & Stanley, B. (2015). Preliminary effectiveness of adjunct mindfulness-based cognitive therapy to prevent suicidal behavior in outpatients who are at elevated suicide risk. Mindfulness, 6(6), 1345–1355. doi:10.1007/s12671-015-0405-8

Crane, C., Barnhofer, T., Duggan, D. S., Hepburn, S., Fennell, M. V., & Williams, J. (2008).

Mindfulness-based cognitive therapy and self-discrepancy in recovered depressed patients with a history of depression and suicidality. Cognitive Therapy and Research, 32(6), 775–787. doi:10. 1007/s10608-008-9193-y

Forkmann, T., Brakemeier, E. L., Teismann, T., Schramm, E., & Michalak, J. (2016). The Effects of mindfulness-based cognitive therapy and cognitive behavioral analysis system of psychotherapy added to treatment as usual on suicidal ideation in chronic depression: Results of a randomized-clinical trial. Journal of Affective Disorders, 200, 51–57. doi:10.1016/j.jad.2016.01. 047

Forkmann, T., Wichers, M., Geschwind, N., Peeters, F., van Os, J., Mainz, V., & Collip, D. (2014). Effects of mindfulness-based cognitive therapy on self-reported suicidal ideation: Results from a randomised controlled trial in patients with residual depressive symptoms. Comprehensive Psychiatry, 55(8), 1883–1890. doi:10.1016/j.comppsych.2014.08.043

Galante, J., Dufour, G., Vainre, M., Wagner, A. P., Stochl, J., Benton, A., … Jones, P. B. (2018). A mindfulness-based intervention to increase resilience to stress in university students (the Mindful Student Study): A pragmatic randomized controlled trial. Lancet Public Health, 3(2), e72–e81. doi:10.1016/s2468-2667(17)30231-1

Goldin, P. R., & Gross, J. J. (2010). Effects of mindfulness-based stress reduction (MBSR) on emotion regulation in social anxiety disorder. Emotion (Washington, D.C.).), 10(1), 83–91. doi: 10.1037/a0018441

Higgins, J., & Altman, D. G. (2008). Assessing risk of bias in included studies. Cochrane

Handbook for Systematic Reviews of Interventions: Cochrane Book Series (pp. 187–241).

Higgins, J. P. T., Altman, D. G., Gøtzsche, P. C., Ju€ni, P., Moher, D., Oxman, A. D., … Sterne, J. A. C. (2011). The Cochrane Collaboration's tool for assessing risk of bias in randomised tri- als. BMJ, 343, d5928. doi:10.1136/bmj.d5928

Higgins, J. P., Thompson, S. G., Deeks, J. J., & Altman, D. G. (2003). Measuring inconsistency in meta-analyses. BMJ, 327(7414), 557–560. doi:10.1136/bmj.327.7414.557

Hill, C. L., & Updegraff, J. A. (2012). Mindfulness and its relationship to emotional regulation. Emotion, 12(1), 81–90. doi:10.1037/a0026355

Hjelmeland, H., Hawton, K., Nordvik, H., Bille-Brahe, U., De Leo, D., Fekete, S., … Wasserman, D. (2002). Why people engage in parasuicide: A cross-cultural study of intentions . Suicide and Life-Threatening Behavior, 32(4), 380–393. doi:10.1521/suli.32.4.380.22336

Hofmann, S. G., Sawyer, A. T., Witt, A. A., & Oh, D. (2010). The effect of mindfulness-based therapy on anxiety and depression: A meta-analytic review. Journal of Consulting and Clinical Psychology, 78(2), 169–183. doi:10.1037/a0018555

Holden, R. R., & DeLisle, M. M. (2006). Factor structure of the Reasons for Attempting Suicide Questionnaire (RASQ) with suicide attempters. Journal of Psychopathology and Behavioral Assessment, 28(1), 1–8. doi:10.1007/s10862-006-4532-3

Jadad, A. R., Moore, R. A., Carroll, D., Jenkinson, C., Reynolds, D. J. M., Gavaghan, D. J., &

McQuay, H. J. (1996). Assessing the quality of reports of randomized clinical trials: Is blinding necessary? Controlled Clinical Trials, 17(1), 1–12. doi:10.1016/0197-2456(95)00134-4

Johnson, S. B., Goodnight, B. L., Zhang, H., Daboin, I., Patterson, B., & Kaslow, N. J. (2018). Compassion-based meditation in African Americans: Self-criticism mediates changes in depression. Suicide & Life-Threatening Behavior, 48(2), 160–168. doi:10.1111/sltb.12347

Kabat-Zinn, J. (1990). Full catastrophe living: Using the wisdom of your body and mind to face stress, pain and illness. New York, NY: Delacorte.

Kabat-Zinn, J. (1994). Wherever you go there you are. New York, NY: Hyperion.

Khoury, B., Lecomte, T., Fortin, G., Masse, M., Therien, P., Bouchard, V., … Hofmann, S. G. (2013). Mindfulness-based therapy: A comprehensive meta-analysis. Clinical Psychology Review, 33(6), 763–771. doi:10.1016/j.cpr.2013.05.005

Klainin-Yobas, P., Cho, M. A. A., & Creedy, D. (2012). Efficacy of mindfulness-based interventions on depressive symptoms among people with mental disorders: A meta-analysis. International Journal of Nursing Studies, 49(1), 109–121. doi:10.1016/j.ijnurstu.2011.08.014

Klonsky, E. D., May, A. M., & Saffer, B. Y. (2016). Suicide, suicide attempts, and suicidal ideation. Annual Review of Clinical Psychology, 12, 307–330. doi:10.1146/annurev-clinpsy-021815- 093204

Kochanek, K. D., Murphy, S. L., Xu, J., & Tejada-Vera, B. (2016). Deaths: final data for 2014. Retrieved from https://www.cdc.gov/nchs/data/nvsr/nvsr65/nvsr65_04.pdf.

Lamis, D. A., & Lester, D. (2012). Risk factors for suicidal ideation among African American and European American college women. Psychology of Women Quarterly, 36(3), 337–349. doi:10. 1177/0361684312439186

Leahey, T. M., Crowther, J. H., & Irwin, S. R. (2008). A cognitive-behavioral mindfulness group therapy intervention for the treatment of binge eating in bariatric surgery patients. Cognitive and Behavioral Practice, 15(4), 364–375. doi:10.1016/j.cbpra.2008.01.004

May, A. M., & Klonsky, E. D. (2013). Assessing motivations for suicide attempts: Development and psychometric properties of the inventory of motivations for suicide attempts. Suicide & Life-Threatening Behavior, 43(5), 532–546. doi:10.1111/sltb.12037

May, A. M., O'Brien, K. H. M., Liu, R. T., & Klonsky, E. D. (2016). Descriptive and psychometric properties of the Inventory of Motivations for Suicide Attempts (IMSA) in an inpatient adoles- cent sample. Archives of Suicide Research: Official Journal of the International Academy for Suicide Research, 20(3), 476–482. doi:10.1080/13811118.2015.1095688

Office of the US Surgeon General & National Action Alliance for Suicide Prevention. (2012). 2012 National Strategy for Suicide Prevention: Goals and objectives for action: A report of the U.S. surgeon general and of the National Action Alliance for Suicide

Prevention. Washington, DC: US Department of Health & Human Services. Retrieved from https://www.ncbi.nlm.nih. gov/books/NBK109917/.

Orwin, R. G. (1983). A fail-safe N for effect size in meta-analysis. Journal of Educational Statistics, 8(2), 157–159. Retrieved from https://journals.sagepub.com/doi/pdf/10.3102/10769986008002157?casa_token=LvqfNysBURsAAAAA:16qc2VEz51LhVlis9Jo5KCMa5xDdjJI Qrg1FytYGYolz8pwrjGaLGcw12a73xf-NdzVcDlU2H5LAcw.

Per, M., Spinelli, C., Sadowski, I., Schmelefske, E., Anand, L., & Khoury, B. (2020). Evaluating the effectiveness of mindfulness-based Interventions in incarcerated populations: A meta-analysis. Criminal Justice and Behavior, 47(3), 310–330. doi:10.1177/0093854819891457

Piet, J., & Hougaard, E. (2011). The effect of mindfulness-based cognitive therapy for prevention of relapse in recurrent major depressive disorder: A systematic review and meta-analysis. Clinical Psychology Review, 31(6), 1032–1040. doi:10.1016/j.cpr.2011.05.002

Pirkis, J., San Too, L., Spittal, M. J., Krysinska, K., Robinson, J., & Cheung, Y. T. D. (2015). Interventions to reduce suicides at suicide hotspots: A systematic review and meta-analysis. The Lancet Psychiatry, 2(11), 99. doi:10.1016/S2215-0366(15)00266-7

Raj, S., Sachdeva, S. A., Jha, R., Sharad, S., Singh, T., Arya, Y. K., & Verma, S. K. (2019).

Effectiveness of mindfulness based cognitive behavior therapy on life satisfaction, and life orientation of adolescents with depression and suicidal ideation. Asian Journal of Psychiatry, 39, 58–62. doi:10.1016/j.ajp.2018.12.001

Sokero, P. (2006). Suicidal ideation and attempts among psychiatric patients with major depressive disorder. Publications of the National Health Institute, Helsinki, Finland. Retrieved from https://helda.helsinki.fi/bitstream/handle/10138/23041/suicidal.pdf?sequence=2.

Statistics Canada. (2011). The 10 Leading Causes of Death, 2011. Retrieved from http://www.stat- can.gc.ca/pub/82-625-x/2014001/article/11896-eng.htm.

Tarrier, N., Taylor, K., & Gooding, P. (2008). Cognitive-behavioral interventions to reduce suicide behavior: A systematic review and meta-analysis. Behavior Modification, 32(1), 77–108. doi:10.1177/0145445507304728

Teasdale, J. D., Segal, Z. V., Williams, J. M. G., Ridgeway, V. A., Soulsby, J. M., & Lau, M. A. (2000). Prevention of relapse/recurrence in major depression by mindfulness-based cognitive therapy. Journal of Consulting and Clinical Psychology, 68(4), 615–623. doi:10.1037/0022-006X. 68.4.615

Torok, M., Han, J., Baker, S., Werner-Seidler, A., Wong, I., Larsen, M. E., & Christensen, H. (2020). Suicide prevention using self-guided digital interventions: A systematic review and meta-analysis of randomised controlled trials. The Lancet Digital Health, 2(1), e25–e36. doi:10. 1016/S2589-7500(19)30199-2

Wakeman, E. E. (2010). Modified core mindfulness skills training in an adolescent female correctional sample. The University of Alabama, Ann Arbor. Retrieved from https://proxy.library.mcgill.ca/login?url=https://search.proquest.com/docview/851807587?accountid=12339.

World Health Organization. (2010). Towards evidence-based suicide prevention programs. Retrieved from http://apps.who.int/iris/bitstream/handle/10665/207049/9789290614623_eng.pdf?sequence=1&isAllowed=y.

Wykes, T., Steel, C., Everitt, B., & Tarrier, N. (2008). Cognitive behavior therapy for schizophrenia: Effect sizes, clinical models, and methodological rigor. Schizophrenia Bulletin, 34(3), 523–537. doi:10.1093/schbul/sbm114

Yen, S., Ranney, M. L., Tezanos, K. M., Chuong, A., Kahler, C. W., Solomon, J. B., & Spirito, A. A. (2019). Skills to enhance positivity in suicidal adolescents: Results from an open development trial. Behavior Modification, 43(2), 202–221. doi:10.1177/0145445517748559

Tables and Figures

FIGURE 1. Search results flowchart.

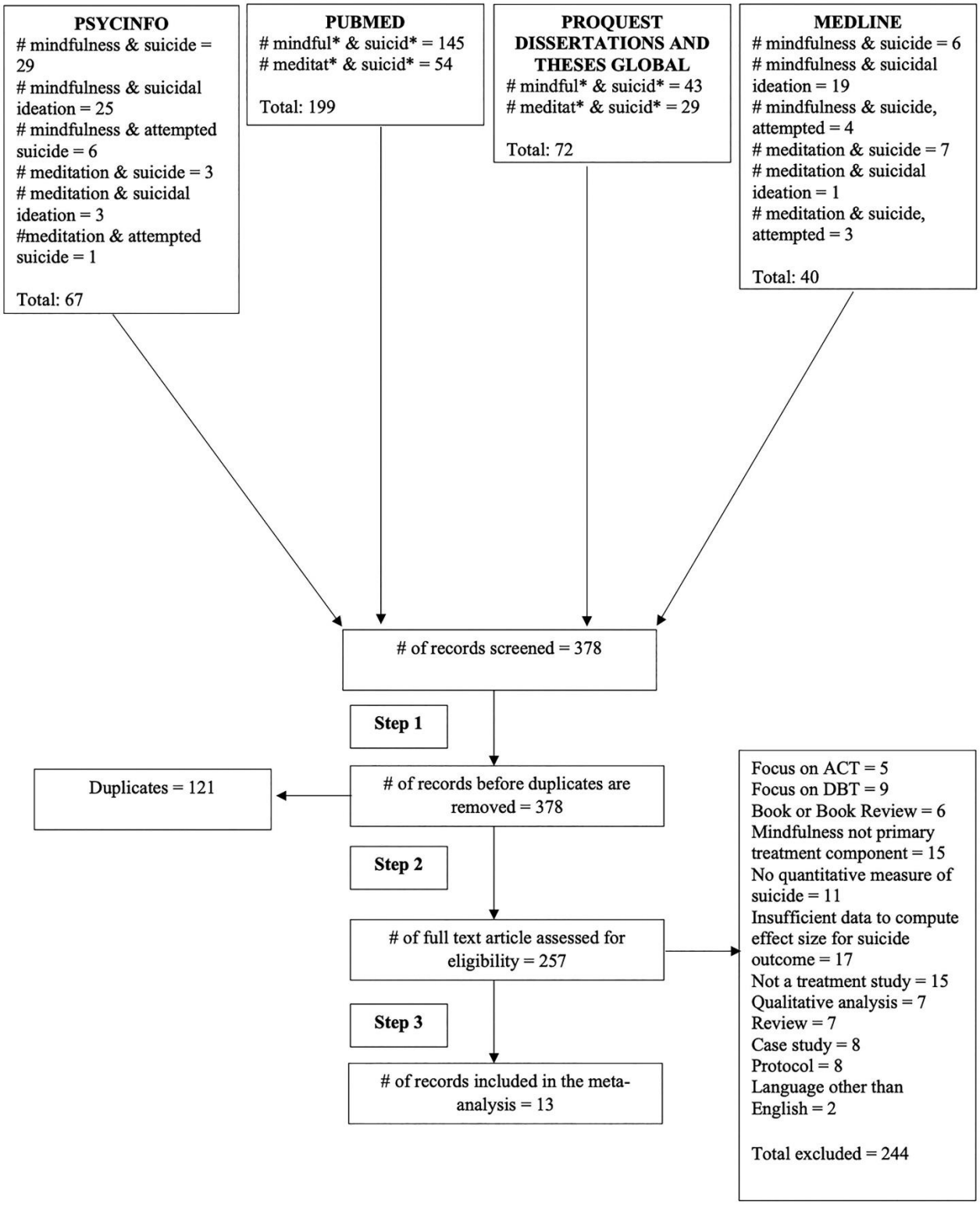

TABLE 1. Characteristics of individual study designs.

Study	Treatment group (n)	Control group (n)	Total hours spent in treatment	Publication type	Suicide outcome measure (description of measure)	Other outcome measures used
Barber-Lomax (2011)	Mindfulness (7)	N/A	6	Doctoral dissertation	LEIDS-R H/S Subscale (self-report)	BDI-II, MAAS, LEIDS-R
Barnhofer et al. (2015)	MBCT (52)	CPE (54) and TAU (26)	16	Journal article	SCS (self-report)	BDI-II
Barnhofer et al. (2009)	MBCT (14)	TAU (14)	16	Journal article	BSS (interview)	BDI-II
Chesin, Benjamin€ • Phillips, et al. (2016)	MBCT-S (10)	N/A	18	Journal article	LEIDS-R H/S Subscale (self-report)	LEIDS-R, FFMQ, SCS-S, RRS-B, Stroop Task, CPT, BSRT, Benton VRT
Chesin et al. (2015)	MBCT-S (16)	N/A	18	Journal article	BSS (interview)	BDI-II
Crane et al. (2008)	MBCT (19)	Wait-list (23)	16	Journal article	BDI-II, item 9 (self-report)	BDI-II, SDQ
Forkmann, Brakemeier, Teismann, Schramm, and Michalak (2016)	MBCT (35)	CBASP (36) and TAU (36)	20	Journal article	BDI-II, item 9 (self-report); HAMD, item 3 (interview)	BDI-II, HAM-D
Forkmann et al. (2014)	MBCT (64)	Wait-list (66)	20	Journal article	IDS-SR (self-report)	Negative Affect, Pleasantness, Positive

						Affect, HAM-D, KIMS, PSWQ, RSS
Galante et al. (2018)	MSS (254)	TAU (216)	Unspecified	Journal article	CORE-OM, items 16 and 24 (self-report)	CORE-OM, WEMWBS
Johnson et al. (2018)	G-CAMP (35)	Support group (24)	Unspecified	Journal article	BDI-II, item 9 (self-report)	BDI-II, SCritS
Wakeman (2010; Study 1)	DBT-M (8)	N/A	20	Doctoral dissertation	ISO-30 (self-report)	AARS, BASC-2 SRP MASC, RADS-2
Wakeman (2010; Study 2)	DBT-M (36)	N/A	20	Doctoral dissertation	ISO-30 (self-report)	BASC-2 SRP, BASC-2 PRS
Yen, et al. (2019)	STEP (20)	N/A	Unspecified	Journal article	SIQ (self-report)	N/A

Note. AARS = Adolescent Anger Rating Scale; BASC-2 PRS = Behavior Assessment System for Children-2, Parent Rating Scale; BASC-2 SRP = Behavior Assessment System for Children-2, Self-Report Scale; Benton VRT = Benton Visual Retention Test; BDI-II = Beck Depression Inventory-II; BSRT = Buschke Selective Reminding Test; BSS = Beck Scale for Suicidal Ideation; CBASP = Cognitive Behavioral Analysis System of Psychotherapy; CORE-OM = Clinical Outcomes in Routine Evaluation Measure; CPE = cognitive psychoeducation; CPT = Continuous Performance Test, Identical Pairs Version; DBT-M = mindfulness component of dialectical behavior therapy; FFMQ = Five-Factor Mindfulness Questionnaire; G-CAMP = Grady Compassion and Meditation Program; HAM-D = Hamilton Depression Scale; IDS-SR = Inventory of Depressive Symptomology-Self-Report; ISO-30 = Inventory of Suicide Orientation; KIMS = Kentucky Inventory of Mindfulness Skills; LEIDS-R = Leiden Index of Depression Sensitivity-Revised; LOT-R = Revised Life Orientation Test; MAAS = Mindful Attention Awareness Scale; MASC = Multidimensional Anxiety Scale for Children; MBCT = mindfulness-based cognitive therapy; MBCT-S = mindfulness-based cognitive therapy for suicide prevention; MSS = Mindfulness Skills for Students Course; MSSI = Modified Scale for Suicidal Ideation; PSWQ = Penn State Worry Questionnaire; RADS-2 = Reynolds Adolescent Depression Scale-2; RRS-B = Response Style Questionnaire-Ruminative Responses Brooding Subscale; RSS = Rumination on Sadness Scale; ScritS = Self-Criticism Scale; SCS = Suicidal Cognitions Scale; SDQ = Strengths and Difficulties Questionnaire; SIQ = Suicide Ideation Questionnaire; SLS = Satisfaction With Life Scale;

STEP = Skills to Enhance Positivity; TAU = treatment as usual; WEMWBS = Warwick-Edinburgh Mental Well-being Scale.

TABLE 2. Characteristics of study samples.

Study	Diagnosis or condition	Age group	Sample type	Mean age	% Females
Barber-Lomax (2011)	History of suicide or self-harm	Adult	Mental health service clients	18	63
Barnhofer et al. (2015)	Suicidal depression	Adult	Community	44.5	74
Barnhofer et al. (2009)	Depression	Adult	Community	42.07	71
Chesin, Benjamin-Phillips, et al. (2016)	History of suicide attempts or current ideation	Adult	Psychiatric outpatient	41.7	80
Chesin et al. (2015)	High suicide risk	Adult	Psychiatric outpatient	41.7	83
Crane et al. (2008)	In recovery from depression	Adult	Community	49.75	Unspecified
Forkmann et al. (2016)	Chronic depression	Adult	Psychiatric outpatient	48.4	58
Forkmann et al. (2014)	Residual depression	Adult	Psychiatric outpatient	44.6	79
Galante et al. (2018)	N/A	Adult	University students	Unspecified	61
Johnson et al. (2018)	Recent suicide attempt	Adult	African American public hospital patients	44.4	50
Wakeman (2010; Study 1)	N/A	Adolescent	Juvenile correctional facility inmates	16.12	100
Wakeman (2010; Study 2)	N/A	Adolescent	Juvenile correctional facility inmates	16.13	100
Yen et al. (2019)	Suicide attempt or ideation	Adolescent	Psychiatric inpatient	15.9	75

TABLE 3. Effects of individual studies and overall effects for all outcome measures in pre-post studies.

				Confidence interval			
Study	Hedge's g	SE	Variance	Lower limit	Upper limit	z value	p value
Barber-Lomax (2011)	0.54	0.27	0.07	0.02	1.07	2.02	.04*
Barnhofer et al. (2015)	0.32	0.11	0.01	0.1	0.54	2.88	.00***
Barnhofer et al. (2009)	0.8	0.23	0.06	0.35	1.26	3.44	.00***
Chesin, Benjamin-Phillips et al. (2016)	0.49	0.35	0.12	0.19	1.18	1.41	0.16
Chesin et al. (2015)	0.44	0.19	0.04	0.06	0.82	2.27	.02*
Crane et al. (2008)	0.22	0.17	0.03	-0.12	0.56	1.27	0.21
Forkmann et al. (2016)	0.44	0.17	0.03	0.11	0.78	2.58	.01**
Forkmann et al. (2014)	0.58	0.11	0.01	0.37	0.78	5.5	.00***
Galante et al. (2018)	0.18	0.05	0.002	0.09	0.23	3.37	.00***
Johnson et al. (2018)	0.78	0.15	0.02	0.486	1.064	5.249	.00***
Wakeman (2010; Study 1)	0.23	0.25	0.06	-0.26	0.71	0.9	0.37
Wakeman (2010; Study 2)	0.21	0.13	0.02	-0.05	0.46	1.61	0.11
Yen et al. (2019)	1.104	0.214	0.046	0.684	1.525	5.153	.00***
Overall Effect	0.603	0.125	0.016	0.357	0.849	4.81	.00***

Note. SE = standard error. *p < .05, **p < .01, ***p < .001.

TABLE 4. Effects grouped by type of treatment in pre-post studies.

				Confidence interval			
Treatment type (n)	Hedge's g	SE	Variance	Lower limit	Upper limit	z value	p value
Author-Developed MBIs (2)	0.27	0.15	0.02	â^'.03	0.56	1.75	0.08
MBCT-S (2)	0.45	0.17	0.03	0.12	0.78	2.67	.008**
MBCT (6)	0.45	0.09	0.01	0.28	0.62	5.19	.00***
CAMP (1)	0.78	0.15	0.02	0.49	1.06	5.25	.00***
STEP (1)	1.1	0.21	0.05	0.68	1.53	5.15	.00***
DBT-M (2)	0.21	0.11	0.01	-.01	0.43	1.85	0.07

Note. CAMP = Compassion and Meditation Program; DBT-M = mindfulness component of dialectical behavior therapy; MBCT = mindfulness-based cognitive therapy; MBCT-S = mindfulness-based cognitive therapy for suicide prevention; MBI = mindfulness-based interventions; = SE = standard error; STEP = Skills to Enhance Positivity. *p < .05, **p < .01, ***p < .001.

TABLE 5. Effects of mindfulness-based interventions grouped by type of outcome measure for pre-post studies.

				Confidence intervals			
Outcome category (n studies)	Hedge's g	SE	Variance	Lower limit	Upper limit	z value	p value
Anxiety (k=3)	0.39	0.25	0.06	-.10	0.88	1.57	0.12
Depression (k=12)	0.47	0.1	0.01	0.28	0.67	4.73	.00***
Mindfulness (k=3)	0.81	0.12	0.01	0.58	1.04	6.82	.00***
Suicide (k=13)	0.61	0.14	0.02	0.33	0.88	4.35	.00***
Other (k=8)	0.68	0.2	0.04	0.29	1.07	3.38	.00***

Note. SE = standard error. *p < .05, **p < .01, ***p < .001.

TABLE 6. Effects of mindfulness-based interventions grouped by type of outcome measure for controlled studies.

				Confidence intervals			
Outcome category (n studies)	Hedge's g	SE	Variance	Lower limit	Upper limit	z value	p value
Anxiety (k=1)	0.52	0.18	0.03	0.17	0.87	2.93	.003**
Depression (k=6)	0.43	0.1	0.01	0.24	0.63	4.37	.00***
Mindfulness (k=1)	0.73	0.18	0.03	0.38	1.08	4.06	.00***
Suicide ideation (k=7)	0.36	0.09	0.01	0.2	0.53	4.23	.00***
Other (k=4)	0.42	0.08	0.01	0.27	0.57	5.6	.00***

Note. SE = standard error.*p < .05, **p < .01, ***p < .001

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FIGURE 2. Cochrane risk of bias ratings across studies.

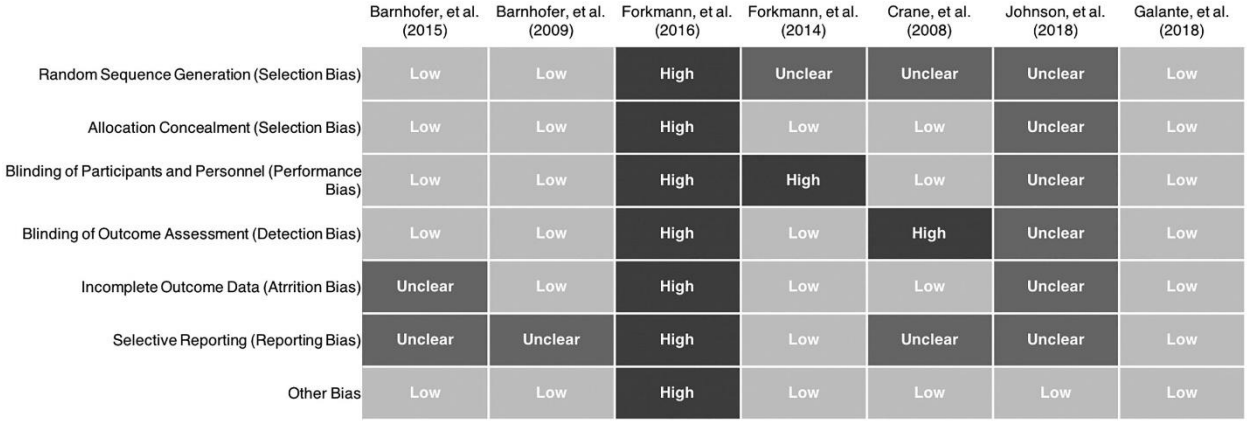

FIGURE 3. Overall Cochrane risk of bias ratings.