

Mindfulness and Weight Loss: A Systematic Review

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Objective: Mindfulness training has been incorporated increasingly into weight loss programs to facilitate dietary and physical activity changes. This systematic review of studies using mindfulness-based programs for weight loss evaluated study methodologies with the goal of determining the current evidence in support of mindfulness interventions for weight loss. **Methods:** Published studies of mindfulness-based interventions for weight loss were identified through systematic review including a comprehensive search of online databases. Studies were reviewed and graded according to methodological strengths and weaknesses. **Results:** A total of 19 studies, including 13 randomized controlled trials and 6 observational studies, evaluated the effects of mindfulness-based interventions on weight among individuals attempting weight loss. Twelve of the studies were published in peer-reviewed journals and seven were unpublished dissertations. Among the eight randomized controlled trials published in peer-reviewed journals, six documented significant weight loss among participants in the mindfulness condition, one reported no significant change, and one failed to report body mass index at program completion. None of the studies documented a relationship between changes in mindfulness and weight loss. **Conclusion:** Significant weight loss was documented among participants in mindfulness interventions for 13 of the 19 studies identified for review. However, studies do not clarify the degree to which changes in mindfulness are a mechanism responsible for weight loss in mindfulness interventions. Methodological weaknesses and variability across studies limit the strength of the evidence. Further research is needed to document and evaluate the psychological, behavioral, and biological mechanisms involved in the relationship between mindfulness and weight loss. **Key words:** BMI, obesity, weight loss, mindfulness, mindfulness-based intervention.

RCT = randomized controlled trial; **MBSR** = Mindfulness-Based Stress Reduction.

INTRODUCTION

Obesity continues to be a major public health problem in the United States today as reflected in recent data indicating that 65% of Americans are overweight or obese (1). Although weight management programs have proliferated in response to the problem, they are plagued by poor weight loss outcomes. It has become clear that education is not sufficient to facilitate weight loss and that comprehensive programs need to address ongoing barriers to weight loss (2,3). Thus, increased research attention has been directed toward identifying and modifying factors that influence one's ability to engage in the behavioral changes necessary for weight loss.

In recent years, multidisciplinary approaches with behavioral support have been the gold standard of behavioral weight management treatment and typically include diet and physical activity components within a cognitive behavioral framework (4,5). These programs are designed to decrease barriers to dietary and physical activity changes while enhancing psychosocial and environmental factors associated with successful weight loss. Mindfulness training has been incorporated increasingly into weight loss programs to facilitate dietary and physical activity changes (6).

Mindfulness originated in East Asian tradition and reflects the Buddhist concept of mindfulness meditation. There are many ways mindfulness has been construed in both treatment and research, but a common element in the operationalization of

mindfulness is a focus on attending to the experiences of the current moment without reacting or judging the observations (e.g., accepting feelings of sadness rather than trying to change them). Mindfulness can include but is not limited to sensory experience, thoughts, and emotions (7,8). Brown and Ryan (8) suggest that mindfulness is a capacity varying in strength from one individual to another, and numerous researchers have suggested that mindfulness is a skill that can be taught (9,10).

Broadly, mindfulness has been associated with enhanced well-being (8). Individuals who tend to be mindful are more likely to report adaptive characteristics (e.g., self-compassion) and less likely to report maladaptive characteristics (e.g., rumination) (11). According to Brown et al. (12), mindfulness facilitates healthy and adaptive self-regulation. Indeed, mindfulness has been associated with various measures of regulatory capacity including self-control (13,14), regulation of sleep (15), and emotion regulation (16). Greater mindfulness also is associated with lower levels of depressive or anxious symptoms, lower negative affect, and higher positive affect (8,12). In addition, evidence has emerged suggesting that mindfulness is associated with physical well-being as well as mental well-being (12).

There are numerous reasons mindfulness could be helpful in the context of weight management (6,17). The ability to modify behavioral patterns is integral to weight loss, and the process of monitoring diet and activity level to decrease calorie consumption and increase caloric expenditure requires substantial self-regulatory capacity. With increased mindfulness, an individual can alter responses rather than continue habitual behavioral patterns that may be inconsistent with an individual's goals and needs (e.g., recognizing bodily signals of hunger and fullness to prevent overeating in response to negative emotions or social cues).

In addition to requiring self-regulation, weight loss is a process that often includes periods of discomfort. Decreased caloric consumption may lead to feelings of hunger, which can be highly aversive. Furthermore, increasing caloric expenditure requires greater physical activity, which may be associated with muscle soreness and pain. Feelings such as hunger and soreness

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are uncomfortable, may be viewed as punishing, and may ultimately discourage an individual from initiating or maintaining life-style changes necessary for weight loss (18,19). However, mindfulness may facilitate tolerance of the discomforts associated with weight loss and greater insight into the process, allowing an individual to continue working toward established weight loss goals (20,21). Thus, it is thought that individuals who exhibit greater mindfulness may be more resilient and better prepared to confront the challenges of weight management.

Past reviews have summarized studies evaluating the relationship between mindfulness and eating behavior, a potential mechanism through which mindfulness may influence weight loss (22–24). Recently, O'Reilly and colleagues (24) conducted a review of mindfulness-based interventions for obesity-related eating behavior, and Katterman and colleagues (23) reviewed mindfulness interventions for eating pathology (i.e., binge eating and emotional eating). Both reviews incorporated studies with weight loss as a secondary outcome, but neither review addressed weight loss as a primary outcome. In addition, neither review focused on mindfulness as a measured mechanism of treatment effects. Measuring mindfulness is essential in determining the degree to which increases in mindfulness may be a mechanism by which mindfulness interventions lead to weight loss. No prior review has focused on methodological strengths and weaknesses of studies in this area or on the degree to which mindfulness may serve as an active treatment component for observed changes in weight or other outcomes.

This review was conducted to focus exclusively on studies of mindfulness-based interventions for weight loss and to examine methodological strengths and weaknesses. The primary goal of the review was to evaluate effects of mindfulness-based interventions on weight change and to further evaluate mindfulness changes as a mechanism by determining the degree to which weight loss is associated with increased mindfulness. Because mindfulness-based weight management programs often include multiple treatment components, there may be several active components in the studies that have been conducted. Thus, measuring change in mindfulness is important for determining treatment fidelity, specifically addressing whether participants received the “active ingredient” of the intervention. Additional features of treatment fidelity (e.g., provider training and treatment implementation) are important areas for future study but beyond the scope of this review. Studies were categorized according to methodological rigor (e.g., randomized controlled trial [RCT] and observational longitudinal study), and each study was evaluated with regard to a) the procedure for assessing mindfulness as a construct and b) the degree to which the study methodology facilitated documentation of a relationship between mindfulness and weight loss.

METHODS

Literature Search

Review of the literature was conducted in accordance with the PRISMA guidelines for systematic reviews and meta-analyses (25,26). To identify studies for inclusion, a comprehensive search of multiple online databases was conducted, including multidisciplinary databases (e.g., Google Scholar, Academic

OneFile, Academic Search Complete, Scopus, Web of Science, and Cochrane Library) as well as discipline-specific databases (e.g., Medline, PsycINFO, PubMed, CINAHL). Search terms included *mindfulness* or *mindfulness-based intervention*, *Acceptance and Commitment Therapy*, *Dialectical Behavior Therapy*, *weight loss* or *weight management*, *obesity* or *body mass index*, and *diet*.

Study Selection

The following inclusion criteria were used to select studies for review: a) original research articles, theses, or dissertations; b) evaluation of a mindfulness-based intervention, defined as an intervention that included at least one training session focused on mindfulness skills such as mindfulness meditation, mindful eating practices, or acceptance-based skills; c) study sample seeking treatment for weight management; and d) weight measured as an outcome variable at baseline and program completion. Articles were excluded if a case study design was implemented, if the sample comprised children or adolescents, or if data were presented only at a conference and no publication or thesis/dissertation from the data was identifiable in the search. Also, studies of postbariatric surgery patients ($n = 3$) were excluded because these patients represent a relatively small proportion of obese individuals and postsurgery weight loss occurs much more rapidly than weight loss in behavioral weight management programs (27). Articles generated from each literature search were reviewed for content relevance based on the title of the study, the study abstract, and the full content of the document.

Data Extraction

The first author (K.L.O.) reviewed all studies and extracted relevant study features for review. In the review process, studies were grouped according to the strength of the methodology used, with RCTs providing the most rigorous test of efficacy for interventions (28) followed by observational studies and cross-sectional designs, as shown in Table 1. Within each category of study designs, methodological factors were evaluated to determine the strength of the study and its utility for evaluating changes in mindfulness as a mechanism leading to weight loss. Factors of critical importance in evaluating the research design included the following: a) use of a validated measure of mindfulness, b) documentation of weight change among participants, and c) statistical analyses of the relationship between changes in mindfulness and weight change. Effect sizes also were extracted when published or effect sizes were calculated if sufficient data were available in the publication. Although it has been argued that mindfulness cannot be assessed adequately with psychometric tools (29), operationalization and objective measurement is critical for empirical study of the mindfulness construct. Thus, in reviewing the procedure for assessing mindfulness in each study, the highest ratings were given to psychometrically sound self-report measures of mindfulness (i.e., published psychometric tools with known reliability and established validity) as opposed to alternative conceptualizations of mindfulness such as amount of time spent practicing mindfulness skills or meditation. Because change in both primary outcomes (i.e., weight and mindfulness) could occur during intervention but still be unrelated, this review also examined the degree to which studies documented a relationship between change in mindfulness and change in weight.

According to these review criteria, the strongest data addressing the influence of increased mindfulness on weight loss would be generated from an RCT in which increased mindfulness and decreased weight were documented among mindfulness participants, and statistical analyses documented a significant association between changes in mindfulness and changes in weight. Using those criteria, the studies were grouped into four classes, A to D. Class A studies were defined as RCTs with a validated measure of mindfulness, assessment of weight change, and analyses evaluating the relationship between change in mindfulness and weight loss. Class B studies were RCTs missing one or more components of a Class A study. Class C studies were longitudinal observational studies with a validated measure of mindfulness, assessment of weight change, and analyses of the relationship between change in mindfulness and weight change. Class D studies were observational studies missing one or more components of a Class C study. Within each class of studies, published articles from peer-reviewed journals were considered stronger evidence than unpublished theses or dissertations.

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TABLE 1. Studies Examining Mindfulness-Based Interventions for Weight Loss

Study	Study Design and Sample Description	Study Methods and Duration	Study Outcome
Class B studies			
Alberts et al. (30)	RCT among overweight and obese men and women ($n = 19$)	Novel 7-session mindfulness-based intervention to increase acceptance of food cravings compared with no additional treatment (10-wk study)	Both conditions significantly decreased weight. [(intervention: $-1.92 [1.73]$ kg; $t(9) = 3.51, p < .01$) (control: $-1.11 [1.38]$ kg; $t(8) = 2.42, p = .04$); mindfulness was not assessed. ^a
Daubenmier et al. (31)	RCT among overweight and obese women ($n = 47$)	Novel mindfulness-based intervention combining components of MBSR and MB-EAT compared with wait-list control (4-mo study)	No significant weight change within intervention group ($-0.03 [2.7]$ kg) or control group ($0.038 [1.9]$ kg) or between groups ($p = .56, d = -0.17$). Significant increase in 3 KIMS subscales (observe ($0.17 [0.5]$; $d = 0.58$), act aware ($0.18 [0.5]$; $d = 0.56$), and nonjudge ($0.47 [0.7]$; $d = 0.66$)) compared with controls. Association between mindfulness change and weight change was not assessed.
Forman et al. (32)	RCT among overweight and obese men and women ($n = 128$)	Novel acceptance-based weight-loss intervention combined with behavior components of LEARN and DPP programs compared with standard behavioral therapy condition (40-wk study)	Significant weight loss for the mindfulness group (10.9% [8.32%]) and control group (8.74% [8.38%]) and no significant difference between groups ($F(1,126) = 1.35, p = .24; \eta^2 = 0.01$); mindfulness was not assessed.
Lillis et al. (33)	RCT among patients who had completed at least 6 mo of a weight loss program ($n = 84$)	1-day mindfulness and acceptance-based workshop compared with wait list control (6-h workshop with assessment at 3 mo postintervention)	Significant weight loss among intervention participants ($-0.40 [1.11]$ kg/m ²) compared with controls ($0.20 [0.75]$ kg/m ²) at follow-up ($F(1,83) = 9.80, p < .01, d = 0.68$); mindfulness was not assessed.
Mantzios and Giannou (34)	RCT among undergraduate students attempting weight loss ($n = 170$)	1-day mindfulness training session followed by either group-based or individual mindfulness meditation (6-wk study)	Group meditation lost (1.83 kg) significantly more weight compared with individual meditation (0.52 kg). Mindfulness (MAAS) increased in both groups, but did not differ by group. Association between mindfulness change and weight change was not assessed. ^a
Mantzios and Wilson (35)	RCT among normal-weight and overweight undergraduates interested in losing weight ($n = 72$)	Daily mindful eating activity before and during meals compared with a daily control task before and during meals (5-wk study)	Significant weight loss among intervention participants ($1.33 [0.99]$ kg) compared with controls ($0.53 [0.85]$ kg; $t(70) = 8.6, p < .001, \eta^2 = 0.51$). Mindfulness (MAAS) increased among intervention participants and decreased among controls ($F(1,70) = 130.90, p < .001, \eta^2 = 0.65$). Association between mindfulness change and weight change was not assessed.
Miller et al. (36)	RCT among overweight and obese individuals diagnosed as having Type 2 diabetes ($n = 52$)	MB-EAT with medical nutrition therapy components compared with diabetes self-management education (3-mo study)	Mindfulness group ($-1.78 [0.54]$ kg) and control group ($-3.24 [0.57]$ kg) significantly decreased weight at program completion. Total FFMQ score significantly increased among mindfulness participants ($0.19 [0.08]$) compared with controls ($0.09 [0.08]$). Association between mindfulness change and weight change was not assessed. ^a

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TABLE 1. (Continued)

Study	Study Design and Sample Description	Study Methods and Duration	Study Outcome
Tapper et al. (37)	RCT among normal-weight and obese women attempting weight loss ($n = 62$)	Novel ACT-based intervention versus individuals directed to continue their own weight loss plans (four 2-h workshops administered for 4 mo)	BMI at program completion was not reported; mindfulness was not assessed. ^a
Davis (38)	RCT among overweight and obese adults ($n = 71$)	SBWL with mindfulness meditation compared with SBWL with resistance training, and SBWL alone (6-mo intervention)	Significant weight loss in the mindfulness group ($-8.0 [0.2]$ kg), resistance group ($-8.8 [1.9]$ kg), and SBWL group ($-6.1 [2.4]$ kg) but no significant difference between groups. Significant increase in mindfulness (MAAS; $p < .001$) over time but no significant difference between groups ($p = .49$). Association between mindfulness change and weight change was not assessed. ^a
Fletcher (39)	RCT among current and former patients in a weight loss clinic ($n = 72$)	ACT intervention focused on physical activity compared with wait-list control group (1-day intervention with assessment after 3 mo).	Significant weight loss in mindfulness group (-4.5 lb, $p = .049$) and control group (-3.9 lb, $p = .063$) but no difference between groups. "Nonjudgment" mindfulness facet (FFMQ) significantly changed among mindfulness and control groups. "Observe," "act with awareness," and "nonreact" facets increased among controls. ^a
Frisvold (40)	RCT among premenopausal nurses at increased risk for cardiovascular disease ($n = 40$)	MBSR compared with perimenopausal education. Each group received 8-wk diet and exercise intervention (16-wk study).	No significant BMI change among mindfulness group (29.62 [4.35] at baseline to 29.23 [4.3] at program completion) or the control group (30.24 [4.36] to 30.15 [4.42]). Mindfulness (CAM) increased in the mindfulness group (32.5 [6.03] to 35.75 [6.26]) and the control group (33.0 [6.9] to 35.07 [6.53]). ^a
Katterman (41)	RCT among normal-weight and overweight college women interested in weight management ($n = 58$)	1-day ACT intervention compared with no treatment control (16-wk study)	Significant weight change among intervention participants ($-4.24 [7.87]$ lbs) compared with the control condition ($+0.19 [5.15]$ lbs); $F(1,40) = 5.28$, $p = .03$, $\eta^2 = 0.12$; mindfulness was not assessed. ^a
Spadaro (42)	RCT among overweight and obese men and women ($n = 46$).	SBWL with mindfulness meditation compared with SBWL alone (24-wk study)	Weight loss in the mindfulness group (6.89 [4.74] kg) and the control group (4.07 [5.65] kg) but no significant difference between groups. Mindfulness (MAAS) and "nonjudge" facet (FFMQ) increased among mindfulness and control groups. Association between mindfulness change and weight change was not assessed. ^a
Class C studies			
Forman et al. (43)	Uncontrolled trial among overweight and obese women ($n = 29$)	Novel acceptance-based weight loss intervention combining behavior components of LEARN program with acceptance-based strategies (12-wk study)	Significant weight loss at program completion (6.6% body weight; $d = 0.42$). Significant increase in mindfulness (PHLMS) at program completion ($t(17) = -3.33$, $p < .01$, $d = 0.78$). Change in mindfulness at program completion was not associated with change in weight at program completion ($r = 0.06$, $p = .80$).

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TABLE 1. (Continued)

Study	Study Design and Sample Description	Study Methods and Duration	Study Outcome
Class D studies			
Dalen et al. (45)	Uncontrolled trial among obese men and women ($n = 10$)	Group-based MEAL program teaching skills to increase awareness of eating and emotions, and decrease self-judgment (6-wk study)	BMI at program completion was not reported. Significant increase in 3 KIMS subscales ([observe, $d = 0.8$], [awareness, $d = 0.6$], and [describe, $d = 0.7$]) ^a
Kidd et al. (46)	Uncontrolled trial among obese women ($n = 12$)	Weekly group program based on "Eat, Drink, and Be Mindful" workbook (8-wk study)	No significant change in weight ($p = .56$, $d = 0.04$) or mindfulness (MEQ; $p = .51$)
Niemeier et al. (47)	Uncontrolled trial among overweight and obese men and women high in internal disinhibition ($n = 21$)	ABBI combining SBWL tools with acceptance-based strategies (24-wk study)	Significant weight loss at program completion (-12.0 kg, $SE = 14$); mindfulness was not assessed. ^a
Hamel (48)	Uncontrolled trial among overweight and obese adults from the community ($n = 10$)	Novel, 10-session mindfulness-based intervention focused on mindful eating (13-wk study)	No significant BMI change ($t(4) = 1.06$, $p = .35$, $d = 0.21$). Significant increase in mindful eating (MEQ; $t(4) = -3.74$, $p = .02$) but no change in mindfulness as measured by the MAAS. Association between mindfulness change and weight change was not assessed.
Lundgren (49)	Uncontrolled trial among overweight and obese adults recruited from community ($n = 33$)	Mindfulness meditation (based on MBSR) in addition to 14 weekly sessions of behavioral weight management (20-wk study)	Significant BMI decrease from baseline (31.3 [3.6]) to program completion (30.3 [4.2]; $F = 15.8$, $p = .001$, $d = 0.21$); mindfulness was not assessed.

RCT = randomized controlled trial; MBSR = Mindfulness-Based Stress Reduction; MB-EAT = Mindfulness-Based Eating Awareness Training; KIMS = Kentucky Inventory of Mindfulness Skills; LEARN = Lifestyles, Education, Attitudes, Relationships, Nutrition; DPP = Diabetes Prevention Program; MAAS = Mindful Attention Awareness Scale; FFMQ = Five Facet Mindfulness Questionnaire; ACT = Acceptance and Commitment Therapy; BMI = body mass index; SBWL = standard behavioral weight loss; CAM = Cognitive and Affective Mindfulness Scale; PHLMS = Philadelphia Mindfulness Scale; MEAL = Mindful Eating And Living; ABBI = Acceptance-Based Behavioral Intervention; SE = standard error; MEQ = Mindful Eating Questionnaire.

Class A = RCTs with a validated measure of mindfulness, assessment of weight change, and analyses evaluating the relationship between change in mindfulness and weight loss (none of the studies met the Class A criteria); Class B = RCTs missing one or more components of a Class A study; Class C = longitudinal observational studies with a validated measure of mindfulness, assessment of weight change, and analyses of the relationship between change in mindfulness and weight change; Class D = observational studies that were missing one or more components of a Class C study.

^a Effect sizes were not reported for this study, and data were insufficient for calculating effect sizes.

Risk of Bias Assessment

A risk of bias assessment was conducted by examining individual components of each study to further inform conclusions regarding treatment effects. At the "study level," retention/attrition, attendance, and adherence data were extracted from each study. At the "outcome level," information regarding the assessment of weight (i.e., measured by research staff versus self-reported) was extracted. Because the assessment of mindfulness is a key criterion in this review, it was not included in the risk of bias assessment. Results of the bias assessment are described at the end of the results section and summarized in Table 2.

RESULTS

The search protocol returned 353 studies. Sixty of the studies were identified as relevant based on the document title, but only 12 articles and 7 dissertations were identified as relevant for inclusion after review of abstracts and full document content.

Class A Studies

None of the studies met the Class A criteria of RCT design, inclusion of a validated measure of mindfulness, assessment of weight change, and statistical analyses evaluating the relationship between mindfulness and weight loss.

Class B Studies

Thirteen studies evaluating the impact of mindfulness-based interventions on weight change were RCTs that did not meet the full Class A criteria (30–42). Five of the 13 studies were unpublished dissertations (38–42). The 13 study samples were varied, ranging from community-residing individuals, to patients with Type 2 diabetes, nurses, and undergraduate students. The sample sizes of studies ranged from 19 to 170 participants with most studies having a sample size within the range of 45 to 90 participants. There was variability in the types of interventions used across studies. Eight studies used novel interventions that incorporated mindfulness-based strategies in addition to psychoeducation regarding strategies for weight loss (30–32,36,38,40–42), and five provided mindfulness-based components without additional psychoeducation regarding weight loss strategies (33–35,37,39). Among the eight published studies, six documented weight loss among individuals in the mindfulness condition (30,32–36), but only four of the studies measured mindfulness (31,34–36) and none of the studies evaluated the relationship between change in weight and change in mindfulness. Among the five unpublished dissertations, four documented

TABLE 2. Data Influencing Risk of Bias in Reviewed Studies

Study	Attrition/Retention	Attendance	Adherence	Weight Measurement
Alberts et al. (30)	Not reported	Not reported	7.6 (4.7) min self-reported minutes practicing mindfulness per day	Recorded by study personnel
Dalen et al. (45)	100% retention	1 participant missed 1 session	Not reported	Method not reported
Davis (38)	72% retention	63.7% (30.2%) classes attended in total sample	5.29 (2.9) self-reported mindfulness practices per week	Recorded by study personnel
Daubenmier et al. (31)	92% retention	68% classes attended among all participants	98 (79) self-reported minutes practicing mindfulness per week; 5.9 (4.4) meals eaten mindfully per week	Recorded by study personnel
Fletcher (39)	81% retention among ACT condition and 86% retention among controls	Not relevant due to single-session intervention	Not reported	Recorded by study personnel
Forman et al. (43)	65.5% retention	74% classes attended by completers	60.09 (23.98) homework assignments submitted	Recorded by study personnel
Forman et al. (32)	77% retention	77% of classes attended by ACT participants; 70.4% attended by controls	Not reported	Recorded by study personnel
Frisvold (40)	90% retention	12.3 (1.8) of 16 classes attended by MBSR participants; 10.1 (2.2) by controls	Not reported	Recorded by study personnel
Hamel (48)	50% retention	Not reported	Not reported	Method not reported
Katterman (41)	81% retention	97% of classes attended by completers	Not reported	Recorded by study personnel
Kidd et al. (46)	58% retention	78% of completers attended ≥ 4 classes	Not reported	Recorded by study personnel
Lillis et al. (33)	95% retention	Not relevant due to single-session intervention	73% of participants reported using the treatment manual	Recorded by study personnel
Lundgren (49)	58% retention	Not reported	Average of 7.4 self-reported mindfulness practices per week during the first 7 wk and 4.2 practices per week during weeks 8–20	Method not reported
Mantzios and Giannou (34)	83% retention	2.98 (2.18) missed sessions among group-based mindfulness participants compared with 1.67 (1.87) among individual mindfulness participants	Not reported	Recorded by study personnel
Mantzios and Wilson (35)	60% retention	Not relevant due to self-guided intervention	Participants were excluded if they did not complete 3 diaries per day	Recorded by study personnel
Miller et al. (36)	75% retention	Not reported	Not reported	Recorded by study personnel
Niemeier et al. (47)	86% retention	86% class attendance	Not reported	Recorded by study personnel
Spadaro (42)	76% retention	75% class attendance among mindfulness participants and 62% among controls	34.9 min of self-reported mindfulness practice per week; self-reported 5.29 (2.9) mindfulness practices per week	Recorded by study personnel
Tapper et al. (37)	100% retention in intervention group and 90% in control group	48% attended all workshops	Not reported	Recorded by study personnel

ACT = Acceptance and Commitment Therapy; MBSR = Mindfulness-Based Stress Reduction.

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significant weight loss in mindfulness participants (38,39,41,42) and four studies measured mindfulness (38–40,42). None of the Class B dissertations evaluated the relationship between change in mindfulness and weight loss at program completion.

Class C Studies

One study met the criteria of a Class C study. Forman and colleagues (43) conducted an observational, longitudinal study of the effects of a 12-week acceptance-based weight loss intervention that included a mindfulness component among overweight and obese women ($n = 29$). Participants were assessed at baseline and at program completion, and mindfulness was measured with the Philadelphia Mindfulness Scale (44). Significant weight loss was documented between baseline and program completion, and mindfulness increased from baseline to program completion. However, there was no relationship between percentage of weight loss at program completion and mindfulness change from baseline to program completion. This study included documented changes in weight and mindfulness and is the only published study directly testing the relationship between a validated measure of mindfulness and weight change.

Class D Studies

Five observational studies did not meet Class C criteria (45–49). Two of the five were unpublished dissertations (48,49). The samples for the studies comprised community-residing individuals, and sample sizes ranged from 5 to 33 participants. All five studies used novel interventions that combined mindfulness-based components with psychoeducation for weight loss strategies (45–49). One of the three published studies documented significant weight loss among participants but did not measure mindfulness (47). The other two published studies measured mindfulness, but one of the studies did not document significant weight loss among participants (46) and the other study reportedly measured weight at program completion but did not include data on post-program weight in the results (45). The relationship between change in mindfulness and weight loss was not assessed in any study. One dissertation in this group of studies documented significant weight loss but did not measure mindfulness (49), and the other dissertation failed to observe significant weight loss among participants (48).

Risk of Bias Assessment

Retention data were available for all but one (30) of the 19 studies, and retention ranged from 50% (48) to 100% (45). Attendance data were available for 12 of 16 studies, but attendance was not relevant for two studies evaluating 1-day workshops (33,39) or for one study of a self-guided intervention (35). Attendance data in the remaining studies were reported in a variety of ways. Reported class attendance ranged from 63% (38) to 98% (45), and percent of participants who completed a study-established threshold number of classes ranged from 48% (37) to 78% (46). Seven of 19 studies (30,31,33,38,42,43,49) provided information about adherence to intervention recommendations, as shown in Table 2. Sixteen of 19 studies included objective measurement of participant weight at baseline and program

completion (30–43,46,47), with the primary method being a digital scale. Three studies did not clearly indicate whether weight was assessed by study staff members or was collected via self-report methods (45,48,49). Most studies provided information regarding retention and measurement of weight as a primary outcome. However, attendance and adherence were inconsistently available for review. When reported, results for retention, attendance, and adherence were highly variable rendering the conclusions vulnerable to bias.

DISCUSSION

Of the 19 studies identified for review, 13 documented significant weight loss among participants in a mindfulness condition (30,32–36,38,39,41–43,47,49). Thus, the weight outcomes might suggest that mindfulness is beneficial for weight loss. However, consideration of methodological strengths and weaknesses results in a less sanguine view of increased mindfulness as a mechanism for weight loss. Among the 13 RCTs reflecting the strongest test of mindfulness interventions, three of the published studies documented significant weight loss and significant improvement in mindfulness (on at least one subscale of a mindfulness measure) at program completion (34–36), as did three unpublished dissertations (38,39,42), but the relationship between change in weight and change in mindfulness was not evaluated. Two RCTs (one published (31) and one unpublished (40)) documented significant improvement in mindfulness but failed to find significant weight loss. Three additional RCTs resulted in significant weight loss among intervention participants but did not measure mindfulness (30,32,33). Among the six observational studies, three reported significant weight loss among participants (43,47,49), but the methodologically strongest of the observational studies failed to find a significant association between weight loss and mindfulness change at program completion despite significant change in both variables (43). Effect sizes for weight loss ranged from 0.01 to 0.68 among RCTs and 0.04 to 0.42 among the observational studies, reflecting treatment effects ranging from weak to strong in both types of studies.

The degree to which studies elucidate the relationship between weight loss and mindfulness is limited by methodological factors. Only 7 of the 12 published studies included a measure of mindfulness (31,34–36,43,45,46), and approximately one-third of the 19 studies did not include a measure of mindfulness (30,32,33,37,41,47,49). Forman and colleagues (43) conducted the only empirical assessment of the relationship between a validated measure of mindfulness and weight change. However, they found that increased mindfulness was not associated with weight loss at program completion.

Measurement of mindfulness is essential in documenting the validity and efficacy of the mindfulness intervention. Because most of the reviewed interventions were comprehensive and included many components (e.g., education regarding diet and physical activity, self-monitoring of behavior) in addition to mindfulness training, assessment of mindfulness is especially important for documentation of the extent to which increased mindfulness

is an active component of treatment. The absence of any measure of mindfulness in multicomponent programs severely limits conclusions about the influence of mindfulness per se on weight loss because a measure of mindfulness is necessary to confirm that changes in mindfulness are associated with weight loss. There are various ways to operationalize mindfulness, and numerous approaches have been used to measure the construct. A secular definition of mindfulness has been the focus of this review, although this more “Westernized” view of mindfulness may not adequately represent the construct, as it was originally conceived in Buddhist teachings (29). Further research is needed to operationalize alternative conceptualizations of mindfulness and to establish alternative, reliable methods for measuring mindfulness. Measurement of the construct remains essential for future efforts to empirically study mindfulness and to determine the degree to which increased mindfulness is a mechanism leading to weight loss. As the study of mindfulness has progressed, assessment tools have increased in number. Six different mindfulness measures were used among the studies reviewed (8,10,44,50–52), and efforts to improve the measurement of mindfulness are ongoing (53). As is the case with selection of any psychometric tool, it is essential to review the psychometric properties of available options and identify a measure that is appropriate theoretically and conceptually to measure the construct of interest (see Baer (53) for an overview of measuring mindfulness).

Assessing mindfulness is one strategy that will enhance the methodological rigor of mindfulness studies and provide clarity regarding mindfulness change as an active component of outcomes. In addition, it would be important to use more rigorous research designs such as a constructive research design (i.e., control group that receives all of the intervention components except mindfulness; intervention group receives everything including mindfulness). In such a study, differential effects on outcome variables among mindfulness participants could then be more readily attributed to the mindfulness component. Another promising, scientifically rigorous approach would be to use a mindfulness-based intervention of known efficacy rather than a novel or hybrid intervention. For example, replicated findings suggest that Mindfulness-Based Stress Reduction (MBSR (7)), a manualized empirically supported intervention, leads to reliable increases in mindfulness, and in a systematic review of MBSR implemented among patients with various health conditions, reliable effects of medium size were found (54). Although other evidence-based treatments such as Acceptance and Commitment Therapy and Dialectical Behavior Therapy include a mindfulness component and are effective for the treatment of a variety of psychological disorders (55,56), use of MBSR or other mindfulness-specific interventions would provide greater control of the mindfulness content than studies with novel, untested mindfulness-based interventions.

It would also be important to isolate mindfulness as an active component of treatment by using more appropriate control groups. A variety of control conditions were used among studies in this review, ranging from active treatment to wait-list groups. Wait-list or no-treatment control groups provide control for the effect of time but do not control for other aspects of the intervention

experience such as social support. Active treatment control conditions also may pose a threat to validity as demonstrated by the fact that seven of the eight reviewed RCTs that measured mindfulness (including published studies and unpublished dissertations) documented increased mindfulness in both the intervention and the control conditions (31,34,36,38–40,42). MacCoon and colleagues (57) developed and validated an intervention specifically designed to serve as an active control condition when testing the effects of MBSR. The authors aimed to isolate the effects of mindfulness from MBSR by providing a control condition that would account for potentially confounding variables (e.g., structural features of the program such as number and duration of sessions) but would not affect mindfulness among control participants.

Although mindfulness is increasingly incorporated into weight management programs (6,58), it remains unclear whether mindfulness actively influences weight loss. Among published and unpublished studies, there is no solid evidence that changes in mindfulness have been an active component of treatment when weight loss has been observed. Furthermore, incomplete reporting of individual components identified in the risk of bias assessment (e.g., attendance and especially adherence) underscores the need for more complete reporting of study level variables that may contribute to biased estimates of treatment effects.

There is a need for further studies that will provide a more rigorous test of mindfulness as a treatment for weight loss. A number of methodological concerns have been identified, and suggestions to improve upon these weaknesses in the literature have been provided. Measurement of mindfulness and careful attention to control conditions are two strategies that will facilitate a scientifically rigorous approach in this area of research and will better inform the intervention literature. Greater control of study variables (e.g., intervention components known to have an impact on weight loss such as behavior monitoring) is warranted to improve the strength of data regarding effects of mindfulness treatment on weight loss and the role of mindfulness as a mechanism of treatment effects. Closer attention to methodological issues identified in this review will facilitate development of mindfulness interventions for weight loss that are both empirically driven and theoretically sound.

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