



Mindfulness as therapy for disordered eating: a systematic review

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Practice points

- There is growing interest in mindfulness-based cognitive-behavioral therapies (CBTs), such as dialectical behavior therapy (DBT), mindfulness-based cognitive therapy (MBCT), mindfulness-based eating awareness training (MB-EAT), and acceptance and commitment therapy (ACT), as treatments for a range of disordered eating concerns.
- DBT modified for disordered eating is a standalone treatment for bulimia nervosa (BN), binge eating disorder (BED) and eating disorders comorbid with borderline personality disorder or substance use disorders.
- Evidence for MBCT is limited. Preliminary uncontrolled data suggest that MBCT alone may be a promising treatment for binge eating in patients diagnosed with BED.
- Early controlled studies suggest that MB-EAT is a useful intervention targeting binge eating and compulsive overeating.
- Evidence for ACT is limited for BN, BED and general disordered eating concerns. However, ACT alone seems to promote greater functioning and quality of life in patients with obesity, and an ACT-enhanced weight loss program promotes and maintains weight loss.
- Available evidence for mindfulness-based CBTs for disordered eating concerns varies in methodological rigor, and across interventions and types of disordered eating concerns. There is considerable overlap across different mindfulness-based CBTs and significant variation even within a single type of mindfulness-based CBT.
- As with other clinical interventions, evidence is extremely limited for mindfulness-based interventions as treatments for anorexia nervosa.
- Although mindfulness-based CBTs appear to be promising interventions, it remains unclear if these treatment modalities are comparable to the extant treatments of choice for disordered eating concerns. Additional research is needed in this area.

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SUMMARY Recently there has been growing interest in mindfulness-based cognitive-behavioral therapies in the field of disordered eating treatment as an alternative or as an adjunct to extant treatment. The aims of this review are to comprehensively identify, summarize and critically evaluate the available outcome evidence of mindfulness-based cognitive-behavioral therapies as treatments for a range of disordered eating concerns. This review suggests that mindfulness-based interventions, especially modified dialectical behavior therapy, seem to be promising treatments for bulimia nervosa, binge eating disorder, and eating disorders with borderline personality disorders and substance use disorders. However, evidence is extremely limited on mindfulness-based interventions as treatments for anorexia nervosa. Limitations and future directions are also discussed in this review.

Recently, there has been a growing interest in the application of mindfulness-based cognitive-behavioral therapies (CBTs) in disordered eating treatment [1-3]. Examples of these interventions include dialectical behavior therapy (DBT) [4], mindfulness-based cognitive therapy (MBCT) [5], acceptance and commitment therapy (ACT) [6], mindfulness-based eating awareness training (MB-EAT) [7], mindfulness-action based cognitive-behavioral therapy (MACBT) [8] and other similar approaches. DBT, MBCT and ACT, which were originally developed for treating other psychiatric conditions, have been adapted for a range of disordered eating concerns in recent years [1,3]. MB-EAT and MACBT are mindfulness-based interventions developed specifically for treating disordered eating concerns. As a whole, these interventions are considered mindfulness-based mainly because they explicitly aim to promote mindfulness processes (e.g., openly and fully experiencing the present moment with purpose), not necessarily because they include a formal mindfulness meditation practice [9]. It is also important to note that the cultivation of mindfulness is not the sole focus of these interventions. In other words, these interventions target mindfulness to improve functioning. The purpose of this article is to provide a comprehensive descriptive review of these interventions as treatments of disordered eating concerns.

To date, CBT is the treatment of choice for binge eating disorder (BED) [10,11] and bulimia nervosa (BN) [12]. CBT models generally focus on irrational thoughts and feelings about body shape and weight that influence disordered eating behaviors [13,14]. A major goal of CBT is to promote normal eating habits, in addition to undermining dysfunctional cognitions and concerns with body shape and weight [14]. CBT eliminates binge eating and purging in 30-50% of all BN cases [12,15], and overall abstinence rates

from binge eating among patients with BED are approximately 60-70% at post-treatment [11,12,16]. Research shows that remaining patients still engage in disordered eating behaviors [11,17,18], dropout of treatment or fail to respond. Furthermore, no evidence-based treatment has yet been identified for anorexia nervosa (AN) [12]. These findings suggest that there is still room for improvement in the treatment of disordered eating concerns.

Mindfulness-based interventions for disordered eating

Partially responding to these concerns, mindfulness-based CBTs have been recently investigated as standalone treatments or as an adjunct to existing disordered eating treatments. To date, various forms of mindfulness-based interventions have been tested as treatments for individuals with a range of disordered eating concerns, including BN [19-21], BED [22-29], obesity and weight regulation issues [30-33], AN [34,35], eating disorders (EDs) with comorbid psychiatric conditions [8,36-38], and negative body image [39]. This applied movement coincides with a growing body of research pointing to the role of emotion and behavior regulation in disordered eating [40-42]. As mindfulness-based CBTs explicitly target the reduction of maladaptive regulation strategies and the promotion of adaptive regulation strategies (e.g., mindfulness), they are theorized to be particularly suitable for treating disordered eating concerns [1,9,43].

Descriptive review & analytic strategy

Evidence for mindfulness-based CBTs as a treatment of disordered eating concerns is still limited, but it has been rapidly growing in recent years. To date, conceptual and empirical reviews of modified DBT [44], MB-EAT [29] and ACT [45] are separately available. Related to the present topic, there is one systematic review

that has descriptively evaluated various forms of mindfulness-based interventions (e.g., DBT, MBCT and ACT) as a whole movement [46]. However, the systematic review is slightly outdated as the literature search was completed in January 2010. Furthermore, the review excluded outcome studies on patients with subclinical levels of EDs or those with other disordered eating concerns (e.g., negative body image and obesity). Given the dimensional and multifaceted nature of disordered eating, including studies with a broader range of disordered eating concerns seems appropriate.

The aim of the present review is to comprehensively identify, summarize and critically evaluate DBT, MBCT, MB-EAT, ACT and other similar approaches, such as MACBT [8], combined together as a whole applied movement and separately as unique treatments. Publications were identified through several means, including searches of major databases (e.g., PubMed, PsychInfo, Web of Science and EBSCOhost), requests on professional list servers and personal contacts. We continued the search until February 2013. Following a previous review study [44], only English-language peer-reviewed journal articles that present original empirical research were included. By focusing on the outcomes of mindfulness-based CBTs, studies that exclusively focused on underlying models, assessment, clinician acceptability and cost-effectiveness were excluded from the review. Disordered eating concerns were broadly defined, including clinical and subclinical ranges of ED diagnoses in the DSM-IV-TR, as well as relevant disordered eating concerns, such as negative body image and obesity. All forms of outcome data are listed in **Table 1**, but only a small portion of the studies are covered in detail in the text. The secondary data analyses of previously published studies were excluded from **Table 1** to avoid redundancy.

Dialectical behavior therapy

DBT was originally developed for the treatment of self-injurious and parasuicidal behaviors and is most often used in treating individuals diagnosed with borderline personality disorder (BPD) [4]. A central feature of BPD is chronic emotion dysregulation [47], and DBT teaches skills targeting emotion regulation, distress tolerance, acceptance and mindful awareness. Standard DBT is typically delivered on an outpatient basis over the course of 1 year and includes four

modes of treatment: weekly individual therapy sessions; weekly skills training groups; weekly therapist team meetings and consultation; and daily availability of the primary therapist for phone consultations. Since maladaptive regulation strategies are also key aspects of disordered eating [42], and because disordered eating behaviors can be conceptualized as being maladaptive coping strategies for escaping and/or avoiding distressing emotions [42,48], DBT seems to be particularly suitable to disordered eating treatment.

We located 16 peer-reviewed articles on DBT investigating its effect on a range of disordered eating concerns, including BN [19–21], BED [22–25], AN [49], and EDs comorbid with BPD [36–38,50] or substance use disorder (SUD) [51] (**Table 1**). In these studies, standard DBT was tailored to disordered eating concerns. The modifications include content changes (e.g., inclusion of appetite awareness), length (e.g., 20 weeks instead of 1 year) and removal of treatment components (e.g., group skills training and individual therapy).

Our review suggests that the modified DBT is a promising standalone treatment for reducing binge eating and purging in patients diagnosed with BN, as well as binge eating in patients diagnosed with BED. The rates of abstinence from these behavioral symptoms at post-treatment are comparable to those of CBT, although there is no study available that directly compared DBT and CBT. As shown in **Table 1**, low dropout rates from DBT are worth noting. However, follow-up data of DBT are limited, especially in the area of BN treatment. Following are notable outcome studies on DBT as a treatment for a range of disordered eating concerns.

Two randomized controlled trials (RCTs) have investigated the effects of DBT on binge eating and purging with a sample of patients diagnosed with BN. In the first RCT, 31 females who averaged at least one binge/purge episode per week were randomly assigned to either 20 weeks of individual DBT or a wait-list control [19]. Twenty-five participants (80.6%) met full criteria for BN and six met modified criteria at pre-treatment. The manual-based individual DBT focused on mindfulness as part of maladaptive emotion regulation skills. At post-treatment, approximately 30% of DBT patients demonstrated abstinence from binge eating and purging, while no wait-list patients reached abstinence; 36% of DBT and 14% of wait-list

Table 1. Available outcome evidence on mindfulness-based cognitive-behavioral therapies.

Study (year)	Treatment and setting	Sample characteristics and DE concerns	Format/length	Assessment	Major findings	Ref.
DBT						
Randomized controlled trials						
Hill <i>et al.</i> (2011)	DBT-AF (n = 18) Treatment control (n = 14) USA	Adult females with full and subthreshold BN (at least one binge and one vomit episode per week); M _{age} : 22.7 years; M _{BMI} : 23.2; 94% white; 3% Asian-American; 3% African-American	Group, appetite-focused DBT modified for BN (12 weeks)	Pre, mid, post	DBT-AF < control on BN symptoms at mid; 61.5% in DBT no longer met full or subthreshold BN criteria at post	[20]
Safer <i>et al.</i> (2010)	DBT (n = 50) ACGT (n = 51) USA	Adults with BED; female: 86%; male: 15%; M _{BMI} : 36.38; M _{age} : 52.2 years; 76% white; 13% Latino; 5% Asian; 3% African-American	Group, modified for BED (20 weeks)	Pre, post, 3-, 6- and 12-month FU	DBT < ACGT dropout rate (4% DBT vs 33.3% ACGT); DBT > ACGT on abstinence rate at post; DBT gain faded at FUs	[25]
Safer <i>et al.</i> (2001)	DBT (n = 16) Wait-list (n = 15) USA	Adult women with full (n = 25) and subclinical (n = 6) BN; M _{age} : 34 years; 87.1% white; M _{BMI} : 23.7 (SD: 5.6)	Individual, modified for BN (20 sessions of 50-min therapy in 20 weeks)	Pre, post	DBT (28.6%, n = 4) > wait-list (0%) abstinent from binge eating/purge at post; 35.7% of DBT (n = 5) and 13.5% wait-list improved (i.e., 88% reduction in binge eating, 89% reduction in purging); 35.7% DBT (n = 5) and 80% (n = 12) wait-list remained symptomatic	[19]
Telch <i>et al.</i> (2001)	DBT (n = 22) Wait-list (n = 22) Specialized research clinic in the USA	Adult women diagnosed with BED; M _{age} : 50 years; 94% white; M _{BMI} : 36.4 (SD: 6.6)	Group, modified for BED (20 weeks)	Pre, post, 3- and 6-month FU	Dropout rate of 18% in DBT (n = 4) vs 27% wait-list (n = 6); DBT (89% of completers; n = 16) > wait-list (12.5%; n = 2) on abstinence from binge eating at post; 67% of DBT completers (n = 12) abstinent at 3-month FU; 56% of DBT completers (n = 10) abstinent at 6-month FU	[24]
Quasi-experimental and case series designs						
Courbasson <i>et al.</i> (2012)	DBT (n = 15) TAU (n = 10) Outpatient mental health clinic in the USA	Adult females who met criteria for concurrent ED (BED, BN and AN) and SUD (abuse or dependence); M _{age} : 32.5 years	Standard DBT (12 months) modified for concurrent EDs and SUDs	Pre, post, 3- and 6-month FU	DBT > TAU on retention rate at post and FU; improvement in various DE attitudes and behaviors	[51]
Ben-Porath <i>et al.</i> (2009)	DBT-informed partial hospitalization (n = 40; pre-post design) Eating disorders center in the USA	Adult male (n = 1) and female (n = 39) outpatients diagnosed with either an ED with BPD (n = 16) or an ED without BPD (n = 24); M _{BMI} : 21.96; M _{age} : 26 years	30 h of partial hospitalization per week, including DBT group and telephone consultation modified for ED (73 days of stay on average)	Pre, post	Reduced ED outcomes in both groups at post	[36]

ACGT: Active comparison group therapy; ACT: Acceptance and commitment therapy; AN: Anorexia nervosa; BED: Binge eating disorder; BN: Bulimia nervosa; BPD: Borderline personality disorder; CBMI: Cognitive-behavioral mindfulness intervention; CBT: Cognitive-behavioral therapy; DBT: Dialectical behavior therapy; DBT-AF: Appetite focused dialectical behavior therapy; DE: Disordered eating; DSME: Diabetes self-management education; ED: Eating disorder; EDNOS: Eating disorder not otherwise specified; FAP: Functional analytic psychotherapy; FU: Follow-up; MACBT: Mindfulness-action based cognitive-behavioral therapy; M_{age}: Mean age; MB-EAT: Mindfulness-based eating awareness training; MBCT: Mindfulness-based cognitive therapy; M_{BMI}: Mean BMI; Mid: Mid-treatment; OCD: Obsessive-compulsive disorder; PECB: Psychoeducation/cognitive-behavioral intervention; Post: Post-treatment; Pre: Pre-treatment; SD: Standard deviation; SUD: Substance use disorder; TAU: Treatment as usual.

Table 1. Available outcome evidence on mindfulness-based cognitive-behavioral therapies (cont.).

Study (year)	Treatment and setting	Sample characteristics and DE concerns	Format/length	Assessment	Major findings	Ref.
DBT (cont.)						
Quasi-experimental and case series designs (cont.)						
Chen <i>et al.</i> (2008)	DBT (n = 8; case series design) in outpatients USA	Adult females; median age: 31 years (range: 24–56 years); all Caucasian except one Korean-American; BED with BPD (n = 5), BN with BPD (n = 3)	Standard DBT modified to DE concerns, such as binge eating (6 months)	Pre, post, 6-month FU	Large effect size from pre to post on objective binge eating, global DE and global adjustment; large effect size from pre to FU in these outcomes	[38]
Glisenti <i>et al.</i> (2012)	Case series design CBT (n = 2) DBT (n = 2) Australia	Obese adult males (n = 2) and females (n = 2) rated high on emotional eating but without ED diagnoses; M_{age} : 31 years (range: 28–39 years); M_{BMI} : 38.5 (range: 32.8–41.5)	22 1-h weekly individual sessions	Pre, post, 1-, 2-, 4- and 8-week FU	Steady decrease in body weight from pre to FU for the DBT cases (lost 10.1 and 7.6% of initial body weight); both CBT cases had minimal weight loss from pre to FU (lost 0.7 and 0.6% of initial body weight); reduction in frequency of emotional eating and emotional distress, but no overall reductions for the CBT cases	[65]
Hepworth (2011)	Mindful eating group (n = 33; pre-post design) Eating disorder clinic in Australia	33 female patients diagnosed with an ED (M_{age} : 21.42 years); AN (n = 17), BN (n = 10), EDNOS (n = 6)	Group therapy adapted from DBT (10-week manualized program)	Pre, post	Large effect size from pre to post in disordered eating attitudes	[63]
Klein <i>et al.</i> (2012)	DBT (completer n = 5) Community clinic in the USA	White females with BED; full BED (n = 2), subthreshold BED (n = 2), BN (n = 1); M_{age} : 39.6 years	Group DBT modified for DE concerns (2.0–2.5-h sessions over 18 weeks)	Weekly until the end of treatment	50% attrition rate; for completers, reduction in binge eating and BN symptoms at post	[66]
Kröger <i>et al.</i> (2010)	DBT (n = 24; pre-post design) Specialized BPD unit of a university clinic in Germany	White European adult females who met criteria for either AN with BPD (n = 9) or BN with BPD (n = 15); M_{age} : 31.1 years	Inpatient treatment for BPD (12 weeks) and added module for comorbid EDs (including self-monitoring, weekly weighing, weekly education group and meals eaten as a group)	Pre, post, 15-month FU	At FU, 54% remission rate for BN and 33% for AN, 44% of AN crossed over to BN	[37]
Palmer <i>et al.</i> (2003)	DBT (n = 7; case series) Outpatient treatment setting in the UK	Adult females diagnosed with an ED with BPD; BN with BPD (n = 5), BED with BPD (n = 1), EDNOS with BPD (n = 1); M_{age} : 24.7 years	Standard DBT with additional weight and eating skills training (6–18 months)	6-month epochs before, during and after 18-month FU DBT	No dropouts from the program; reduction in self-harm and DE pathology at FUs (up to 18-month FU)	[50]

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Table 1. Available outcome evidence on mindfulness-based cognitive-behavioral therapies (cont.).

Study (year)	Treatment and setting	Sample characteristics and DE concerns	Format/length	Assessment	Major findings	Ref.
DBT (cont.)						
Quasi-experimental and case series designs (cont.)						
Salbach-Andrae <i>et al.</i> (2008)	DBT (n = 12; pre-post design) Outpatient hospital in Germany	Adolescent females diagnosed with an ED; AN (n = 6), BN (n = 6); M _{age} : 16.5 years (range: 14–17 years)	Standard DBT modified for adolescent EDs, including weekly individual sessions, weekly DBT skills group and intersession telephone sessions (25 weeks)	Pre, post	Increased BMI for all diagnosed with AN at post; all who engaged in binge eating reported a reduction in frequency at post; six out of seven who engaged in high-frequency vomiting at pre reported a reduction at post; all those diagnosed with BN continued to meet ED criteria (BN or EDNOS)	[49]
Telch <i>et al.</i> (2000)	DBT (n = 11; pre-post design) University clinic in the USA	Adult females diagnosed with BED; M _{age} : 45 years; 90.9% white, not Hispanic; 9.1% Pacific Islander	2-h weekly DBT groups modified for BED (20 weeks)	Pre, post, 3- and 6-month FU	Reduction in binge eating at post and maintained at FUs; 82% (n = 9) no longer met criteria for BED at post; eight abstained from binge eating at 3-month FU; seven remained abstinent at 6-month FU	[23]
Case studies						
Safer <i>et al.</i> (2007)	DBT (n = 1) University clinic in the USA	16-year-old female with binge eating and a history of AN; BMI: 23.2	Individual DBT modified for adolescents with BED; family sessions added (21 weeks)	Pre, post, 3-month FU	Binge episodes decreased from 22 per month to four per month at post; one binge episode 1 month after treatment and no additional episodes reported at FU	[26]
Safer <i>et al.</i> (2001)	DBT (n = 1) USA	36-year-old Caucasian female diagnosed with BN; BMI: 19.9	Individual DBT sessions (20 weeks)	Weekly, 6-month FU	Both binge and purge episodes dropped to zero at week 5, and were maintained through treatment; reported two binge-purge episodes since treatment at 6-month FU	[21]
MBCT						
Randomized controlled trials						
Alberts <i>et al.</i> (2012)	MBCT (n = 12) Wait-list (n = 14) The Netherlands	Adult females with disordered eating behaviors without ED diagnosis (AN or BN); M _{age} = 48.5 years; M _{BMI} : 32.7 (range: 23.5–45.8)	Group MBCT tailored to disordered eating behaviors (eight 2.5-h weekly sessions)	Pre, post	MBCT > wait-list in degree of decrease in food craving, dichotomous thinking, body image concerns, emotional eating and external eating	[56]
Quasi-experimental and case series designs						
Baer <i>et al.</i> (2005)	MBCT (n = 10; pre-post design) Outpatient clinic in the USA	Adult females with full or subclinical BED (full: 6, subclinical: 4); 90% white; 10% biracial	Ten weekly group sessions	Pre, post	Reduction of objective binge episodes and increase in mindfulness at post	[17]

ACT: Active comparison group therapy; AN: Anorexia nervosa; BED: Binge eating disorder; BN: Bulimia nervosa; BPD: Borderline personality disorder; CBMI: Cognitive-behavioral mindfulness intervention; CBT: Cognitive-behavioral therapy; CT: Cognitive therapy; DBI: Dialectical behavior therapy; DBI-AF: Appetite focused dialectical behavior therapy; DE: Disordered eating; DSM-E: Diabetes self-management education; ED: Eating disorder; EDNOS: Eating disorder not otherwise specified; FAP: Functional analytic psychotherapy; FU: Follow-up; MACBI: Mindfulness-action based cognitive-behavioral therapy; M_{age}: Mean age; MB-EAT: Mindfulness-based eating awareness training; MBCT: Mindfulness-based cognitive therapy; M_{BMI}: Mean BMI; Mid: Mid-treatment; OCD: Obsessive-compulsive disorder; PECB: Psychoeducation/cognitive-behavioral intervention; Post: Post-treatment; Pre: Pre-treatment; SD: Standard deviation; SUD: Substance use disorder; TAU: Treatment as usual.

Table 1. Available outcome evidence on mindfulness-based cognitive-behavioral therapies (cont.).

Study (year)	Treatment and setting	Sample characteristics and DE concerns	Format/length	Assessment	Major findings	Ref.
MBCT (cont.)						
Case studies						
Baer <i>et al.</i> (2005)	MBCT (n = 1) University clinic in the USA	Adult Caucasian female with binge eating concern; BMI: 21	Ten weekly individual MBCT sessions with weekly food diaries and daily mindfulness exercises	Pre, post, 6-month FU	Improvement in binge-related behaviors at post and FU; abstinence from objective and subjective binges at FU	[55]
MB-EAT						
Randomized controlled trials						
Kristeller <i>et al.</i> (2013)	MB-EAT (n = 50) PECEB (n = 48) Wait-list control (n = 42) University clinics in the USA	150 adults who engage in binge eating; 12% male; 13% 'minority' (20 African-Americans, one Hispanic); M_{age} : 46.5 years (range: 20–74 years); M_{BMI} : 40.3 (range: 26–78); 66% (n = 100) met full criteria for BED	12 manualized sessions (nine weekly group sessions and three monthly 'booster sessions') of either MB-EAT or PECEB or assignment to wait-list	Pre, post, 1- and 4-month FU	Both treatment groups showed decreases in binge days, severity of compulsive overeating and depression compared with the wait-list control; at 4-month FU, 95% of the MB-EAT group who had met criteria for BED no longer met criteria compared with 76% of those in the PECEB group; mindfulness practice predicted improvement in weight loss and severity of compulsive overeating	[7]
Miller <i>et al.</i> (2012)	MB-EAT adapted for adults with Type 2 diabetes (n = 27) DSME (n = 25)	52 adults with Type 2 diabetes for the MB-EAT: M_{age} : 53.9 years (range: 45.7–62.1 years); 81.5% white; 18.5% black; 0% Asian For the DSME: M_{age} : 54.0 years (range: 47–61 years); 72% white; 24% black; 4% Asian	Both treatments consisted of eight weekly and two biweekly 2.5-h group sessions, as well as 1-month FU and 3-month FU sessions	Pre, post, 3-month FU	Both groups showed significant reductions in caloric intake and glycemic load from pre to FU and the groups did not differ in change in weight or glycemia at the end of the intervention; MB-EAT group showed significantly less dietary intake and greater weight reduction	[57]
Quasi-experimental and case series designs						
Kristeller <i>et al.</i> (1999)	MB-EAT (n = 18; single-group extended baseline design) USA	18 adult females diagnosed with BED; M_{age} : 46.5 years (range: 25–62 years); M_{BMI} : 40.3 (range: 28–52)	Seven meditation-based group sessions for BED (over 6 weeks)	Pre, post, 3-week FU	Reduction of binge frequency and severity at post; amount of time using eating-related mediation predicted decreases in binge eating	[28]

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Table 1. Available outcome evidence on mindfulness-based cognitive-behavioral therapies (cont.).

Study (year)	Treatment and setting	Sample characteristics and DE concerns	Format/length	Assessment	Major findings	Ref.
ACT						
Randomized controlled trials						
Juarascio <i>et al.</i> (2010)	ACT (n = 27) CT (n = 28) University Clinic in the USA	Adult males and females with clinical and subthreshold ED and comorbid psychiatric diagnosis (49.1% anxiety; 29.2% depressive; 11.1% adjustment); M _{age} : 26 years; 71% white; 5% African-American; 13% Asian; 2% Latino	Individual, nonspecific to ED (length varied; mean: 12.7 sessions)	Pre, post	ACT < CT on eating pathology at post (CT produced modest decreases in eating pathology; ACT produced large decreases)	[60]
Lillis <i>et al.</i> (2009)	ACT (n = 40) Wait-list (n = 44) University clinic in the USA	Obese adults: M _{age} : 50.8 years; 90.5% white; 2.4% African-American; 4.7% Latino; 2.4% multiracial; 90.5% female	Workshop not focusing on weight loss or diet (1 day, 6 h)	Pre, 3-month FU	ACT > wait-list on improvement in obesity-related stigma, quality of life, distress tolerance and BMI; psychological flexibility mediated changes in outcomes	[31]
Pearson <i>et al.</i> (2012)	ACT (n = 39) Wait-list (n = 34) University clinic in the USA	Adult females with body image concerns; M _{age} : 43.4 years; M _{BMI} : 29.3	Workshop modified for body dissatisfaction and DE attitudes (1 day, 8 h)	Pre, 1- and 2-week FU	ACT < wait-list on body-related anxiety at FUs; ACT > wait-list on psychological acceptance and weight-related psychological flexibility at FUs	[39]
Weinland <i>et al.</i> (2012)	ACT (n = 19); TAU (n = 20) local center for minimally invasive surgery in Sweden	Adult males (10.3%) and females (89.7%) who underwent bariatric surgery; M _{age} : 43 years; M _{BMI} : 27.2	Two face-to-face ACT sessions and 6 weeks of internet treatment with a 30-min weekly telephone support session	Pre, post	Significant improvements in disordered behavior, self-perceived body dissatisfaction, quality of life and acceptance of previously avoided thoughts and feelings related to weight for ACT compared with TAU	[32]
Quasi-experimental and case series designs						
Berman <i>et al.</i> (2009)	ACT (n = 3; case series design) USA	Adult Caucasian females diagnosed with AN and/or serious medical complications due to AN; BMIs: 18.6–19.1; ages: 24, 24 and 56 years	Individual, modified for AN (17–19 twice-weekly sessions)	Pre, post, 12-month FU	Two showed improvement in AN symptoms and one worsened at post; improvement maintained for one of the two at FU, and the one who got worse at post improved at FU	[34]
Case studies						
Heffner <i>et al.</i> (2002)	ACT (n = 1) Department clinic in the USA	15-year-old Caucasian female diagnosed with AN-restricting type; BMI: <18	Individual (12 sessions)	Every session	Reduction in AN symptoms and increase in weight	[35]
Martin-Murcia <i>et al.</i> (2011)	ACT-enhanced FAP (n = 1) Spain	17-year-old female diagnosed with AN and OCD	Individual FAP with ACT components (20 individual sessions over 9 months)	Every 3 sessions, 3-, 6- and 12-month FU	Reduction in binge episodes and restriction and increase in weight and behavior activation at post; improvement maintained at all FUs	[61]

ACT: Active comparison group therapy; ACT: Acceptance and commitment therapy; AN: Anorexia nervosa; BED: Binge eating disorder; BN: Bulimia nervosa; BPD: Borderline personality disorder; CBMI: Cognitive-behavioral mindfulness intervention; CBT: Cognitive-behavioral therapy; CT: Cognitive therapy; DBT: Dialectical behavior therapy; DBT-AF: Appetite focused dialectical behavior therapy; DE: Disordered eating; DSME: Diabetes self-management education; ED: Eating disorder; EDNOS: Eating disorder not otherwise specified; FAP: Functional analytic psychotherapy; FU: Follow-up; MACBT: Mindfulness-action based cognitive-behavioral therapy; M_{age}: Mean age; MB-EAT: Mindfulness-based eating awareness training; MBCT: Mindfulness-based cognitive therapy; M_{age}: Mean age; M_{BMI}: Mean BMI; Mid-treatment; OCD: Obsessive-compulsive disorder; PECB: Psychoeducation/cognitive-behavioral intervention; Post: Post-treatment; Pre: Pre-treatment; SD: Standard deviation; SUD: Substance use disorder; TAU: Treatment as usual.

Table 1. Available outcome evidence on mindfulness-based cognitive-behavioral therapies (cont.).

Study (year)	Treatment and setting	Sample characteristics and DE concerns	Format/length	Assessment	Major findings	Ref.
Other mindfulness-based CBTs						
Randomized controlled trials						
Daubenmier <i>et al.</i> (2011)	Mindfulness intervention (n = 24) compared with a wait-list control (n = 23) USA	Adult females over 40 years old; BMI: ≥ 25 ; 62% white; 15% Hispanic/Latina; 15% Asian/Pacific Islander; 9% other Treatment group: M_{BMI} : 31.4, SD: 4.7; M_{age} : 40.4 years, SD: 8.0 Control group: M_{BMI} : 30.8, SD: 4.8; M_{age} : 41.4 years, SD: 6.7	Nine 2.5-h mindfulness classes and a 7-h meditation day over the course of 4 months	Pre, 4-month FU	Improvements in mindfulness, anxiety and external-based eating for the treatment group compared with the wait-list control; improvements in mindfulness, chronic stress and CAR corresponded with abdominal fat loss; no group differences on average CAR, weight or abdominal fat from pre- to post-treatment; however, significant reduction in CAR in obese treatment participants and weight maintenance, while obese participants in the control group had stable CAR and experienced weight gain	[62]
Quasi-experimental and case series designs						
Courbasson <i>et al.</i> (2011)	MACBT (n = 38; pre-post design) Canada	Adult males (n = 8) and females (n = 30) diagnosed with comorbid BED and SUD; M_{age} : 42 years	Group (16 2-h weekly groups)	Pre, post	Improvements in objective binge eating episodes, disordered eating attitudes, alcohol and drug addiction severity	[8]
Forman <i>et al.</i> (2009)	Acceptance-based behavioral intervention (n = 29) in participant's worksite location during work hours USA	29 overweight or obese women; 19 completers; M_{age} : 43.66 years; 52% Caucasian; 48% African-American; M_{BMI} : 35.77	Behavioral weight loss group (12 weekly group sessions); acceptance and mindfulness components, which were drawn primarily from ACT, were added to the group	Pre, post, 6-month FU	Among completers, weight loss averaged 6.6% of body weight at post and 9.6% at 6-month FU	[30]
Leahey <i>et al.</i> (2008)	CBMI (n = 7; case series) in a hospital where the surgery was performed USA	Patient who underwent bariatric surgery (women: 86%; white: 86%; M_{age} : 54 years; range: 49–64 years)	Group intervention (75-min weekly group sessions for 10 weeks)	Pre, post	Improvement in binge eating symptoms, depressive symptomatology, emotion regulation skills and increased motivation to change maladaptive eating behavior at post	[33]

ACGT: Active comparison group therapy; ACT: Acceptance and commitment therapy; AN: Anorexia nervosa; BED: Binge eating disorder; BN: Bulimia nervosa; BPD: Borderline personality disorder; CBMI: Cognitive-behavioral mindfulness intervention; CBT: Cognitive-behavioral therapy; CT: Cognitive therapy; DBT: Dialectical behavior therapy; DBT-AF: Appetite focused dialectical behavior therapy; DE: Disordered eating; DSME: Diabetes self-management education; ED: Eating disorder; EDNOS: Eating disorder not otherwise specified; FAP: Functional analytic psychotherapy; FU: Follow-up; MACBT: Mindfulness-action based cognitive-behavioral therapy; M_{age} : Mean age; MB-EAT: Mindfulness-based eating awareness training; MBCT: Mindfulness-based cognitive therapy; M_{BMI} : Mean BMI; Mid: Mid-treatment; OCD: Obsessive-compulsive disorder; PECB: Psychoeducation/Cognitive-behavioral intervention; Post: Post-treatment; Pre: Pre-treatment; SD: Standard deviation; SUD: Substance use disorder; TAU: Treatment as usual.

patients improved (i.e., 88% reduction in binge eating and 89% reduction in purging).

A second RCT compared an appetite-focused DBT (DBT-AF) group to a delayed treatment control for binge eating and purging [20]. Thirty-two women who engaged in at least one binge/purge episode per week were randomly assigned to either DBT-AF or to a 6-week delayed treatment control. The DBT-AF treatment condition consisted of 12 weekly group therapy sessions that focused on appetite awareness, adaptive emotion regulation skills and eating behaviors guided by hunger and satiety cues. After 6 weeks, participants assigned to the delayed treatment condition were offered the DBT-AF. At the midpoint of therapy, DBT-AF participants reported significantly fewer BN symptoms than those in the control condition. At post-treatment, 27% of the 26 individuals who entered treatment (18 originally assigned to DBT-AD and eight from the delayed treatment control) had abstained from binge/purge episodes over the past month. Approximately 61% of participants no longer met full or subclinical criteria for BN.

Two RCTs investigated the efficacy of modified DBT for BED. In the first RCT, 30 adult females who met criteria for BED were randomly assigned to either the DBT group or a wait-list control condition [24]. The treatment consisted of 20 weeks of a DBT group adapted for BED. At post-treatment, 89% of participants in DBT achieved abstinence from binge eating compared with 12.5% of control participants. DBT participants also had significantly lower scores on measures of weight concerns, shape concerns, and eating concerns than controls and significantly lower emotional eating scores (i.e., less of an urge to eat when angry). At a 3-month follow-up, 67% of DBT participants were abstinent and 56% of them still remained abstinent at a 6-month follow-up.

A second RCT on BED compared DBT to an active comparison group therapy (ACGT) [25]. One hundred and one adults who met criteria for BED were randomly assigned to the DBT condition or the ACGT condition. The ACGT condition was developed to be comparable to the DBT group in rationale and procedures. The DBT condition consisted of 20 2-h DBT group sessions, which consisted of a mindfulness skills module, emotion regulation module and distress tolerance module. Treatment suitability ratings were similar for both conditions.

The DBT group had a significantly lower dropout rate (4%) than the ACGT group (33.3%). Binge abstinence and reductions in the number of binge episodes were achieved more quickly for the DBT group (64%) than for the ACGT group (36%), but the difference did not persist over the 3-, 6- and 12-month follow-up assessments. A subsequent analysis revealed that participants who met criteria for either avoidant personality disorder or who had an earlier age of onset of being overweight and/or dieting (defined as less than 15 years old) had poorer outcomes when receiving ACGT compared with DBT [52].

DBT also seems to be a promising standalone treatment for EDs with comorbid psychiatric conditions, including BPD and SUDs [44]. These findings are particularly encouraging as these psychiatric disorders sometimes co-occur with disordered eating conditions, such as BN and BED [44,53]. One study investigated the impact of a 12-month DBT intervention on concurrent EDs (AN, BN or BED) and SUDs [51]. Twenty five female outpatients who met these diagnostic criteria were randomly assigned to either the DBT condition or treatment as usual (TAU; 1.5 h weekly group). Results revealed that the DBT group had a significantly lower dropout rate (20%) than the TAU group (80%). Given the greater dropout rate in TAU, the random assignment was discontinued. At 6-month follow-up, 60% of DBT participants remained in the study compared with no TAU participants. DBT patients demonstrated reductions in behavioral and attitudinal features of disordered eating, substance use and severity, and negative mood regulation. Several uncontrolled trials also revealed that DBT reduced disordered eating behaviors among patients with comorbid ED and BPD [36–38,50].

Mindfulness-based cognitive therapy

MBCT was developed to prevent major depressive episodes for those diagnosed with major depressive disorder [5]. MBCT was derived largely from Kabat-Zinn's mindfulness-based stress reduction (MBSR) [54]. MBCT teaches nonjudgmental acceptance of one's private experience and encourages individuals to focus less on reacting to difficult thoughts and feelings, and more on observing and accepting them. It typically consists of eight weekly group therapy sessions. MBCT has been applied as a treatment for individuals who struggle with binge eating [17,55].

Evidence for MBCT is still limited, but preliminary uncontrolled findings have shown that MBCT decreased the number of binge episodes and reduced emotional eating of patients with clinical and subclinical BED [17,55]. In addition, one RCT examined MBCT as a treatment for problematic eating behaviors, food cravings, dichotomous thinking and negative body image with a sample of 26 nonclinical adult females [56]. From pre- to post-treatment there was a significant increase in mindfulness for the MBCT group compared with the wait-list control group, and there were significantly fewer external eating and emotional eating episodes for the MBCT group, but not for the control.

Mindfulness-based eating awareness training

MB-EAT was developed specifically to treat BED and is based loosely on MBSR. MB-EAT is typically delivered in a group format over nine sessions. It incorporates a variety of mindfulness and meditation exercises, both general (i.e., mindfulness of breath and body) and specific to eating concerns (i.e., mindful eating). As with MBCT, MB-EAT focuses on developing and practicing nonjudgmental awareness and acceptance of thoughts, feelings and physical sensations, especially in the context of disordered eating. Our review suggests that MB-EAT is a promising treatment option for BED.

An RCT investigated the efficacy of a 12-session group MB-EAT intervention compared with a 12-session psychoeducation/cognitive-behavioral intervention (PECB) and a wait-list control group for overweight or obese individuals [7]. One hundred and fifty participants (12% male; 13% 'minority'; 66% met full criteria for BED) were randomly assigned to the MB-EAT group (n = 50), the PECB group (n = 48) or the wait-list control (n = 42). Both treatment groups showed comparable decreases in binge days and self-reported severity of compulsive overeating and improvements related to depression as compared with the wait-list group. At the 4-month follow-up, 95% of participants in the MB-EAT group who had met criteria for BED no longer met criteria, compared with 76% of those in the PECB group. In addition, mindfulness practice predicted improvement in weight loss and severity of compulsive overeating.

In addition, an uncontrolled open trial investigated the effects of MB-EAT for binge eating in a sample of 18 obese women who met the

criteria for BED [28]. The MB-EAT condition consisted of seven sessions over 6 weeks. Weekly binge episodes dropped from over four times per week at pre-treatment to approximately 1.5 times at post-treatment. Nine participants reduced the number of binges to less than one per week, and five reported one to two times per week.

A prospective RCT compared MB-EAT adapted for adults with Type 2 diabetes (n = 27) to 'Smart Choices' diabetes self-management education (n = 25) [57]. Both conditions consisted of a 3-month group-based intervention followed by 1- and 3-month follow-up sessions. Participants ranged in age from 35–65 years (mean age: 53.9 years; standard deviation: 8.2), had been diagnosed with Type 2 diabetes for at least 1 year and had a BMI of at least 27. Both groups showed significant reductions in caloric intake and glycemic load from pre-treatment to follow-up assessments, and the groups did not differ in change in weight or glycemia at the end of the intervention. However, the MB-EAT group showed significantly less dietary intake and greater weight reduction.

Acceptance & commitment therapy

ACT is a transdiagnostic approach to a range of psychiatric concerns [6]. In practice, ACT primarily emphasizes the promotion of global functioning and not necessarily symptom reduction [6,43]. One of the fundamental assumptions of ACT is that many psychiatric concerns are inevitable aspects of the human experience. From the ACT perspective, it is the patients' excessive attempts to control or avoid some of the psychiatric symptoms that cause long-term functional impairment [58]. The goal of ACT is to help patients learn to build adaptive and open regulation strategies (e.g., mindful awareness and acceptance) in order to promote global functioning. ACT has been delivered in individual therapy, group therapy and workshop formats, and the length of ACT interventions vary greatly from one day to 6 months [43,59].

In the areas of broadly defined disordered eating concerns, we have located four RCTs [31,32,39,60], one case series [34] and two case reports [35,61] for ACT interventions. Although findings from these studies are encouraging [45], it remains unclear whether ACT would be an effective standalone treatment for patients with a range of disordered eating concerns, especially for those with clinical levels of disordered eating. To date, no RCTs or uncontrolled open trials have

investigated the effect of ACT on individuals who met criteria for BN or BED. Regarding AN, one case series [34] and two case reports [35,61] are available, suggesting that an individual format of ACT may be a useful outpatient treatment for patients diagnosed with AN.

Regarding general disordered eating pathology, one RCT presented the effect of ACT on comorbid disordered eating pathology within a subsample of clients with anxiety and depression [60]. The study revealed that both ACT and conventional CBT decreased eating pathology from pre- to post-treatment, but the ACT group showed greater reductions. Given the limited methodological rigor (e.g., single measure of disordered eating pathology), it is premature to draw any conclusion regarding the effectiveness of ACT for disordered eating and its relative effects compared with CBT. Another RCT investigated the effect of a 1-day ACT workshop for negative body image and general eating pathology among adult females who self-identified as 'having greater concerns about body image' [39]. Results revealed that the ACT condition decreased disordered eating attitudes, preoccupations with eating, weight and shape, and body anxiety at 1- and 2-week follow-ups.

Finally, our review suggests that ACT may be an effective standalone treatment for improving general functioning and quality of life among people with obesity and those who underwent bariatric surgery [31,32], and that an ACT-enhanced behavioral weight regulation program promotes and maintains weight loss [30].

Other mindfulness-based CBTs

Several mindfulness-based interventions, which may not be classified as one of the above-mentioned CBTs, are available, and preliminary controlled and uncontrolled trials have shown favorable outcomes of these interventions. Examples include MACBT for BED with comorbid SUDs [8] and cognitive-behavioral mindfulness intervention for patients who underwent bariatric surgery [33]. One controlled study tested the efficacy of a novel mindfulness intervention to reduce stress eating among overweight and obese women [62]. Forty-seven women (mean BMI: 31.2) were randomly assigned to either the mindfulness intervention or a wait-list control group. The intervention was based on components from MBSR, MBCT and MB-EAT, including body scanning, mindful yoga stretching, loving kindness meditation and mindful eating. The treatment group consisted

of nine 2.5-h classes and one 7-h meditation day over the course of 4 months. Participants who were assigned to the wait-list were offered the mindfulness intervention after completing the post-treatment assessments. From pre- to post-treatment, the intervention group participants showed improvements in mindfulness, anxiety and external-based eating as compared with the wait-list controls, and improvements in mindfulness, chronic stress and cortisol awakening response (CAR) corresponded with loss of abdominal fat. There were no group differences on average CAR, weight or abdominal fat from pre- to post-treatment; however, obese treatment participants showed significant reductions in CAR and maintained their weight, while obese participants in the control group had stable CAR and experienced weight gain.

Discussion

Although evidence is still limited, there have been an increased number of studies investigating mindfulness-based CBTs as standalone treatments or as adjuncts to other standard treatments for a range of disordered eating concerns. Available evidence varies in methodological rigor, types of mindfulness-based CBTs, types of disordered eating concerns and age groups of patients. Regarding limitations in methodological rigor, over 60% of outcome studies included in the review are uncontrolled trials with a smaller sample size. The sample size of RCTs in this area is also generally small with a few exceptions [7,25,31].

Taking these concerns into consideration, preliminary findings suggest that mindfulness-based CBTs as a whole is promising as a treatment for BN, BED and obesity. We did not find empirical studies that directly compared these interventions with treatments of choice, such as CBT. Therefore, it remains unclear whether mindfulness-based CBTs add to the outcomes of extant treatments for BN, BED and obesity. One clinical area that mindfulness-based CBTs, especially DBT, may add to the extant treatment is disordered eating concerns comorbid with BPD or SUD. Furthermore, consistent with extant disordered eating literature, evidence is extremely limited for mindfulness-based CBTs as a treatment for AN. Only one uncontrolled open trial of DBT [49], one uncontrolled open trial of a DBT-informed mindful eating group [63] and a few case series/case report studies of ACT [34,35,61] were found for AN treatment.

Regarding the type of mindfulness-based CBTs, modified DBT appears to be a promising standalone treatment for BN, BED and EDs comorbid with BPD or SUDs [12]. Although there is not an RCT directly comparing DBT to existing evidence-based treatments, the effects of DBT on binge eating and purging are comparable with those of CBT. Furthermore, it is worthwhile continuing to investigate the effects of DBT for comorbid EDs and BPD as there is no established treatment of choice in this area. Preliminary uncontrolled data suggest that MBCT, MB-EAT and others that are similar may be useful as a treatment for binge eating in patients with BED. Finally, with regard to ACT, data are still limited for disordered eating concerns in general. However, preliminary results suggest that ACT alone seems to promote greater functioning and quality of life in patients with obesity [31,32], and an ACT-enhanced weight loss program promotes and maintains weight loss [30]. As the format of ACT interventions varies considerably across studies, it is important to investigate an optimal form of ACT that is feasible, acceptable and beneficial for a given disordered eating concern.

Conclusion & future perspective

In the future, it is important to investigate the mechanisms of change across mindfulness-based interventions in addition to accumulating outcome data. The investigation of mechanisms serves two major purposes. One is to see whether mindfulness-based CBTs are qualitatively distinct from conventional CBTs. The literature suggests that the reduction of maladaptive emotion regulation and optimization of mindfulness skills are distinct mechanisms in mindfulness-based CBTs. If this is not the case, it is pragmatic not to differentiate them from extant therapies. Second, there is considerable overlap across the different mindfulness-based CBTs (e.g., DBT, ACT, MBCT and MB-EAT) and significant variation within a single type of

mindfulness-based CBT (e.g., ACT). Using a mechanism-based treatment classification promotes our understanding of mindfulness-based CBTs and disordered eating treatment without unnecessarily increasing the number of new treatment labels.

As stated elsewhere [64], the present review suggests that it is also important to consider the external validity of empirical studies. Although data on mindfulness-based CBTs are encouraging, the focus is still placed on their internal validity. As such, the extent to which or to whom these findings are generalized is still unclear. Similarly, some studies included in the present review did not provide key characteristics of research participants, such as age and BMI. As these variables moderate treatment effects, future studies should report these key variables and analyze treatment outcomes based on them. Finally, it remains unclear whether mindfulness-based CBTs add to the extant treatments of choice for disordered eating concerns and whether these interventions are beneficial for the subgroups of patients who do not respond to the extant treatment of choice [15].

Preliminary evidence for mindfulness-based interventions as a whole is promising, but data are still limited. Investigation of mechanisms of change in addition to outcomes while clearly elucidating participant characteristics would be crucial to investigate whether mindfulness-based CBTs contribute to further development and evaluation of evidence-based treatments for disordered eating.

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