Meta-analysis of the effectiveness of psychological and medical treatments for binge-eating disorder

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Abstract

Objective: To provide a comprehensive meta-analysis on the efficacy of psychological and medical treatments for binge-eating disorder (BED), including those targeting weight loss. ***Method:*** Through a systematic search before March 2018, 81 published and unpublished randomized-controlled trials (RCTs), totaling 7,515 individuals with BED (DSM-IV, DSM-5), were retrieved and analyzed using random-effect modeling. ***Results:*** In RCTs with inactive control groups, psychotherapy, mostly consisting of cognitive-behavioral therapy, showed large-size effects for the reduction of binge-eating episodes and abstinence from binge eating, followed by structured self-help treatment with medium-to-large effects when compared to wait-list. Pharmacotherapy and pharmacological weight loss treatment mostly outperformed pill placebo conditions with small effects on binge-eating outcome. These results were confirmed for the most common treatments of cognitive-behavioral therapy, self-help treatment based on cognitive-behavioral therapy, and lisdexamfetamine. In RCTs with active control groups, there was limited evidence for the superiority of one treatment category or treatment. In a few studies, psychotherapy outperformed behavioral weight loss treatment in short- and long-term binge-eating outcome and led to lower longer-term abstinence than self-help treatment, while combined treatment revealed no additive effect on binge-eating outcome over time. Overall study quality was heterogeneous and the quality of evidence for binge-eating outcome was generally very low. **Conclusions:** This comprehensive meta-analysis demonstrated the efficacy of psychotherapy, structured self-help treatment, and pharmacotherapy for patients with BED. More high quality research on treatments for BED is warranted, with a focus on long-term maintenance of therapeutic gains, comparative efficacy, mechanisms through which treatments work, and complex models of care.

Keywords: Meta-analysis; binge-eating disorder; treatment; intervention

Public Health Significance Statement

This comprehensive meta-analysis on psychological and medical treatments for binge-eating disorder demonstrates the efficacy of psychotherapy, structured self-help treatment, and pharmacotherapy. Psychotherapy may be prioritized over behavioral weight loss treatment, self-help treatment, and combined treatment. These results can be used as guidance in translating evidence-based treatments into clinical practice.

Binge-eating disorder (BED), characterized by recurrent binge eating that occurs in the absence of regular inappropriate compensatory behaviors, was first included as its own diagnostic entity in the Fifth Edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association [APA], 2013). Extant literature has indicated BED to be associated with severe health impairments, including increased eating disorder and general psychopathology, mental disorder comorbidity, obesity and associated medical sequelae, and decreased quality of life (Kessler et al., 2013; Mitchell, 2016; Wilfley, Citrome, & Herman, 2016). With a lifetime prevalence rate of 1.9%, BED is the most common eating disorder, typically developing in adolescence or early adulthood (Kessler et al., 2013; Swanson, Crow, Le Grange, Swendsen, & Merikangas, 2011). An increasing number of clinical studies evaluating the outcome of diverse treatment approaches to BED has been published and compiled in meta-analyses and systematic reviews (e.g., Berkman et al., 2015; Brownley et al., 2016; Ghaderi et al., 2018; Hay, 2013; Hay & Claudino, 2012; Linardon, Wade, de la Piedad Garcia, & Brennan, 2017; McElroy, Guerdjikova, Mori, & O'Melia, 2012; Palavras, Hay, & Claudino, 2017; Reas & Grilo, 2008, 2015; Stefano, Bacaltchuk, Blay, & Appolinario, 2008; Vocks et al., 2010), informing evidence-based clinical guideline development (e.g., Association of the Scientific Medical Societies [AWMF], 2010; National Institute for Health and Care Excellence [NICE], 2017) that are aimed at guiding the translation of clinical research into practice (for review see Hilbert, Hoek, & Schmidt, 2017).

Three comprehensive meta-analyses examined several broader treatment categories in BED: Vocks et al. (2010) analyzed 38 treatment studies with prospective randomized-controlled (RCTs), non-randomized-controlled, or uncontrolled designs, searched up to June 2006. In examining post-treatment effects in the 21 RCTs, they found that psychotherapy and structured self-help treatment, both mostly based on cognitive-behavioral therapy (CBT), led to greater improvements in binge eating and eating disorder psychopathology than wait-list.

In RCTs, pharmacotherapy - mainly antidepressants - improved binge eating more than pill placebo, but did not improve eating disorder psychopathology. Both psychotherapy and pharmacotherapy significantly reduced depression when compared to inactive control conditions. Psychotherapy, self-help treatment, and pharmacotherapy did not lead to significant changes in body weight, and drop-out rates did not differ from those in inactive control conditions. The limitations of this meta-analysis included its lack of a risk of bias assessment, adverse events examination, and systematic documentation of the search process. The comparative efficacy of treatment categories was evaluated in indirect comparisons only, not accounting for patient, treatment, or setting characteristics that differ between categories.

More recently, a comprehensive systematic review and meta-analysis of 34 psychological and pharmacological RCTs for BED searched up to November 2015 (for MEDLINE up to May 2016) confirmed greater rates of abstinence from binge eating in CBT than in inactive control conditions at post-treatment (Berkman et al., 2015; Brownley et al., 2016). Furthermore, second-generation antidepressants and the central nervous stimulant lisdexamfetamine were superior to pill placebo for binge eating and eating disorder psychopathology, and the former also demonstrated a significant improvement in depression. Studies with high risk of bias were excluded, and the comparisons were based on a low number of studies and treatment categories, limiting this study's utility for clinical guideline development. Similar limitations apply to the meta-analysis by Ghaderi et al. (2018) based on 45 RCTs searched up to November 2016, also excluding studies with a high risk of bias. This study confirmed a significantly greater efficacy of CBT and CBT self-help treatment for improving binge eating, eating disorder psychopathology, and depression, but not body mass index (BMI, kg/m^2) when compared to wait-list. When compared to pill placebo, greater effects were found for selective serotonin reuptake inhibitors on binge eating, but not on depression and BMI, and for lisdexamfetamine on binge eating and BMI. While for Brownley et al.'s (2016) study, the comparative efficacy was quantified indirectly in a network meta-

analysis of pharmacotherapy studies only (Peat et al., 2017), Ghaderi et al. (2018) examined a few active treatment comparisons, however, collapsing treatment categories (e.g., CBT and CBT self-help treatment), which thus limits specificity of findings.

In contrast to these comprehensive meta-analyses, other meta-analyses specifically focused on a few categories of treatment for BED, for example, pharmacotherapy (Reas & Grilo, 2008), especially antidepressants (Stefano et al., 2008) or lisdexamfetamine (Fornaro et al., 2016), structured self-help (Beintner, Jacobi, & Schmidt, 2014; Traviss-Turner, West, & Hill, 2017), CBT or CBT self-help (Linardon, Wade et al., 2017), or mixed cognitive-behavioral applications and behavioral WLT (Palavras et al., 2017). With such a narrow focus on treatment categories, these studies have limited value for evidence-based clinical guideline development. The comparative efficacy of diverse treatments is key in this context: Head-to-head comparisons are suited to elucidate the potency of a treatment directly in relation to another treatment and can help to clarify treatment specificity. However, while one previous meta-analysis based on direct comparisons found some comparative efficacy of CBT versus other psychotherapies or pharmacotherapy on binge-eating outcome (Linardon, Fairburn, Fitzsimmons-Craft, Wilfley, & Brennan, 2017), others did not (Linardon, Wade et al., 2017; Spielmans et al., 2013). Further clarification on comparative efficacy is thus warranted, ideally broadening the focus to other treatment categories. In addition, it remains unclear to what extent treatment efficacy varies by patient or treatment characteristics, or by methodological aspects including study quality. So far, only few moderators of treatment have been assessed previously for BED, with inconclusive results (Linardon, de la Piedad Garcia, & Brennan, 2017).

In light of an increasing number of clinical studies of BED and/or long-term follow-ups, it is thus timely and relevant to update, refine, and extend the evidence on the efficacy of psychological and medical treatments by: (1) adding all available treatment categories, considering those that have been examined for BED, but have not been part of previous

comprehensive meta-analyses, in order to examine their short- and long-term efficacy; (2) conducting direct comparisons of treatments in order to further clarify whether one treatment outperforms another; and (3) facilitating moderator analyses that indirectly explore patient, treatment, and methodological characteristics and study quality in relation to treatment outcome. Thus, the present meta-analysis sought to assess and compare the efficacy of psychological and medical treatments for individuals with BED in RCTs regarding binge eating, eating disorder and general psychopathology, and body weight; to determine adverse events and treatment drop-out; and to examine risk of bias and moderators.

Methods

Registration and Search

This study, building upon the meta-analysis by Vocks et al. (2010), was registered in the PROSPERO International Prospective Register of Systematic Reviews (CRD42016043604). Methodological detail is given elsewhere (Hilbert et al., 2017).

The search strategy included terms related to binge eating and diverse forms of psychological and medical interventions in title, abstract, and keywords (or full texts): (binge eat*) AND (efficac* OR effect* OR outcome OR counsel* OR interven* OR pharmaco* OR drug OR psychoanaly* OR psychotherap* OR therap* OR treat* OR train* OR weight loss OR weight reduction OR self-help OR bariatric surg* OR weight loss surg* OR weight reduction surg* OR obesity surg*). Language was restricted to English. Published, unpublished, and ongoing studies from inception to February 2018 were sought.

The search was conducted independently by two psychologists (M.Sc. level), who resolved disagreement through consensus. The search was conducted in (1) electronic databases (AMED, ANNUAL REVIEWS, CDSR, CINAHL, Clinical Psychology Review, DARE, EMBASE, LILACS, MEDLINE, NIHR Centre for Reviews and Dissemination, PsycINFO, PubMED, PUBPSYCH, Web of Science); (2) national and international trials registers (CenterWatch Clinical Trials Listing Service, CENTRAL, ClincalTrials.gov,

Community Research and Development Information Service of the European Union, Deutsches Register Klinischer Studien, EU Clinical Trials Register, European Medicines Agency, Hong Kong Clinical Trials Register, ISRCTN Trial Registry, PROSPERO, South African National Clinical Trial Register, UK Clinical Trials Gateway, WHO International Clinical Trials Registry Platform); (3) pharmaceutical industry trials registers (AstraZeneca Clinical Trials, Eli Lilly and Company Clinical Trial Registry, GlaxoSmithKline Clinical Trial Register, NovartisClinicalTrials.com); and (4) through manual searches (reference lists of included studies and review articles identified during the search, and publications in the International Journal of Eating Disorders from 1990 to February 2018). Authors of ongoing studies were contacted.

Study Selection

We included: (1) psychological (e.g., psychotherapy, self-help treatment) and medical (e.g., pharmacotherapy, bariatric surgery) treatment studies that were (2) applied to individuals with a pre-treatment diagnosis of BED according to DSM-IV (APA, 1994) or DSM-5 (including BED of low frequency and/or limited duration; APA, 2013); (3) used an RCT design; (4) assessed the core symptomatology of BED (binge-eating episodes or days, abstinence from binge eating, and/or diagnosis of BED); (5) provided sufficient detail to allow the calculation of effect sizes (e.g., *M*, *SD* and/or *n*, % at pre-treatment and post-treatment or follow-up(s)), including a pre-treatment and at least one post-treatment or follow-up assessment; (6) provided separate data reports for patients with BED in studies examining multiple patient groups; and (7) were written in English. Excluded were: (1) double reports of the same trial; and (2) case reports and studies with a sample size smaller than $n = 10$.

The screening process was conducted in two steps: (1) Two psychologists (M.Sc. level) independently reviewed all abstracts and titles for eligibility. Based on automatic and manual screening, double publications of the same trial were excluded. Disagreement was resolved through consensus. If deemed eligible or where eligibility was unclear, full-text

reports were obtained. (2) The two psychologists independently assessed all full-text reports for inclusion. Where unclear because of a lack of information, study authors were contacted. Disagreement was resolved by consensus and under supervision of the first author. Additional publications referred to in the primary included paper were obtained. Multiple reports within the framework of one study were assembled in order to form one unit of analysis.

Data Extraction

The standardized coding scheme and handbook used by Vocks et al. (2010) with evidence of good interrater reliability was extended and updated. The handbook provides definitions, coding instructions, examples, and an overview of data management. Data extraction was performed independently by two trained psychologists (M.Sc. level). Data collection referred to: Eligibility, study design, inclusion and exclusion criteria, participant characteristics (e.g., sociodemographics according to PROGRESS: Place, Race, Occupation, Gender, Religion, Education, Socioeconomic status, Social status; O'Neill et al., 2014), time points of assessment, sample size, intervention characteristics (e.g., duration, integrity), outcomes, drop-out, adverse events, and risk of bias. The Cochrane Collaboration's Risk of Bias Tool (Higgins & Green, 2011) was used to assess the risk of bias in published studies. All available information reported in text, tables, or figures was extracted. In order to retrieve missing data, authors were contacted. Missing data were coded as such, but not imputed.

Interrater reliability, determined for the primary outcome variables (see below), was almost perfect with 95% agreement between raters. Disagreement between raters was resolved through consensus and in consultation with the first author. In order to evaluate consistency with Vocks et al. (2010), interstudy reliability was determined for the primary outcome variables, and was almost perfect with 93% agreement between ratings.

Outcome Measures

Primary outcomes were the number of binge-eating episodes and abstinence from binge eating. Binge-eating episodes are defined as eating an amount of food that is definitely

larger than what other people would eat under similar circumstances, associated with a sense of loss of control over eating (APA, 2013). The number of episodes rather than the number of days with binge-eating episodes were reported because of their representation in the DSM-5 diagnostic criteria and greater availability of data. Abstinence from binge eating was defined as zero binge-eating episodes over a specified time frame. Diagnosis of BED according to DSM-IV (APA, 1994) or DSM-5 (APA, 2013) was not reported because of a lack of data.

As secondary outcomes, eating disorder psychopathology was operationalized through attitudes regarding eating behavior and body image, and general psychopathology was operationalized through measures of depression (see Hilbert et al., 2017). Body weight and BMI (kg/m^2) were considered if based on objective measurement. Adverse events and drop-out from treatment were recorded and categorized (cf. Berkman et al., 2015).

A considerable heterogeneity of instruments were used. If more than one instrument was used per outcome, the selection of one instrument per study followed a unified hierarchical strategy, unlike in Vocks et al. (2010): Generally, interview measures were prioritized over self-report measures. From these, instruments providing a multidimensional assessment were prioritized over those providing a unidimensional assessment, which applied to eating disorder psychopathology and depression only.

Meta-Analyses

First, in between-group analyses, the pre- to post-treatment and/or follow-up effect was compared for active treatment versus inactive control conditions, lacking the active ingredient (e.g., no treatment, wait-list, pill placebo; Higgins & Green, 2011; Meinert, 2012), per treatment category (e.g., psychotherapy), including sensitivity analyses for the most common treatments. Second, multiple active treatments were directly compared across and within treatment categories to evaluate comparative efficacy pre- to post-treatment and/or follow-up. Active treatments have an active ingredient intended to produce a treatment effect (e.g., different variant of the same intervention, medication, or therapy; Higgins & Green,

2011; Meinert, 2012). Third, in order to explain heterogeneity of pooled effects, meta-regression analysis was conducted to indirectly compare treatment, patient, and method characteristics and study quality on primary outcomes at post-treatment (see Hilbert et al., 2017, and moderation analysis table described below).

For continuous outcomes, the treatment effect was measured as a standardized mean difference between pre-treatment and post-treatment and/or follow-up(s) as well as a mean difference for unique scales. Hedge's *g*, which corrects for bias given small sample sizes, was used as a measure of effect size (0.20, small; 0.50, medium; 0.80, large). Mean and standard deviation (*SD)* were not estimated if only median and interquartile range were provided. Large-sample approximations were made for computing sample variance and Wald-type confidence intervals were used for outcomes. For categorical outcomes, the treatment effect was determined as odds ratios at post-treatment and/or follow-up(s), determined on a logarithmic scale and where ½ was added to all cell entries with zero counts (1.44, small; 2.48, medium; 4.27, large; Borenstein, Hedges, Higgins, & Rothstein, 2009). More than two arms from one study within a given treatment category were treated with hierarchical methods (Gleser & Olkin, 2009).

Meta-analyses were conducted if at least two studies provided data. Random effects models were computed. The statistic *Q* and variance τ^2 from the random effects model were used to assess and test for heterogeneity. Since it was high, comparison with fixed effects models as a sensitivity analysis was not deemed feasible. For assessment of reporting biases, funnel plots with differences in means on the horizontal axis, and standard error on the vertical axis, were inspected. Trim and fill procedures with the R0 estimator (Duval & Tweedie, 2000a, 2000b) and the fail-safe *N* were used to assess reporting bias. The fail-safe *N* indicates how many papers with null results would need to be added for a "small effect size," taken here to be 0.20 for standardized mean differences and 1.5 for odds ratios (Orwin, 1983). Standard power analytic methods for random effects models (Hedges & Pigott, 2001) showed

that the power for the primary outcomes ranged from 20% for the smaller categories (e.g., self-help WLT) to 100% for the larger categories (e.g., psychotherapy). All data were analyzed using the "metafor" package of R version 3.4.2 (R Core Team, 2016; Viechtbauer, 2010). A two-tailed $\alpha < .05$ was applied to significance testing.

Quality of Evidence

The overall quality of evidence was rated for the primary outcomes according to the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach (Schünemann, Brożek, Guyatt, & Oxman, 2013). Internal validity (risk of bias, inconsistency, imprecision, publication bias) and external validity (indirectness) were rated for each treatment category. Two psychologists (M.Sc. level) conducted the GRADE rating together, using evidence profiles, for presentation in a summary of findings table. For unpublished studies, because the risk of bias rating was not available, a GRADE rating was not made.

Results

Inclusion and Study Characteristics

As shown in the PRISMA flow diagram (Figure 1), the literature search yielded 11,363 articles after removal of duplicates. Following title and abstract screening, 579 full texts were screened for eligibility, from which 81 were included in this study (60 studies excluded because of ≥ 5 inclusion criteria not fulfilled, Table A1, online supplement; for study effect sizes, see Forest plots described below). The 81 studies collated a total of 195 conditions (study arms). Of these conditions, 138 were active and 57 were inactive conditions. A total of 76 studies were published as original articles, 2 studies were published as abstract (Yu et al., 2017) or poster (Navia et al., 2017), while 3 studies were unpublished (Hilbert et al., Richard et al., Schag et al.).

Among the active treatment conditions (Table B1, online supplement), of the 43 psychotherapy conditions most used CBT, with a few conditions utilizing interpersonal psychotherapy, psychodynamic, and humanistic therapies. Fourteen structured self-help

conditions, mostly based on CBT, were conducted in a guided or unguided format. Pharmacotherapy was evaluated in 30 conditions, including second generation antidepressants, central nervous system stimulants, anticonvulsants, and other medications. Regarding WLTs, behavioral WLT was utilized in 7 conditions, combining diet, exercise, and/or behavioral strategies. Behavioral weight loss guided self-help treatment was utilized in 3 conditions. Pharmacological WLT was utilized in 5 conditions. For bariatric surgery, no RCTs were available. Combined treatment was utilized in 30 conditions, and mostly included combinations of CBT, behavioral WLT, and pharmacological interventions. Inpatient treatment was used in 6 conditions with a focus on weight loss, or on BED and weight loss. Treatment characteristics are described in Table A1, online supplement.

Among the inactive control conditions (Table B1, online supplement), most psychotherapy and self-help treatment studies used wait-list control, while a few studies used no treatment control, attention placebo, or usual care. All pharmacotherapy, pharmacological WLT, and combined treatment studies with inactive control conditions utilized pill placebo. Inactive control conditions in behavioral or self-help WLT studies were wait-list, attention placebo, or usual care. No inactive control conditions were used in inpatient treatment studies.

Sample Characteristics

The included studies encompassed $N = 7{,}515$ individuals with BED. Of these, 2,488 were treated in active conditions and compared with 2,400 patients in inactive control conditions. A total of 2,627 patients came from active conditions in RCTs without inactive control conditions. Baseline sociodemographic and clinical characteristics are summarized in Table C1, online supplement. One study included patients under the age of 18 (Hilbert et al.).

Pre-treatment to Post-treatment Change versus Inactive Control

The meta-analytical pre- to post-treatment results are displayed in Figure 2 (see Table D1, online supplement, for detailed results). Regarding primary outcomes, binge-eating episodes were significantly reduced with a large pooled effect size by psychotherapy and with

medium effect size by self-help treatment, when compared to inactive control conditions, mostly wait-list. They were further reduced with small effect sizes by pharmacotherapy and pharmacological WLT in comparison to pill placebo (see Forest plot in Figure D1). For abstinence from binge eating, the pooled odds ratio was significant in psychotherapy and self-help treatment, providing large odds ratios of 9.9 or 8.5, respectively, as well as in pharmacotherapy and pharmacological WLT with small odds ratios, when compared to the abovementioned inactive control conditions (see Forest plot in Figure D2). The effects on binge-eating outcome were non-significant in self-help WLT and combined treatment. Descriptively, post-treatment rates of abstinence from binge eating were between 45% and 54% in RCTs with inactive control conditions (psychotherapy 53%, 95% CI 45 to 61%; self-help-treatment 46%, 95% CI 33 to 59%; pharmacotherapy 45%, 95% CI 40 to 50%; pharmacological WLT 54%, 95% CI 44 to 64%; combined treatment 46%, 95% CI 39 to 54%).

Regarding secondary outcomes, eating disorder psychopathology was significantly reduced with medium effect size by psychotherapy and self-help treatment when compared to inactive control conditions such as wait-list, and with small effect size by combined treatment when compared to pill placebo, while effects for pharmacotherapy and pharmacological WLT versus pill placebo were non-significant. Depression was significantly reduced with small effect size by psychotherapy and combined treatment versus inactive control conditions. Body weight was significantly reduced with large effect size in pharmacological WLT (-3.6 kg), with medium effect size in combined treatment (-3.6 kg), and with small effect size in pharmacotherapy (-2.3 kg), when compared to pill placebo. BMI was significantly reduced with small effect sizes in pharmacotherapy and pharmacological WLT when compared to pill placebo. All other effects on secondary outcomes were non-significant, or data were unavailable (i.e., for self-help WLT).

For patients in active intervention conditions, 24 pharmacotherapy, 3 pharmacological weight loss and 4 combined treatment studies reported adverse events. In all, 2,656 events were reported in 1,825 patients (586 gastrointestinal upset, 763 sympathetic nervous system arousal, 472 sleeping disorders, 267 headache, and 568 miscellaneous events). For patients in inactive control conditions, i.e. pill placebo, 22 pharmacotherapy studies and 1 combined treatment study reported adverse events. Here, 1,099 events were reported in 1,430 patients (223 gastrointestinal upset, 203 sympathetic nervous system arousal, 208 sleeping disorders, 179 headache, and 286 miscellaneous events). For pharmacotherapy compared to pill placebo, the incidence rate ratio for adverse events was 2.1 (95% CI 1.8 to 2.5, $p < .001$). Because of adverse events, 184 patients terminated treatment (10.1%), while 68 patients terminated the inactive control intervention (4.8%). A meta-analysis showed an odds ratio of 2.2 (95% CI 1.6 to 3.1, $p < .001$) for discontinuing pharmacotherapy versus pill placebo due to adverse events.

Compared to inactive control conditions, mainly wait-list, drop-out from treatment was significantly increased in psychotherapy and self-help treatment with small odds ratios of 1.9 or 2.4, respectively. Descriptively, drop-out ranged from 19% to 29% in RCTs with inactive control condition (psychotherapy 19%, 95% CI 15 to 23%; self-help treatment 24%, 95% CI 19 to 31%; pharmacotherapy 29%, 95% CI 25 to 33%; self-help WLT 22%, 95% CI 8 to 49%; pharmacological WLT 26%, 95% CI 18 to 36%; combined treatment 22%, 95% CI 18 to 27%).

A sensitivity analysis confirmed the results for the most frequently used treatments of CBT, CBT self-help treatment, and lisdexamfetamine (Table E1, online supplement). CBT self-help treatment showed an additional significant small-size reduction of depression versus inactive control conditions, mostly wait-list. Lisdexamfetamine showed significant medium-size effects on binge-eating episodes and abstinence from binge eating and a large-size effect on body weight, but a less than small-size effect on body mass index, when compared to pill placebo.

Only a few studies provided data on long-term follow-up effects versus inactive control conditions so that meta-analyses were not conducted.

Pre-treatment to Follow-up Change versus Active Control

The direct comparison of treatment categories at post-treatment and follow-ups is presented in Figure 3 and Table F1, online supplement. Because of limited data, Table F1 contains single study results in addition to meta-analytic results in order to complement the discussion.

Psychotherapy had significantly higher odds for abstinence from binge eating at 3-6-month follow-up (Peterson et al., 1998, 2009) and lower odds for drop-out than CBT self-help treatment (de Zwaan et al., 2017; Peterson et al., 1998, 2009; Wilson et al., 2010), but no further short- and long-term differences were found in primary and secondary outcomes. Data were unavailable for meta-analytic comparison of psychotherapy versus pharmacotherapy. When compared to behavioral WLT, psychotherapy led to significantly lower binge-eating episodes and eating disorder psychopathology at post-treatment, and a significantly higher abstinence from binge eating at 6-12-month follow-up (2-4 RCTs: Grilo et al., 2011; Munsch et al., 2007; Nauta et al., 2000; Wilson et al., 2010). However, psychotherapy resulted in a significantly lower BMI loss than behavioral WLT at post-treatment. Psychotherapy did not differ from combined treatment (all containing CBT) on either of the primary and secondary outcomes across time points, but showed a significantly lower drop-out (2-4 RCTs: Grilo et al., 2011; Le Grange et al., 2002; Ricca et al., 2001, 2009). Within the psychotherapies, a comparison of CBT versus other psychotherapies, including humanistic therapy, interpersonal therapy, and psychodynamic therapy, showed a significantly greater post-treatment reduction of binge-eating days in CBT, but no further differences on the primary and secondary outcomes emerged across time points (2-3 RCTs: Safer et al.., 2010; Tasca et al., 2006; Wilfley et al., 2002).

Data were unavailable for meta-analytic comparisons on self-help treatment versus pharmacotherapy, behavioral WLT, self-help WLT, and combined treatment. Comparisons within the self-help treatment category found no significant short- and long-term differences on the primary and secondary outcomes between CBT guided self-help and CBT unguided self-help (2-3 RCTs; Carter & Fairburn, 1998; Peterson et al., 1998, 2009).

Pharmacotherapy (fluoxetine, fluvoxamine) yielded a lower reduction of binge-eating episodes at post-treatment and 6-12-month follow-up than combined treatment with CBT (2 RCTs; Grilo et al., 2005c; Ricca et al., 2001). Data were unavailable on comparisons of pharmacotherapy with behavioral WLT. Comparing specific medications, fluoxetine did not differ from other second generation antidepressants (i.e., fluvoxamine, sertraline) in its effects on the primary and secondary outcomes (2 RCTs; Leombruni et al., 2008; Ricca et al., 2001).

Behavioral WLT had a significantly higher effect than combined treatment with CBT and with or without desipramine on eating disorder psychopathology at 3-6-month follow-up (2-3 RCTs: Agras et al., 1994; de Zwaan et al., 2005; Grilo et al., 2011). It also had a lower effect on depression and a higher effect on BMI at post-treatment. Data were unavailable on comparisons of pharmacological or self-help WLT with combined treatment and on different modalities of WLTs. Data were further unavailable for comparisons of different modalities of inpatient treatment.

Moderation Analyses

In the meta-regression analyses on moderators of primary outcomes from pre- to post-treatment (Table G1, online supplement), abstinence from binge eating, but not the reduction of binge-eating episodes was significantly higher in group versus individual treatment. Short-term treatments (< 10 weeks) showed significantly greater effects on binge-eating episodes than longer-term treatments (≥ 10 weeks), but no differences were found for abstinence. Regarding the mode of recruitment, the primary outcomes did not differ by clinical recruitment versus population-based or mixed recruitment.

Patient baseline characteristics were significant moderators of the reduction of binge-eating episodes, but not of abstinence from binge eating: The lower patients' age and BMI, the higher the proportion of women in the RCT (≥ 90%, the median value), and the higher the baseline number of binge-eating episodes, the greater the reduction of binge-eating episodes.

Regarding methodology, the primary outcomes were not significantly moderated by analytic design (intent-to-treat vs. completer analyses) or time frame of assessment of binge eating (4-week vs. 1-week assessment). Regarding the method of assessment, interview-based assessment recorded lower improvement of binge-eating episodes than questionnaire or diary-based assessment. Moderation analyses were not conducted for treatment integrity check, therapist training, manualization of treatment, and diagnosis and duration of BED because of a lack of data.

Study Quality

The methodological quality across studies varied widely (Table H1, online supplement). Across all 76 published RCTs, only 10 (13%) studies were judged as having an overall low risk of bias according to the Cochrane criteria, while most studies were categorized as unclear (32, 42%) or high (34, 45%) risk of bias. Considering the risk of bias per study arm within treatment category (Figure H1), the greatest number of low risk of bias ratings was found for self-help treatment and pharmacological interventions, whereas the greatest number of high risk of bias ratings were assigned to self-help WLT and inpatient treatment. The risk of bias and blinding per se were not significant moderators for the primary outcomes (Table G1, online supplement).

Reporting Biases

Funnel plot analyses using trim and fill methods for the primary outcomes documented that the estimates were not substantially affected by reporting biases, despite evidence of non-reporting of studies (Figures I1 to I2). For example, 43 RCTs were available for estimating the effect of active intervention versus inactive control on the pre- to post-treatment change of

binge-eating episodes. The trim and fill methods indicated that 6 studies are missing (p = .0078), which would change the standardized effect size from 0.50 to 0.43.

Quality of Evidence

The overall quality of evidence regarding the primary outcomes from RCTs with an inactive control group was very low across treatment categories and low for binge-eating episodes in combined treatment studies, as displayed in Figure 4. The main reasons for downgrading the quality of evidence were limitations, inconsistency, indirectness, imprecision, and publication bias.

Discussion

Over the past decade, the literature on the treatment of BED has more than doubled. This meta-analysis confirmed, refined, and extended previous findings of comprehensive meta-analyses (Brownley et al., 2016; Ghaderi et al., 2018; Vocks et al., 2010): Psychotherapy showed large-size effects in RCTs with inactive control groups, mostly wait-list control, for the primary outcomes of binge-eating episodes and abstinence from binge eating, followed by structured self-help treatment with medium-to-large effects. Pharmacotherapy and pharmacological WLT significantly improved binge-eating outcome in most RCTs when compared to pill placebo, with small effect sizes, whereas effects of self-help WLT and combined treatment were non-significant. Across these treatments, post-treatment abstinence from binge eating ranged from 45% to 54%. In contrast to short-term data, there was a lack of data on longer-term efficacy versus inactive control conditions, so that a controlled meta-analytical evaluation of the maintenance of therapeutic gains was not conducted. For comparative efficacy directly derived from RCTs with active control groups, there was little meta-analytical evidence for the superiority of one treatment category or specific treatment in the short or long term.

Efficacy Within Treatment Categories

Regarding psychotherapy, the high efficacy for binge-eating outcome in comparison with inactive control conditions such as wait-list is consistent with previous meta-analyses (Brownley et al., 2016; Ghaderi et al., 2018; Vocks et al., 2010). As in Vocks et al. (2010), medium and small effect sizes with psychotherapy were found for the post-treatment improvement of eating disorder psychopathology and depression, respectively; these were among the highest across all treatment categories, whereas body weight was not significantly reduced when compared to inactive control conditions. Depression and obesity, both representing comorbid conditions of BED (Kessler et al., 2013), are usually not within the main focus of psychotherapy for BED (e.g., Fairburn, 2008); augmenting the efficacy in these parameters awaits further research, for example, through specific interventions (e.g., Grilo, Reas, & Mitchell, 2016; Palavras et al., 2017). Notably, the odds of drop-out from treatment showed a two-fold increase in psychotherapy (and self-help treatment) when compared to inactive control groups, though the rate of 19% was among the lowest. Clinically, the significant odds of attrition highlight the relevance of therapeutically fostering and maintaining patient motivation in treatment, for example, through motivation-enhancing communication strategies and interventions (Dray & Wade, 2012).

The majority of psychotherapy trials used CBT, and a sensitivity analysis confirmed its efficacy, providing large evidence for this approach (Ghaderi et al., 2018; Linardon, Wade et al., 2017). However, there were only a few studies offering comparisons between different psychotherapies: A direct comparison with other conceptually and procedurally distinct bona fide psychotherapies showed that CBT outperformed other psychotherapies, including humanistic therapy, interpersonal psychotherapy, and psychodynamic therapy regarding a greater post-treatment reduction of days with binge eating with small effect size. This result is in line with Linardon, Wade et al. (2017) who found superiority of CBT versus other active psychotherapies on binge-eating outcome. A separate consideration of these other psychotherapies, however, demonstrated that CBT (i.e., dialectical behavior therapy) was only

superior to humanistic therapy at post-treatment with higher abstinence from binge eating, lower depression, and lower attrition in one study (Safer et al., 2010; Table F1, online supplement). This treatment had been conceptualized as a credible psychological placebo controlling for common factors (e.g., therapeutic alliance; Wampold, 2015), while lacking specific ingredients for the treatment of BED (Safer & Hugo, 2006). It was based on its own theory, provided a treatment rationale, and utilized non-specific common factor interventions. Thus, limited evidence speaks for the specificity of CBT in the treatment of BED when compared to non-specific humanistic therapy. Simultaneously, the relevance of common factors in the treatment of patients with BED needs to be recognized, as the efficacy of humanistic therapy approached that of CBT, which is in line with findings on other mental disorders (Wampold, 2015).

In contrast, no differences between CBT and other conceptually and procedurally distinct bona fide psychotherapies specifically addressing the symptomatology of BED (i.e., interpersonal psychotherapy, Wilfley et al., 2002; psychodynamic therapy, Tasca et al., 2006) were found (Table F1, online supplement), which is consistent with Spielmans et al.'s (2013) meta-analysis and evidence from other mental disorders (Wampold, 2015). Thus, the specificity of CBT versus other psychotherapies using other active ingredients to address the symptomatology of BED was not shown. This absence of significant differences may be attributable to treatment foci on overlapping or equally relevant maintenance factors of binge eating, an overlap in the use or similar potency of specific interventions, and/or the abovementioned relevance of common factors. Limited evidence makes it currently impossible to exactly determine the contribution of these putative factors to the outcome of psychotherapies for BED. In a few studies of BED, treatment-specific mediators or mechanisms of action have not been identified (Brauhardt, de Zwaan, & Hilbert, 2014; Linardon, de la Piedad Garcia et al., 2017), and common factor relationship variables were a non-specific predictor of psychotherapy outcome (Brauhardt et al., 2014). Given this limited

research on BED and considering evidence from other mental disorders (Wampold, 2015), it remains plausible to assume that both specific ingredients and common factors contribute to psychotherapy outcome of BED, despite the lack of comparative efficacy in a couple of studies in this meta-analysis. Overall, as the comparative efficacy results of CBT versus other bona fide psychotherapies were based on a small number of studies only, a definitive conclusion that CBT outperforms other psychotherapies does not seem to be justified based on this meta-analysis' results. More research is warranted in order to clarify comparative efficacy and identify through which mechanisms psychotherapies, ideally based on validated maintenance models, work for patients with BED, for example, through mediator analyses, experimental designs, or dismantling studies (Kazdin, 2007).

Favorable results were documented for structured self-help treatment, mostly applying CBT manuals, with medium-to-large effects on post-treatment binge-eating outcome versus inactive control conditions such as wait-list, which is smaller than in the few initial studies examined by Vocks et al. (2010). As with psychotherapy, eating disorder psychopathology was improved with medium effect size when compared to inactive control conditions, while there were no significant effects on body weight consistent with Vocks et al. (2010). No significant effects existed for depression either, although its improvement reached significance in a sensitivity analysis on CBT self-help treatment, providing additional support for the CBT approach (Ghaderi et al., 2018). However, there was not enough evidence for direct meta-analytical comparison of different self-help manuals. A direct comparison of self-help treatment in guided versus unguided format, all based on CBT, did not reveal any differences on the primary outcomes in a low number of RCTs, which is consistent with a previous meta-regression analysis indirectly comparing self-help treatments for BED and bulimia nervosa (Beintner et al., 2014). Although our results permit speculation that in BED guidance may not be indispensable for a favorable binge-eating outcome, optimal levels and types of guidance still need further clarification (Wilson & Zandberg, 2012). Significantly

elevated odds for drop-out from self-help treatment were observed in 24% of patients, which is consistent with the literature (Beintner et al., 2014), and advocates for measures to improve adherence, for example, with guidance by a mental health specialist.

For pharmacotherapy, as in previous meta-analyses (Brownley et al., 2016; Ghaderi et al., 2018; Vocks et al., 2010), the majority of pharmacological agents were second generation antidepressants whereas more recently, the central nervous stimulant lisdexamfetamine has been evaluated, approved by the US Food and Drug Administration in 2015 as the only drug with an indication for the treatment of BED. Pharmacotherapy outperformed pill placebo in most RCTs, showing small effects on binge-eating outcome compared to pill placebo and a small-size weight loss effect, while eating disorder psychopathology and depression were not significantly improved. A sensitivity analysis for lisdexamfetamine confirmed the significance of weight-related effects and additionally documented significant medium-size effects on binge-eating outcome, which is consistent with previous meta-analytic results (Ghaderi et al., 2018). The results are further consistent with meta-analyses showing greater abstinence from binge eating after treatment with lisdexamfetamine and second-generation antidepressants than with placebo in RCTs, while results on weight loss depression, and eating disorder psychopathology were heterogeneous (Brownley et al., 2016; Fornaro et al., 2016; Ghaderi et al., 2018). Only a few studies on second-generation antidepressants compared specific medications, without showing any differential effects. Overall, attrition rates for pharmacotherapy were 29%, but were not significantly increased when compared to pill placebo. However, the incidence rate of adverse events and the related odds of premature discontinuation were significant and amounted to roughly 2 in pharmacotherapy, consistent with previous meta-analytical evidence (Fornaro et al., 2016), which requires - together with the substantial attrition rate - careful consideration in the treatment of patients with BED. Of note, pharmacotherapy trials (and several combined treatment trials) were the only studies to systematically provide data on adverse events. Further adequately powered efficacy trials are

needed in order to discern mechanisms of action of different agents and establish optimal doses and administration specifics (Reas & Grilo, 2015). Agents efficacious in the treatment of comorbid mental disorders, such as attention-deficit/hyperactivity disorder or substance use disorder, as well as obesity are promising candidates for future pharmacotherapy evaluations in patients with BED (McElroy, 2017; Reas & Grilo, 2015).

Regarding treatments offering a combination of interventions, this meta-analysis newly documented, in a small number of RCTs with inactive control groups, non-significant effects on binge-eating outcome versus pill placebo, but significant small-size improvements of eating disorder psychopathology and depression in addition to a medium-size weight loss effect. Due to the heterogeneity of combined treatments, the low number of study arms, and various control conditions, however, it was not possible to compare different combination treatments versus inactive control conditions or against each other.

As in previous meta-analyses (Ghaderi et al., 2018; Vocks et al., 2010), RCTs comparing behavioral WLT with inactive control conditions in patients with BED were lacking, so that the efficacy of this standard obesity treatment approach could not be meta-analytically determined for BED. Regarding further WLTs in comparisons with diverse inactive control conditions in RCTs, a few studies did not show that self-help WLT significantly improved binge-eating outcome. Data on other outcomes were not sufficient for meta-analysis. Pharmacological WLT significantly improved binge-eating outcome at post-treatment with small effects and weight loss with large effect when compared to pill placebo. However, effects were non-significant for eating disorder psychopathology and depression. Of note, pharmacological WLT studies used sibutramine or d-fenfluramine, and both were withdrawn from the market in many countries for the treatment of obesity because of a risk of major cardiovascular events. Studies offering other currently licensed anti-obesity medications in patients with BED such as orlistat were not contained in pharmacological WLT trials (but in 3 arms of combined treatment). Further, this study searched for surgical

WLT being increasingly applied to patients with BED (Meany, Conceição, & Mitchell, 2014), but did not locate any RCT, likely related to the fact that randomization is ethically difficult in the surgical treatment approach.

Unlike the other treatment categories, inpatient treatments do not represent a conceptually distinct approach to treatment, but rather an intensive form of combined treatment with a focus on weight loss, or on BED and weight loss, in an inpatient setting. Although a few RCTs on inpatient treatment were retrieved, comparisons with inactive control conditions were unavailable, and data on different modalities were insufficient, so that the efficacy of inpatient treatment for patients with BED was not evaluated.

Comparative Efficacy Across Treatment Categories

Overall, from direct comparisons there was little evidence for the superiority of one treatment category. Psychotherapy led to higher follow-up rates of abstinence from binge eating and lower drop-out than CBT self-help treatment in a low number of RCTs, which is consistent with narrative review (Peat et al., 2017), suggesting a higher efficacy of psychotherapy which is commonly offered with greater intensity and higher level of guidance by a therapist. The comparative efficacy of psychotherapy versus pharmacotherapy was addressed by one study only, demonstrating superiority of CBT in reducing binge-eating episodes at post-treatment and follow-up and BMI at follow-up when compared to second-generation antidepressants (Ricca et al., 2001; Table F1, online supplement). Based on this single study, a definitive conclusion for the comparison of psychotherapy or CBT versus pharmacotherapy cannot be drawn. In contrast, psychotherapy revealed greater short- and long-term efficacy for binge-eating outcome than behavioral WLT in several RCTs, which confirms meta-regression and systematic review results (Peat et al., 2017; Vocks et al., 2010). While psychotherapy was more efficacious than behavioral WLT in the short term for improving eating disorder psychopathology, it had lower effects on BMI. Grilo et al. (2011) additionally documented a greater abstinence from binge eating in psychotherapy (CBT), but

no differences on BMI at follow-up (Table F1). These results are consistent with a systematic review (Peat et al., 2017) and suggest that psychotherapy outperforms behavioral WLT on BED symptomatology, but has lower effect on BMI, presumably in the short term only. These effects may be attributable to differences in treatment foci (BED versus obesity) and related interventions within these treatments (Palavras et al., 2017). Possibly related to the documented high efficacy of psychotherapy, there were no differential effects of psychotherapy versus combined treatment in several RCTs, except for a lower drop-out from treatment. In contrast, pharmacotherapy yielded a lower improvement of binge-eating episodes than combined treatment at both post-treatment and follow-up. In addition, there was single study support (Grilo et al., 2005c; Table F1) for the superiority of combined treatment on abstinence from binge eating and eating disorder psychopathology in the short and long term as well as depression in the short term, but a lower longer-term effect on BMI, which is consistent with a narrative review (Grilo et al., 2016). Very little evidence was available for comparisons among the categories of self-help treatment, pharmacotherapy, behavioral WLT, and combined treatment, and no evidence was available for inpatient treatment.

Moderation Analyses

Meta-regression analyses based on indirect comparisons served to elucidate influences of treatment, patient, and methodological characteristics on the primary outcomes at post-treatment. The superiority of group versus individual treatment format for binge-eating outcome may be related to the fact that the majority of psychotherapy studies with high efficacy for the primary outcomes were conducted in a group format. Shorter duration of treatment may be less suited for the treatment of BED than longer duration because of high symptomatic burden, for example, as reflected in the high number of binge-eating episodes at baseline or long duration of BED. Clinical versus population-based or mixed recruitment did not moderate primary outcomes, suggesting a similar symptom profile of patients across treatment settings and recruitment avenues.

Regarding patient characteristics, the fact that lower baseline age and BMI, higher proportion of women, and higher number of binge-eating episodes significantly predicted a greater post-treatment reduction of binge-eating episodes, is unlikely to reflect matching of patients with these characteristics into treatments with higher efficacy (Table C1, online supplement), although combinations of moderators, for example, interactions with treatment category, were not considered because of potential interrelations among variables. Rather, lower age and BMI may reflect a lower chronicity of BED. A higher proportion of women may indicate a greater compliance with treatment regimens. Higher baseline binge-eating episodes may allow for larger changes to occur. More research is warranted to further clarify the inconclusive evidence on patient characteristics as treatment moderators (Linardon, de la Piedad Garcia et al., 2017).

Regarding methodology, no moderating effect on primary outcomes was found for: the use of intent-to-treat analyses versus completer analyses and time frame of assessment of binge eating over the last 1 week versus 4 weeks. Interview-based assessment was associated with lower improvement of binge-eating episodes compared to questionnaire or diary-based assessment, suggesting an overestimation of therapeutic effects by self-report. Further moderation analyses were not conducted because of a lack of data.

Limitations of Included Studies

Regarding the risk of bias, study quality was heterogeneous. The most common problem, beyond a lack of blinding of participants and/or personnel, which is hardly feasible in psychological treatment studies, was a bias through confounding variables that were not sufficiently considered. In addition, a low risk of bias for blinding of outcome assessors, attrition bias, and reporting incomplete outcome data, was found in only a minority of studies. The lowest overall risk of bias was found in pharmacological treatment studies. Of note is that moderation analysis did not reveal any difference on the primary outcomes by risk of bias or blinding. Despite evidence for data censoring, it was not likely to impact outcomes

meaningfully. These results indicate that an unclear or high risk of bias does not lead to an overestimation of treatment efficacy regarding the primary outcomes. Given the multiple risks of bias assigned to many treatment studies, future clinical studies are nevertheless recommended to systematically consider risk of bias potential at the time of study planning.

Further study limitations pertained to the heterogeneous reporting of sample characteristics, making equity-relevant comparisons according to the PROGRESS framework impossible. While in most studies female patients were overrepresented, presumably because of gender-specific health care-seeking, many studies restricted the inclusion to patients in a specific age or BMI range. Only one RCT on an adolescent population fulfilled the inclusion criteria (Hilbert et al.). In general, future research should specifically target or not exclude underrepresented groups for better generalization of treatment effects. Finally, especially for pharmacotherapy, it is notable that many studies applied restrictive exclusion criteria regarding mental or medical comorbidities and were conducted by one research team only, which makes the generalization of effects challenging and underlines the necessity to examine diverse, clinically heterogeneous populations with BED. Regarding outcome assessments, it was surprising that remission from BED and quality of life, two core clinical outcome criteria, were assessed in a minority of studies only, so that the results were not included in this report.

Strengths and Limitations of the Meta-Analysis

Strengths of this study are the provision of a comprehensive meta-analysis on the efficacy of psychological and medical treatments for BED, allowing for high generalizability to clinical practice. Current guidelines for protocol development, reporting, and quality evaluation were followed (see Hilbert et al., 2017), including the Meta-Analysis Reporting Standards (MARS; American Psychological Association, 2008). The broad search, screening, and data extraction, based on a standardized coding scheme, were performed by two scientists independently. Interrater agreement of coding was almost perfect. A new search for the total publication time period was carried out because of increased quality standards for meta-

analyses. A very high interstudy reliability with Vocks et al. (2010) for studies published up to June 2006 was found, lending additional support to reliability. In contrast to Vocks et al. (2010) and to the study protocol (Hilbert et al., 2017), unpublished studies were included in order to limit publication bias, while non-randomized controlled studies and uncontrolled studies and the analysis of within-condition results were omitted from this meta-analysis in order to rule out confounding through time and assessment effects. We examined a broad range of clinically relevant primary and secondary outcome variables that were derived from assessments that varied across studies, which speaks for generalizability, although specific psychometric properties were not provided because of the variation of measures across studies. Single treatments were grouped into broader treatment categories (Table A1, online supplement), making variations within treatment categories likely. Direct comparisons from RCTs were examined for establishing comparative efficacy, while indirect comparisons served to identify moderators of treatment only.

Limitations are that study language was restricted to English and economic aspects were not considered. The power for determining effects on binge-eating outcome ranged from low for the small treatment categories to excellent for the large treatment categories. Because of a limited database, caution is required, especially when interpreting the results on the smaller treatment categories, pre-treatment to follow-up change, comparative efficacy, and moderation analyses. Regarding study quality, although it may seem to be a limitation that we did not exclude studies with high risk of bias, risk of bias was not found to be a moderator of treatment outcome.

Clinical and Research Implications

In this meta-analysis, informing the renewal of the German evidence-based clinical guideline for BED (AWMF, 2010), the overall quality of evidence for the main outcomes was rated to be low to very low across treatment categories for various GRADE factors (Schünemann, Brożek, Guyatt, & Oxman, 2013), which is consistent with the NICE eating

disorder guideline (2017). With this low overall quality in mind, this study underlined a high efficacy of psychotherapy, especially CBT, and self-help treatment for binge-eating outcome. These effects have to be weighed against a lack of data on adverse events and high drop-out rate particularly in self-help treatment. While this meta-analysis' results overall confirm self-help treatment, especially if based on CBT, as efficacious, its potentially lower longer-term efficacy and higher drop-out rate support its use if psychotherapy is not available (e.g., during waiting periods) or not acceptable. Of note is that self-help treatment was found to be less costly, however, not necessarily more cost-effective than psychotherapy (König et al., 2018). Evaluating stepped care models, with self-help treatment as a first step and psychotherapy as a second step would allow to provide an evidence base to the respective recommendation of the NICE guidelines (2017) and permit addressing the increased discontinuation from self-help treatment (Tasca et al., 2018). In both treatment categories, the specificity of effects in comparison to placebo, for example, psychological placebo (cf. Safer & Hugo, 2006), and in comparison to other active treatments awaits further study.

Pharmacotherapy was found to be efficacious with small-size advantages over pill placebo, while lisdexamfetamine showed a medium-size effect on binge eating. These mostly small effects raise questions regarding effective agents and clinical trial design, while the placebo response documented in this meta-analysis is consistent with previous research demonstrating a substantial, but similar placebo response in BED as in other mental disorders (Blom et al., 2014). While the specificity of pharmacological agents in relation to pill placebo has generally been documented, only few studies compared different medications, without documenting specificity with regard to other pharmacological agents, which represents an important area of further research. Overall, pharmacotherapy effects have to be weighed against a complete lack of data on long-term administration, increased risk for adverse events, and related premature attrition from treatment.

Methodologically, it is important to note that pill placebo conditions commonly used in pharmacological RCTs, especially in double-blind designs, are more rigorous than wait-list control conditions commonly used in psychological treatment RCTs, as they control not only for time and assessment effects, but also for expectancy and demand characteristics. Thus, the effect sizes of pill-placebo-controlled pharmacological versus wait-list-controlled psychological trials are not comparable. Pill placebo conditions are further not comparable to psychological placebo conditions, as used in Safer et al. (2010), that sought to control for expectancy and demand characteristics: If not unblinded, for example, through side effects of the active medication, pill placebo is in double-blind RCTs indistinguishable from the active treatment to patients, therapists, and assessors, leading to the lowered risk of bias described above. Because of the placebo effect that substantially influences expectations and learning, based on a patient's psychobiological responses to the treatment context (Ashar, Chang, & Wager, 2017), pill placebo, albeit lacking an active ingredient, is more similar to active control conditions than to other inactive control conditions such as wait-list or no treatment. In future research, other designs and forms of pill placebo may be used in order to disentangle or control the placebo effect, for example, active placebos, mimicking side effects of the active medication, thereby decreasing the probability of unblinding (Ashar et al., 2017; Jensen, Bielefeldt, & Hróbjartsson, 2017). A clarification of the psychobiological mechanisms underlying the placebo effect in BED could help to maximize the efficacy of diverse medical and psychological treatment approaches for this disorder.

Clinically, because of its higher short- and long-term efficacy for the treatment of binge eating, psychotherapy may be prioritized over behavioral WLT. Because of its higher longer-term effect on binge-eating outcome and lower drop-out, psychotherapy may be prioritized over self-help treatment if both treatments are available. As combinations of psychotherapy with behavioral WLT and/or pharmacotherapy have not been found to have any short- or long-term additive effect on primary or secondary outcomes, they may not be

prioritized over psychotherapy alone. More high quality research on these and other psychological and medical treatments for BED is warranted, with a focus on the long-term maintenance of therapeutic gains, comparative efficacy, mechanisms through which treatments work, and complex models of care.

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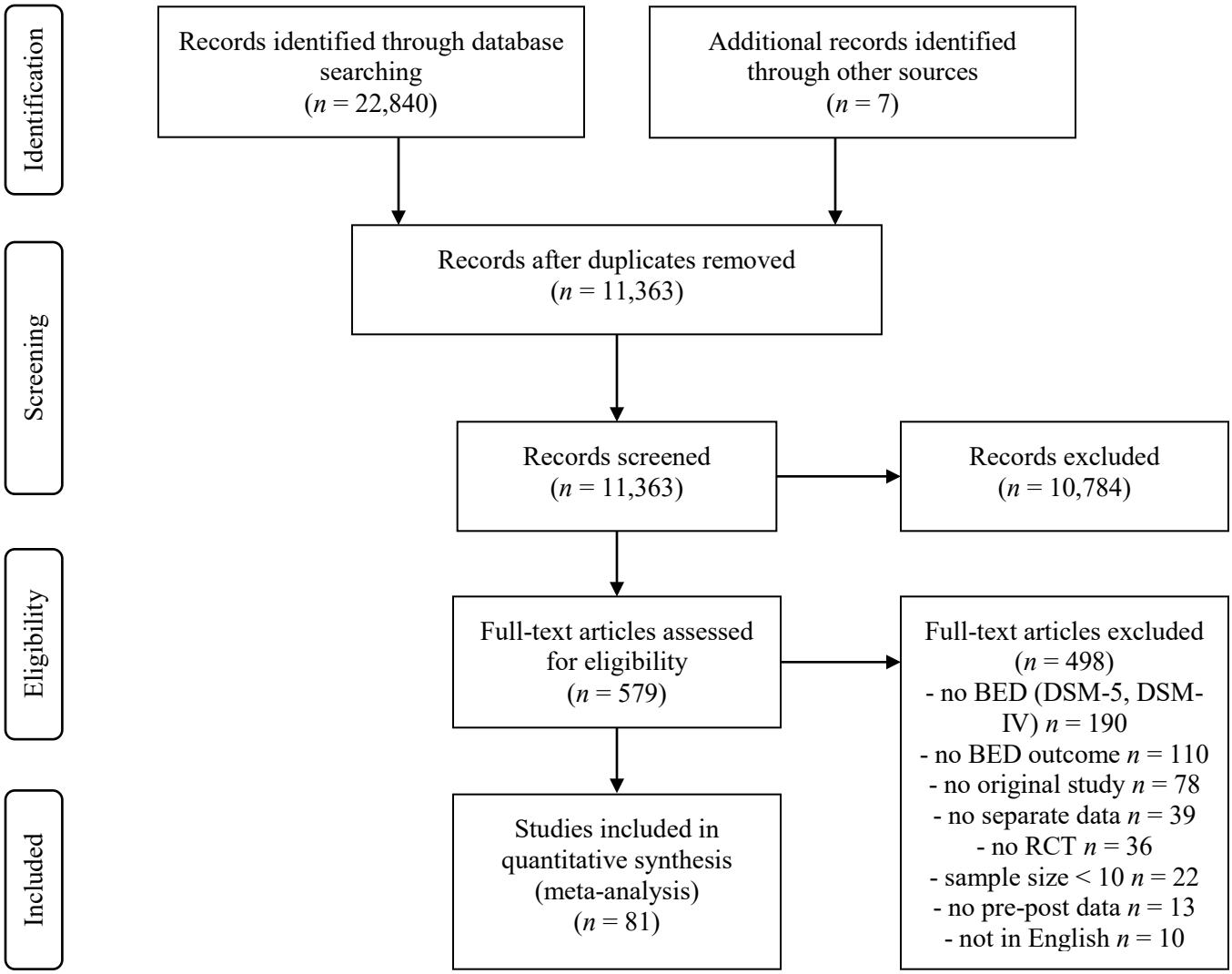
Figure Captions

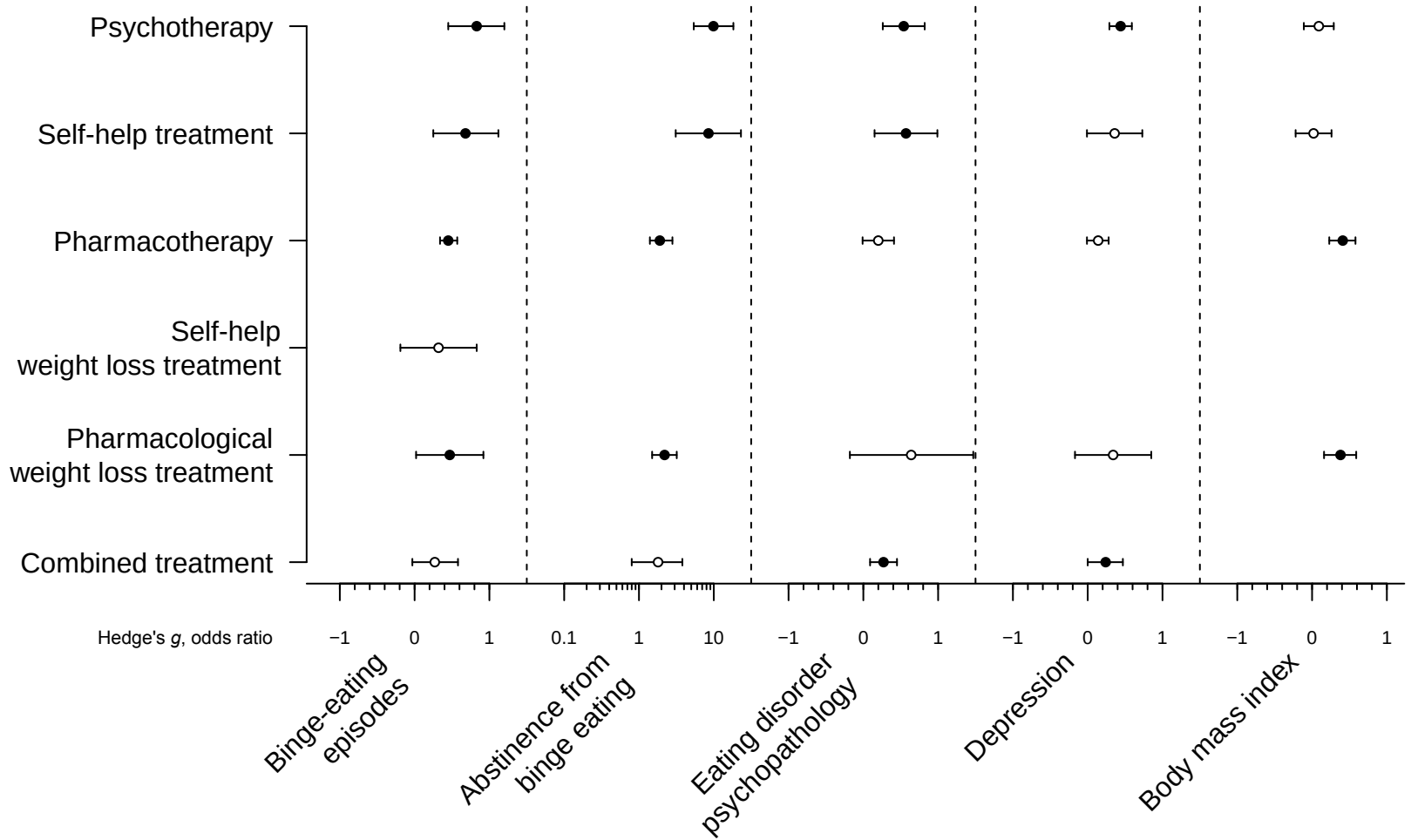
Figure 1. Flow diagram of included studies according to "Preferred reporting items for systematic review and meta-analysis protocols" (PRISMA-P).

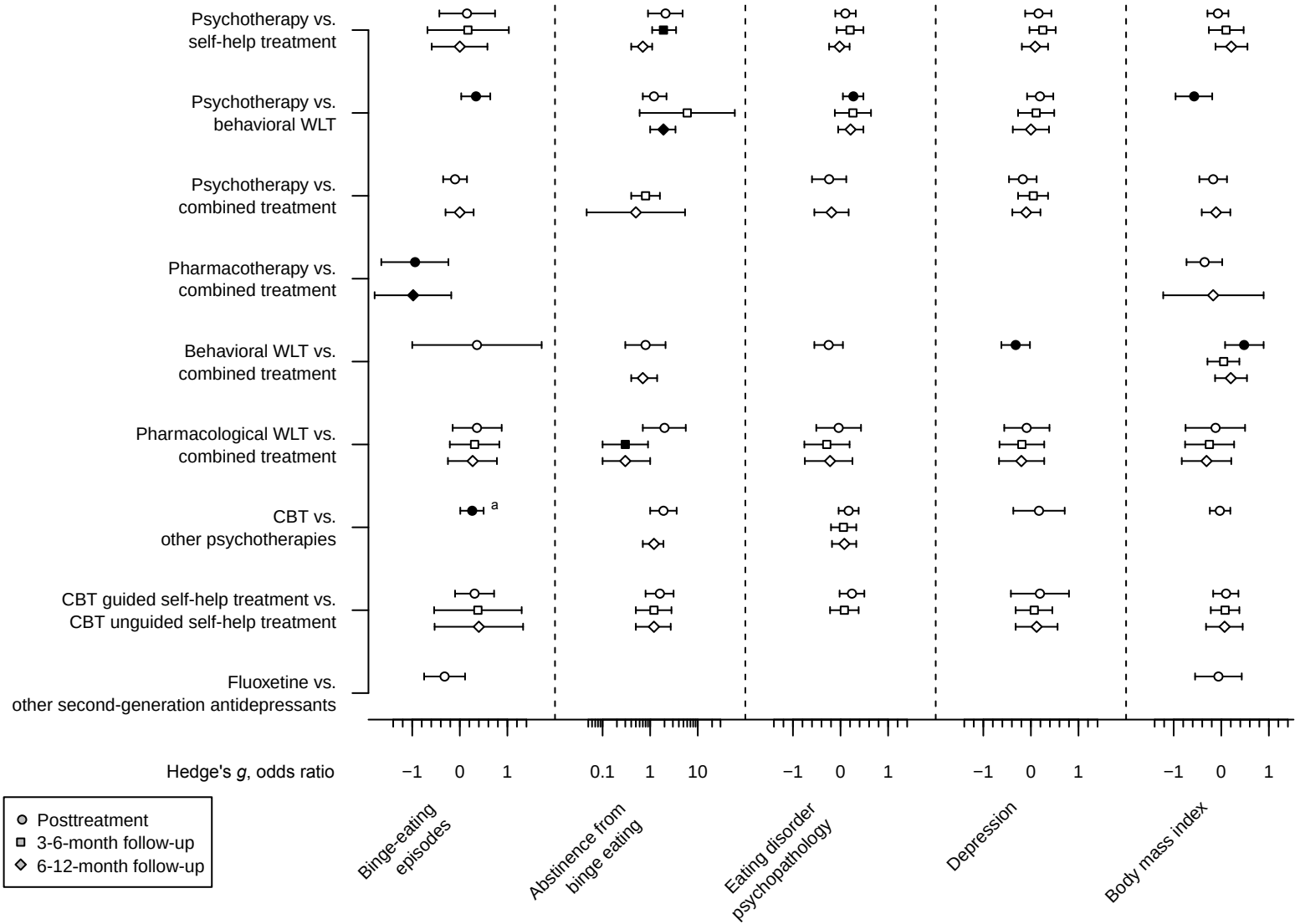
Figure 2. Pre-treatment to post-treatment change per treatment category versus inactive control. Black dots indicate significance ($p < .05$), white dots indicate non-significance ($p \geq .05$).

Figure 3. Pre-treatment to follow-up change versus active control across and within treatment categories. WLT indicates weight loss treatment, CBT indicates cognitive-behavioral therapy. Black dots indicate significance ($p < .05$), white dots indicate non-significance ($p \geq .05$).
[a]Days with binge eating.

Figure 4. Summary of findings for the main comparisons.


Identification
Screening
Eligibility
Included
Records identified through database searching (n = 22,840)
Additional records identified through other sources (n = 7)
Records after duplicates removed (n = 11,363)
Records screened (n = 11,363)
Records excluded (n = 10,784)
Full-text articles assessed for eligibility (n = 579)
Full-text articles excluded (n = 498)
- no BED (DSM-5, DSM-IV) n = 190
- no BED outcome n = 110
- no original study n = 78
- no separate data n = 39
- no RCT n = 36
- sample size < 10 n = 22
- no pre-post data n = 13
- not in English n = 10
Studies included in quantitative synthesis (meta-analysis) (n = 81)


Psychotherapy
Self-help treatment
Pharmacotherapy
Self-help weight loss treatment
Pharmacological weight loss treatment
Combined treatment
Hedge's g, odds ratio
−1
0
1
0.1
1
10
−1
0
1
−1
0
1
−1
0
1
Binge-eating episodes
Abstinence from binge eating
Eating disorder psychopathology
Depression
Body mass index


Psychotherapy vs. self-help treatment
Psychotherapy vs. behavioral WLT
Psychotherapy vs. combined treatment
Pharmacotherapy vs. combined treatment
Behavioral WLT vs. combined treatment
Pharmacological WLT vs. combined treatment
CBT vs. other psychotherapies
CBT guided self-help treatment vs. CBT unguided self-help treatment
Fluoxetine vs. other second-generation antidepressants
a
Hedge's g, odds ratio
−1 0 1
0.1 1 10
−1 0 1
−1 0 1
−1 0 1
Posttreatment
3-6-month follow-up
6-12-month follow-up
Binge-eating episodes
Abstinence from binge eating
Eating disorder psychopathology
Depression
Body mass index

Patient or population: Adults with binge-eating disorder
Settings: Outpatient and inpatient settings
Intervention: Psychological and medical treatments
Comparison: Inactive control group in randomized-controlled trials

Outcomes by treatment category	Control	Intervention	Relative effect (mean difference or odds ratio)	No. of studies/ participants	Quality of evidence (GRADE)	Comments
Psychotherapy						
Binge-eating episodes	0.18	1.11	0.83	11/672	⊕○○○[a]	
Abstinence from binge eating	0.13	0.60	9.9	10/667	⊕○○○[b]	
Self-help treatment						
Binge-eating episodes	0.50	1.26	0.72	7/461	⊕○○○[a]	
Abstinence from binge eating	0.08	0.44	8.9	5/422	⊕○○○[b]	
Pharmacotherapy						
Binge-eating episodes	1.62	1.92	0.46	16/1534	⊕○○○[c]	
Abstinence from binge eating	0.27	0.44	2.0	22/2495	⊕○○○[c]	
Pharmacological weight loss treatment						
Binge-eating episodes	1.08	2.15	0.47	3/354	⊕○○○[b]	
Abstinence from binge eating	0.37	0.56	2.2	4/424	⊕○○○[c]	
Self-help weight loss treatment						
Binge-eating episodes	0.72	0.91	0.36	2/75	⊕○○○[b]	
Abstinence from binge eating					-	only 1 study available
Combined treatment						
Binge-eating episodes	0.94	1.23	0.26	4/485	⊕⊕○○[d]	
Abstinence from binge eating	0.31	0.45	1.8	5/356	⊕○○○[d]	

[a]downgraded by three levels due to limitations, inconsistency, indirectness, and imprecision
[b]downgraded by three levels due to limitations, indirectness, and imprecision
[c]downgraded by three levels due to limitations, indirectness, imprecision, and publication bias
[d]downgraded by three levels due to indirectness and imprecision

Meta-analysis of the efficacy of psychological and medical treatments

for binge-eating disorder

Online supplement

Online supplement A	Included studies	Table A1, Reference list
Online supplement B	Study characteristics	Table B1
Online supplement C	Sample characteristics	Table C1
Online supplement D	Pre-treatment to post-treatment change	Table D1, Figures D1, D2
Online supplement E	Sensitivity analysis	Table E1
Online supplement F	Active treatment comparison	Table F1
Online supplement G	Moderation analysis	Table G1
Online supplement H	Study quality	Table H1, Figure H1
Online supplement I	Reporting bias	Figures I1, I2

Table A1

Included studies: Characteristics

Source	Abbreviated study arm	Intervention description	Treatment category	*N*	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
Psychotherapy											
Agras et al. (1995)	Agras (1995)	CBT	CBT	39	12	12	Wait-list	11	Group	ABS, EDP, DE, BW	pre, post
Alfonsson et al. (2015)	Alfonsson (2015)	Behavioral activation	CBT	50	10	8.85	Wait-list	50	Group	OBEd, ABS, EDP, DE, DO	pre, post, 3m, 6m
Allen & Craighead (1999)	Allen (1999)	Appetite awareness training	CBT	15	8	8	Wait-list	14	Group	OBE, ABS, EDP, DE	pre, post
Brambilla et al. (2009)	Brambilla (2009) CBT	CBT	CBT	10	24	24	Active		Group	OBE, BW, BMI	pre, post
de Zwaan et al. (2017)	de Zwaan (2017) CBT	CBT	CBT	86	16	20	Active		Individual	OBEd	pre, post
Dingemans et al. (2007)	Dingemans (2007)	CBT	CBT	30[a]	20	15	Wait-list[b]	22	Group	OBE, ABS, EDP, DE, DO	pre, post, 12m

Source	Abbreviated study arm	Intervention description	Treatment category	N	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
Ferrer-Garcia et al. (2017)	Ferrer-Garcia (2017) CBT	CBT	CBT	13	6	3	Active		Individual	OBE, ABS, EDP	pre, post
Ferrer-Garcia et al. (2017)	Ferrer-Garcia (2017) VR-CET	CBT with virtual reality cue exposure training	CBT	16	6	3	Active		Individual	OBE, ABS, EDP	pre, post
Gorin et al. (2003)	Gorin (2003) CBT	CBT	CBT	32	12	12	Wait-list, active	31	Group	OBE, ABS, EDP, DE, BMI, DO	pre, post, 6m
Gorin et al. (2003)	Gorin (2003) CBT-spouse	CBT with spouse involvement	CBT	31	12	12	Wait-list, active	31	Group	OBE, ABS, EDP, DE, BMI	pre, post, 6m
Grilo et al. (2011)	Grilo (2011) CBT	CBT	CBT	45[a]	24	16	Active		Group	OBE, ABS, EDP, DE, BW, BMI	pre, post, 6m, 12m
Hilbert et al. (DRKS00000542)	Hilbert et al.	CBT	CBT	29[a]	20	16	Wait-list	32	Individual	OBE, ABS	pre, post
Hilbert & Tuschen-	Hilbert (2004)	CBT with body	CBT	14	30	19.6	Active		Group	OBE, ABS, REM,	pre, post,

Source	Abbreviated study arm	Intervention description	Treatment category	N	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
Caffier (2004)	CBT-exposure	exposure								EDP, DE, BMI	4m
Hilbert & Tuschen-Caffier (2004)	Hilbert (2004) CBT-cognitive	CBT with cognitive body image intervention	CBT	14	30	18.6	Active		Group	OBE, ABS, REM, EDP, DE, BMI	pre, post, 4m
Kristeller et al. (2014)	Kristeller (2014) CBT	Psychoeducational CBT	CBT	35	9	9	Wait-list, active	31	Group	REM	pre, post
Kristeller et al. (2014)	Kristeller (2014) MBAT	Mindfulness-based eating awareness training	Other	31	9	9	Wait-list, active	31	Group	REM	pre, post
Le Grange et al. (2002)	Le Grange (2002) CBT	CBT	CBT	22[a]	12	12	Active		Group	OBE, REM, EDP, DE, BMI, DO	pre, post, 12m
Lewer et al. (2017)	Lewer (2017)	Body image therapy	CBT	15	10	10	Wait-list	21	Group	OBE, EDP, DE, BMI	pre, post
Munsch et al.	Munsch	CBT	CBT	44[a]	16	10.77	Active		Group	OBE, OBEd, ABS,	pre, post,

Source	Abbreviated study arm	Intervention description	Treatment category	N	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
(2007); Munsch, Meyer, & Biedert (2012)	(2007) CBT									REM, EDP, DE, QOL, BMI, DO	72m
Nauta et al. (2000); Nauta, Hospers, & Jansen (2001)	Nauta (2000) CBT	Cognitive therapy	CBT	21[a]	15	15	Active		Group	OBEd, ABS, REM, EDP, DE, BW, DO	pre, post, 6m, 12m
Pendleton et al. (2002)	Pendleton (2002) CBT	CBT	CBT	29	17	16	Active		Group	OBEd, ABS, DE	pre, post, 6m, 12m
Pendleton et al. (2002)	Pendleton (2002) CBT-maintenance	CBT + maintenance	CBT	28	43	28	Active		Group	OBEd, ABS, DE	pre, post, 6m
Peterson et al. (1998), Peterson et al. (2001)	Peterson (1998) CBT	CBT	CBT	16[a]	8	14	Wait-list, active	11	Group	OBE, ABS, REM, EDP, DE, BMI	pre, post, 1m, 6m, 12m

Source	Abbreviated study arm	Intervention description	Treatment category	N	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
Peterson et al. (2009)	Peterson (2009) CBT	CBT	CBT	60[a]	20	15	Wait-list, active	69	Group	OBE, OBEd, ABS, EDP, DE, QOL, BMI	pre, post, 6m, 12m
Preuss et al. (2017)	Preuss (2017) ImpulsE	Inhibitory control training	CBT	15[a]	10	10	Active		Group	OBEd, ABS, EDP, BW, BMI	pre, post, 1m, 3m
Preuss et al. (2017)	Preuss (2017) CBT	CBT	CBT	8[a]	10	10	Active		Group	OBEd, ABS, EDP, BW, BMI	pre, post, 1m, 3m
Ricca et al. (2009)	Ricca (2009) CBT	CBT	CBT	24[a]	24	22	Active		Individual	OBE, BMI	pre, post, 12m
Ricca et al. (2010)	Ricca (2010) individual CBT	CBT	CBT	72[a]	24	22	Active		Individual	REM	pre, post, 36m
Ricca et al. (2010)	Ricca (2010) group CBT	CBT	CBT	72[a]	22	20	Active		Group	REM	pre, post, 36m

Source	Abbreviated study arm	Intervention description	Treatment category	N	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
Ricca et al. (2001)	Ricca (2001) CBT	CBT	CBT	20	24	22	Active		Individual	OBE, BMI, DO	pre, post, 6m
Richard et al. (ACTRN12614000894695)	Richard et al.	Eye movement desensitization reprocessing	EMDR	16[a]	10	10	Wait-list	22	Individual	OBE, OBEd, EDP, DE, BMI	pre, post
Safer et al. (2010)	Safer (2010) DBT	DBT	CBT	50[a]	21	20	Active		Group	ABS, EDP, DE, BW, BMI, DO	pre, post, 12m
Safer et al. (2010)	Safer (2010) humanistic	Active comparison group therapy	Humanistic	51[a]	21	20	Active		Group	ABS, EDP, DE, BW, BMI, DO	pre, post, 12m
Schag et al. (DRKS00007689)	Schag et al.	Impulsivity-focused CBT	CBT	41[a]	8	8	No treatment	39	Group	OBE, OBEd, EDP, DE, BMI	pre, post, 3m
Tasca et al. (2006)	Tasca (2006) IPT	Psychodynamic IPT	Psycho-dynamic	48	16	12.35	Wait-list, active	40	Group	OBEd, ABS, EDP, DE, BMI, DO	pre, post, 6m, 12m
Tasca et al. (2006)	Tasca (2006)	CBT	CBT	47	16	11.77	Wait-list,	40	Group	OBEd, ABS, EDP,	pre, post,

Source	Abbreviated study arm	Intervention description	Treatment category	N	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
	CBT						active			DE, BMI, DO	6m, 12m
Telch, Agras, & Linehan (2001)	Telch (2001)	DBT	CBT	22	20	20	Wait-list[b]	22	Group	OBE, OBEd, ABS, EDP, DE, BW	pre, post, 3m, 6m
Wagner et al. (2016)	Wagner (2016)	CBT	Internet-based CBT	69[a]	11	16	Wait-list	70	Individual	OBE, ABS, EDP, DE, BW, BMI	pre, post, 3m, 6m, 12m
Wilfley et al. (2002)	Wilfley (2002) CBT	CBT	CBT	81[a]	20	16.6	Active		Group + Individual	OBEd, ABS, EDP, BMI, DO	pre, post, 4m, 8m
Wilfley et al. (2002)	Wilfley (2002) IPT	IPT	IPT	81[a]	20	17.7	Active		Group + Individual	OBEd, ABS, EDP, BMI	pre, post, 4m, 8m
Wilson et al. (2010)	Wilson (2010) IPT	IPT	IPT	75[a]	24	19	Active		Individual	OBEd, ABS, EDP, BMI, BW	pre, post, 12m, 24m
Yu et al. (2017)	Yu (2017)	CBT face-to-face	CBT	9	12	12	Active		Individual	OBE, EDP, BW,	pre, post

Source	Abbreviated study arm	Intervention description	Treatment category	*N*	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
Yu et al. (2017)	CBT face Yu (2017) CBT web	CBT web-based	CBT	8	12	12	Active		Individual	BMI OBE, EDP, BW, BMI	pre, post
Self-help treatment											
Carter & Fairburn (1998)	Carter (1998) unguided self-help	Unguided self-help	CBT unguided self-help	24[a]		12	(Wait-list)[c], active	24	Individual	OBE, ABS, EDP, BMI	pre, post, 3m, 6m
Carter & Fairburn (1998)	Carter (1998) guided self-help	Guided self-help	CBT guided self-help	24[a]	7	12	(Wait-list)[c], Active	24	Individual	OBE, ABS, EDP, BMI, DO	pre, post, 3m, 6m
de Zwaan et al. (2017)	de Zwaan (2017) guided self-help	Internet-based guided self-help	CBT guided self-help	84	16	18	Active		Individual	OBEd	pre, post
Duarte et al. (2017)	Duarte (2017)	Compassionate-	Other	17		4	Wait-list	16	Group +	OBE, EDP, DE,	pre, post,

Source	Abbreviated study arm	Intervention description	Treatment category	N	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
		based guided self-help	guided self-help						Individual	BMI	1m
Grilo & Masheb (2005a)	Grilo (2005a) guided self-help	CBT guided self-help	CBT guided self-help	37[a]	6	12	Attention-placebo, active	15	Individual	OBE, ABS, EDP, DE, BMI	pre, post
Grilo, White et al. (2013b)	Grilo (2013b)	CBT self-help	CBT unguided self-help	24		16	Usual care	24	Individual	OBE, ABS, EDP, DE, BMI, DO	pre, post
Kelly & Carter (2015)	Kelly (2015) other unguided self-help	Self-compassion training self-help	Other unguided self-help	15[a]		3	Wait-list, active	13	Individual	OBE, OBEd, EDP, DE, BMI, DO	pre, post
Kelly & Carter (2015)	Kelly (2015) CBT unguided	CBT self-help	CBT unguided	13[a]		3	Wait-list, active	13	Individual	OBE, OBEd, EDP, DE, BMI,DO	pre, post

Source	Abbreviated study arm	Intervention description	Treatment category	N	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
	self-help		self-help								
Masson et al. (2013)	Masson (2013)	DBT guided self-help	CBT guided self-help	30[a]		13	Wait-list	30	Individual	OBE, ABS, EDP, DO	pre, post, 6m
Peterson et al. (1998, 2001)	Peterson (1998) unguided self-help	CBT structured self-help	CBT unguided self-help	15[a]	14	8	Wait-list, active	11	Group	OBE, ABS, REM, EDP, DE, BMI	pre, post, 1m, 6m, 12m
Peterson et al. (1998, 2001)	Peterson (1998) guided self-help	CBT partial self-help	CBT guided self-help	19[a]	14	8	Wait-list, active	11	Group	OBE, ABS, REM, EDP, DE, BMI	pre, post
Peterson et al. (2009)	Peterson (2009) unguided self-help	CBT self-help	CBT unguided self-help	67[a]	15	20	Wait-list, active	69	Group	OBE, OBEd, ABS, EDP, DE, QOL, BMI	pre, post, 6m, 12m

Source	Abbreviated study arm	Intervention description	Treatment category	N	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
Peterson et al. (2009)	Peterson (2009) guided self-help	CBT therapist-assisted	CBT guided self-help	63[a]	15	20	Wait-list, active	69	Group	OBE, OBEd, ABS, EDP, DE, QOL, BMI	pre, post, 6m, 12m
Wilson et al. (2010)	Wilson (2010) guided self-help	CBT guided self-help	CBT guided self-help	66[a]	10	24	Active		Individual	OBEd, ABS, EDP, BW, BMI	pre, post, 12m, 24m
Pharmacotherapy											
Arnold et al. (2002)	Arnold (2002)	Fluoxetine	Second generation anti-depressants	30[a]		6	Placebo	30		OBE, ABS, DE, BW, BMI, ADV, DO	pre, post
Brownley et al. (2013)	Brownley (2013) high dose	Chromium high dose	Other	8		24	Placebo	30		OBE, ADV, DO	pre, post

Source	Abbreviated study arm	Intervention description	Treatment category	N	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
Brownley et al. (2013)	Brownley (2013) moderate dose	Chromium moderate dose	Other	9		24	Placebo	30		OBE, ADV, DO	pre, post
Grilo, Masheb, & Wilson (2005c); Grilo et al. (2012)	Grilo (2005c) fluoxetine	Fluoxetine	Second generation anti-depressants	27[a]		16	Active, placebo	27		OBE, ABS, EDP, DE, BMI	pre, post, 6m, 12m
Guerdjikova et al. (2008)	Guerdjikova (2008)	Escitalopram	Second generation anti-depressants	21[a]		12	Placebo	23		OBE, OBEd, ABS, EDP, DE, BW, BMI, ADV, DO	pre, post
Guerdjikova et al. (2009)	Guerdjikova (2009)	Lamotrigine	Anticonvulsant	26[a]		16	Placebo	25		OBE, OBEd, ABS, EDP, DE, BW, BMI, ADV, DO	pre, post

Source	Abbreviated study arm	Intervention description	Treatment category	N	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
Guerdjikova et al. (2012)	Guerdjikova (2012)	Duloxetine	Second generation anti-depressants	20[a]		12	Placebo	20		OBE, OBEd, ABS, EDP, DE, BW, BMI, ADV, DO	pre, post
Guerdjikova et al. (2016)	Guerdjikova (2016)	Lisdexamfetamine	Central nervous system stimulants	25[a]		12	Placebo	25		OBE, OBEd, ABS, EDP, ADV, DO	pre, post
Hudson et al. (1998)	Hudson (1998)	Fluvoxamine	Second generation anti-depressants	42[a]		9	Placebo	43		ABS, ADV, DO	pre, post
Leombruni et al. (2008)	Leombruni (2008)	Fluoxetine	Second generation	20		24	Active			OBE, ABS, EDP, DE, BW, BMI	pre, post

Source	Abbreviated study arm	Intervention description	Treatment category	N	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
	fluoxetine		anti-depressants								
Leombruni et al. (2008)	Leombruni (2008) sertraline	Sertraline	Second generation anti-depressants	22		24	Active			OBE, ABS, EDP, DE, BW, BMI	pre, post
McElroy et al. (2000)	McElroy (2000)	Sertraline	Second generation anti-depressants	18[a]		6	Placebo	16		OBE, ABS, ADV, DO	pre, post
McElroy, Arnold et al. (2003a)	McElroy (2003a)	Topiramate	Anti-convulsant	30[a]		14	Placebo	31		ABS, ADV, DO	pre, post
McElroy, Hudson et al. (2003b)	McElroy (2003b)	Citalopram	Second generation	19[a]		6	Placebo	19		OBE, OBEd, ABS, EDP, DE, BW,	pre, post

Source	Abbreviated study arm	Intervention description	Treatment category	N	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
			anti-depressants							BMI, ADV, DO	
McElroy et al. (2006)	McElroy (2006)	Zonisamide	Anti-convulsant	30[a]		16	Placebo	30		ABS, BW ADV, DO	pre, post
McElroy, Guerdjikova et al. (2007a)	McElroy (2007a)	Atomoxetine	Central nervous system stimulants	20[a]		10	Placebo	20		ABS, ADV, DO	pre, post
McElroy, Hudson et al. (2007b)	McElroy (2007b)	Topiramate	Anti-convulsant	195[a]		16	Placebo	199		OBE, OBEd, ABS, BMI, ADV, DO	pre, post
McElroy et al. (2011)	McElroy (2011)	Acamprosate	Other	20[a]		10	Placebo	20		OBE, OBEd, ABS, EDP, DE, QOL, BW, BMI, ADV, DO	pre, post

Source	Abbreviated study arm	Intervention description	Treatment category	N	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
McElroy et al. (2013)	McElroy (2013)	ALKS-33	Other	32[a]		6	Placebo	37		OBE, OBEd, ABS, BW, ADV, DO	pre, post
McElroy, Guerdjikova et al. (2015a)	McElroy (2015a)	Armodafinil	Other	30[a]		10	Placebo	30		OBE, OBEd, ABS, BW, ADV, DO	pre, post
McElroy, Hudson, Ferreira-Cornwell et al. (2015b)	McElroy (2015b) study 1	Lisdexamfetamine	Central nervous system stimulants	192[a]		12	Placebo	191		ABS, ADV, DO	pre, post
McElroy, Hudson, Ferreira-Cornwell et al. (2015b)	McElroy (2015b) study 2	Lisdexamfetamine	Central nervous system stimulants	195[a]		12	Placebo	195		ABS, ADV, DO	pre, post
McElroy, Hudson,	McElroy	Lisdexamfetamine	Central	66[a]		11	Active,	64		OBE, OBEd, ABS,	pre, post

Source	Abbreviated study arm	Intervention description	Treatment category	N	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
Mitchell et al. (2015c)	(2015c) 30mg	30mg	nervous system stimulants				Placebo			BW, ADV, DO	
McElroy, Hudson, Mitchell et al. (2015c)	McElroy (2015c) 50mg	Lisdexamfetamine 50mg	Central nervous system stimulants	65[a]		11	Active, placebo	64		OBE, OBEd, ABS, BW, ADV, DO	pre, post
McElroy, Hudson, Mitchell et al. (2015c)	McElroy (2015c) 70mg	Lisdexamfetamine 70mg	Central nervous system stimulants	65[a]		11	Active, placebo	64		OBE, OBEd, ABS, BW, ADV, DO	pre, post
Navia et al. (2017)	Navia (2017)	Dasotraline	Other	159[a]		12	Placebo	160		OBE, OBEd, ABS, EDP, BW, BMI, ADV, DO	pre, post

Source	Abbreviated study arm	Intervention description	Treatment category	N	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
Pearlstein et al. (2003)	Pearlstein (2003)	Fluvoxamine	Second generation anti-depressants	9		12	Placebo	11		OBEd, ABS, EDP, DE, BW, ADV, DO	pre, post
Ricca et al. (2001)	Ricca (2001) fluoxetine	Fluoxetine	Second generation anti-depressants	21		24	Active			OBE, BMI, ADV, DO	pre, post, 6m
Ricca et al. (2001)	Ricca (2001) fluvoxamine	Fluvoxamine	Second generation anti-depressants	22		24	Active			OBE, BMI, ADV, DO	pre, post, 6m
White & Grilo (2013)	White (2013)	Bupropion	Second generation	31[a]		8	Placebo	30		OBE, ABS, EDP, DE, BMI, ADV,	pre, post

Source	Abbreviated study arm	Intervention description	Treatment category	N	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
			anti-depressants							DO	
Behavioral weight loss treatment											
Agras et al. (1994)	Agras (1994) WLT	Weight loss treatment	Diet, exercise, behavioral strategies	37	30	36	Active		Group	ABS, EDP, DE, BW, ADV, DO	pre, post, 12m
de Zwaan et al. (2005)	de Zwaan (2005) WLT	Very low calorie diet	Diet, exercise, behavioral strategies	35[a]	24	24	Active		Group	OBE, ABS, BW, BMI	pre, post, 1m, 6m, 12m
Grilo et al. (2011)	Grilo (2011) WLT	Behavioral weight loss treatment	Diet, exercise, behavioral	45[a]	16	24	Active		Group	OBE, ABS, EDP, DE, BW, BMI	pre, post, 6m, 12m

Source	Abbreviated study arm	Intervention description	Treatment category	N	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
			strategies								
Levine, Marcus, & Moulton (1996)	Levine (1996)	Exercise	Exercise	44		24	Wait-list	33	Individual	ABS, DE, BW	pre, post
Munsch et al. (2007); Munsch, Meyer, & Biedert (2012)	Munsch (2007) WLT	Behavioral weight loss treatment	Diet, exercise, behavioral strategies	36[a]	10.75	16	Active		Group	OBE, OBEd, ABS, REM, EDP, DE, QOL, BMI, DO	pre, post
Nauta et al. (2000); Nauta, Hospers, & Jansen (2001)	Nauta (2000) WLT	Behavioral therapy	Diet, exercise, behavioral strategies	16[a]	15	15	Active		Group	OBEd, ABS, REM, EDP, DE, BW	pre, post, 6m, 12m
Wilson et al. (2010)	Wilson (2010) WLT	Behavioral weight loss treatment	Diet, Exercise	64[a]	20	24	Active		Individual	OBEd, ABS, EDP, BW, BMI	pre, post, 12m, 24m

Source	Abbreviated study arm	Intervention description	Treatment category	N	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
Self-help weight loss treatment											
Barnes et al. (2017)	Barnes (2017) MI	Behavioral weight loss guided self-help with motivational interviewing	Behavioral WLT guided self-help	8	5	12	Usual care, active	8	Individual	OBE, OBEd	pre, post, 3m, 12m
Barnes et al. (2017)	Barnes (2017) NP	Behavioral weight loss guided self-help with nutrition psychoeducation	Behavioral WLT guided self-help	7	5	12	Usual care, active	8	Individual	OBE, OBEd	pre, post, 3m, 12m
Grilo & Masheb (2005a)	Grilo (2005a) WLT self-help	Behavioral weight loss guided self-help	Behavioral WLT guided self-help	38[a]	6	12	Attention-placebo, active	15	Individual	OBE, ABS, EDP, DE, BMI	pre, post
Pharmacological weight loss treatment											

Source	Abbreviated study arm	Intervention description	Treatment category	N	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
Appolinario et al. (2003)	Appolinario (2003)	Sibutramine	Anti-obesity medication	30[a]		12	Placebo	30		OBEd, ABS, EDP, DE, BW, ADV, DO	pre, post
Grilo et al. (2014)	Grilo (2014) sibutramine	Sibutramine	Anti-obesity medication	26[a]		16	Active, placebo	27		OBE, ABS, EDP, DE, BW, BMI,	pre, post, 6m, 12m
Milano et al. (2005)	Milano (2005)	Sibutramine	Anti-obesity medication	10		12	Placebo	10		OBEd, EDP, ADV	pre, post
Stunkard et al. (1996)	Stunkard (1996)	d-Fenfluramine	Anti-obesity medication	14		8	Placebo	14		OBE, OBEd, ABS, ADV, GDO	pre, post, 1m, 4m
Wilfley et al. (2008)	Wilfley (2008)	Sibutramine	Anti-obesity medication	152[a]		24	Placebo	152		OBE, OBEd, ABS, EDP, QOL, BW, BMI, DO	pre, post
Combined treatment											
Agras et al. (1994)	Agras (1994) CBT + WLT	CBT + weight-loss treatment	CBT + WLT	36	30	36	Active		Group	ABS, EDP, DE, BW, ADV, DO	pre, post, 12m

Source	Abbreviated study arm	Intervention description	Treatment category	N	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
Agras et al. (1994)	Agras (1994) CBT + WLT + desipramine	CBT + weight-loss treatment + desipramine	CBT + WLT + medication	36	21	36	Active		Group	ABS, EDP, DE, BW, ADV, DO	pre, post, 12m
Brambilla et al. (2009)	Brambilla (2009) CBT + WLT + sertraline + topiramate	Diet + CBT + sertraline + topiramate	CBT + WLT + medication	10	24	24	Active		Group	OBE, EDP, BW, BMI	pre, post
Brambilla et al. (2009)	Brambilla (2009) CBT + WLT + sertraline	Diet + CBT + sertraline	CBT + WLT + medication	10	24	24	Active		Group	OBE, BW, BMI	pre, post
Cassin et al. (2008)	Cassin (2008)	Self-help + adapted motivation	CBT unguided	54		16	Active		Individual	OBEd, ABS, REM, DE, DO	pre, post

Source	Abbreviated study arm	Intervention description	Treatment category	N	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
		interviewing	self-help + motivational interview								
Devlin et al. (2005)	Devlin (2005) CBT + WLT + fluoxetine	Behavioral weight control + CBT + fluoxetine	WLT + CBT + medication	28[a]	10.9 + 13.6	20	Active		Group + individual	OBE, EDP, DE, BW, DO	pre, post
Devlin et al. (2005)	Devlin (2005) CBT + WLT + placebo	Behavioral weight control + CBT + placebo	WLT + CBT + placebo	25[a]	10.7 + 12.4	20	Active		Group + individual	OBE, EDP, DE, BW	pre, post
Devlin et al. (2005)	Devlin (2005) WLT + fluoxetine	Behavioral weight control + fluoxetine	WLT + medication	32[a]	10.5	20	Active		Group	OBE, EDP, DE, BW	pre, post
Devlin et al. (2005)	Devlin (2005) WLT +	Behavioral weight control + placebo	WLT + placebo	31[a]	8.8	20	Active		Group	OBE, EDP, DE, BW	pre, post

Source	Abbreviated study arm	Intervention description	Treatment category	N	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
	placebo										
de Zwaan et al. (2005)	de Zwaan (2005) CBT + WLT	CBT + very low calorie diet	CBT + WLT	36[a]	34	24	Active		Group	OBE, ABS, BW, BMI	pre, post, 1m, 6m, 12m
Golay et al. (2005)	Golay (2005)	Hypocaloric diet + orlistat	WLT + medication	44[a]		24	Placebo		Individual	REM, EDP, DE, ADV, DO	pre, post
Grilo, Masheb, & Wilson (2005c); Grilo et al. (2012)	Grilo (2005c) CBT + fluoxetine	CBT + fluoxetine	CBT + medication	26[a]	16	16	Active, placebo	27	Individual	OBE, ABS, EDP, DE, BMI	pre, post, 6m, 12m
Grilo, Masheb, & Wilson (2005c); Grilo et al. (2012)	Grilo (2005c) CBT + placebo	CBT + placebo	CBT + placebo	28[a]	16	16	Active, placebo only	27	Individual	OBE, ABS, EDP, DE, BMI	pre, post, 6m, 12m
Grilo, Masheb, & Salant (2005b)	Grilo (2005b)	CBT guided self-help + orlistat	CBT guided self-help +	25[a]	6	12	Placebo	25	Individual	OBE, ABS, EDP, DE, DO	pre, post, 3m

Source	Abbreviated study arm	Intervention description	Treatment category	*N*	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
			medication								
Grilo et al. (2011)	Grilo (2011) CBT + WLT	CBT + behavioral weight loss treatment	CBT + WLT	35[a]	32	40	Active		Group	OBE, ABS, EDP, DE, BW, BMI	pre, post, 6m, 12m
Grilo & White (2013a)	Grilo (2013a)	Orlistat + behavioral weight loss	WLT + medication	20[a]	12.2	16	Placebo	20	Individual	ABS, EDP, DE, BMI	pre, post, 6m
Grilo et al. (2014)	Grilo (2014) unguided self-help + sibutramine	CBT unguided self-help + sibutramine	CBT unguided self-help + medication	26[a]		16	Active, placebo	27	Individual	OBE, ABS, EDP, DE, BW, BMI	pre, post, 6m, 12m
Grilo et al. (2014)	Grilo (2014) unguided self-help + placebo	CBT unguided self-help + placebo	CBT unguided self-help + placebo	25[a]		16	Active, placebo only	27	Individual	OBE, ABS, EDP, DE, BW, BMI	pre, post, 6m, 12m
Le Grange et al.	Le Grange	CBT + ecological	CBT + other	19[a]	12	12	Active		Group	OBE REM, EDP,	pre, post,

Source	Abbreviated study arm	Intervention description	Treatment category	N	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
(2002)	(2002) CBT + momentary assessment	momentary assessment								DE, BMI, DO	12m
Masheb et al. (2011)	Masheb (2011) CBT + diet	CBT + low energy-diet	CBT + WLT	25[a]	16.8	26	Active		Individual	ABS, DO	pre, post, 6m, 12m
Masheb et al. (2011)	Masheb (2011) CBT + counseling	CBT + general nutrition counseling	CBT + WLT	25[a]	19.1	26	Active		Individual	ABS	pre, post, 6m, 12m
Molinari et al. (2005)	Molinari (2005) CBT + WLT	CBT + diet	CBT + WLT	22	42	54	Active		Group + individual	DO	pre, post
Molinari et al. (2005)	Molinari (2005) WLT +	Diet + fluoxetine	WLT + medication	22	18	54	Active		Group + individual	OBE, ADV, DO	pre, post

Source	Abbreviated study arm	Intervention description	Treatment category	N	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
	fluoxetine										
Molinari et al. (2005)	Molinari (2005) CBT + WLT + fluoxetine	CBT + diet + fluoxetine	CBT + WLT + medication	21	42	54	Active		Group + individual	ADV, DO	pre, post
Pataky et al. (2013)	Pataky (2013)	Rimonabant + Diet	WLT + medication	143 [a]		26	Placebo	146	Individual	OBE, EDP, BW, DO	pre, post
Pendleton et al. (2002)	Pendleton (2002) CBT + WLT	CBT + exercise	CBT + WLT	28	16	17	Active		Group	OBEd ABS, DE	pre, post, 6m, 12m
Pendleton et al. (2002)	Pendleton (2002) CBT + WLT maintenance	CBT + exercise maintenance	CBT + WLT	29	28	43	Active		Group	OBEd ABS, DE	pre, post, 6m

Source	Abbreviated study arm	Intervention description	Treatment category	N	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
Ricca et al. (2001)	Ricca (2001) CBT + fluoxetine	CBT + fluoxetine	CBT + medication	22	22	24	Active		Individual	OBE, BMI, ADV, DO	pre, post, 6m
Ricca et al. (2001)	Ricca (2001) CBT + fluvoxamine	CBT + fluvoxamine	CBT + medication	23	22	24	Active		Individual	OBE, BMI, ADV, DO	pre, post, 6m
Ricca et al. (2009)	Ricca (2009) CBT + zonisamide	CBT + zonisamide	CBT + medication	28[a]	22	24	Active		Individual	OBE, BMI, ADV, DO	pre, post, 12m
Inpatient treatment											
Cesa et al. (2013)	Cesa (2013) inpatient + CBT	Inpatient multimodal treatment + CBT	Multimodal inpatient BED treatment	30[a]	15	6	Active		Group + individual	EDP, BW, BMI, DO	pre, post, 12m

Source	Abbreviated study arm	Intervention description	Treatment category	N	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
			including CBT								
Cesa et al. (2013)	Cesa (2013) inpatient + enhanced CBT	Inpatient multimodal treatment + Virtual reality-enhanced CBT	Multimodal inpatient BED treatment including virtual reality-enhanced CBT	31[a]	15	6	Active		Group + individual	EDP, BW, BMI, DO	pre, post, 12m
Cesa et al. (2013)	Cesa (2013) inpatient	Inpatient multimodal treatment	Multimodal inpatient WLT	29[a]		6	Active		Group + individual	EDP, BW, BMI, DO	pre, post, 12m

Source	Abbreviated study arm	Intervention description	Treatment category	N	n_{se}	t_{treat}	Control	n_c	Format	Outcomes	Time points
Riva et al. (2003)	Riva (2003) inpatient	Inpatient weight loss treatment	Multimodal inpatient WLT	9	5	6	Active		Group	ABS, BW	pre, post, 6m
Riva et al. (2003)	Riva (2003) inpatient + experiential therapy	Inpatient weight loss treatment + experiential cognitive therapy	Multimodal inpatient BED treatment + WLT	9	15	6	Active		Group + individual	ABS, BW	pre, post, 38m, 78m, 146m
Riva et al. (2003)	Riva (2003) inpatient + CBT	Inpatient weight loss treatment + CBT	Multimodal inpatient BED treatment + WLT	9	15	6	Active		Group	ABS, BW	pre, post, 6m

Notes. CBT, cognitive-behavioral therapy; IPT, interpersonal psychotherapy; DBT, dialectical behavior therapy; MBAT, mindfulness-based awareness training; WLT, behavioral weight loss treatment; number of patients in treatment condition; n_{se}, number of sessions; t_{treat} treatment duration in weeks; $n_{c,}$ number of patients in inactive control condition; OBE, number of objective binge-eating episodes; OBEd, number of days with objective binge-eating episodes; ABS, abstinence from binge eating; REM, remission from binge-eating disorder; EDP, eating disorder psychopathology; DE, depression; QOL, quality of life; BW, body weight; BMI, body mass index; ADV, adverse events; DO, reasons for drop-out from treatment; pre, pre-treatment; post, post-treatment; 3m, 3-month follow-up etc. Listed outcomes refer to analyzed data of the post-treatment assessment only.

[a]Intent-to-treat data. [b]Comparison between treatment group and control group examined at post-treatment only because follow-up data were confounded with them. [c]In Carter & Fairburn (1998), data of the wait-list control group not used because of confounding with those of treatment group.

Included studies: References

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Table B1

Study characteristics: Active conditions with sample size per treatment category (k/n) in randomized-controlled trials (RCT).

	Total
Psychotherapy	43/1535
Cognitive-behavioral therapy	36/1218
Interpersonal psychotherapy	2/156
Psychodynamic therapy	1/48
Humanistic therapy	1/51
Other psychotherapy	3/62
Self-help treatment	14/498
Guided self-help treatment	8/340
Cognitive-behavioral guided self-help treatment	7/323
Other guided self-help treatment	1/17
Unguided self-help treatment	6/158
Cognitive-behavioral unguided self-help treatment	5/143

	Total
Other unguided self-help treatment	1/15
Pharmacotherapy	30/1469
Second generation antidepressants	14/328
Central nervous system stimulants	7/628
Anticonvulsants	3/255
Other pharmacotherapy	6/258
Behavioral weight loss treatment	7/277
Diet	0/0
Exercise	1/44
Diet, exercise	1/64
Diet, exercise, behavioral strategies	5/169
Self-help weight loss treatment	3/53
Pharmacological weight loss treatment	5/232
Combined treatment	30/934

	Total
Cognitive-behavioral therapy + pharmacological interventions	6/150
Cognitive-behavioral therapy + behavioral weight loss treatment	8/236
Cognitive-behavioral therapy + behavioral weight loss treatment + pharmacological interventions	5/105
Behavioral weight loss treatment + pharmacological interventions	4/118
Other combined treatment	7/225
Inpatient treatment	6/117
Multimodal inpatient binge-eating disorder and weight loss treatment	4/79
Multimodal inpatient weight loss treatment	2/38

Note. Treatment format: psychotherapy, group format: 29, individual format: 12, group plus individual format: 2; self-help treatment, group format: 4, individual format: 9, group plus individual format: 1; behavioral weight loss treatment, group format: 5, individual format: 2; self-help weight loss treatment, individual format: 3; combined treatment, group format: 11, individual format: 14, group plus individual format: 5; inpatient treatment: group format: 2, group plus individual format: 4.

Table C1

Sample characteristics

	Psycho-therapy	Self-help treatment	Pharmaco-therapy	Weight loss treatment			Combined treatment	Inpatient treatment
				Behavioral	Self-help	Pharmaco-logical		
Sex, % female	90%	89%	85%	91%	76%	89%	89%	87%
	(32/1392)	(11/551)	(28/2641)	(7/310)	(1/38)	(5/465)	(26/1108)	(6/117)
Age, years	43.8 ± 10.8	45.7 ± 10.8	40.2 ± 10.4	42.5 ± 9.4	46.0 ± 9.2	41.1 ± 10.0	42.1 ± 15.3	31.8 ± 7.8
	(33/1509)	(10/536)	(28/2682)	(6/294)	(1/38)	(3/417)	(25/1076)	(4/99)
Body weight, kg	101.2 ± 22.2	100.3 ± 14.0	101.5 ± 20.8	101.3 ± 17.8	-	101.2 ± 18.7	104.8 ± 17.1	106.7 ± 17.4
	(11/503)	(1/66)	(23/2405)	(6/274)		(4/445)	(13/619)	(6/117)
Body mass	37.0 ± 7.6	36.0 ± 6.4	36.3 ± 6.4	36.8 ± 5.2	36.0 ± 6.6	36.4 ± 5.7	37.7 ± 6.0	40.7 ± 5.1
index, kg/m^2	(28/1276)	(12/532)	(29/2702)	(6/294)	(1/38)	(2/357)	(23/609)	(3/90)
Binge-eating	15.0 ± 10.3	19.4 ± 12.8	22.8 ± 12.7	19.5 ± 14.0	13.0 ± 10.8	14.2 ± 9.6	18.2 ± 14.6	-
episodes, n	(23/865)	(10/485)	(29/2702)	(4/193)	(3/61)	(3/385)	(18/737)	
Binge-eating	14.7 ± 7.2	16.1 ± 7.2	17.8 ± 5.2	15.6 ± 6.8	11.3 ± 7.2	12.8 ± 5.0	15.0 ± 7.6	-

	Psycho-therapy	Self-help treatment	Pharmaco-therapy	Weight loss treatment			Combined treatment	Inpatient treatment
				Behavioral	Self-help	Pharmaco-logical		
days, n	(15/902)	(4/349)	(19/2319)	(3/116)	(2/23)	(3/384)	(4/215)	
Duration of BED, years	17.9 ± 10.5 (10/337)	-	18.0 ± 10.7 (7/594)	-	-	-	7.3 ± 10.8 (7/490)	-
Treatment sessions, n	14.8 ± 5.3 (43/1940)	11.1 ± 5.5 (9/503)	-	19.3 ± 6.9 (6/233)	5.3 ± 0.6 (3/61)	-	21.8 ± 9.4 (23/624)	13.0 ± 4.5 (5/88)
Duration of treatments, weeks	16.5 ± 7.8 (43/1940)	12.2 ± 6.6 (14/676)	13.7 ± 6.0 (30/2722)	23.3 ± 6.9 (7/310)	12.0 ± 0.0 (3/61)	14.4 ± 6.1 (5/465)	26.0 ± 12.2 (30/1224)	6.0 ± 0.0 (6/117)

Note. Displayed are *M* ± *SD* and (*k*, number of study arms / *n*, number of participants).

Table D1

Pre-treatment to post-treatment change versus inactive control

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
Psychotherapy									
Binge-eating episodes	0.83 (9.5)	0.45 - 1.20 (5.6 - 13.4)	4.3	< .001	12/672	28	0.29	35(11), < .001	79
Binge-eating abstinence	9.9	5.4 - 18.3	7.3	< .001	12/721	63	0.30	14(11), .25	33
Eating disorder psychopathology	0.54	0.26 - 0.82	3.8	< .001	11/719	21	0.15	34(10), < .001	70
Depression	0.44	0.29 - 0.59	5.8	< .001	11/719	14	0.00	4(10), .94	0
Body weight (kg)	0.15 (1.9)	-0.11 - 0.40 (-1.3 - 5.2)	1.1	.26	3/236	0	0.00	0(2), .95	0
Body mass index (kg/m^2)	0.09 (0.4)	-0.11 - 0.29 (-0.4 - 1.3)	0.9	.37	6/394	0	0.00	1(5), .93	0

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
Drop-out	1.88	1.13 - 3.14	2.4	0.015	13/842	8	0.31	19(12), .078	38
Self-help treatment									
Binge-eating episodes	0.68 (6.6)	0.25 - 1.12 (3.4 - 9.8)	3.1	.0021	10/554	20	0.29	22(9), .0084	78
Binge-eating abstinence	8.5	3.1 - 23.1	4.2	< .001	7/502	38	0.84	15(6), .024	60
Eating disorder psychopathology	0.57	0.15 - 0.99	2.7	.008	6/353	14	0.13	15(5), .0097	63
Depression	0.36	-0.74	1.9	.054	5/293	7	0.08	8(4), .093	51
Body mass index (kg/m^2)	0.02 (0.2)	-0.22 - 0.26 (-0.1 - 0.6)	0.2	.87	5/308	0	0.00	4(4), .39	0
Drop-out	2.08	1.17 - 3.71	2.5	.013	7/383	3	0.00	5(6), .55	7
Pharmacotherapy									
Binge-eating episodes	0.45	0.34 - 0.57	7.5	< .001	19/1664	15	0.01	36(18), .0075	10

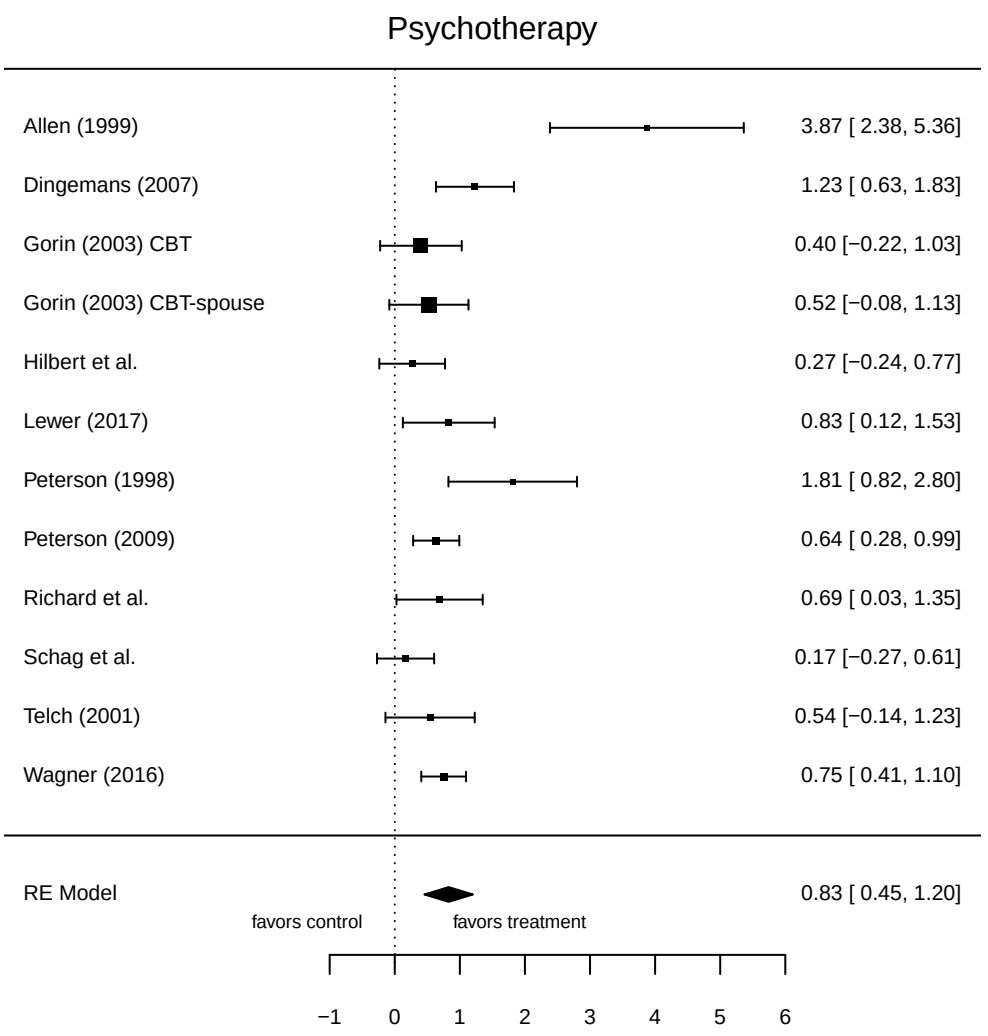
	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
	(3.5)	(2.2 - 4.9)							
Binge-eating abstinence	1.9	1.4 - 2.8	3.6	< .001	24/2627	17	0.39	53(23), < .001	66
Eating disorder psychopathology	0.20	-0.42	1.9	.058	13/1216	4	0.07	26(12), .010	60
Depression	0.14	-0.29	1.9	.064	10/788	0	0.00	11(9), .27	2
Body weight (kg)	0.48	0.23 - 0.73	3.8	< .001	13/616	31	0.16	43(12), < .001	65
	(2.3)	(1.3 - 3.3)							
Body mass index (kg/m^2)	0.41	0.23 - 0.58	4.6	< .001	11/1086	3	0.03	14(10), .15	34
	(1.5)	(1.1 - 1.9)							
Drop-out	1.19	0.88 - 1.62	1.1	.26	23/2498	0	0.16	36(22), .032	42
Self-help weight loss treatment									
Binge-eating episodes	0.32	-0.19 - 0.83	1.2	.22	3/83	3	0.04	2(2), .46	21
	(3.3)	(-1.2 - 7.9)							

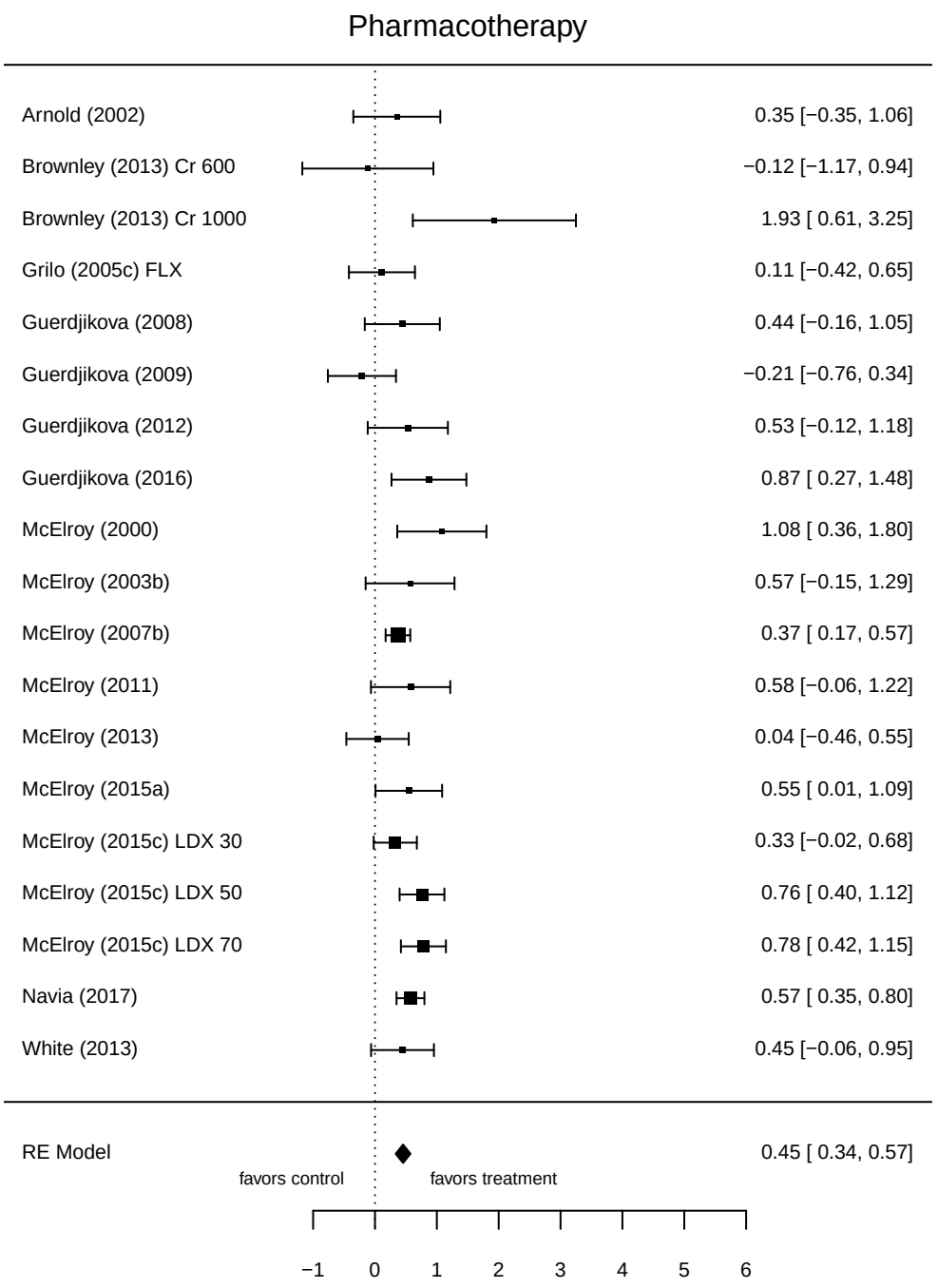
	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
Pharmacological weight loss treatment									
Binge-eating episodes	0.47	0.02 - 0.92	2.1	.039	3/354	3	0.09	4(2), .12	53
	(3.5)	(-0.1 - 7.0)							
Binge-eating abstinence	2.2	1.5 - 3.2	3.9	< .001	4/424	5	0.00	1(3), .79	0
Eating disorder psychopathology	0.64	-1.65	1.5	.12	4/421	12	0.60	13(3), .0052	91
Depression	0.34	-1.02	1.3	.19	2/113	2	0.06	2(1), .17	46
Body weight (kg)	0.89	0.19 - 1.58	2.5	.012	5/448	12	0.50	21(4), < .001	87
	(3.6)	(0.8 - 6.5)							
Body mass index (kg/m^2)	0.38	0.16 - 0.59	3.5	< .001	2/344	1	0.00	0(1), .96	0
	(1.2)	(0.5 - 1.9)							
Drop-out	0.67	0.45 - 1.00	-2.0	.051	5/465	-	0.00	3(4), .52	0
Combined treatment									

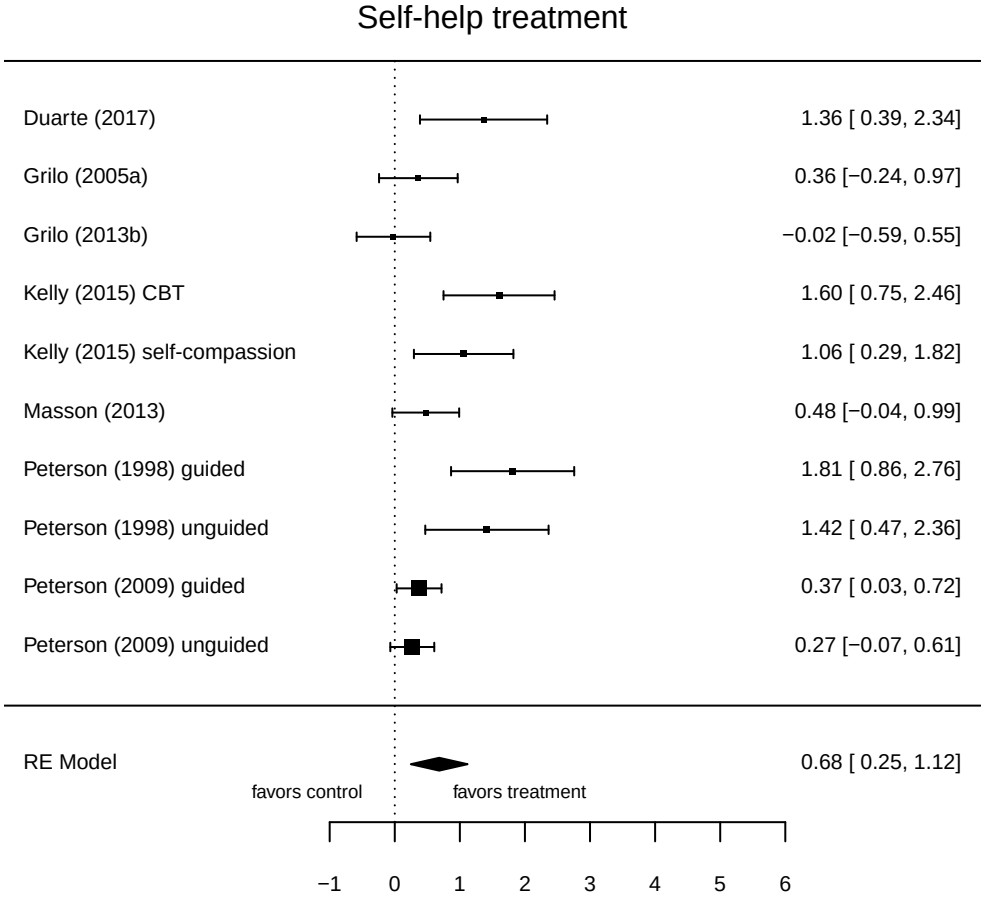
	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k*/*n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
Binge-eating episodes	0.27 (3.7)	-0.03 - 0.58 (1.7 - 5.7)	1.7	.082	6/532	0	0.06	10(5), 0.087	56
Binge-eating abstinence	1.8	0.8 - 3.8	1.5	.13	7/409	3	0.41	9(6), 0.16	57
Eating disorder psychopathology	0.27	0.09 - 0.45	2.9	.0035	4/468	2	0.00	0(3), 0.97	0
Depression	0.24	0.00 - 0.47	2.0	.046	4/287	1	0.00	2(3), 0.53	1
Body weight (kg)	0.54 (3.6)	0.35 - 0.74 (1.6 - 5.6)	5.4	< .001	3/412	3	0.00	0(2), 0.84	0
Drop-out	0.88	0.58 - 1.33	-0.6	.53	5/576	-	0.01	4(4), 0.38	5

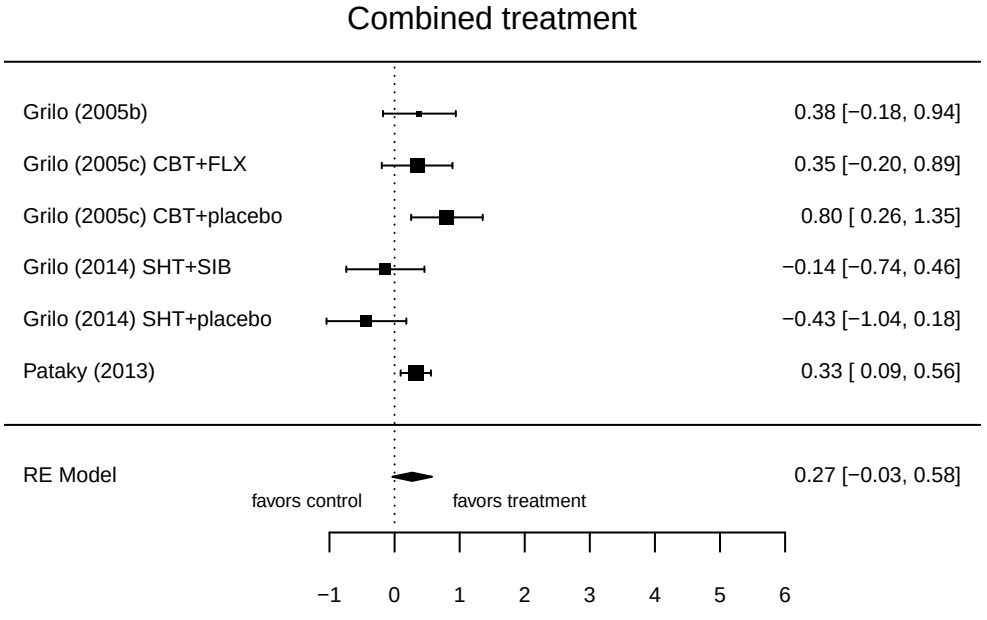
[a]Mean differences are calculated as treatment minus control where the mean within each group is pre-treatment minus post-treatment. Displayed are standardized values and 95% confidence interval (CI), and raw values and 95% CI in parentheses. Odds ratios use the control arm as reference. I^2, total heterogeneity; *k*, number of pairs of study arms; *n*, number of patients; *Q*, test statistic of heterogeneity; τ^2, estimated total heterogeneity in random effects models.

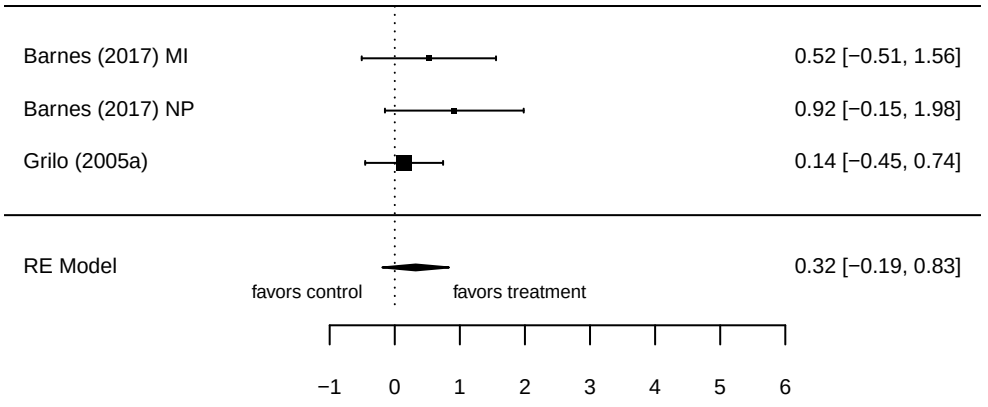
Figure D1. Forest plots for pre-treatment to post-treatment change in binge-eating episodes in randomized-controlled trials with inactive control











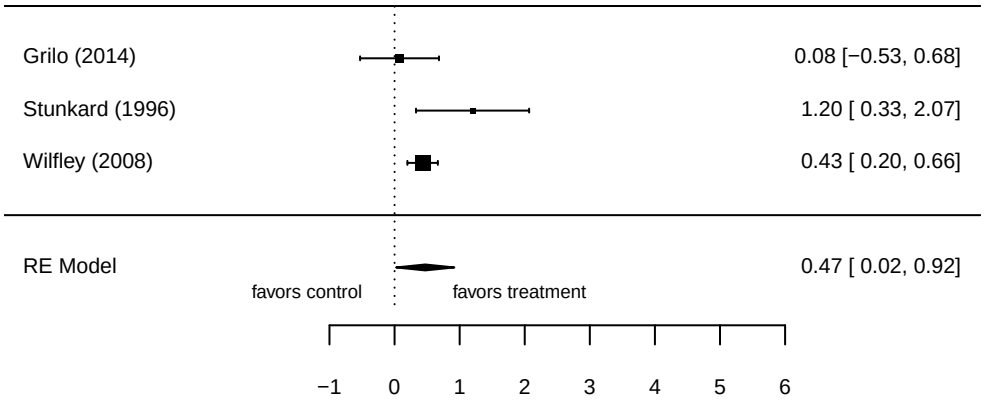
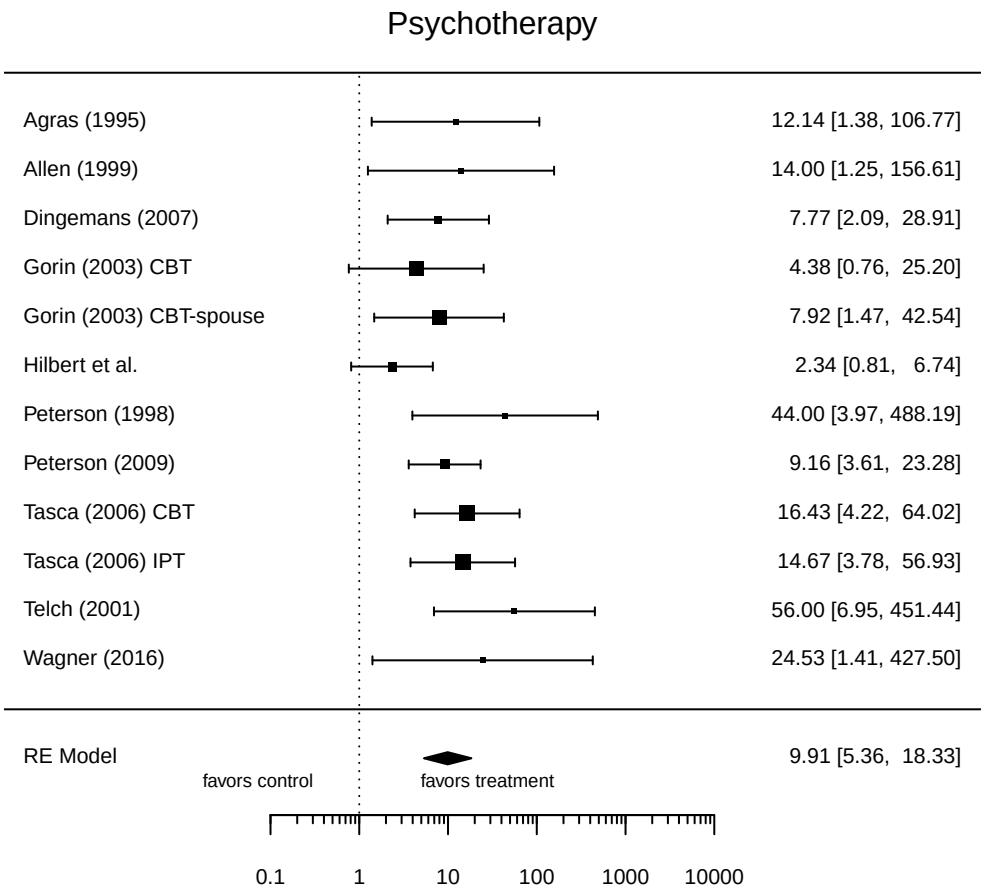
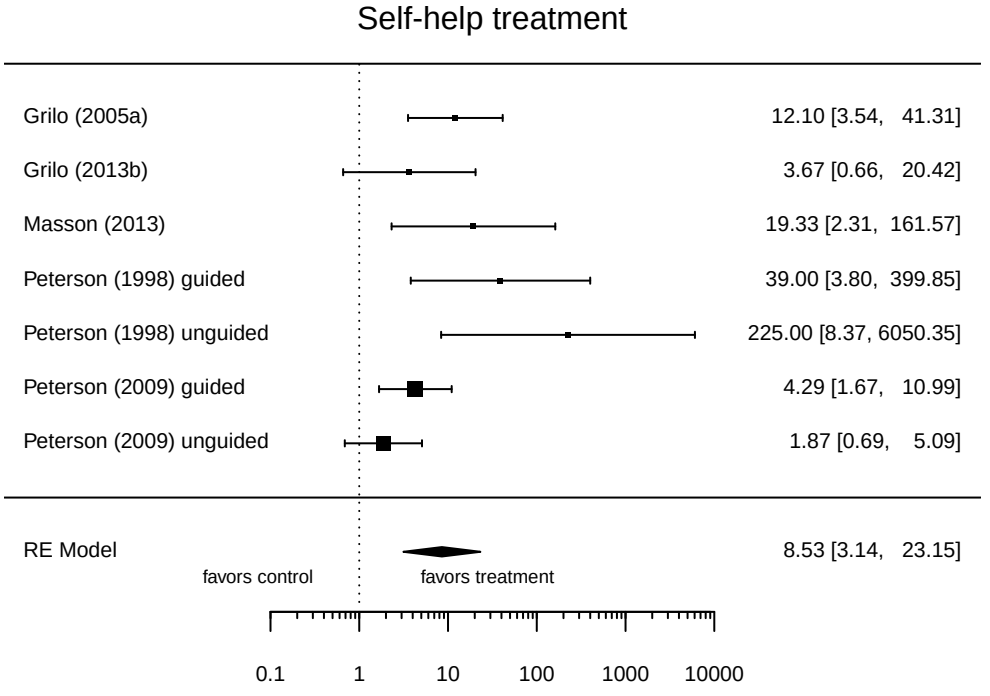
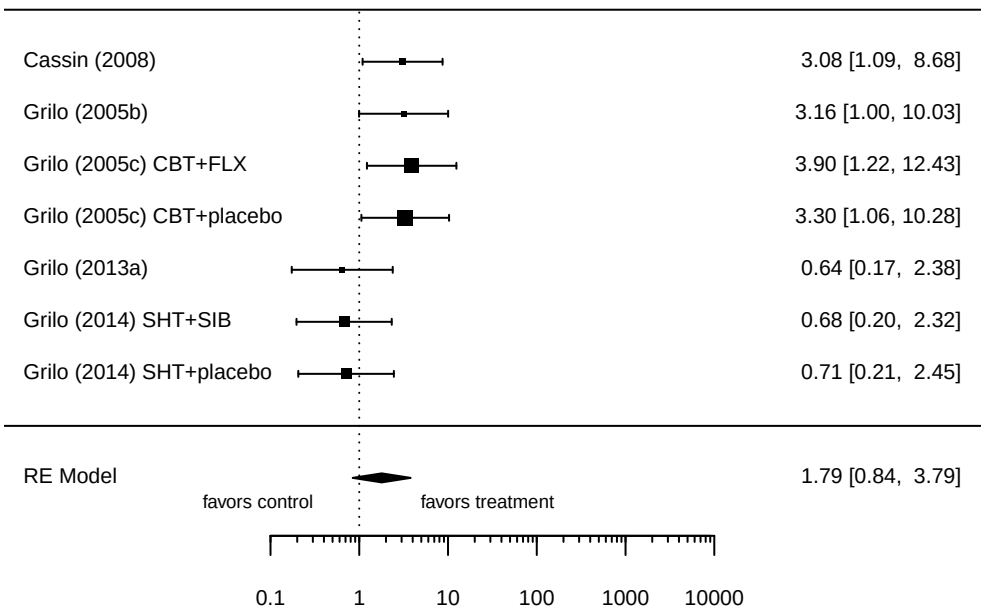
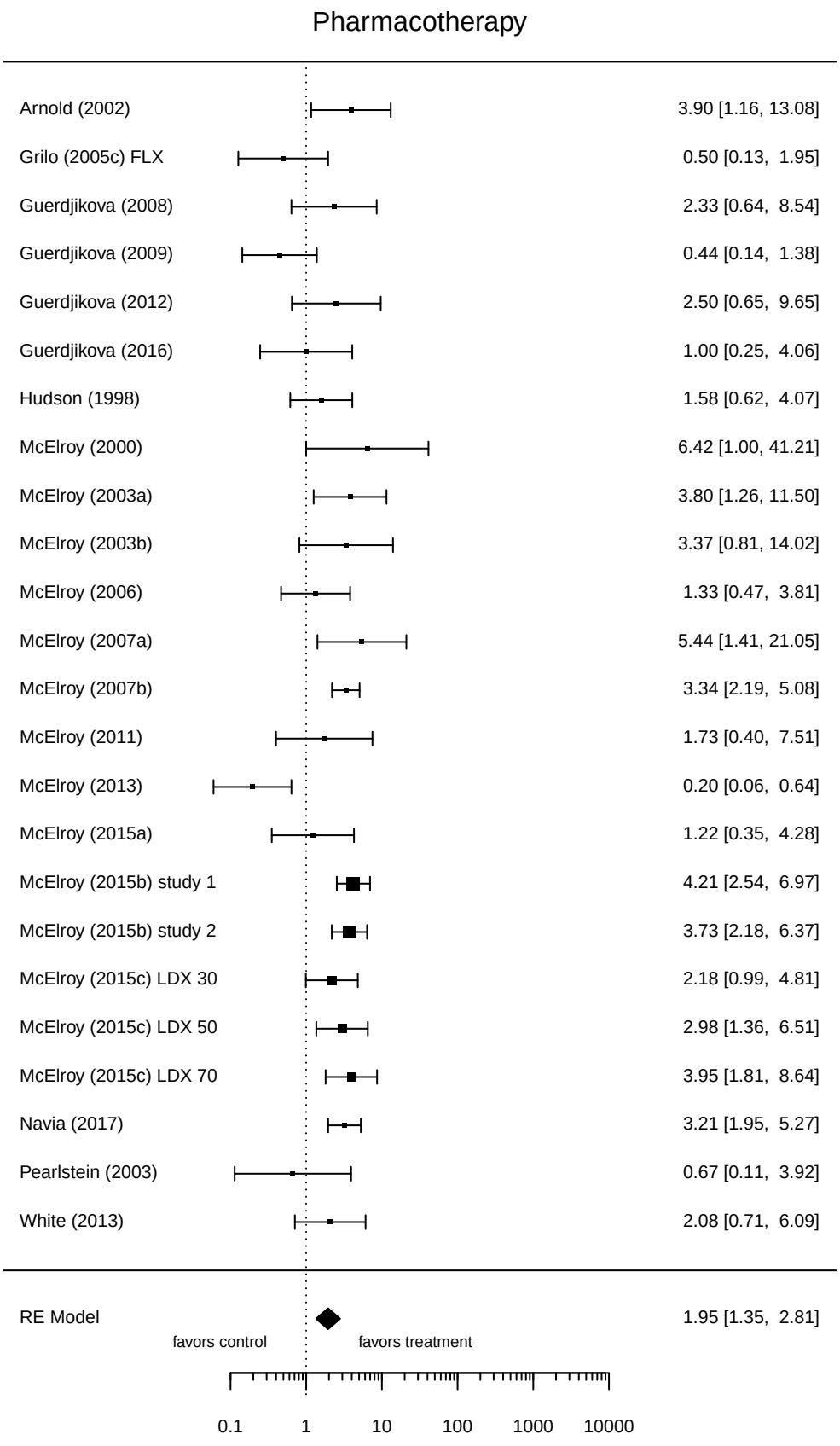


Figure D2. Forest plots for the odds of abstinence from binge eating at post-treatment in randomized-controlled trials with inactive control









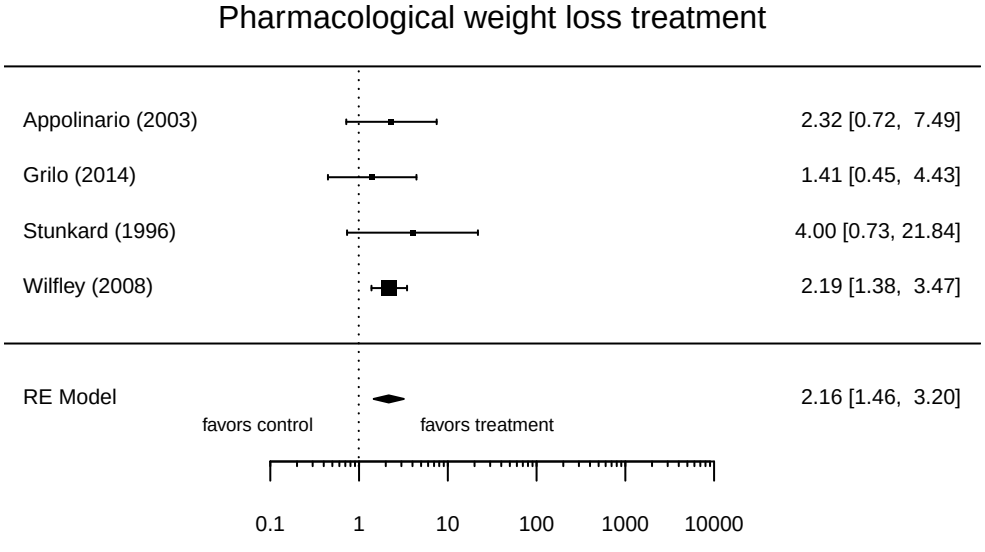


Table E1

Sensitivity analysis: Pre-treatment to post-treatment change for the most commonly used treatments per treatment category versus inactive control

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
Psychotherapy – Cognitive-behavioral therapy									
Binge-eating episodes	0.87 (9.2)	0.42 - 1.33 (5.2 - 13.2)	3.8	< .001	11/655	26	0.41	35(10), < .001	85
Binge-eating abstinence	10.0	5.3 - 18.6	7.2	< .001	11/651	58	0.36	14(10), .19	36
Eating disorder psychopathology	0.65	0.37 - 0.93	4.6	< .001	9/593	23	0.11	21(8), .0073	63
Depression	0.44	0.28 - 0.61	5.3	< .001	9/593	14	0.00	3(8), .91	0
Body weight (kg)	0.15 (1.9)	-0.11 - 0.40 (-1.3 - 5.2)	1.1	.26	3/236	0	0.00	0(2), .95	0
Body mass index (kg/m^2)	0.14	-0.09 - 0.37	1.2	.22	4/288	0	0.00	0(3), .99	0

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
	(0.6)	(-0.4 - 1.6)							
Dropout	2.2	1.1 - 4.1	2.4	.018	10/654	9	0.39	15(9), .094	40
Self-help treatment - Cognitive-behavioral therapy self-help treatment									
Binge-eating episodes	0.74	0.40 - 1.08	4.3	< .001	19/1159	39	0.29	54(18), < .001	81
	(7.6)	(4.5 - 10.7)							
Binge-eating abstinence	9.0	5.3 - 15.3	8.1	< .001	18/1153	95	0.43	39(17), .0019	43
Eating disorder psychopathology	0.54	0.32 - 0.76	4.9	< .001	13/889	26	0.08	29(12), .0034	58
Depression	0.35	0.20 - 0.49	4.7	< .001	12/829	12	0.01	9(11), .62	20
Body weight (kg)	0.15	-0.11 - 0.40	1.1	.26	3/236	0	0.00	0(2), .95	0
	(1.9)	(-1.3 - 5.2)							
Body mass index (kg/m^2)	0.05	-0.12 - 0.22	0.6	.55	7/544	0	0.00	3(6), .79	0
	(0.2)	(-0.4 - 0.9)							

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
Dropout	2.3	1.5 - 3.5	3.8	< .001	15/976	11	0.12	17(14), .26	18
Pharmacotherapy – Lisdexamfetamine									
Binge-eating episodes	0.65 (6.0)	0.39 - 0.92 (-0.2 - 12.1)	4.9	< .001	4/425	6	0.00	9(3), .033	0
Binge-eating abstinence	3.1	2.0 - 5.0	4.8	< .001	6/1165	9	0.00	7(5), .26	0
Body weight (kg)	0.94 (3.2)	0.63 - 1.25 (2.2 - 4.2)	5.9	< .001	2/178	5	0.00	0(1), .55	0
Body mass index (kg/m^2)	0.22 (0.9)	0.00 - 0.44 (0.0 - 1.7)	2.0	.047	7/322	0	0.00	3(6), .76	0
Dropout	1.0	0.7 - 1.4	-0.1	.88	4/953	-	0.00	0(3), .96	0

[a]Mean differences are calculated as treatment minus control where the mean within each group is pre-treatment minus post-treatment. Displayed are standardized values and 95% confidence interval (CI), and raw values and 95% CI in parentheses. Odds ratios use the control arm as reference. I^2, total heterogeneity; *k*, number of pairs of study arms; *n*, number of patients; *Q*, test statistic of heterogeneity; τ^2, estimated total heterogeneity in random effects models.

Table F1

Pre-treatment to follow-up change versus active control

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
Comparative effectiveness across treatment categories									
Psychotherapy versus Self-help treatment									
Binge-eating episodes	0.15 (2.1)	-0.43 - 0.74 (-4.7 - 9.0)	0.5	.61	4/308	-	0.24	12(3), .0059	80
3-6 months	0.17 (1.4)	-0.68 - 1.03 (-6.7 - 9.5)	0.4	.69	4/206	-	0.60	20(3), < .001	87
6-12 months	-0.00 (-0.5)	-0.59 - 0.58 (-6.8 - 5.8)	-0.0	.99	4/206	-	0.21	10(3), .017	71
Binge-eating abstinence	2.1	0.9 - 4.8	1.8	.068	4/308	0	0.22	7(3), .079	39
3-6 months	1.9	1.1 - 3.5	2.2	.026	4/308	0	0.00	6(3), .11	0

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
6-12 months	0.7	0.4 - 1.1	-1.5	.13	5/308	-	0.00	1(4), .96	0
Eating disorder psychopathology	0.10	-0.11 - 0.32	1.0	.33	5/449	0	0.00	1(2), .70	0
3-6 months	0.20	-0.08 - 0.48	1.4	.16	4/308	2	0.00	1(3), .73	0
6-12 months	-0.02	-0.24 - 0.19	-0.2	.83	5/449	0	0.00	3(4), .55	0
Depression	0.16	-0.12 - 0.43	1.1	.27	4/308	0	0.00	2(3), .54	0
3-6 months	0.25	-0.03 - 0.52	1.7	.080	4/308	4	0.00	2(3), .60	0
6-12 months	0.09	-0.19 - 0.36	0.6	.53	4/308	0	0.00	1(3), .75	0
Body weight (kg)	*0.11 (1.0)*	*-0.22 - 0.44 (-2.0 - 4.0)*	*0.6*	*.52*	*1/141*	*0*	-	-	-
Body mass index (kg/m^2)	-0.07 (-0.2)	-0.29 - 0.15 (-1.0 - 0.7)	-0.6	.52	5/449	-	0.00	4(4), .41	4

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
3-6 months	0.10	-0.26 - 0.47	0.6	.58	4/206	0	0.02	4(3), .24	16
	(0.7)	(-1.2 - 2.5)							
6-12 months	0.21	-0.12 - 0.55	1.2	.21	4/206	0	0.00	1(3), .86	0
	(1.0)	(-0.6 - 2.6)							
Drop-out	0.2	0.1 - 0.4	-5.0	< .001	6/627	-	0.00	4(5), .56	0
Psychotherapy versus Pharmacotherapy									
Binge-eating episodes	*1.67*	*0.98 - 2.37*	*4.7*	*< .001*	*2/66*	*10*	*0.00*	*1(1), .41*	*0*
	(8.6)	*(5.6 - 11.6)*							
6-12 months	*1.87*	*0.93 - 2.81*	*3.9*	*< .001*	*2/66*	*11*	*0.19*	*3(1), .071*	*52*
	(9.6)	*(5.6 - 13.5)*							
Body mass index (kg/m^2)	*0.50*	*-0.10 - 1.10*	*1.6*	*.099*	*2/66*	*3*	*0.00*	*0(1), .97*	*0*
	(1.5)	*(-0.2 - 3.2)*							

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
6-12 months	*0.69 (2.1)*	*0.08 - 1.29 (0.4 - 3.8)*	*2.2*	*.027*	*2/66*	*3*	*0.00*	*0(1), .85*	*0*
Drop-out	*0.5*	*0.1 - 2.1*	*-0.9*	*.35*	*2/83*	*-*	*0.00*	*0(1), .80*	*0*
Psychotherapy versus Behavioral weight loss treatment									
Binge-eating episodes	0.34 (3.0)	0.03 - 0.64 (0.3 - 5.6)	2.2	.030	2/170	1	0.00	0(1), .70	0
3-6 months	*0.32 (3.5)*	*-0.14 - 0.77 (-1.4 - 8.4)*	*1.4*	*.17*	*1/76*	*1*	-	-	-
6-12 months	*0.26 (2.9)*	*-0.19 - 0.71 (-2.0 - 7.8)*	*1.1*	*.26*	*1/76*	*0*	-	-	-
Binge-eating abstinence	1.2	0.7 - 2.2	0.6	.56	4/346	0	0.18	6(3), .13	46
3-6 months	6.0	0.6 - 60	1.5	.13	2/107	9	1.85	2(1), .12	59

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
6-12 months	1.9	1.0 - 3.4	2.1	.040	3/225	4	0.03	2(2), .34	11
Eating disorder psychopathology	0.27	0.05 - 0.48	2.5	.014	4/346	3	0.00	2(3), .55	0
3-6 months	0.26	-0.12 - 0.64	1.3	.19	2/107	1	0.00	0(1), .84	0
6-12 months	0.21	-0.05 - 0.48	1.6	.12	3/225	0	0.00	0(1), .92	0
Depression	0.19	-0.08 - 0.47	1.4	.17	3/207	1	0.00	1(2), .57	0
3-6 months	0.11	-0.27 - 0.49	0.5	.58	2/107	0	0.00	1(1), .35	0
6-12 months	-0.00	-0.38 - 0.38	-0.0	.99	2/107	0	0.00	0(1), .88	0
Body weight (kg)	-0.46 (-5.5)	-0.98 - 0.07 (-12.1 - 1.0)	-1.7	.086	2/229	-	0.10	4(1), .054	73
3-6 months	*-0.25 (-3.1)*	*-0.70 - 0.21 (-8.8 - 2.6)*	*-1.1*	*.29*	*1/76*	-	-	-	-

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
6-12 months	*-0.19*	*-0.64 - 0.26*	*-0.8*	*.40*	*1/76*	*0*	-	-	-
	(-2.5)	*(-8.1 - 3.2)*							
Body mass index (kg/m^2)	-0.57	-0.96 - -0.19	-3.0	.0032	3/309	-	0.07	5(2), .074	63
	(-1.6)	(-2.4 - -0.8)							
3-6 months	*-0.24*	*-0.69 - 0.22*	*-1.0*	*.31*	*1/76*	-	-	-	-
	(-0.8)	*(-2.3 - 0.7)*							
6-12 months	*-0.12*	*-0.57 - 0.33*	*-0.5*	*.61*	*1/76*	-	-	-	-
	(-0.4)	*(-1.9 - 1.1)*							
Drop-out	0.6	0.2 - 1.4	-1.2	.23	4/346	-	0.46	7(3), .067	59
Psychotherapy versus Combined treatment									
Binge-eating episodes	-0.10	-0.35 - 0.15	-0.8	.45	7/281	-	0.00	6(6), .38	0
	(-1.0)	(-2.9 - 0.9)							

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
3-6 months	*-0.17 (-1.8)*	*-0.66 - 0.31 (-6.9 - 3.3)*	*-0.7*	*.48*	*1/67*	-	-	-	-
6-12 months	-0.00 (-0.0)	-0.30 - 0.29 (-2.1 - 2.1)	-0.0	.98	5/199	0	0.00	0(4), .99	0
Binge-eating abstinence	*0.8*	*0.3 - 2.1*	*-0.4*	*.71*	*1/80*	*0*	-	-	-
3-6 months	0.8	0.4 - 1.6	-0.6	.54	3/194	-	0.00	2(2), .32	0
6-12 months	0.5	0.0 - 5.4	-0.6	.56	2/137	-	2.68	8(1), .0037	88
Eating disorder psychopathology	-0.24	-0.60 - 0.12	-1.3	.18	2/121	-	0.00	0(1), .99	0
3-6 months	*-0.34*	*-0.82 - 0.15*	*-1.4*	*.17*	*1/67*	-	-	-	-
6-12 months	-0.19	-0.55 - 0.17	-1.0	.30	2/121	-	0.00	0(1), .64	0
Depression	-0.17	-0.46 - 0.12	-1.2	.24	4/235	-	0.00	3(3), .45	5

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
3-6 months	0.05	-0.27 - 0.36	0.3	.78	3/194	0	0.00	0(2), .78	0
6-12 months	-0.10	-0.39 - 0.20	-0.7	.51	3/178	-	0.00	1(2), .70	0
Body weight (kg)	-0.51	-1.42 - 0.39	-1.1	.27	3/120	-	0.43	8(2), .015	75
	(-4.7)	(-11.7 - 2.4)							
3-6 months	*-0.05*	*-0.53 - 0.43*	*-0.2*	*.83*	*1/67*	-	-	-	-
	(-0.6)	*(-6.4 - 5.1)*							
6-12 months	*-0.02*	*-0.50 - 0.46*	*-0.1*	*.93*	*1/67*	-	-	-	-
	(-0.3)	*(-5.9 - 5.4)*							
Body mass index (kg/m^2)	-0.17	-0.46 - 0.12	-1.2	.24	7/281	-	0.03	8(6), .21	19
	(-0.8)	(-1.9 - 0.3)							
3-6 months	*-0.06*	*-0.54 - 0.42*	*-0.2*	*.80*	*1/67*	-	-	-	-
	(-0.2)	*(-1.8 - 1.4)*							

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
6-12 months	-0.11 (-0.5)	-0.41 - 0.19 (-1.6 - 0.6)	-0.7	.47	5/199	-	0.00	4(4), .46	0
Drop-out	0.5	0.3 - 0.9	-2.2	.029	5/235	-	0.00	0(4), .99	0
Self-help treatment versus Behavioral weight loss treatment									
Binge-eating days	*0.08 (0.8)*	*-0.26 - 0.43 (-2.4 - 4.0)*	*0.5*	*.63*	*1/130*	*0*	-	-	-
Binge-eating abstinence	*1.2*	*0.6 - 2.4*	*0.5*	*.61*	*1/130*	*0*	-	-	-
6-12 months	*2.0*	*0.9 - 4.4*	*1.7*	*.086*	*1/107*	*1*	-	-	-
Eating disorder psychopathology	*0.25*	*-0.09 - 0.60*	*1.4*	*.15*	*1/130*	*1*	-	-	-
6-12 months	*0.35*	*-0.04 - 0.73*	*1.8*	*.076*	*1/107*	*1*	-	-	-
Body weight (kg)	*-0.32*	*-0.66 - 0.03*	*-1.8*	*.071*	*1/130*	-	-	-	-

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
	(-3.4)	*(-7.1 - 0.3)*							
Body mass index (kg/m^2)	*-0.47*	*-0.82 - -0.12*	*-2.6*	*.0084*	*1/130*	-	-	-	-
	(-1.3)	*(-2.3 - -0.3)*							
Drop-out	*1.1*	*0.5 - 2.4*	*0.3*	*.78*	*1/130*	*0*	-	-	-
Self-help treatment versus Self-help weight loss treatment									
Binge-eating episodes	*0.13*	*-0.32 - 0.59*	*0.6*	*.56*	*1/75*	*0*	-	-	-
	(1.6)	*(-3.7 - 6.9)*							
Binge-eating abstinence	*4.7*	*1.7 - 12.8*	*3.1*	*.0022*	*1/75*	*3*	-	-	-
Eating disorder psychopathology	*0.14*	*-0.31 - 0.60*	*0.6*	*.53*	*1/75*	*0*	-	-	-
Depression	*0.03*	*-0.43 - 0.48*	*0.1*	*.91*	*1/75*	*0*	-	-	-
Body mass index (kg/m^2)	*-0.34*	*-0.80 - 0.11*	*-1.5*	*.14*	*1/75*	-	-	-	-

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
	(-1.2)	*(-2.8 - 0.4)*							
Drop-out	*0.3*	*0.1 - 1.0*	*-2.0*	*.042*	*1/75*	-	-	-	-
Pharmacotherapy versus Combined treatment									
Binge-eating episodes	-0.94	-1.65 - -0.24	-2.6	.0086	4/174	-	0.34	12(3), .0093	76
	(-8.2)	(-10.9 - -5.5)							
3-6 months	*-0.35*	*-0.94 - 0.23*	*-1.2*	*.24*	*2/70*	-	*0.00*	*0(1), .93*	*0*
	(-4.8)	*(-12.2 - 2.7)*							
6-12 months	-0.98	-1.79 - -0.18	-2.4	.017	4/136	-	0.46	11(3), .0097	77
	(-8.5)	(-11.8 - -5.2)							
Binge-eating abstinence	*0.1*	*0.0 - 0.5*	*-3.2*	*.0013*	*2/108*	-	*0.00*	*0(1), .75*	*0*
3-6 months	*0.1*	*0.0 - 0.7*	*-2.2*	*.025*	*2/108*	-	*0.00*	*1(1), .38*	*0*
6-12 months	*0.1*	*0.0 - 0.7*	*-2.3*	*.020*	*2/108*	-	*0.00*	*1(1), .43*	*0*

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
Eating disorder psychopathology	*-0.55*	*-1.02 - -0.08*	*-2.3*	*.023*	*2/108*	-	*0.00*	*0(1), .98*	*0*
3-6 months	*-0.91*	*-1.40 - -0.43*	*-3.7*	*< .001*	*2/108*	-	*0.00*	*0(1), .53*	*0*
6-12 months	*-0.67*	*-1.28 - -0.06*	*-2.2*	*.030*	*2/108*	-	*0.07*	*3(1), .089*	*48*
Depression	*-0.49*	*-0.96 - -0.02*	*-2.0*	*.043*	*2/108*	-	*0.00*	*0(1), .92*	*0*
6-12 months	*-0.31*	*-0.84 - 0.22*	*-1.2*	*.25*	*1/54*	-	*0.03*	*2(1), .17*	*31*
Body weight (kg)	*-0.03* *(-0.2)*	*-0.56 - 0.49* *(-3.4 - 3.0)*	*-0.1*	*.91*	*2/84*	-	*0.00*	*0(1), .89*	*0*
Body mass index (kg/m^2)	-0.35 (-1.8)	-0.73 - 0.02 (-3.2 - -0.4)	-1.9	.063	4/174	-	0.00	7(3), .085	0
3-6 months	*1.12* *(3.8)*	*0.49 - 1.75* *(1.9 - 5.6)*	*3.5*	*< .001*	*2/70*	*6*	*0.00*	*0(1), .81*	*0*

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
6-12 months	-0.17 (-0.4)	-1.22 - 0.89 (-3.9 - 3.0)	-0.3	.76	4/136	2	0.95	19(3), <.001	88
Drop-out	1.0	0.5 - 2.3	0.1	.94	4/196	0	0.00	1(3), .92	0
Behavioral weight loss treatment versus Combined treatment									
Binge-eating episodes	0.36 (3.2)	-1.00 - 1.72 (-11.1 - 17.5)	0.5	.60	2/151	1	0.91	17(1), < .001	94
3-6 months	*-0.41 (-5.3)*	*-0.89 - 0.07 (-11.3 - 0.7)*	*-1.7*	*.092*	*1/69*	-	-	-	-
6-12 months	*-0.28 (-3.6)*	*-0.76 - 0.20 (-9.6 - 2.4)*	*-1.1*	*.25*	*1/69*	-	-	-	-
Binge-eating abstinence	0.8	0.3 - 2.1	-0.5	.64	3/235	-	0.49	6(2), .061	65
3-6 months	*0.5*	*0.2 - 1.3*	*-1.5*	*.14*	*1/69*	-	-	-	-

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
6-12 months	0.7	0.4 - 1.4	-1.0	.33	3/80	-	0.00	1(2), .57	0
Eating disorder psychopathology	-0.25	-0.55 - 0.05	-1.7	.097	3/226	-	0.00	1(2), .53	0
3-6 months	*-0.63*	*-1.11 - -0.14*	*-2.5*	*.012*	*1/69*	-	-	-	-
6-12 months	*-0.44*	*-0.92 - 0.05*	*-1.8*	*.076*	*1/69*	-	-	-	-
Depression	-0.32	-0.62 - -0.02	-2.1	.035	3/226	-	0.00	0(2), .84	0
3-6 months	*-0.21*	*-0.69 - 0.27*	*-0.9*	*.39*	*1/69*	-	-	-	-
6-12 months	*-0.12*	*-0.60 - 0.35*	*-0.5*	*.61*	*1/69*	-	-	-	-
Body weight (kg)	0.22 (2.1)	-0.14 - 0.59 (-1.5 - 5.7)	1.2	.22	4/262	0	0.06	6(3), .091	49
3-6 months	0.03 (0.0)	-0.32 - 0.37 (-3.3 - 3.3)	0.1	.88	2/140	0	0.01	1(1), .30	8

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
6-12 months	0.09 (0.6)	-0.25 - 0.42 (-2.3 - 3.4)	0.5	.61	2/140	0	0.00	0(1), .55	0
Body mass index (kg/m^2)	0.48 (1.3)	0.08 - 0.89 (-0.2 - 2.9)	2.3	.020	2/151	2	0.03	2(1), .21	36
3-6 months	0.05 (0.1)	-0.29 - 0.38 (-0.9 - 1.0)	0.3	.78	2/140	0	0.00	1(1), .45	0
6-12 months	0.20 (0.5)	-0.13 - 0.54 (-0.4 - 1.4)	1.2	.23	2/140	0	0.00	1(1), .47	0
Drop-out	1.5	0.3 - 8.8	0.4	.66	2/151	1	1.22	4(1), .057	72
Pharmacological weight loss treatment versus Combined treatment									
Binge-eating episodes	0.36 (6.7)	-0.15 - 0.88 (-1.8 - 15.2)	1.4	.17	2/89	1	0.00	1(1), .35	0

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
3-6 months	0.31 (5.5)	-0.21 - 0.83 (-3.1 - 14.1)	1.2	.25	2/88	1	0.00	0(1), .70	0
6-12 months	0.27 (4.8)	-0.25 - 0.78 (-3.8 - 13.5)	1.0	.31	2/88	0	0.00	1(1), .43	0
Binge-eating abstinence	2.0	0.7 - 5.6	1.4	.17	2/103	2	0.00	0(1), .94	0
3-6 months	0.3	0.1 - 0.9	-2.2	.030	2/103	-	0.00	1(1), .47	0
6-12 months	0.3	0.1 - 1.0	-1.9	.060	2/103	-	0.00	0(1), .87	0
Eating disorder psychopathology	-0.04	-0.51 - 0.43	-0.2	.88	2/103	-	0.00	0(1), .78	0
3-6 months	-0.29	-0.76 - 0.19	-1.2	.23	2/103	-	0.00	0(1), .75	0
6-12 months	-0.22	-0.75 - 0.25	-0.9	.36	2/103	-	0.00	0(1), .99	0
Depression	-0.09	-0.56 - 0.39	-0.4	.72	2/103	-	0.00	1(1), .43	0

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
3-6 months	-0.19	-0.66 - 0.28	-0.8	.43	2/103	-	0.00	0(1), .55	-
6-12 months	-0.20	-0.67 - 0.28	-0.8	.41	2/103	-	0.00	1(1), .46	0
Body weight (kg)	-0.14	-0.69 - 0.42	-0.5	.63	2/89	-	0.02	2(1), .22	21
	(-1.8)	(-7.8 - 4.1)							
3-6 months	-0.06	-0.57 - 0.46	-0.2	.83	2/88	-	0.00	1(1), .39	0
	(-0.7)	(-6.4 - 5.0)							
6-12 months	-0.25	0.77 - 0.27	-0.9	.34	2/88	-	0.00	0(1), .80	0
	(-3.1)	(-9.0 - 2.9)							
Body mass index (kg/m^2)	-0.12	-0.75 - 0.50	-0.4	.70	2/89	-	0.07	2(1), .12	42
	(-0.4)	(-2.4 - 1.5)							
3-6 months	-0.25	-0.76 - 0.27	-0.9	.35	2/88	-	0.00	0(1), .52	0
	(-0.8)	(-2.4 - 0.8)							

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
6-12 months	-0.31 (-1.1)	-0.83 - 0.21 (-2.8 - 0.6)	-1.2	.24	2/88	-	0.00	0(1), .81	0
Drop-out	1.6	0.5 - 5.3	0.8	.43	2/103	1	0.00	0(1), .95	0
Comparative effectiveness within treatment categories									
Psychotherapy: CBT versus other psychotherapies									
Binge-eating days	0.26 (1.4)	0.01 - 0.50 (0.2 - 2.7)	2.1	.040	2/257	0	0.00	1(1), .48	0
Binge-eating abstinence	1.9	1.0 - 3.6	1.9	.052	3/333	2	0.15	4(2), .16	45
3-6 months	*1.1*	*0.4 - 3.1*	*0.2*	*.81*	*1/67*	*1*	-	-	-
6-12 months	1.2	0.7 - 1.9	0.6	.55	3/306	0	0.00	2(2), .33	0
Eating disorder psychopathology	0.17	-0.04 - 0.38	1.6	.11	3/358	0	0.00	1(2), .73	0

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
3-6 months	0.06	-0.20 - 0.33	0.5	.65	2/218	0	0.00	1(1), .42	0
6-12 months	0.08	-0.18 - 0.33	0.6	.56	2/239	0	0.00	0(1), .66	0
Depression	0.17	-0.37 - 0.71	0.6	.54	2/196	0	0.11	4(1), .055	73
3-6 months	*-0.09*	*-0.57 - 0.39*	*-0.4*	*.71*	*1/67*	-	-	-	-
6-12 months	*0.20*	*-0.22 - 0.63*	*0.9*	*.34*	*1/88*	*1*	-	-	-
Body weight (kg)	*0.07*	*-0.32 - 0.46*	*0.4*	*.72*	*1/101*	*0*	-	-	-
	(1.0)	*(-4.4 - 6.3)*							
Body mass index (kg/m^2)	-0.03	-0.24 - 0.19	-0.3	.80	3/333	-	0.00	1(2), .74	0
	(-0.2)	(-1.0 - 0.6)							
Drop-out	0.6	0.2 - 1.9	-0.8	.43	4/424	-	0.95	10(3), .021	75
Psychotherapy: CBT versus humanistic therapy									
Binge-eating abstinence	*3.6*	*1.6 - 8.1*	*3.0*	*.0024*	*1/101*	*3*	-	-	-

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
6-12 months	*1.1*	*0.4 - 2.5*	*0.1*	*.91*	*1/88*	*0*	-	-	-
Eating disorder psychopathology	*0.30*	*-0.09 - 0.69*	*1.5*	*.13*	*1/101*	*1*	-	-	-
6-12 months	*0.15*	*-0.27 - 0.57*	*0.7*	*.49*	*1/88*	*0*	-	-	-
Depression	*0.44*	*0.05 - 0.84*	*2.2*	*.028*	*1/101*	*2*	-	-	-
6-12 months	*0.20*	*-0.22 - 0.63*	*0.9*	*.34*	*1/88*	*1*	-	-	-
Body weight (kg)	*0.07*	*-0.32 - 0.46*	*0.4*	*.72*	*1/101*	*0*	-	-	-
	(1.0)	*(-4.4 - 6.3)*							
Body mass index (kg/m^2)	*0.09*	*-0.30 - 0.48*	*0.5*	*.64*	*1/101*	*0*	-	-	-
	(0.05)	*(-1.4 - 2.4)*							
Drop-out	*0.1*	*0.0 - 0.4*	*-3.2*	*.0015*	*1/101*	*-*	-	-	-

Psychotherapy: CBT versus interpersonal psychotherapy

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
Binge-eating days	*0.19*	*-0.12 - 0.50*	*1.2*	*.23*	*1/162*	*0*	-	-	-
	(0.13)	*(-0.8 - 3.4)*							
Binge-eating abstinence	*1.6*	*0.8 - 3.5*	*1.3*	*.21*	*1/158*	*1*	-	-	-
6-12 months	*0.9*	*0.5 - 1.8*	*-0.2*	*.82*	*1/151*	-	-	-	-
Eating disorder psychopathology	*0.13*	*-0.17 - 0.44*	*0.9*	*.39*	*1/162*	*0*	-	-	-
Body mass index (kg/m^2)	*-0.10*	*-0.41 - 0.21*	*-0.6*	*.52*	*1/158*	-	-	-	-
	-0.3	*(-1.2 - 0.6)*							
Drop-out	*1.3*	*0.5 - 3.7*	*0.5*	*.60*	*1/162*	*0*	-	-	-
Psychotherapy: CBT versus psychodynamic therapy									
Binge-eating days	*0.37*	*-0.03 - 0.78*	*1.8*	*.070*	*1/95*	*1*	-	-	-

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
	(1.5)	*(-0.1 - 3.1)*							
Binge-eating abstinence	*1.1*	*0.4 - 2.8*	*0.2*	*.81*	*1/74*	*0*	-	-	-
3-6 months	*1.1*	*0.4 - 3.1*	*0.2*	*.81*	*1/67*	*0*	-	-	-
6-12 months	*2.4*	*0.8 - 7.0*	*1.6*	*.11*	*1/67*	*2*	-	-	-
Eating disorder psychopathology	*0.09*	*-0.31 - 0.49*	*0.4*	*.67*	*1/95*	*0*	-	-	-
3-6 months	*-0.10*	*-0.58 - 0.38*	*-0.4*	*.68*	*1/67*	-	-	-	-
Depression	*-0.11*	*-0.51 - 0.29*	*-0.5*	*.59*	*1/95*	-	-	-	-
3-6 months	*-0.09*	*-0.57 - 0.39*	*-0.4*	*.71*	*1/67*	-	-	-	-
Body mass index (kg/m^2)	*-0.04*	*-0.49 - 0.42*	*-0.2*	*.87*	*1/74*	-	-	-	-
	(-0.2)	*(-3.1 - 2.7)*							
Drop-out	*0.9*	*0.3 - 2-4*	*-0.2*	*.85*	*1/95*	-	-	-	-

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
Self-help treatment: CBT guided self-help versus CBT unguided self-help									
Binge-eating episodes	0.31 (4.9)	-0.10 - 0.72 (-0.3 - 10.1)	1.5	.14	3/229	2	0.07	4(2), .13	51
3-6 months	0.38 (4.5)	-0.54 - 1.30 (-6.3 - 15.4)	0.8	.42	3/173	2	0.57	11(2), .0049	88
6-12 months	0.40 (4.9)	-0.53 - 1.33 (-5.3 - 15.1)	0.8	.40	2/104	2	0.35	4(1), .041	76
Binge-eating abstinence	1.6	0.8 - 3.1	1.4	.16	3/229	-	0.03	4(2), .14	8
3-6 months	1.2	0.5 - 2.8	0.4	.68	2/104	0	0.00	0(1), .66	0
6-12 months	1.2	0.5 - 2.7	0.4	.72	2/104	1	0.00	1(1), .47	0
Eating disorder psychopathology	0.24	-0.02 - 0.50	1.8	.068	3/229	2	0.00	0(2), .82	0

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
3-6 months	0.08	-0.22 - 0.38	0.5	.61	3/173	0	0.00	0(2), 1.0	0
6-12 months	*0.06*	*-0.33 - 0.44*	*0.3*	*.77*	*1/104*	*0*	*0.00*	*0(1), .61*	*0*
Depression	0.19	-0.42 - 0.80	0.6	.54	2/160	1	0.12	2(1), .12	58
3-6 months	0.07	-0.32 - 0.45	0.3	.74	2/104	0	0.00	0(1), .57	0
6-12 months	0.12	-0.32 - 0.56	0.5	.58	2/104	1	0.20	1(1), .28	15
Body mass index (kg/m^2)	0.10 (0.3)	-0.17 - 0.36 (-0.7 - 1.4)	0.7	.47	3/229	-	0.00	2(2), .31	0
3-6 months	0.08 (0.2)	-0.22 - 0.38 (-1.1 - 1.5)	0.5	.62	3/173	-	0.00	3(2), .27	0
6-12 months	0.07 (0.2)	-0.32 - 0.45 (-1.6 - 2.0)	0.3	.74	2/104	-	0.00	1(1), .42	0
Drop-out	1.3	0.1 - 11.9	0.2	.81	3/212	2	2.90	6(2), .041	80

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
Self-help treatment: CBT unguided self-help versus self-compassion training unguided self-help									
Binge-eating days	*0.44*	*-0.31 - 1.19*	*1.2*	*.25*	*1/28*	*1*	-	-	-
	(2.7)	*(-1.6 - 7.0)*							
Eating disorder psychopathology	*-0.61*	*-1.37 - 0.15*	*-1.6*	*.11*	*1/28*	-	-	-	-
Depression	*-0.43*	*-1.18 - 0.32*	*-1.1*	*.26*	*1/28*	-	-	-	-
Body mass index (kg/m^2)	*-0.68*	*-1.44 - 0.09*	*-1.7*	*.082*	*1/28*	-	-	-	-
	(-0.4)	*(-0.8 - 0.0)*							
Drop-out	*0.2*	*0.0 - 2.4*	*-1.2*	*.22*	*1/28*	-	-	-	-
Pharmacotherapy: Fluoxetine versus other second generation antidepressants									
Binge-eating episodes	-0.32	-0.75 - 0.11	-1.5	.15	2/85	-	0.00	0(1), .51	0

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
	(-2.3)	(-6.3 - 1.8)							
6-12 months	*-0.53*	*-1.23 - 0.18*	*-1.5*	*.14*	*1/32*	-	-	-	-
	(-3.0)	*(-6.8 - 0.8)*							
Binge-eating abstinence	*0.5*	*0.1 - 2.3*	*-0.9*	*.38*	*1/31*	-	-	-	-
Eating disorder psychopathology	*0.24*	*-0.37 - 0.85*	*0.8*	*.44*	*1/42*	*1*	-	-	-
Depression	*-0.09*	*-0.70 - 0.51*	*-0.3*	*.76*	*1/42*	-	-	-	-
Body weight (kg)	*-0.18*	*-0.89 - 0.52*	*-0.5*	*.61*	*1/31*	-	-	-	-
	(-0.2)	*(-3.0 - 2.6)*							
Body mass index (kg/m^2)	-0.06	-0.55 - 0.43	-0.2	.81	2/63	-	0.00	0(1), .81	0
	(-0.2)	(-1.4 - 1.1)							
6-12 months	*-0.10*	*-0.80 - 0.59*	*-0.3*	*.77*	*1/32*	-	-	-	-

	Mean difference or odds ratio[a]	95% CI	*Z*	*p*	*k/n*	Fail-safe *N*	τ^2	*Q*(df), p_Q	I^2 (%)
	(-0.3)	*(-2.3 - 1.7)*							
Drop-out	0.9	0.3 - 2.3	-0.3	.76	2/85	-	0.00	0(1), .95	0

[a]Mean differences are calculated as treatment minus control where the mean within each group is pre-treatment minus post-treatment or follow-up. Displayed are standardized values and 95% confidence interval (CI), and raw values and 95% CI in parentheses. Odds ratios use the control arm as reference. I^2, total heterogeneity; *k*, number of pairs of study arms; *n*, number of patients; *Q*, test statistic of heterogeneity; τ^2, estimated total heterogeneity in random effects models; CBT, cognitive-behavioral therapy. Single study results are italicized.

Table G1

Moderator analyses for pre-treatment to post-treatment change versus inactive control

Between-group comparisons	Point estimate[a]	95% CI	*Q*(df)	*p*	*k/n*
Treatment format (reference: individual therapy)					
Binge-eating episodes	Group: 0.27	-0.02 - 0.57	3.4(1)	.064	52/3860
Binge-eating abstinence	Group: 4.78	2.39 - 9.57	19.5(1)	< .001	55/4758
Duration of treatment (reference: shorter therapies, i.e. < 10 weeks)					
Binge-eating episodes	Longer therapies: -0.28	-0.52 - -0.04	5.2(1)	.023	53/3880
Binge-eating abstinence	Longer therapies: 1.18	0.61 - 2.23	0.2(1)	.63	55/4758
Mode of recruitment (reference: clinical)					
Binge-eating episodes	Population-based: 0.30	0.05 - 0.56	5.5(2)	.063	37/2658
	Mixed: 0.18	-0.06 - 0.43			
Binge-eating abstinence	Population-based: 2.27	1.09 - 4.75	5.5(2)	.064	40/3396
	Mixed: 2.21	0.98 - 5.02			
Age (per decade)					
Binge-eating episodes	-0.29	-0.51 - 0.07	6.7(1)	.0095	39/3465

Between-group comparisons	Point estimate[a]	95% CI	*Q*(df)	*p*	*k/n*
Binge-eating abstinence	0.79	0.36 - 1.73	0.3(1)	.56	41/4146
Sex (reference: ≥ 90% women)					
Binge-eating episodes	< 90% women: -0.20	-0.37 - -0.03	5.3(1)	.021	46/3641
Binge-eating abstinence	< 90% women: 0.74	0.49 - 1.12	2.0(1)	.16	48/4390
Body mass index (per kg/m^2)					
Binge-eating episodes	-0.046	-0.076 - -0.016	8.8(1)	.0013	44/3310
Binge-eating abstinence	0.93	0.84 - 1.01	2.8(1)	.092	45/4292
Number of binge-eating episodes at baseline (per episode/28 days)					
Binge-eating episodes	0.024	0.003 - 0.044	5.2(1)	.023	53/3880
Binge-eating abstinence	1.01	0.96 - 1.06	0.1(1)	.77	48/4360
Type of analysis (reference: intent-to-treat)					
Binge-eating episodes	Completer: 0.16	-0.13 - 0.44	1.2(1)	.28	53/3880
Binge-eating abstinence	Completer: 1.55	0.81 - 2.94	1.8(1)	.19	55/4758
Time-frame of assessment (reference: binge eating last week)					
Binge-eating episodes	Last 4 weeks: -0.15	-0.38 - 0.08	1.6(1)	.20	53/3880

Between-group comparisons	Point estimate[a]	95% CI	*Q*(df)	*p*	*k/n*
Binge-eating abstinence	Last 4 weeks: 1.43	0.79 - 2.60	1.4(1)	.24	53/4676
Method of assessment (reference: interview)					
Binge-eating episodes	Questionnaire: 0.04	-0.25 - 0.34	8.0(2)	.019	52/3565
	Diary: 0.52	0.16 - 0.88			
Binge-eating abstinence	Questionnaire: 1.87	0.62 - 5.64	1.3(3)	.73	52/4366
	Diary: 1.10	0.49 - 2.45			
	Recall: 0.84	0.13 - 5.67			
Risk of bias (reference: low risk according to Cochrane)					
Binge-eating episodes	Unclear risk: 0.22	-0.11 - 0.54	3.5(2)	.18	53/3819
	High risk: 0.33	-0.02 - 0.67			
Binge-eating abstinence	Unclear risk: 1.42	0.62 - 3.22	0.7(2)	.70	54/4700
	High risk: 1.32	0.53 - 3.27			
Blinding (reference: blinded trial)					
Binge-eating episodes	Uncertain if blinded: 0.26	0.02 - 0.51	5.3(2)	.072	37/2912
	Not blinded: 0.38	-0.09 - 0.86			

Between-group comparisons	Point estimate[a]	95% CI	*Q*(df)	*p*	*k/n*
Binge-eating abstinence	Uncertain if blinded: 1.12	0.56 - 2.27	3.8(2)	.15	41/3728
	Not blinded: 4.16	0.96 - 18.01			

[a]Change in standardized difference of mean differences or multiplicative factor in odds ratio compared to the reference category. Cochrane, Cochrane Collaboration's Risk of Bias Tool (Higgins & Green, 2011).

Table H1

Risk of bias of the included studies

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants (performance bias)	Blinding of personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias	Total Cochrane
Agras et al. (1994)	?	?	+	?	-	+	-	+	+
Agras et al. (1995)	?	?	+	?	?	?	-	+	?
Alfonsson et al. (2015)	-	?	+	?	+	+	-	+	+
Allen & Craighead (1999)	?	+	+	?	?	+	-	+	+
Appolinario et al. (2003)	-	-	-	-	-	-	-	?	-
Arnold et al. (2002)	?	-	-	-	?	?	-	?	?
Barnes et al. (2017)	?	?	+	+	?	+	+	+	+

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants (performance bias)	Blinding of personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias	Total Cochrane
Brambilla et al. (2009)	?	?	-	-	+	+	?	+	+
Brownley et al. (2013)	?	?	?	?	?	-	?	+	?
Carter & Fairburn (1998)	-	-	+	?	-	?	-	?	-
Cassin et al. (2008)	-	-	-	+	+	?	?	+	+
Cesa et al. (2013)	-	?	?	+	?	+	+	+	+
Devlin et al. (2005)	?	?	?	?	-	?	?	?	?
de Zwaan et al. (2005)	?	?	+	+	?	+	?	+	+
de Zwaan et al. (2017)	-	-	+	+	-	-	-	?	-
Dingemans et al. (2007)	?	-	+	?	?	?	-	+	?

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants (performance bias)	Blinding of personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias	Total Cochrane
Duarte et al. (2017)	?	?	+	+	?	+	?	+	+
Ferrer-Garcia et al. (2017)	-	?	+	+	?	?	?	+	+
Golay et al. (2005)	-	-	-	-	?	?	-	-	?
Gorin et al. (2003)	?	?	+	?	?	+	-	+	+
Grilo & Masheb (2005a)	-	-	+	+	?	?	-	?	?
Grilo et al. (2005b)	-	-	-	-	-	-	-	?	-
Grilo et al. (2005c)	-	-	-	?	?	?	-	?	-
Grilo et al. (2011)	-	?	+	+	?	?	-	?	?
Grilo & White (2013a)	?	-	-	-	?	?	?	+	?

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants (performance bias)	Blinding of personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias	Total Cochrane
Grilo et al. (2013b)	-	?	+	?	-	-	-	+	-
Grilo et al. (2014)	-	-	?	-	-	?	-	?	-
Guerdjikova et al. (2008)	-	-	-	-	?	?	-	+	?
Guerdjikova et al. (2009)	-	-	-	-	?	+	-	+	+
Guerdjikova et al. (2012)	-	-	-	-	?	?	-	+	?
Guerdjikova et al. (2016)	-	-	-	-	?	-	-	?	-
Hilbert & Tuschen-Caffier (2004)	?	?	?	+	-	?	-	+	?
Hudson et al. (1998)	?	?	-	-	?	?	?	+	+
Kelly & Carter (2015)	-	?	+	?	?	-	+	+	+

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants (performance bias)	Blinding of personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias	Total Cochrane
Kristeller et al. (2014)	?	?	+	?	?	+	+	+	+
Le Grange et al. (2002)	?	?	?	+	?	?	-	?	?
Leombruni et al. (2008)	?	?	?	?	?	+	-	+	+
Levine et al. (1996)	?	?	+	?	?	?	+	+	+
Lewer et al. (2017)	-	?	+	+	?	+	?	+	+
Masheb et al. (2011)	-	-	?	?	?	+	+	?	+
Masson et al. (2013)	-	?	+	+	-	-	?	+	?
McElroy et al. (2000)	?	?	?	?	?	-	?	+	?
McElroy et al. (2003a)	-	-	-	-	?	?	-	+	?

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants (performance bias)	Blinding of personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias	Total Cochrane
McElroy et al. (2003b)	?	?	-	?	-	-	-	?	?
McElroy et al. (2006)	-	?	-	?	?	-	-	?	?
McElroy et al. (2007a)	-	?	-	?	?	?	-	+	?
McElroy et al. (2007b)	-	?	?	-	?	?	-	?	?
McElroy et al. (2011)	-	-	?	-	?	?	-	+	?
McElroy et al. (2013)	-	-	-	-	-	+	-	+	+
McElroy et al. (2015a)	-	-	-	-	?	?	-	+	?
McElroy et al. (2015b)	-	?	-	?	?	?	?	+	?
McElroy et al. (2015b)	-	?	-	?	?	?	?	+	?

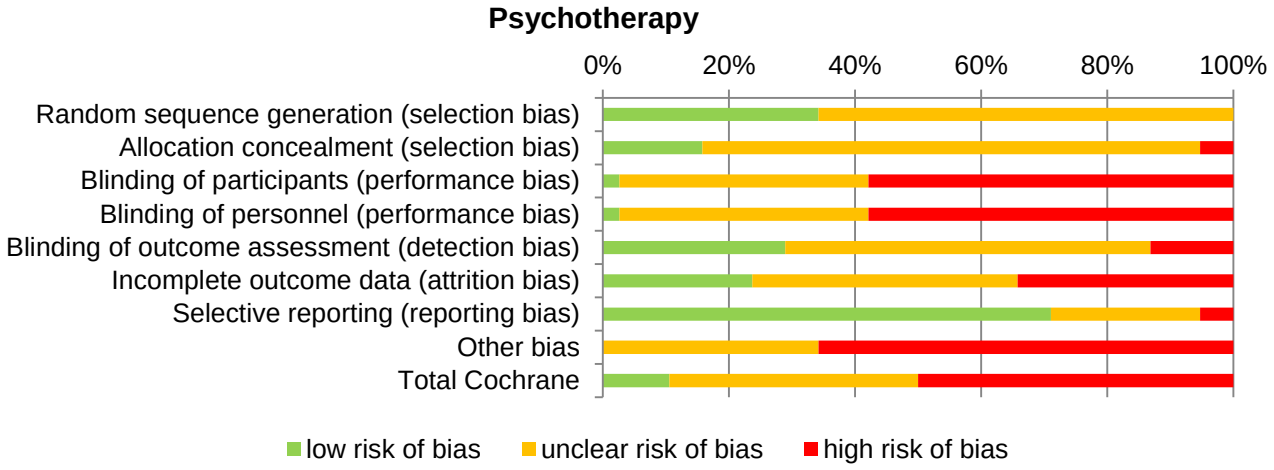
	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants (performance bias)	Blinding of personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias	Total Cochrane
McElroy et al. (2015c)	-	?	-	?	?	?	-	+	?
Milano et al. (2005)	?	?	?	?	?	-	+	+	+
Molinari et al. (2005)	?	?	?	+	?	?	+	+	+
Munsch et al. (2007)	?	?	+	+	+	-	-	+	+
Nauta et al. (2000)	?	?	?	+	?	?	-	+	?
Pataky et al. (2013)	-	-	-	-	?	-	?	+	+
Pearlstein et al. (2003)	?	?	?	?	-	+	+	+	+
Pendleton et al. (2002)	?	?	?	?	?	+	-	+	+
Peterson et al. (1998)	?	?	?	?	?	?	-	+	+

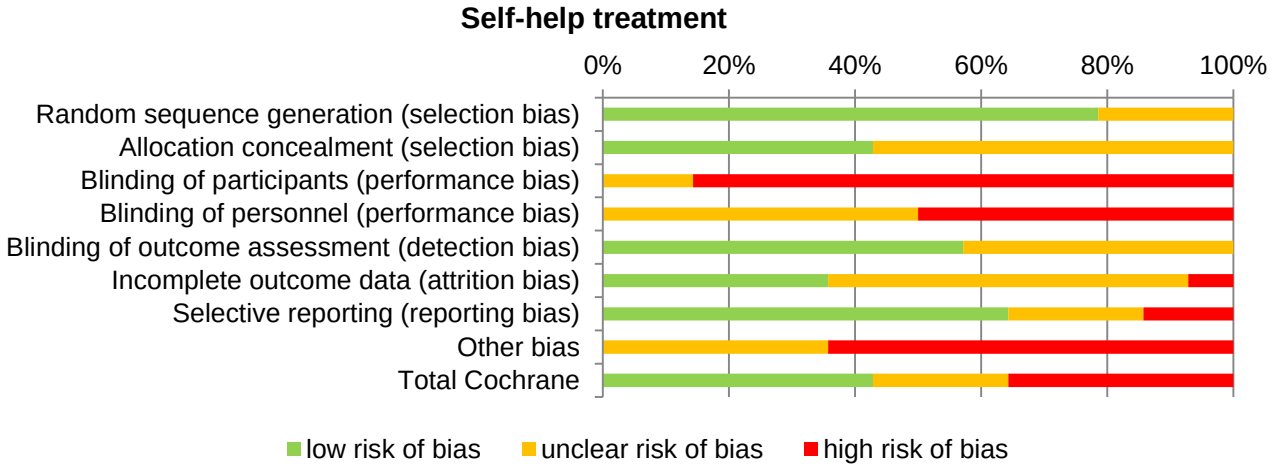
	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants (performance bias)	Blinding of personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias	Total Cochrane
Peterson et al. (2009)	-	-	+	+	-	?	-	+	-
Preuss et al. (2017)	-	?	?	+	-	-	-	?	?
Ricca et al. (2001)	?	+	+	?	?	-	?	+	+
Ricca et al. (2009)	?	?	+	+	?	-	?	+	?
Ricca et al. (2010)	-	-	+	+	-	?	-	?	-
Riva et al. (2003)	?	?	+	?	-	+	+	+	+
Safer et al. (2010)	?	?	?	+	?	-	?	?	?
Stunkard et al. (1996)	-	?	?	?	?	+	?	+	+
Tasca et al. (2006)	?	?	?	+	-	+	-	+	+

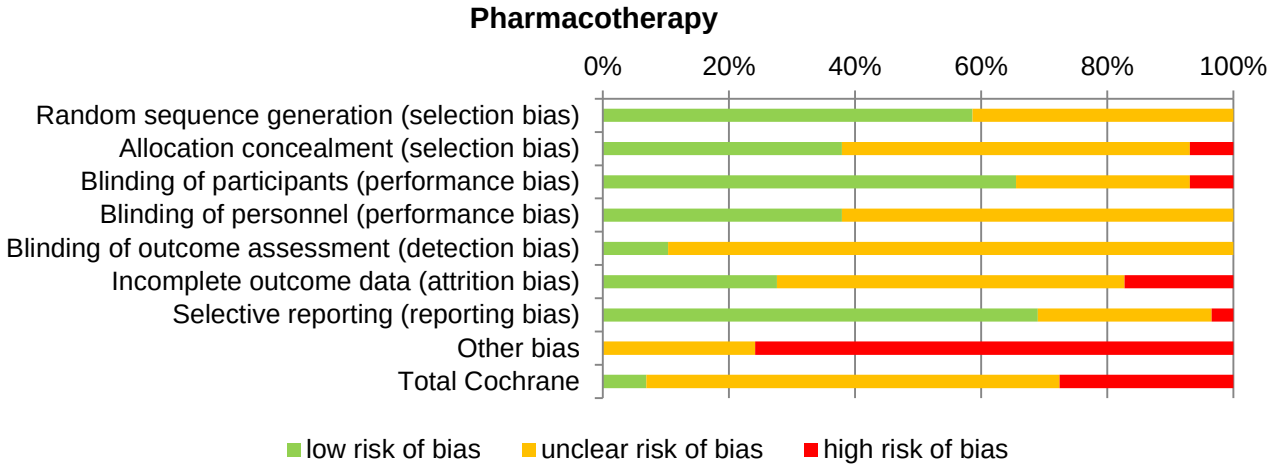
	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants (performance bias)	Blinding of personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias	Total Cochrane
Telch et al. (2001)	?	?	+	?	+	+	-	?	+
Wagner et al. (2016)	-	-	+	+	+	-	-	+	+
White & Grilo (2013)	?	-	-	?	?	?	-	?	?
Wilfley et al. (2002)	?	?	?	?	?	?	-	?	?
Wilfley et al. (2008)	-	?	-	?	?	?	-	+	+
Wilson et al. (2010)	-	?	+	+	-	?	?	?	?

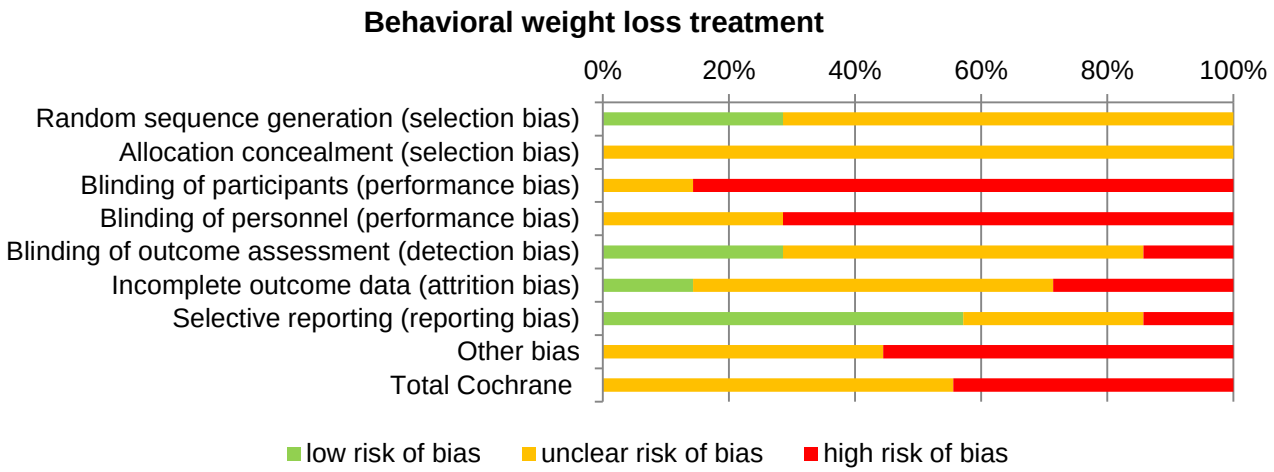
Note. Items from the Cochrane Risk of Bias Tool. "+" indicates high risk of bias, "?" indicates unclear risk of bias, and "-" indicates low risk of bias in the respective domain. Because the risk of bias was assessed for studies with published full-text only, studies by Hilbert et al., Navia et al. (2017), Richard et al., Schag et al., and Yu et al. (2017) were excluded from the rating.

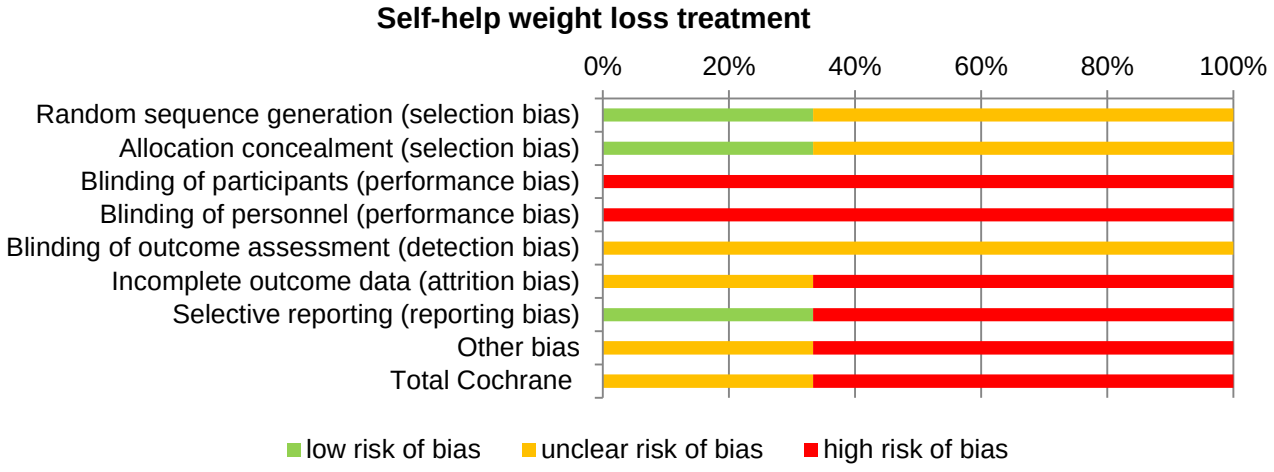
Figure H1. Risk of bias graphs, according to the indicators presented in Table H1.

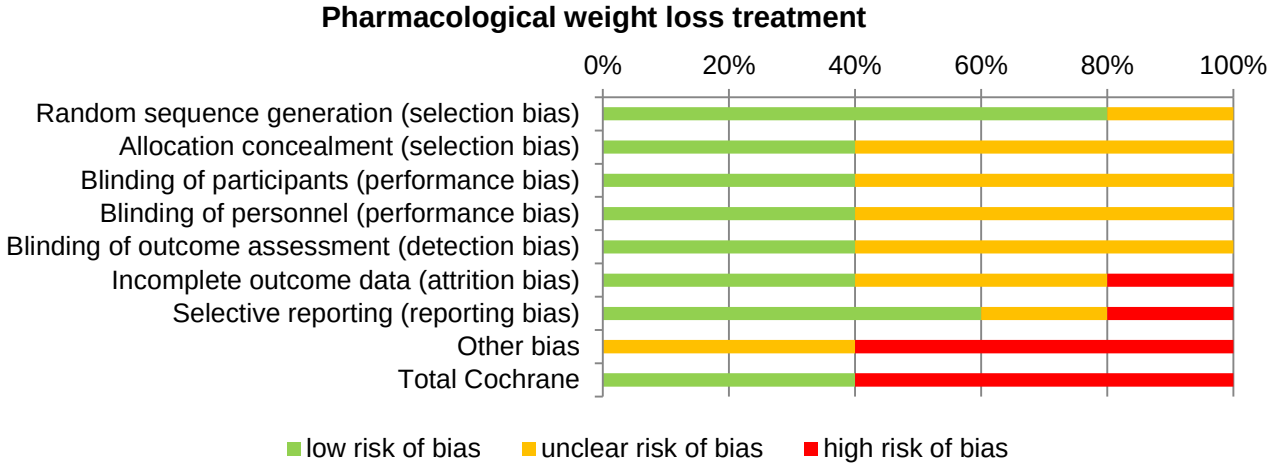


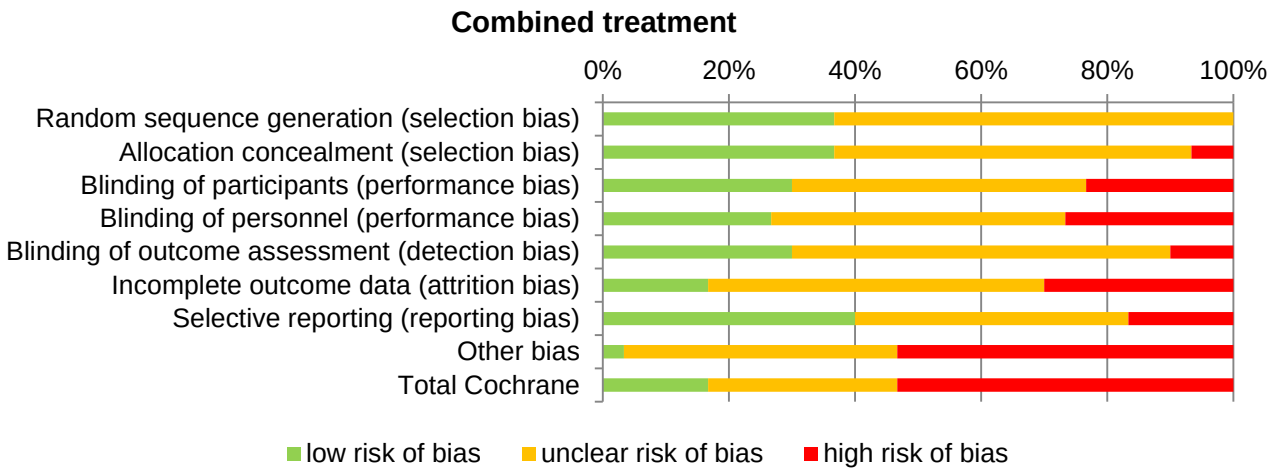





Behavioral weight loss treatment
0%
20%
40%
60%
80%
100%
Random sequence generation (selection bias)
Allocation concealment (selection bias)
Blinding of participants (performance bias)
Blinding of personnel (performance bias)
Blinding of outcome assessment (detection bias)
Incomplete outcome data (attrition bias)
Selective reporting (reporting bias)
Other bias
Total Cochrane
low risk of bias
unclear risk of bias
high risk of bias


Self-help weight loss treatment
0%
20%
40%
60%
80%
100%
Random sequence generation (selection bias)
Allocation concealment (selection bias)
Blinding of participants (performance bias)
Blinding of personnel (performance bias)
Blinding of outcome assessment (detection bias)
Incomplete outcome data (attrition bias)
Selective reporting (reporting bias)
Other bias
Total Cochrane
low risk of bias
unclear risk of bias
high risk of bias


Pharmacological weight loss treatment
0%
20%
40%
60%
80%
100%
Random sequence generation (selection bias)
Allocation concealment (selection bias)
Blinding of participants (performance bias)
Blinding of personnel (performance bias)
Blinding of outcome assessment (detection bias)
Incomplete outcome data (attrition bias)
Selective reporting (reporting bias)
Other bias
Total Cochrane
low risk of bias
unclear risk of bias
high risk of bias


Combined treatment
0%
20%
40%
60%
80%
100%
Random sequence generation (selection bias)
Allocation concealment (selection bias)
Blinding of participants (performance bias)
Blinding of personnel (performance bias)
Blinding of outcome assessment (detection bias)
Incomplete outcome data (attrition bias)
Selective reporting (reporting bias)
Other bias
Total Cochrane
low risk of bias
unclear risk of bias
high risk of bias

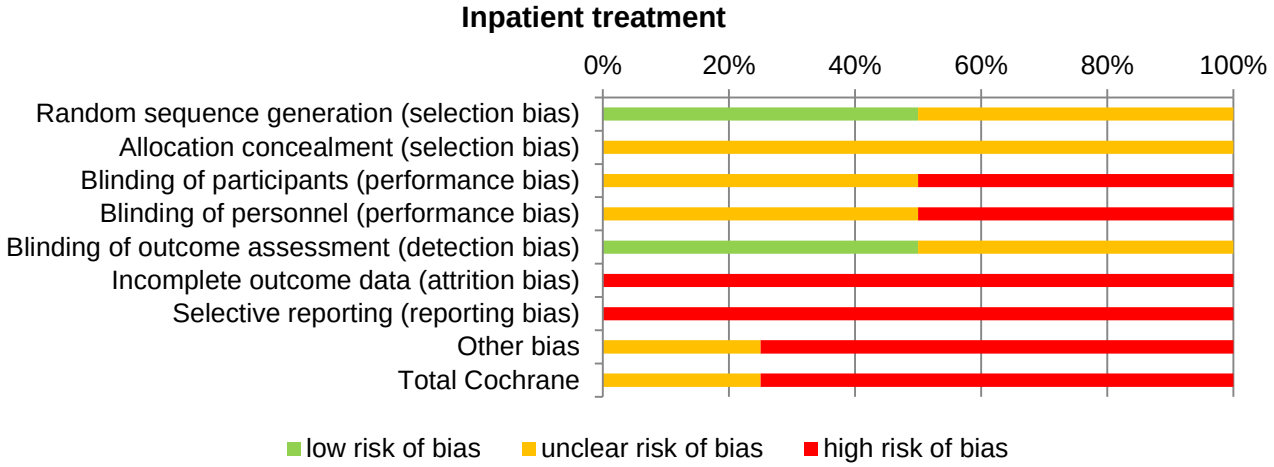

Inpatient treatment
0%
20%
40%
60%
80%
100%
Random sequence generation (selection bias)
Allocation concealment (selection bias)
Blinding of participants (performance bias)
Blinding of personnel (performance bias)
Blinding of outcome assessment (detection bias)
Incomplete outcome data (attrition bias)
Selective reporting (reporting bias)
Other bias
Total Cochrane
low risk of bias
unclear risk of bias
high risk of bias

Figure I1. Funnel plot for pre-treatment to post-treatment change in binge-eating episodes in randomized-controlled trials with inactive control

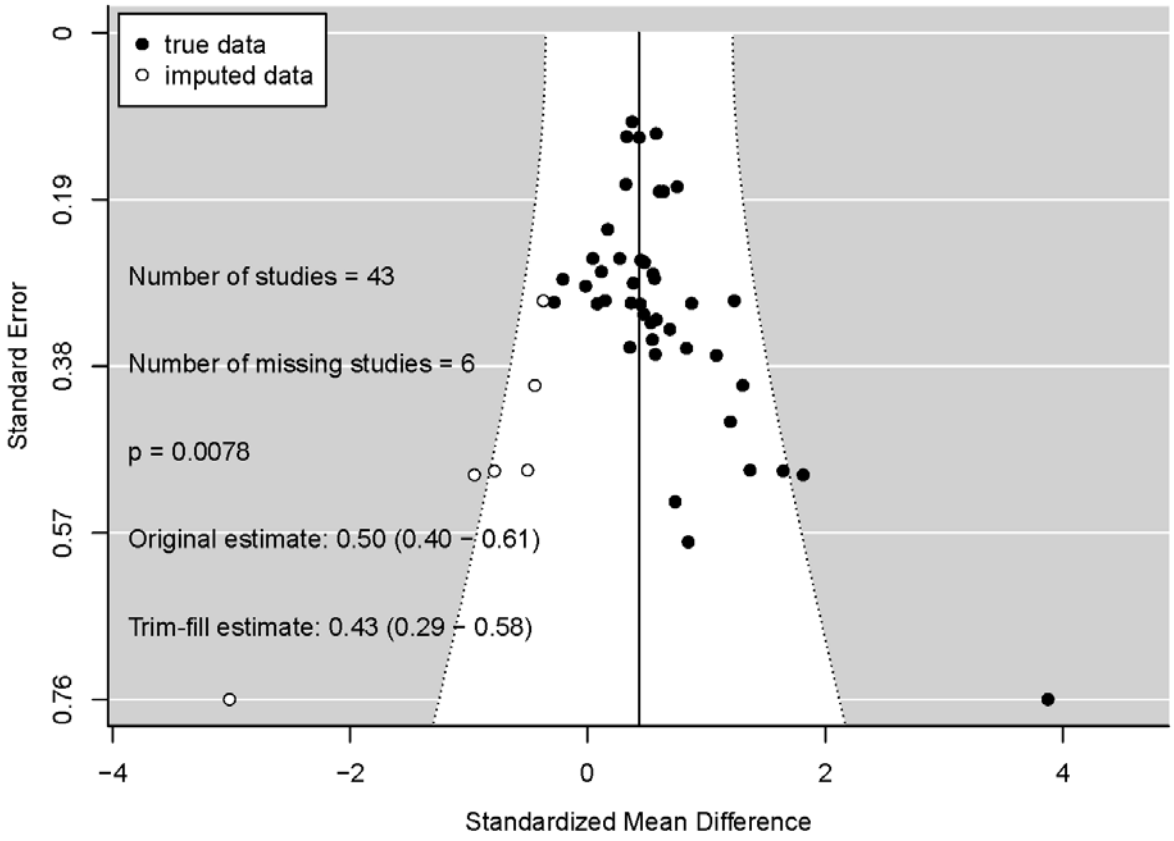


Figure I2. Funnel plots for post-treatment odds of abstinence in randomized-controlled trials with inactive control (top: small effects, bottom: large effects).