REVIEW ARTICLE

Meta-Analysis of the Effectiveness of Psychological and Pharmacological Treatments for Binge Eating Disorder

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ABSTRACT

Objective: The aim of this study was to compute and compare mean effects of various treatments for binge eating disorder.

Method: A total of 38 studies with 1973 participants fulfilled the defined inclusion criteria. Effect sizes, odds ratios, and simple rates were integrated in fixed and random (mixed) effects categorical models.

Results: From randomized controlled trials, psychotherapy and structured self-help, both based on cognitive behavioral interventions, were found to have large effects on the reduction of binge eating. Regarding pharmacotherapy, mainly comprising antidepressants, randomized controlled trials revealed medium effects for the reduction of binge eating. Uncontrolled studies on weight-loss treatments demonstrated moderate reductions of binge eating. Combination treatments did not result in higher effects compared with single-treatment regimens. Except for weight-loss treatment, none of the interventions resulted in a considerable weight reduction.

Discussion: Psychotherapy and structured self-help, both based on cognitive-behavioral interventions, should be recommended as the first-line treatments.

Keywords: binge eating disorder; cognitive-behavioral therapy; pharmacotherapy; weight loss treatment

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Introduction

Binge eating disorder (BED) is a new category in the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV). As so far, only research criteria have been established, BED is subsumed under the category eating disorder not otherwise specified (EDNOS). According to the research criteria, BED is characterized by recurrent episodes of binge eating (BE) that are specified, among other criteria, by eating in a discrete period of time an amount of food that is larger than most other people would eat in a similar period under comparable circumstances, and by a sense of loss of control over eating. An additional criterion is that BE occurs on average at least 2 days a week within a time interval of 6 months. In contrast to bulimia nervosa, BED is not accompanied by regular, inappropriate compensatory behaviors (i.e. purging) to avoid weight gain. In various studies, prevalence rates for BED varied between 0.7% and 6.6% for the general population[1,2] and 30% for persons applying for weight-loss treatment.[3] Recent research indicates that the lifetime prevalence for BED is 1.75 times higher for females than for males.[4] Although no body image-related criterion like that defined for anorexia and bulimia nervosa is included in the DSM-IV research criteria for BED, higher rates of weight and shape concerns (usually quantified using the Eating Disorder Examination)[5,6] have been reported for BED.[7] These concerns seem to be independent of body mass index (BMI).[8] Another co-occurring feature is dietary restraint, which precedes BE or being overweight in about 20% of the patients with BED.[9] Furthermore, a lifetime prevalence for depression of about 40%

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has been reported in BED.[10] Concerning the relationship between BED and depressive symptoms, it is postulated that BE is triggered by negative mood[11–13] and that this effect is enhanced by dietary restraint.[14] Besides these co-occurring mental disorders and symptoms, obesity is a frequent comorbid physical disorder. Recent research indicates that about 70% of patients suffer from obesity grades 1 and 2 (BMI 30–40 kg/m^2) and about 20% from obesity grade 3 (BMI $\geq$ 40 kg/m^2).[2]

To date, the effectiveness of various psychological, pharmacological, and weight-loss treatments for BED has been examined in a relatively large number of studies, which have led to partly inconsistent results. Although some of these findings have been summarized in narrative reviews,[15–18] and studies testing the effects of pharmacotherapy for BED have recently been entered in a meta-analysis[19] integrating 14 placebo-controlled RCTs, the effectiveness of the various forms of treatment for BED has not yet been estimated and directly compared in a meta-analysis. In contrast to narrative reviews, meta-analyses allow the findings of primary research studies to be quantitatively integrated and the effectiveness of various treatment strategies to be objectively compared.[20–22] In addition, meta-analyses have an enhanced statistical power when compared with primary research studies. As they allow the integration of studies across various samples, settings, locations, and therapists, they also reveal more reliable and externally valid results.[22,23]

The selection of studies to be integrated in meta-analyses is still a matter of debate. On the one hand, in terms of evidence of treatment efficacy in general, randomized controlled trials (RCTs) are regarded as the "gold standard."[24,25] On the other hand, due to financial, institutional, ethical, legal, and clinical reasons, both the number and external validity of RCTs is limited.[22,26] Consequently, we did not restrict our meta-analysis to RCTs with an untreated control condition and the estimation of between-group effects (i.e., differences between the post-values of experimental and control groups); we also integrated studies that involved treatment in control conditions as well as uncontrolled studies in order to calculate within-group effect sizes (i.e., pre-post changes).

The aim of the present meta-analysis was to estimate and compare the effectiveness of the available psychological, pharmacological, and weight-loss treatments of BED with regard to the major outcomes of symptomatology concerning BE behavior, body weight, restrained eating, concerns about eating, weight, and shape, depression, and dropout rates.

Method

Data Sources

MEDLINE and PsychINFO databases were searched for eligible studies from the first available year up to June 2006. According to an a priori decision, only published studies were considered, and publication bias was accounted for by a posteriori analysis. Study retrieval was based on the following search terms: binge eating (disorder), counseling, efficacy, effectiveness, intervention, outcome, pharmacotherapy, psychoanalysis, psychotherapy, therapy, treatment, weight loss, and weight reduction. Furthermore, the reference sections of the identified publications were searched to identify additional studies. A total of 234 studies were identified.

Study Selection

The 234 retrieved studies were inspected by two pairs of two authors (SH, RP, BT-C, and SV) independently to assess the following criteria: (1) Treatment studies that integrated RCTs as well as non-randomized and non-controlled studies were included. (2) The diagnoses had to be assessed according to the DSM-IV research criteria for BED in order to obtain externally valid results. (3) The core pathology of BE episodes had to be measured as an outcome measure. (4) Sufficient data to allow the calculation of effect sizes had to be reported. (5) Studies that examined different patient groups had to report separate data for patients with BED. (6) Double publications of the same trial were excluded. (7) Case reports and studies with a sample size smaller than $n = 3$ per treatment group were excluded. This procedure of study assessment allowed 38 studies to be included in the meta-analysis.

Outcome Measures

In addition to BE frequency, the number of days with BE was considered as an outcome measure covering the BE symptomatology in accordance with the DSM-IV research criteria for BED. Additionally, BE abstinence rates were calculated. To assess the general eating disorder pathology, changes on the scales dietary restraint, eating concern, weight concern, and shape concern from the Eating Disorder Examination[5,6] were considered. Scores for depressive symptoms derived from the Beck Depression Inventory,[27] the Hamilton Rating Scale for Depression,[28] the Hospital Anxiety and Depression Scale,[29] and the Symptom Checklist 90-R subscale depression[30] were also integrated because of the high

comorbidity rates of BED with affective disorders.[10] Weight and BMI were included to take the high comorbidity rates between BED and obesity into account.[2] Dropout rates were considered as a proxy of compliance with treatment.

Data Extraction

The 38 identified studies were coded by two clinical psychologists experienced in eating disorders research who used a standardized coding scheme accompanied by a coding handbook. The handbook gave definitions, coding categories/ranges, and formats for all variables as well as examples and an overview of the entire data management process. Following intense training regarding use of the coding scheme and handbook, one randomly selected study was coded by the two raters collaboratively for further training purposes. Afterwards, another 10 randomly selected studies were coded independently by the two raters to allow the computation of interrater reliability. Cohen's kappa was chosen as the coefficient for categorial items, and the intraclass correlation (two-way mixed model, single measure, absolute agreement definition) for continuous data. These coefficients were quite high and ranged from κ/ICC = 0.00–1.00, with a mean of 0.93 and a median of 1.00. Discordant ratings were inspected and corrected by consensualization. The remaining 27 studies were randomly distributed among the raters and coded only once.

Calculation of the Study Effects

The 38 studies included 62 treatment conditions, which were categorized into psychotherapy, structured self-help, pharmacotherapy, weight-loss treatment, and combined treatments. For RCTs with an untreated control group, the effects between the treatment and control group at the end of the intervention were computed (between-group effects). In addition, pre-post treatment effects (within-group effects) were computed for all studies (RCTs plus studies without an untreated control group). For between-group effects on continuous variables, standardized mean differences (effect size, Hedges' d)[31] were calculated. For categorical variables, odds ratios were computed. Within-group effects for single-treatment groups were computed by dividing the difference of pre- and post-means by the pooled standard deviations at the measurement times.[32] Simple rates were used to quantify pre-post effects on categorical variables.

Missing standard deviations were recovered from interquartile ranges and standard errors of the means. If posttreatment variances could not be computed from other values, they were substituted by pretreatment variances. In some studies, effect sizes were obtained from t-values.[22,33]

To protect the analyses against the influence of outliers (extreme effects), a windsorizing procedure was implemented: Post-effect sizes greater than $d = 1.65$ (one-sided z-value at $\alpha = 0.05$) and pre-post-effect sizes greater than $d = 2.33$ (one-sided z-value at $\alpha = 0.01$) were set equal to these upper-limit effect sizes. For all types of effects, appropriate variances were computed[22,34] using the sample size of completers or the intent-to-treat sample size. To avoid correlated effects and results, the following strategies were defined a priori: for the Eating Disorder Examination, effects were computed for the interview[5] and questionnaire format[6] on each of the four scales dietary restraint, eating concern, weight concern, and shape concern. If more than one effect was reported per construct, the mean value of these effects was calculated and, by assuming a correlation of $r = 0.7$, an adjusted effect variance was computed.[35] For depressive symptoms, study effects were computed for a variety of instruments (see earlier). Because all of these instruments are congeneric to the same construct, they were pooled in a single analysis.[31] Multiple effects on depressive symptoms within studies were averaged and, assuming correlations of $r = 0.7$, an adjusted effect variance for the mean effect was computed.[35] For weight and BMI, only one analysis was planned. Missing effects on weight were substituted by effects on BMI, because these are identical under the assumption of constant height. Effects of different treatment conditions within studies were not adjusted for potential correlation.

Integration of Effect Sizes

Because the major objective of the present meta-analysis was to compute and compare the mean effects of available psychological, pharmacological, and combined treatments, the study effects for these classes were integrated by fixed and random (mixed) effects categorical models. Mixed models were computed using the method of moments.[22,23,36,37] To achieve normal distribution and stabilize the variances, odds ratios were transformed by natural logarithm and rates were logit-transformed for modeling. Both measures were transformed back for interpretation. Weighted mean effects for each treatment category were computed along with their variances, z-test, and 95% confidence intervals by the inverse variance method. Forrest plots of the individual study effects and their confidence intervals were produced.

The following weighted homogeneity statistics were computed: Q_{total} to quantify the total variation among the study effects around the weighted grand mean,[22,37] Q_{wi} to quantify the variation of study effects within each design cell (treatment category), Q_w as a global goodness-of-fit test of effect heterogeneity within all design cells, and Q_b as an omnibus test of statistically significant differences between the mean effects. A fitting model is indicated by homogeneity of effects (nonsignificant Q_w),

and statistically different mean effects are indicated by a significant Q_b. A hierarchical strategy was used to establish a parsimonious model: random effects models were applied only if a fixed effect model did not achieve overall fit, indicated by heterogeneous effects within all design cells (significant Q_w). Variance components for fixed and mixed models were computed and examined as a further hint for modeling. Pairwise post-hoc comparisons were calculated using a procedure analogous to the Scheffé test.[31] In addition, these models were applied to pretreatment characteristics (means and rates) with their appropriate standard errors for sample description. Unfortunately, binge frequencies were reported within different time frames, and assessment of depression was based on instruments with different scaling schemes. For both variables, an aggregation was not possible because appropriate standard errors could not be derived.

Publication Bias

To account for publication bias,[38–40] funnel plots of the study effects against their precisions were inspected, and the fail-safe-N was calculated. The fail-safe-N indicates the number of additional unpublished studies with a mean effect of $d = 0.00$ needed to be integrated to reduce the reported mean effect size to $d = 0.21$, indicating a small effect according to Cohen.[41] To get a more conservative estimate for BE abstinence, a critical mean effect of log(or) = 0.00 was considered appropriate.

Results

Sample Characteristics

In sum, the current meta-analysis included 38 studies (Refs. 42–79 were included in the meta-analysis) with a total of 77 conditions (study arms). Of these study arms, 21 were active treatment conditions from RCTs and 15 were control conditions from RCTs (**Table 1**). An additional 41 treatment conditions came from studies that did not have an untreated control condition. A total of 23 treatment conditions from both RCTs and studies without an untreated control condition were assigned to psychotherapy (19 cognitive behavioral therapies and four other kinds of psychotherapy), six conditions to structured self-help (three guided, structured self-help and three nonguided, structured self-help), 16 conditions to pharmacotherapy (eight selective serotonin reuptake inhibitors, three serotonin noradrenaline reuptake inhibitors, four anticonvulsants, and one D-fenfluramine), three conditions to weight-loss treatment, and 14 conditions to combination treatments (five psychotherapy plus pharmacotherapy, eight psychotherapy plus other kinds of treatment, and one pharmacotherapy plus other treatment).

Across all studies and treatment conditions, a total of $n = 1{,}973$ patients were included. Of these, $n = 534$ came from RCT treatment conditions and $n = 330$ from RCT control conditions. Additionally, $n = 1{,}109$ patients were in the active conditions of studies without an untreated control condition. The included samples of the various treatment categories did not differ in sex ratio ($Q_b = 6.79$, df = 4, $p = 0.15$), and homogeneity within the treatment categories was not rejected ($Q_w = 55.95$, df = 54, $p = 0.40$). Regarding age ($Q_b = 10.77$, df = 4, $p = 0.03$) and BMI ($Q_b = 19.61$, df = 4, $p = 0.001$), differences between the treatment categories were significant, but pairwise post-hoc comparisons failed to reach statistical significance. Homogeneity within the treatment categories was not rejected (age: $Q_w = 57.24$, df = 50, $p = 0.22$; BMI: $Q_w = 61.80$, df = 47, $p = 0.07$; see **Table 2**).

Mean Effects and Treatment Comparisons

Mean effect sizes, 95% confidence intervals, number of included study conditions, number of participants, homogeneity statistics (Q_{wi}), fail-safe-N, as well as the model applied (fixed effects model or random effects model) are presented in **Table 3** for the between-group effects and in **Table 4** for the within-group effects.

Binge Eating Frequency

Mean between-group effect sizes were significant and large (according to Cohen)[41] for psychotherapy and structured self-help. For pharmacotherapy, they were significant and medium. Mean effect sizes of the various treatments did not differ significantly. Mean within-group effect sizes were significant for psychotherapy, structured self-help, pharmacotherapy, weight-loss treatments, and combined treatments. Although these mean effects were statistically different, pairwise post-hoc comparisons failed to reach significance.

Days with Binge Eating. For the between-group comparisons, significant and large mean effect sizes were found for psychotherapy and pharmacotherapy. Mean within-group effect sizes were significant for psychotherapy, pharmacotherapy, and combined treatments. No differences among the treatments were found for the two kinds of effect sizes.

Binge Eating Abstinence. For the between-group comparisons, the mean odds ratios of the RCTs were significant for psychotherapy, structured self-

TABLE 1. Characteristics of the included studies

Source	Study Design	Treatment	Sample Size in Treatment Condition	Control Condition	Sample Size in Control Condition
Psychotherapy					
Agras et al.[42]	RCT	CBT	39	Waiting list	11
Castonguay et al.[43]	Pre-post	CBT	75		
Ciano et al.[44]	Pre-post	Analytic psychotherapy	6		
Ciano et al.[44]	Pre-post	Psychoeducation	5		
Eldredge et al.[45]	RCT	CBT	36	Waiting list	10
Fossati et al.[46]	Pre-post	CBT	13		
Gorin et al.[47]	RCT	CBT	32	Waiting list	31
Gorin et al.[47]	RCT	CBT with spouse involvement	31	Waiting list	31
Grilo et al.[48]	RCT	CBT + placebo	28[a]	Placebo	27
Kristeller and Hallett[49]	Pre-post	Meditation	21		
le Grange et al.[50]	Pre-post	CBT	22[a]		
le Grange et al.[50]	Pre-post	CBT + ecological momentary assessment	19[a]		
Nauta et al.[51]	Pre-post	Cognitive therapy	21[a]		
Nauta et al.[51]	Pre-post	Behavior therapy	16[a]		
Painot et al.[52]	Pre-post	CBT	36		
Pendleton et al.[53]	Pre-post	CBT + maintenance	28		
Pendleton et al.[53]	Pre-post	CBT	29		
Peterson et al.[54]	RCT	CBT therapist-led	16[a]	Waiting list	11
Ricca et al.[55]	Pre-post	CBT	20		
Telch et al.[56]	RCT	Dialectical behavior therapy	22	Waiting list	22
Wilfley et al.[57]	Pre-post	CBT	81		
Wilfley et al.[57]	Pre-post	Interpersonal therapy	81		
Wolff and Clark[58]	Pre-post	CBT	20		
Self-help					
Carter and Fairburn[59]	RCT	Pure CBT self-help	24[a]	Waiting list	24
Carter and Fairburn[59]	RCT	Guided CBT self-help	24[a]	Waiting list	24
Latner and Wilson[60]	Pre-post	Self-monitoring	18		
Peterson et al.[54]	RCT	CBT partial self-help	19[a]	Waiting list	11
Peterson et al.[54]	RCT	CBT self-help	15[a]	Waiting list	11
Wells et al.[61]	Pre-post	Telephone-based guided self-help	9		
Pharmacotherapy					
Appolinario et al.[62]	RCT	Sibutramine	30[a]	Placebo	30
Appolinario et al.[63]	Pre-post	Topiramate	8[a]		
Appolinario et al.[64]	Pre-post	Sibutramine	10[a]		
Arnold et al.[65]	RCT	Fluoxetine	30	Placebo	30
Grilo et al.[48]	RCT	Fluoxetine	27[a]	Placebo	27
Hudson et al.[66]	RCT	Fluvoxamine	42[a]	Placebo	43
Malhotra et al.[67]	Pre-post	Venlafaxine	29		
McElroy et al.[68]	RCT	Topiramate	30[a]	Placebo	31
McElroy et al.[69]	RCT	Citalopram	19	Placebo	19
McElroy et al.[70]	RCT	Sertraline	18[a]	Placebo	16
McElroy et al.[71]	Pre-post	Zonisamide	15[a]		
Pearlstein et al.[72]	RCT	Fluvoxamine	12	Placebo	11
Ricca et al.[55]	Pre-post	Fluoxetine	21		
Ricca et al.[55]	Pre-post	Fluvoxamine	22		
Shapira et al.[73]	Pre-post	Topiramate	13		
Stunkard et al.[74]	RCT	D-fenfluramine[b]	14	Placebo	14
Weight-loss treatment					
Agras et al.[75]	Pre-post	Weight-loss treatment	37		
de Zwaan et al.[76]	Pre-post	Weight -loss treatment	35[a]		
Laederach-Hofmann et al.[77]	Pre-post	Weight-loss treatment + psychological support	16		
Combined treatments					
Agras et al.[75]	Pre-post	CBT + weight-loss treatment	36		
Agras et al.[75]	Pre-post	CBT + weight-loss treatment + desipramine	36		
Devlin et al.[78]	Pre-post	CBT + phentermine + fluoxetine	16		
de Zwaan et al.[76]	Pre-post	Weight-loss treatment + CBT	36[a]		
Fichter et al.[79]	Pre-post	Multimodal therapy	68		
Fossati et al.[46]	Pre-post	CBT + nutrition	23		
Fossati et al.[46]	Pre-post	CBT + physical activity	25		
Grilo et al.[48]	RCT	CBT + fluoxetine	26[a]	Placebo	27
Laederach-Hofmann et al.[77]	Pre-post	Weight-loss treatment + psychological support + imipramine	15		
Painot et al.[52]	Pre-post	Nutritional CBT	26		
Pendleton et al.[53]	Pre-post	CBT + exercise	28		
Pendleton et al.[53]	Pre-post	CBT + exercise + maintenance	29		
Ricca et al.[55]	Pre-post	CBT + fluoxetine	22		
Ricca et al.[55]	Pre-post	CBT + fluvoxamine	23		

Notes: RCT, randomized controlled trial with an untreated control condition; Pre-Post, Study with no untreated control condition; CBT, cognitive behavioral therapy.

[a] Intent-to-treat analysis.

[b] Serotonin releaser that is now phased out in several countries.

TABLE 2. Sample characteristics

	Psychotherapy	Structured Self-Help	Pharmacotherapy	Weight-Loss Treatments	Combined Treatments
Sex ratio (% females)					
Mean (SD)	92 (0.27)	97 (0.69)	87 (0.29)	95 (0.80)	90 (0.37)
k/*n*	22/684	6/109	16/340	3/88	12/361
Age					
Mean (SD)	43.54 (1.25)	38.15 (2.61)	37.78 (1.57)	39.58 (3.27)	38.89 (1.61)
k/*n*	21/664	5/94	14/313	3/88	12/361
Body mass index					
Mean (SD)	35.72 (0.54)	32.45 (1.01)	37.34 (0.70)	38.26 (1.35)	35.38 (0.66)
k/*n*	19/607	6/109	12/280	3/88	12/361

Notes: SD, standard deviation; *k*, number of studies; *n*, number of participants.

TABLE 3. Between-group effects for the various treatment categories from randomized controlled trials

		Psychotherapy	Structured Self-Help	Pharmacotherapy
Binge eating frequency (R)	*k*/*n*	5/197	4/152	6/240
	d (95% CI)	0.82* (0.41–1.22)	0.84* (0.37–1.30)	0.52* (0.15–0.89)
	Q_{wi} (df)	1.50 (4)	2.10 (3)	7.23 (5)
	FS-N (0.21)	14	11	8
Days with binge eating (F)	*k*/*n*	4/157	—	4/172
	d (95% CI)	1.04* (0.70–1.38)	—	0.76* (0.45–1.08)
	Q_{wi} (df)	4.68 (3)	—	5.05 (3)
	FS-N (0.21)	15	—	10
Binge eating abstinence rates (F)	*k*/*n*	6/301	4/152	9/445
	OR (95% CI)	6.83* (3.50–13.33)	25.77* (9.74–68.15)	2.19* (1.44–3.31)
	Q_{wi} (df)	5.00 (5)	0.69 (3)	6.96 (8)
	FS-N (0.21)	48	57	24
Dietary restraint (R)	*k*/*n*	2/79	2/96	2/64
	d (95% CI)	0.32 (−0.27 to 0.91)	0.68* (0.09–1.26)	–0.04 (−0.68 to 0.59)
	Q_{wi} (df)	0.00 (1)	1.27 (1)	2.00 (1)
	FS-N (0.21)	1	4	−2
Eating concern (R)	*k*/*n*	2/79	2/96	2/64
	d (95% CI)	0.98* (0.40–1.57)	1.43* (0.84–2.01)	−0.18 (−0.79 to 0.43)
	Q_{wi} (df)	1.55 (1)	0.53 (1)	1.07 (1)
	FS-N (0.21)	7	11	−3
Weight concern (R)	*k*/*n*	2/79	2/96	2/64
	d (95% CI)	0.53* (0.11–0.96)	0.85* (0.43−1.27)	−0.16 (−0.62 to 0.29)
	Q_{wi} (df)	1.86 (1)	0.68 (1)	0.11 (1)
	FS-N (0.21)	3	6	−3
Shape concern (R)	*k*/*n*	2/79	2/96	2/64
	d (95% CI)	0.35 (−0.07 to 0.77)	0.66* (0.25–1.07)	−0.06 (−0.52 to 0.40)
	Q_{wi} (df)	0.37 (1)	0.87 (1)	0.61 (1)
	FS-N (0.21)	1	4	−2
Depressive symptoms (F)	*k*/*n*	5/264	—	5/215
	d (95% CI)	0.36* (0.08−0.64)	—	0.40* (0.12–0.69)
	Q_{wi} (df)	1.96 (4)	—	7.86 (4)
	FS-N (0.21)	3	—	4
Body weight (F)	*k*/*n*	4/178	2/96	6/236
	d (95% CI)	0.09 (−0.21 to 0.39)	0.10 (−0.30 to 0.50)	0.01 (−0.25 to 0.27)
	Q_{wi} (df)	0.58 (3)	0.12 (1)	6.78 (5)
	FS-N (0.21)	−2	−1	−5
Dropout rates (F)	*k*/*n*	7/347	4/152	9/445
	OR (95% CI)	1.05 (0.62–1.78)	0.61 (0.20–1.85)	0.87 (0.55–1.36)
	Q_{wi} (df)	2.30 (6)	5.15 (3)	12.54 (8)
	FS-N (0.01)	−26	204	139

Notes: R, random effects model; F, fixed effects model; *k*, number of studies; *n*, number of participants, *d*, mean between-group effect size; CI, confidence interval; Q_{wi} (df), test of homogeneity within each intervention category; FS-N, fail-safe-N; OR, odds ratio.
* $p < .05$.

help, and pharmacotherapy. The odds ratios significantly differed among these categories. Pairwise post-hoc comparisons revealed higher odds ratios for psychotherapy and structured self-help when compared with pharmacotherapy. Mean within-group comparisons for BE abstinence rates were non-significant for all of the treatment categories and did not differ.

Dietary Restraint. Mean between-group effect sizes of the RCTs were significant and medium sized for structured self-help and nonsignificant for psycho-

TABLE 4. Within-group effects for the various treatment categories indicating pre-post changes

		Psychotherapy	Structured Self-Help	Pharmacotherapy	Weight-Loss Treatments	Combined Treatments
Binge eating frequency (R)	*k*/*n*	11/190	6/107	11/212	2/50	7/184
	d (95% CI)	1.46* (1.12–1.80)	1.09* (0.67–1.50)	1.19* (0.88–1.49)	0.77* (0.11–1.42)	1.57* (1.17–1.97)
	Q_{wi} (df)	4.34 (10)	2.20 (5)	14.72 (10)	1.58 (1)	7.71 (6)
	FS-N (0.21)	65	25	51	5	45
Days with binge eating (R)	*k*/*n*	10/325	—	7/118	—	4/102
	d (95% CI)	1.81* (1.45–2.17)	—	1.49* (1.02–1.96)	—	2.18* (1.58–2.78)
	Q_{wi} (df)	7.44 (9)	—	8.12 (6)	—	0.24 (3)
	FS-N (0.21)	76	—	42	—	37
Binge eating abstinence rates (R)	*k*/*n*	17/567	6/109	13/268	2/72	8/275
	d (95% CI)	0.51 (0.42–0.60)	0.60 (0.43–0.74)	0.44 (0.34–0.55)	0.46 (0.23–0.070)	0.48 (0.36–0.60)
	Q_{wi} (df)	24.24 (16)	6.99 (5)	5.43 (12)	5.71*(1)	3.44 (7)
	FS-N (0.21)	24	11	14	2	10
Dietary restraint (R)	*k*/*n*	9/280	2/40	4/68	—	3/60
	d (95% CI)	0.36* (0.10–0.62)	0.54 (−0.01 to 1.09)	0.16 (−0.25 to 0.57)	—	0.39 (−0.06 to 0.85)
	Q_{wi} (df)	8.94 (8)	1.69 (1)	3.18 (3)	—	2.24 (2)
	FS-N (0.21)	6	3	−1	—	2
Eating concern (R)	*k*/*n*	9/280	2/40	4/68	—	3/60
	d (95% CI)	1.34* (1.00–1.69)	1.30* (0.57–2.03)	0.45 (−0.05 to 0.96)	—	1.34* (0.72–1.95)
	Q_{wi} (df)	11.50 (8)	0.38 (1)	2.02 (3)	—	1.41 (2)
	FS-N (0.21)	48	10	4	—	16
Weight concern (R)	*k*/*n*	9/280	2/40	4/68	—	3/60
	d (95% CI)	0.98* (0.70–1.25)	1.02* (0.45–1.60)	0.42* (0.00–0.84)	—	1.14* (0.64–1.65)
	Q_{wi} (df)	11.69 (8)	0.14 (1)	4.25 (3)	—	2.48 (2)
	FS-N (0.21)	32	7	4	—	13
Shape concern (R)	*k*/*n*	9/280	2/40	4/68	—	3/60
	d (95% CI)	1.10* (0.75–1.46)	0.81* (0.09–1.53)	0.37 (−0.16 to 0.90)	—	0.82* (0.21–1.42)
	Q_{wi} (df)	10.48 (8)	0.12 (1)	4.46 (3)	—	1.87 (2)
	FS-N (0.21)	38	5	3	—	8
Depressive symptoms (R)	*k*/*n*	17/477	—	11/183	2/42	13/323
	d (95% CI)	0.74* (0.59–0.89)	—	0.63* (0.42–0.83)	0.30 (−0.13 to 0.72)	0.79* (0.61–0.97)
	Q_{wi} (df)	18.09 (16)	—	3.92 (10)	0.37 (1)	20.24 (12)
	FS-N (0.21)	42	—	21	0	35
Body weight (R)	*k*/*n*	16/428	3/55	10/184	3/77	12/325
	d (95% CI)	0.01 (−0.14 to 0.16)	0.02 (−0.34 to 0.38)	0.37* (0.17–0.58)	0.50* (0.15–0.85)	0.31* (0.14–0.48)
	Q_{wi} (df)	4.36 (15)	0.07 (2)	27.30*(9)	11.31*(2)	14.23*(11)
	FS-N (0.21)	−14	−2	7	4	5
Dropout rates (R)	*k*/*n*	22/684	6/109	16/340	3/88	12/361
	d (95% CI)	0.19* (0.15–0.24)	0.18* (0.09–0.31)	0.28* (0.21–0.36)	0.21* (0.11–0.37)	0.18* (0.13–0.25)
	Q_{wi} (df)	31.49 (21)	7.11 (5)	12.38 (15)	1.83 (2)	6.92 (11)
	FS-N (0.01)	−402	−99	−431	−61	−207

Notes: R, random-effects model; *k*, number of studies; *n*, number of participants; *d*, mean within-group effect size; CI, confidence interval; Q_{wi} (df), test of homogeneity within each treatment category; FS-N, fail-safe-N.

* $p < .05$.

therapy and pharmacotherapy. Within-group comparisons yielded significant mean effect sizes for psychotherapy, whereas the mean effect sizes for structured self-help, pharmacotherapy, and combined treatments failed to reach significance. No significant differences among the treatments were found for the two kinds of effect sizes.

Eating Concern. Mean between-group effect sizes were significant and large for psychotherapy and structured self-help, whereas the effect size for pharmacotherapy was nonsignificant. The three mean effect sizes differed significantly, and the post-hoc tests indicated significantly larger effect sizes for psychotherapy and structured self-help when compared with pharmacotherapy. Within-group comparisons revealed significant mean effect sizes for psychotherapy, structured self-help, and combined treatments, whereas for pharmacotherapy, mean effect size was nonsignificant. The four mean effect sizes differed significantly, with the pairwise post-hoc comparisons indicating a larger mean effect size for psychotherapy than for pharmacotherapy.

Weight Concern. Mean between-group effect sizes of the RCTs were significant and medium sized for psychotherapy, significant and large for structured self-help, and nonsignificant for pharmacotherapy. The effect sizes of the three treatment categories differed significantly, with pairwise post-hoc comparisons indicating significantly greater effect sizes for structured self-help compared with pharmacotherapy. Within-group comparisons indicated significant mean effect sizes for psychotherapy, structured self-help, pharmacotherapy, and combined

TABLE 5. Homogeneity statistics

	Homogeneity within all groups			Homogeneity between the groups		
	Q_w	df	p	Q_b	df	p
Between-group comparisons						
Binge eating frequency (R)	10.82	12	.55	1.57	2	.46
Days with binge eating (F)	9.73	6	.14	1.35	1	.25
Binge eating abstinence rates (F)	12.66	16	.70	24.66	2	<.001
Dietary restraint (R)	3.26	3	.35	2.68	2	.26
Eating concern (R)	3.15	3	.37	14.83	2	.001
Weight concern (R)	2.65	3	.45	10.58	2	.005
Shape concern (R)	1.85	3	.61	5.22	2	.07
Depressive symptoms (F)	9.82	8	.28	0.05	1	.83
Body weight (F)	7.47	9	.59	0.22	2	.90
Dropout rates (F)	19.99	17	.28	0.83	2	.66
Within-group comparisons						
Binge eating frequency (R)	30.56	32	.54	74.64	4	<.001
Days with binge eating (R)	15.80	18	.61	3.16	2	.21
Binge eating abstinence rates (R)	45.82	41	.28	2.61	4	.63
Dietary restraint (R)	16.04	14	.31	1.37	3	.71
Eating concern (R)	15.31	14	.36	8.88	3	.03
Weight concern (R)	18.56	14	.18	6.29	3	.10
Shape concern (R)	16.92	14	.26	5.14	3	.16
Depressive symptoms (R)	42.62	39	.32	5.15	3	.16
Body weight (R)	57.27	39	.03	14.05	4	.007
Dropout rates (R)	59.72	54	.28	5.87	4	.21

Notes: Q_w, test of homogeneity within all intervention categories; Q_b, omnibus test of homogeneity between the intervention categories; df, degrees of freedom; p, error probability; R, random effects model; F, fixed effects model.

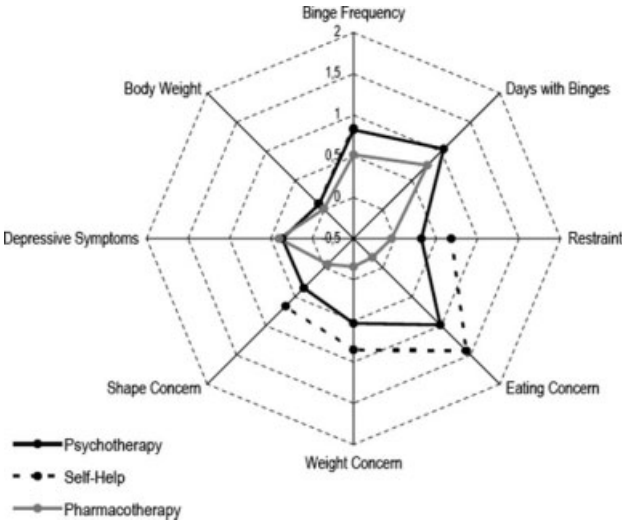
treatments, with no significant differences among these categories.

Shape Concern. The mean between-group effect sizes of the RCTs were significant and medium in size for structured self-help and nonsignificant for psychotherapy and pharmacotherapy. Mean effect sizes for the within-group comparisons were significant for psychotherapy, structured self-help, and combined treatments. Regarding the two kinds of effect sizes, no significant differences were detected among the treatments.

Depressive Symptoms. Mean between-group comparisons indicated significant but small mean effect sizes for psychotherapy and pharmacotherapy. Within-group comparisons revealed significant mean effect sizes for psychotherapy, pharmacotherapy, and combined treatments. For the two kinds of effect sizes, no significant differences were found among the treatments.

Body Weight. Mean between-group effect sizes were not significant for psychotherapy, structured self-help, and pharmacotherapy. These mean effects did not differ significantly. Within-group effect sizes indicated significant effect sizes for pharmacotherapy, weight-loss treatments, and combined

FIGURE 1. Mean between-group effect sizes for the various treatment categories.



treatments and nonsignificant mean effect sizes for psychotherapy and structured self-help. Although the omnibust test indicated significant differences among the five mean effect sizes, none of the pairwise post-hoc comparisons was significant.

Dropout Rates. Odds ratios for the dropout rates for psychotherapy, self-help, and pharmacotherapy were not significant. For the within-group comparisons, dropout rates were significant for each of the five treatment categories. For the two kinds of effect sizes, no differences among the treatments were found.

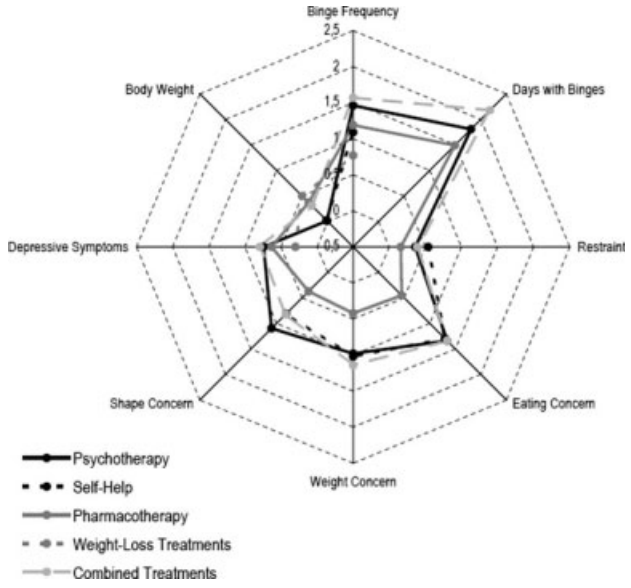
Table 5 summarizes the Q_b and Q_w statistics for the between-group comparisons and within-group comparisons for each outcome measure. Except for the within-group comparison for body weight, Q_w was not significant for each outcome measure, indicating that effect sizes within all treatment categories were not heterogeneous.

Figures 1 and **2** illustrate the mean effect sizes for the treatment categories and outcome measures for the between-group effect sizes and the within-group effect sizes, respectively.

Discussion

To summarize, results of the analyses based on RCTs demonstrate that psychotherapy and structured self-help revealed the highest effect sizes for almost all outcome measures as well as the highest rates of BE abstinence. When considering within-group comparisons comprising not only the RCTs

FIGURE 2. Mean within-group effect sizes for the various treatment categories.



but also studies without an untreated control condition, there is some evidence that combination treatments are also among the most successful forms of intervention, exceeding the effects of pharmacotherapy and weight-loss treatments on most of the outcome measures.

For psychotherapy, large effect sizes were found for the reduction of BE only when we considered the RCTs. Because all of the studies that could be integrated in these analyses according to the inclusion criteria were based on cognitive behavioral therapy, it might be concluded that treatment strategies that directly address disturbed eating patterns and their antecedents[42,45] are effective in the reduction of BE. Further results indicated that the effect of psychotherapy is not restricted to BE behavior but also extends to associated symptoms such as overconcern with eating, weight, and shape. These results suggest that cognitive behavioral therapy for BED is also capable of improving eating- and body-related cognitions. The finding that depressive symptoms were only marginally affected by psychotherapy might be explained by the fact that treatment strategies that aimed at a reduction of negative affect were not within the scope of the interventions. It is possible, however, that the improvements in BE might have slightly influenced depressiveness. Furthermore, psychotherapy did not affect body weight, but again, weight loss was not an explicit goal of these interventions.

These positive findings for psychotherapy based on RCTs are supported by the additional results of analyses including studies without an untreated control condition. In contrast to the RCTs, the treatment conditions that were integrated in these pre-post comparisons for psychotherapy were based on cognitive behavioral therapy only in about 80% of cases. The remaining studies involved interpersonal therapy,[57] psychoanalytic group therapy,[44] psychoeducation,[44] or meditation.[49] Because results of only one non-RCT on each of these forms of treatment have been published so far, no conclusions can be drawn about their effectiveness. Therefore, additional research on the effectiveness of the various hitherto understudied forms of psychotherapy for BED would be desirable.

Further results indicate that structured self-help is effective in reducing BE frequency as well as associated symptoms such as concerns with eating, weight, and shape. Comparable to psychotherapy, no effect on body weight was detected. Because each of the studies was based on cognitive behavioral interventions, it can be speculated that cognitive behavioral therapy is helpful when delivered not only in a conventional "face-to-face" setting but also in a structured self-help format. These results are promising, since in general, structured self-help interventions are easier to disseminate and more cost-effective compared with conventional treatments. However, the number of studies on structured self-help is limited. Moreover, half of the study conditions integrated in this meta-analysis were not pure, structured self-help but were guided in some form (e.g. by frequent telephone contacts),[61] possibly leading to enhanced compliance and treatment success. Because of the lack of data, it was not possible to compare the various samples treated with cognitive behavioral therapy delivered in a "face-to-face" setting and those treated with cognitive behavioral therapy delivered in a structured self-help format regarding the participants' level of functioning (e.g. self-regulation skills). Future research should clarify which patients are sufficiently responsive to structured self-help formats as low-level treatments and which patients need conventional treatment settings.

For pharmacotherapy, effect sizes of the RCTs indicate improvements of medium magnitude concerning the reduction of BE, which is generally in line with the finding of the recent meta-analysis by Reas and Grilo.[19] In contrast to psychotherapy and self-help, in the present meta-analysis, near-zero effects were observed for pharmacotherapy with respect to changes in the eating- and body-related cognitions. With the exception of one study of an anticonvulsant (topiramate), in each of the RCTs drugs that influence the level of serotonin (mostly selective serotonin reuptake inhibitors) were used.

However, depressive symptoms were reduced only slightly. Similar results were obtained for the within-group comparisons. Taken together, results for pharmacotherapy indicate that these drugs have a moderately positive effect on BE and depressive symptoms. Nevertheless, questions should be raised regarding the specificity of the active pharmaceutical ingredients due to the generally rather high placebo response rates[62,65,66,70,72] and the heterogeneity of the drugs examined in the present meta-analysis and in the meta-analysis by Reas and Grilo,[19] in which selective serotonin reuptake inhibitors, serotonin noradrenaline reuptake inhibitors, anticonvulsants, and obesity medication were tested. In addition, possible side effects of the psychotropic drugs have to be taken into account. Such side effects include sexual dysfunction due to use of selective serotonin reuptake inhibitors and serotonin noradrenaline reuptake inhibitors[80,81] as well as depressive symptoms and irritability due to use of anticonvulsants.[82,83]

For weight-loss and combination treatments, the number of RCTs is limited. Therefore, the current meta-analysis had to focus on within-group comparisons of studies without an untreated control condition. Weight-loss treatments achieved a moderate-sized reduction in BE frequency and body weight, but no significant effects were found for depressive symptoms. Although eating behavior seems to be slightly affected by this kind of treatment, psychological changes were not detected.

For combined treatments, considerable effects were found on BE behavior as well as associated symptoms such as eating, weight and shape concerns, and depressive symptoms. Again, body weight was only marginally affected. The finding that most of the effects of these treatments are quantitatively comparable to the effects of psychotherapy might be explained by the fact that 90% of the combined treatments included a component based on cognitive behavioral therapy. Because the mean effects of combined treatments did not differ significantly from the effects of psychotherapy and pharmacotherapy alone, the addition of a further treatment component might not lead to an additive benefit.

It is of considerable clinical significance that most of the participants in the studies were obese, but, with the exception of explicit weight-loss treatments, no intervention was able to decrease body weight. Despite considerable effects on the reduction of BE, it might be speculated that even after being abstinent from BE, the patients' physiological energy balance remained positive.[79]

A comparison of the within-group and between-group effects from the RCTs for each treatment category and outcome parameter reveals that the within-group effect sizes are generally larger than the between-group effect sizes. This discrepancy might be due to the rather high rates of spontaneous remission in BED. For example, a longitudinal study that examined the natural course of BED showed that only 18% of the participants still suffered from a clinical eating disorder after 5 years.[84] Additionally, questions can be raised whether the within-group effect sizes differ between controlled and uncontrolled studies. However, according to the results of the homogeneity statistics, homogeneity was not rejected for almost all treatment categories and dependent variables, the probability is very low that systematic differences do exist between the controlled and non-controlled studies.

For the majority of between-and within-group comparisons, differences among mean effects of the treatment categories were not significant. This finding might be due to a reduced power of this categorial meta-analysis because of the limited number of studies and low sample sizes within the studies and to heterogeneous effects within the treatment categories. Although this heterogeneity was reduced by the introduction of random effects and captured in the variance component of mixed effects, the power to detect statistically significant differences between the mean effects was also diminished.

Several further limitations of this meta-analysis have to be addressed. Because catamnestic data were presented in fewer than half of the identified studies and follow-up periods varied from 3 weeks to 6 years,[49,79] long-term treatment effects were not estimated. Thus, there is a great need for future follow-up studies with extended observation periods. Furthermore, a determination of the number of patients who still fulfilled the DSM-IV research criteria for BED at the end of the various treatments was not possible, because BE abstinence rates were reported only in a very limited number of studies. Additionally, the mean age of the participants in the five treatment categories differed significantly; therefore, age could have been a confounding variable. However, the pairwise post-hoc comparisons concerning age between the various samples did not reach significance. Finally, but most important, the funnel-plots and the fail-safe-N indicated a high probability of inflated mean effects due to publication bias. In the future, publication practices that do not favor studies with a positive or significant outcome are warranted to reduce the probability of this bias.

In sum, psychotherapy—and, more specifically, cognitive behavioral therapy—should be recommended as the first-line treatment of BED. This conclusion is based on the large effect sizes observed in a relatively large number of RCTs. Though structured self-help based on cognitive behavioral therapy also revealed large effect sizes and therefore can be regarded as promising, the number of RCTs published to date is small; thus any definitive conclusions would be premature. Despite the positive effects of interventions based on cognitive behavioral therapy, there is still a potential for improvement. First, because various forms of cognitive-behavioral therapy with diverging ingredients were tested in the included studies, future research should analyze the various components of cognitive-behavioral treatment programs separately to identify the most effective treatment strategies. Second, it is important to identify predictors of treatment response and to examine which kinds of treatment best suit which patients. Third, basic research that would provide background evidence to foster the development of more effective psychological, pharmacological, and weight-loss treatments should be encouraged.

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