Check for updates

REVIEW

Recent advances in therapies for eating disorders [version 1; peer review: 2 approved]

Lauren E. Davis [ID] [1], Evelyn Attia[1,2]

[1]New York State Psychiatric Institute, Columbia University Irving Medical Center, New York, USA
[2]Weill Cornell Medical Center, New York, USA

Abstract

Eating disorders are serious psychiatric illnesses with high rates of morbidity and mortality. Effective treatments have traditionally included behaviorally focused therapies as well as several medication strategies. Recent years have seen promising developments in these treatments, including additional support for family-based approaches for children and adolescents, new evidence for "third-wave" behavioral therapies, and new support for the use of lisdexamfetamine for binge eating disorder and olanzapine for anorexia nervosa. Case study and pilot data are beginning to show limited support for neuromodulatory interventions targeting brain regions thought to be involved in eating disorders. This review summarizes treatment developments over the last several years and points towards future directions for the field.

Keywords
Eating disorders

Open Peer Review

Reviewer Status ✓ ✓

	Invited Reviewers	
	1	**2**
version 1 published 26 Sep 2019	✓	✓

F1000 Faculty Reviews are written by members of the prestigious F1000 Faculty. They are commissioned and are peer reviewed before publication to ensure that the final, published version is comprehensive and accessible. The reviewers who approved the final version are listed with their names and affiliations.

1 **Anja Hilbert**, University of Leipzig Medical Center, Leipzig, Germany

2 **James Lock**, Stanford University, Stanford, USA

Any comments on the article can be found at the end of the article.

Corresponding author: Evelyn Attia (ea12@cumc.columbia.edu)

Author roles: Davis LE: Conceptualization, Writing – Original Draft Preparation, Writing – Review & Editing; **Attia E**: Conceptualization, Writing – Original Draft Preparation, Writing – Review & Editing

Introduction

Eating disorders, including anorexia nervosa (AN), bulimia nervosa (BN), binge eating disorder (BED), and avoidant-restrictive food intake disorder (ARFID), are serious psychiatric illnesses associated with high rates of morbidity and mortality. Recent epidemiological data from a United States population estimated lifetime prevalence rates of 0.80% (AN), 0.28% (BN), and 0.85% (BED), though estimates vary across studies[1,2]. Treatments are frequently multi-faceted, with psychotherapy and pharmacotherapy being commonly utilized across a range of treatment settings. Recent treatment advances in psychotherapies were previously highlighted in a review[3], focusing on the advancement of cognitive-behavioral treatments for BN and BED as well as family-based therapy (FBT) for children and adolescents with AN. Since then, behavioral therapies have continued to flourish and expand, integrating the transdiagnostic model of cognitive-behavioral therapy (CBT) into clinical practice. While BN has the most empirical support for pharmacologic interventions, recent studies have shown support for medications involved in the treatment of BED and AN, including one FDA-approved drug to treat BED.

Across the spectrum of eating disorders, there is still much to be learned about their etiology, their development, and ways in which they can be effectively managed and treated. Recent developments in neuroscience and neuroimaging have begun to identify possible treatment targets for eating and other psychiatric disorders. The neurocircuitry that may be responsible for disturbances in eating behavior has provided the field with new ideas about contributing factors to the development and maintenance of eating disorders and possible treatments for these disturbances.

This review aims to summarize findings from recent studies of psychological, medicinal, and other adjunctive treatments that have been used for individuals with eating disorders. Randomized controlled trials (RCTs) as well as more preliminary reports including open series will be described.

Psychotherapies

The transdiagnostic approach to understanding core cognitive and behavioral features co-occurring across eating disorder diagnoses continues to shape the various psychotherapies in practice today. In recent years, Fairburn and colleagues built upon their initial work developing and studying CBT for BN and BED, creating a transdiagnostic version of CBT (CBT-E)[4]. This manualized treatment uses many of the familiar principles of CBT (e.g. food monitoring, cognitive challenges, etc.) but includes treatment components that specifically target different eating behaviors in order to have relevance across the range of different eating disorders.

A 2015 study[5] randomized 130 transdiagnostic patients (including patients with BN, BED, and "other eating disorder") to either CBT-E or interpersonal psychotherapy (IPT). Levels of general and eating disorder-specific psychopathology were assessed post-treatment, along with BMI and presence of binge eating/purging behaviors. Overall, levels of psychopathology decreased across both groups but with a significantly greater change among those randomized to CBT-E. A greater proportion of patients who received CBT-E achieved remission while in treatment (as defined by a global eating disorder examination score below 1.74) and a greater percentage of patients in CBT-E versus IPT (44.8% versus 21.7%) reported no binge eating, vomiting, or laxative misuse post-treatment. These findings strengthen the evidence base for using cognitive-behavioral treatments for BN and BED and begin to support its use in higher-weight patients with binge eating and purging behaviors.

Two recent meta-analyses[6,7] have further supported the use of CBT for the treatment of both BN and BED. Hilbert and colleagues found that for BED, RCTs comparing CBT to inactive control groups found a significantly reduced number of binge eating episodes as well as abstinence from binge eating overall in individuals undergoing CBT. When examining RCTs that used active control groups, there was no clear treatment that appeared to be superior at reducing episodes of binge eating. For BN, Svaldi *et al.* found through a search of 79 RCTs including 5,775 participants that CBT had the most effect on primary outcome variables (including remission from binge eating and compensatory behaviors, and reductions in symptom severity). These meta-analyses support the use of CBT to treat BN and BED while indicating a need for further research into CBT for BED to interpret its utility above and beyond general psychotherapy.

The transdiagnostic approach to conceptualizing treatment for eating disorders has continued to expand with increased recognition for previously under-identified diagnoses. ARFID is one such example. A newly defined diagnosis in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5)[8], ARFID expanded upon DSM-IV's "Feeding and Eating Disorder of Early Childhood" to better describe the condition of avoidant or restrictive eating not associated with body weight and shape concerns that may present across the lifespan. The new diagnostic category has led clinicians to begin data collection regarding assessment and treatment of individuals who meet criteria for ARFID. Thomas and Eddy[9] adapted the CBT model to ARFID and developed a treatment specifically tailored for the disorder, recently published in a formalized treatment manual. This model is currently being studied in treatment settings and shows initial case study support[10]. By employing the transdiagnostic CBT model in designing treatments, researchers have been able to address a wider variety of eating disorder needs, including those of more recently defined disorders, such as ARFID.

For adolescents with AN, FBT remains a first-choice therapy owing to its demonstrated efficacy in the treatment of young patients[11]. Earlier evidence reported that early response to treatment, specifically initial weight gain, likely predicts end-of-treatment (EOT) remission and treatment outcomes[12,13]. The growing empirical literature continues to suggest that early intervention and weight gain can vastly improve outcomes for adolescents with AN. As a result of FBT's demonstrated

effectiveness, research is now building upon it and extending its reach to various other clinical settings and populations, with positive support.

Recently, Le Grange and colleagues demonstrated that among 121 adolescents with AN, early weight gain predicted improved outcome at EOT in an RCT comparing FBT and individual adolescent-focused therapy (AFT)[14]. The authors found that weight gain of 5.8 pounds by session three of FBT and 7.1 pounds by session four of AFT predicted remission status at EOT. Early weight gain did not predict remission at 6- and 12-month post-treatment follow-up for either treatment, but a survival analysis of weight gain showed FBT to be superior to AFT at 12 months post-treatment. Initial weight gain continues to be a predictive marker of treatment trajectory for adolescents with AN, with FBT maintaining strong empirical support for use in outpatient settings.

Although FBT was originally developed to be delivered in an outpatient setting, recent evidence has supported using the model within treatment programs offered at higher levels of care[15–20]. Matthews et al. reported that 49 hospitalized participants receiving an FBT-guided intervention gained significantly more weight at 3- and 6-months post-discharge (P <0.05 and P <0.01, respectively) than a group of 44 patients examined retrospectively who received treatment as usual (TAU)[21]. Patients who received FBT while hospitalized were also less likely to be re-hospitalized in the 6 months following discharge. Though this was only a pilot study and slightly limited by the retrospective TAU design, evidence for FBT is indicative of clinical utility at all levels of treatment, not just in the outpatient setting.

While the evidence base for FBT in adolescents with AN grows, many patients are still unable to access this intervention for reasons that may include regional differences in numbers of FBT-trained clinicians. In an effort to address this accessibility gap, Le Grange et al.[22] conducted a small study examining the feasibility of delivering FBT via a Telehealth platform. The authors reported that among 10 adolescents with AN or atypical AN, weight increased significantly from baseline to EOT as well as from baseline to 6-month follow-up. Measures of eating disorder severity also showed statistically significant changes during the study period.

As online-based platforms for delivering or augmenting treatment grow in popularity, research continues to test how treatment can be delivered most effectively for patients. One recent study examined an internet-based manualized version of CBT group therapy for BN delivered in a group chat setting and compared it to CBT delivered face-to-face in group therapy[23]. The authors hypothesized that the online therapeutic group chat would not be inferior to the face-to-face group and tested this hypothesis in 149 adults with BN. Results showed that at EOT, the online group chat was inferior to face-to-face therapy at reducing the frequency of binge eating and purging but by 12-month follow-up the online group chat was mostly not inferior to the face-to-face group (it remained inferior for binge-eating frequency). Data suggest that CBT delivered in an online group chat setting may be an acceptable alternative to in-person group CBT, but it may involve a slower trajectory of change than traditional CBT. This online format for treatment may have value for those who otherwise would not have access to care, as well as those with less comorbid psychopathology, owing to longer time to improvement as well as less direct therapist interaction.

For adolescents with BN, FBT has also been shown to be an effective therapy[24]. In a recently conducted RCT of 130 patients with BN or partial BN, participants randomized to FBT achieved significantly higher binge eating and purging abstinence rates (39% versus 20%) than participants receiving CBT adapted for adolescents (CBT-A). This statistically significant difference remained at 6-month follow-up, although abstinence rates were not significantly different by 12-month follow-up.

Preliminary evidence has also been put forth applying FBT to presentations of ARFID. Lock et al.[25] published a case report indicating that the favorable principles of FBT (e.g. parental empowerment, externalization, and reinforcement of serious medical and developmental consequences) are applicable to patients with ARFID as well. A feasibility study was also conducted by Lock et al.[26] of 28 patients with ARFID who were enrolled in either FBT or TAU to examine the appropriateness of conducting an RCT as well as differences in effect size between groups on clinical outcomes. In terms of weight gain, researchers found that both underweight and normal-weight patients gained more weight in FBT-ARFID (Cohen's d = –0.90 and –0.69, respectively) than in TAU. ARFID severity scores, according to the Pica, ARFID, and Rumination Disorder Interview (PARDI), showed a greater reduction in severity (d = 0.83). Results also showed strong differences for change in parental self-efficacy favoring FBT-ARFID (d = –1.49). These results, taken with other supporting evidence for FBT in a variety of settings and across diagnoses, reinforce the need for continued study as well as more large-scale RCTs to promote the use of FBT in clinical settings.

Third-wave behavioral therapies such as dialectical behavior therapy (DBT) and acceptance and commitment therapy (ACT) have also been adapted to treat eating disorders and in recent years have been accumulating data to support their use in treatment. Although originally developed for the treatment of borderline personality disorder (BPD)[27], DBT for eating disorders relies on both theory and evidence of emotion dysregulation in eating disorder patients to suggest its utility[28]. Recent data support the use of DBT in the treatment of BN and BED, but, as yet, there have been no RCTs of DBT for AN[29].

ACT has not yet gathered enough empirical support to be regarded as an evidence-based treatment for eating disorders[30]. The ACT formulation appears to be well suited to addressing some of the underlying maladaptive cognitions and behaviors that are associated with eating disorders[31]. Yet, despite earlier case studies with preliminary support for the treatment[32], more

recent evidence has not shown ACT to perform above and beyond TAU[33]. In 2017, Juarascio et al.[34] published results of a pilot study examining the effects of an ACT adaptation for BED. The ACT formulation, which also incorporated elements of both CBT and DBT, showed favorable results, although reported rates of binge-eating abstinence were similar to those observed with CBT alone. Before existing as a stand-alone treatment, ACT needs further development and evidence for use in eating disorder populations.

Another meta-analysis took interest in examining the effects of psychotherapy on self-esteem in BN and BED[35]. Individuals with eating disorders are often conceptualized as having deficits in self-esteem, which has been regarded as a potential maintaining mechanism of the disorders themselves[36]. The authors wanted to understand how self-esteem might be improved following treatment and which, if any, current psychotherapies produce significant improvements in self-esteem. Initially, the authors found modest improvements in self-esteem for BN and BED across 34 RCTs ($g = 0.44$ and 0.20, respectively), although the authors reported that there was some evidence that the effect sizes were overestimated because of publication bias. In contrast to some previous results indicating the utility of CBT, this meta-analysis found no evidence to support CBT over non-CBT interventions for improving self-esteem. The study was limited by its lack of statistical power, so further studies examining the effect of psychotherapy on self-esteem are still indicated.

The empirical findings supporting the use of psychotherapies in the treatment of eating disorders have been reflected in the National Institute for Health and Care Excellence (NICE) guidelines, published in 2017[37]. They recommend group or individual CBT for AN, BN, and BED as well as family therapy (when indicated) for adolescents with AN and BN. As the evidence base accumulates for efficacious interventions, clinical recommendations will refine to reflect empirically indicated practices.

Medications
Since the identification of distinct categories of eating disorders, pharmacologic interventions have been considered, and RCTs have been conducted to examine the potential benefit of various classes of medication on the core symptoms of eating disorders. The evidence base for antidepressant medications in the treatment of BN and BED has been robust, with outcomes including significant decrease of binge eating and purging behaviors. While fluoxetine is the only medication to have undergone the US FDA approval process that concluded with a specific indication for treatment of BN, many other antidepressants, from both the SSRI and TCA medication classes, have demonstrated statistically and clinically significant superiority compared to placebo at decreasing the frequency of binge eating and purging behaviors[38–45]. Notably, in a study of 387 women with BN, 60 mg fluoxetine demonstrated improved outcome compared with placebo while 20 mg did not[46], suggesting that a higher dose than that commonly utilized for depression is needed in the treatment of BN symptoms.

While antidepressant medications, including fluoxetine, are moderately helpful to individuals with BED in decreasing the frequency of binge eating, they are not associated with weight change effects, leaving many overweight and obese patients with BED interested in adjunctive strategies for their symptoms. BED has been described and studied since its inclusion in DSM-IV as a diagnosis in need of further research but was only recently identified as a formal clinical diagnosis with the publication of DSM-5, in 2013[8,47], and, with this renewed introduction, became the subject of additional investigations to identify helpful strategies for its management. Among these lines of investigation, lisdexamfetamine, a stimulant medication with US FDA indications for the treatment of attention deficit hyperactivity disorder (ADHD), was examined for possible utility in BED. In a randomized double-blind, parallel-group, forced dose titration, placebo-controlled clinical trial at 30 sites, 514 individuals with BED received lisdexamfetamine dimesylate at dosages of 30, 50, and 70 mg or placebo over an 11-week study period[48]. At week 11, statistically significant differences in binge eating days/week decreased with the 50 mg/day and 70 mg/day groups but not the 30 mg/day compared with placebo. Adverse effects were consistent with the known safety profile of the medication. Additionally, the mean (SD) change in body weight was –0.1 (3.09) for the placebo group, –3.1 (3.64) kg for the 30 mg/day treatment group, –4.9 (4.43) kg for the 50 mg/day treatment group, –4.9 (3.93) kg for the 70 mg/day treatment group, and –4.3 (4.09) kg for the combined treatment group (0.001 for each dose versus placebo group comparison in post hoc analysis). Additional studies have confirmed the efficacy of 50 and 70 mg doses in binge eating days and associated symptoms, leading to approval by the FDA for the treatment of BED.

In contrast to BN and BED, AN has posed more of a clinical challenge in medication trials. In efforts to treat symptoms frequently associated with AN, including low mood, anxiety, and obsessionality, and the eating behavioral symptoms that overlap with those seen in BN, antidepressant and other medications have been examined in multiple RCTs without success.

With the development and use of atypical antipsychotic medications that help with psychiatric symptoms including severe anxiety, and are associated with weight gain in other clinical populations including those with psychotic disorders, there has been interest in the eating disorders field about whether these agents may be helpful for individuals with AN. After several small pilot studies suggesting possible benefit of olanzapine in AN[49–53], Attia et al. examined the effects of 16 weeks of olanzapine versus placebo among 152 outpatients with AN across five clinical sites in North America[54]. The authors found that at 16 weeks following randomization, olanzapine was associated with a statistically significant increase in BMI over time compared with that seen in the olanzapine group (0.256 [SD = 0.051] compared with 0.095 [SD = 0.052] per month). The group did not find psychological symptom differences between groups using Yale-Brown Obsessive Compulsive Scale (YBOCS), Center for

Epidemiologic Studies Depression Scale (CES-D), Zung Anxiety Inventory, or Eating Disorders Examination (EDE) but did find statistically significant symptom changes associated with olanzapine on a somatic symptom inventory, with trouble concentrating, difficulty sitting still, trouble falling asleep, and trouble staying asleep being rated as more problematic in the placebo group than the group receiving olanzapine.

Neuromodulation and neuroimaging

Advances in the understanding of the neurocircuitry involved in eating disorders has led to an increased interest in using neuromodulation as a possible treatment, especially for those with severe illness, including those who may be resistant to other established treatments[55]. Recent research has begun to identify neural circuits that are thought to be altered among individuals with eating disorders[56,57]. Specifically, neurocognitive and neuroimaging data have implicated circuits involved in reward learning[58–61], decision making[62,63], stress, affect and negative valence[64,65], appetite regulation[66,67], and self-regulatory control[58,67]. Understanding these circuits and their locations in the brain has been critical for identifying treatment targets that may be used for treatment development with neuromodulation technologies.

Current methods for neuromodulation range from relatively non-invasive modalities like repetitive transcranial magnetic stimulation (rTMS) to more intensive/invasive types such as deep brain stimulation (DBS).

rTMS has been examined as both a probe to test neurobiological hypotheses and a possible therapeutic intervention. One 2016 case series of five adult women with AN measured changes in visual analogue scales (VAS), EDE-Q scores, and BMI before and after 20 sessions of rTMS to the left dorsolateral prefrontal cortex (l-DLPFC)[68]. Results showed overall lower VAS scores across levels of stress, anxiety, urges to restrict, and feelings of fullness post-TMS. There was no notable change in BMI from pre- to post-treatment for the patients, but eating disorder symptomatology (as measured by the EDE-Q) improved and persisted up to the 12-month follow-up. This case study was followed by a larger RCT of 49 patients with AN who were randomized to receive either real or sham rTMS to the l-DLPFC[69]. Patients filled out baseline measures of eating disorder and general psychopathology and then were asked to complete a food challenge task (FCT), which involved watching a video of people eating palatable foods with those same foods in the room, before filling out VAS and receiving the real or sham rTMS treatment. After the

rTMS, patients repeated the FCT and VAS, along with measures of temporal discounting and saliva samples. Primary outcomes were measured by the VAS and described as "core AN symptoms": urges to restrict, levels of feeling full, and levels of feeling fat. Results indicated a trend for group differences in the effects of rTMS on core AN symptoms ($P = 0.056$). While notably the effects of TMS are transient in comparison to other therapeutic interventions, initial evidence provides modest support that TMS may allow for symptom reduction in patients with AN.

The more intensive intervention, DBS, has been used in an open series of 16 patients with treatment-refractory AN and promising results have been reported[70]. DBS treatment targeting the subcallosal cingulate cortex was associated with improved anxiety, depression, emotion regulation, and BMI at 12 months post-surgery. Other case reports of DBS for AN have described similarly promising results, but controlled studies of this intervention are needed to determine the impact of this strategy[71–73].

Many of these data come from preliminary studies in the field, with mixed results suggesting that the clinical utility of these interventions has yet to be fully understood. With the advancement of neuroimaging data enhancing our knowledge of the neurobiological underpinnings of psychiatric illnesses, neuromodulatory targets will continue to be explored.

Conclusion

There have been considerable advances in therapies for eating disorders within the past few years alone. Relying on the recent transdiagnostic CBT-E model of eating disorders[4], CBTs continue to show support for patients with BN and BED[5]. Empirical data indicate that the model can be formulated to fit diagnoses, with promising results[10]. FBT for adolescents has been studied across a variety of contexts[15–22] and multiple diagnoses[14,24,26] with favorable results, underscoring its clinical utility in young patients. Medication trials have led to the FDA approval of lisdexamfetamine for the treatment of BED[48], and there is promise for olanzapine as an adjunctive treatment for weight gain in AN[49–54]. Neuroimaging studies have laid the groundwork for understanding underlying brain mechanisms that may contribute to the development and perpetuation of eating disorders, with neuromodulatory therapies currently being piloted as possible targeted interventions[68–70]. Further research and development are still needed to refine the clinical utility of many treatments, but favorable outcomes point in the direction of progress toward empirically defined, effective eating disorder treatments.

References

F1000 recommended

1. F Udo T, Grilo CM: **Prevalence and Correlates of DSM-5-Defined Eating Disorders in a Nationally Representative Sample of U.S. Adults.** *Biol Psychiatry.* 2018; **84**(5): 345–354.
   PubMed Abstract | **Publisher Full Text** | **Free Full Text** | **F1000 Recommendation**

2. Smink FR, van Hoeken D, Hoek HW: **Epidemiology of eating disorders: incidence,** prevalence and mortality rates. *Curr Psychiatry Rep.* 2012; **14**(4): 406–14.
   PubMed Abstract | **Publisher Full Text** | **Free Full Text**

3. Waller G: **Recent advances in psychological therapies for eating disorders** [version 1; peer review: 2 approved]. *F1000Res.* 2016; **5**: pii: F1000 Faculty Rev-702.
   PubMed Abstract | **Publisher Full Text** | **Free Full Text**

4.   Cooper Z, Fairburn CG: **The Evolution of "Enhanced" Cognitive Behavior Therapy for Eating Disorders: Learning From Treatment Nonresponse.** *Cogn Behav Pract.* 2011; **18**(3): 394–402.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

5.   [F] Fairburn CG, Bailey-Straebler S, Basden S, *et al.*: **A transdiagnostic comparison of enhanced cognitive behaviour therapy (CBT-E) and interpersonal psychotherapy in the treatment of eating disorders.** *Behav Res Ther.* 2015; **70**: 64–71.
PubMed Abstract | **Publisher Full Text** | **Free Full Text** | **F1000 Recommendation**

6.   [F] Hilbert A, Petroff D, Herpertz S, *et al.*: **Meta-analysis of the efficacy of psychological and medical treatments for binge-eating disorder.** *J Consult Clin Psychol.* 2019; **87**(1): 91–105.
PubMed Abstract | **Publisher Full Text** | **F1000 Recommendation**

7.   [F] Svaldi J, Schmitz F, Baur J, *et al.*: **Efficacy of psychotherapies and pharmacotherapies for Bulimia nervosa.** *Psychol Med.* 2019; **49**(6): 898–910.
PubMed Abstract | **Publisher Full Text** | **F1000 Recommendation**

8.   American Psychiatric Association: **Diagnostic and statistical manual of mental disorders.** (5th ed.). Arlington, VA, 2013.
Publisher Full Text

9.   Thomas JJ, Eddy KT: **Cognitive-behavioral therapy for avoidant/restrictive food intake disorder.** Cambridge, UK Cambridge University Press; 2018.
Publisher Full Text

10.   [F] Thomas JJ, Wons OB, Eddy KT: **Cognitive-behavioral treatment of avoidant/restrictive food intake disorder.** *Curr Opin Psychiatry.* 2018; **31**(6): 425–30.
PubMed Abstract | **Publisher Full Text** | **Free Full Text** | **F1000 Recommendation**

11.   [F] Le Grange D, Lock J, Accurso EC, *et al.*: **Relapse from remission at two- to four-year follow-up in two treatments for adolescent anorexia nervosa.** *J Am Acad Child Adolesc Psychiatry.* 2014; **53**(11): 1162–7.
PubMed Abstract | **Publisher Full Text** | **Free Full Text** | **F1000 Recommendation**

12.   Doyle PM, Le Grange D, Loeb K, *et al.*: **Early response to family-based treatment for adolescent anorexia nervosa.** *Int J Eat Disord.* 2010; **43**(7): 659–62.
PubMed Abstract | **Publisher Full Text**

13.   Lock J, Couturier J, Agras WS: **Comparison of long-term outcomes in adolescents with anorexia nervosa treated with family therapy.** *J Am Acad Child Adolesc Psychiatry.* 2006; **45**(6): 666–72.
PubMed Abstract | **Publisher Full Text**

14.   Le Grange D, Accurso EC, Lock J, *et al.*: **Early weight gain predicts outcome in two treatments for adolescent anorexia nervosa.** *Int J Eat Disord.* 2014; **47**(2): 124–9.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

15.   [F] Fink K, Rhodes P, Miskovic-Wheatley J, *et al.*: **Exploring the effects of a family admissions program for adolescents with anorexia nervosa.** *J Eat Disord.* 2017; **5**: 51.
PubMed Abstract | **Publisher Full Text** | **Free Full Text** | **F1000 Recommendation**

16.   Girz L, Lafrance Robinson A, Foroughe M, *et al.*: **Adapting family-based therapy to a day hospital programme for adolescents with eating disorders: Preliminary outcomes and trajectories of change.** *J Fam Ther.* 2013; **35**(S1): 102–120.
Publisher Full Text

17.   Henderson K, Buchholz A, Obeid N, *et al.*: **A family-based eating disorder day treatment program for youth: examining the clinical and statistical significance of short-term treatment outcomes.** *Eat Disord.* 2014; **22**(1): 1–18.
PubMed Abstract | **Publisher Full Text**

18.   Hoste RR: **Incorporating family-based therapy principles into a partial hospitalization programme for adolescents with anorexia nervosa: Challenges and considerations.** *J Fam Ther.* 2015; **37**(1): 41–60.
Publisher Full Text

19.   [F] Peebles R, Lesser A, Park CC, *et al.*: **Outcomes of an inpatient medical nutritional rehabilitation protocol in children and adolescents with eating disorders.** *J Eat Disord.* 2017; **5**: 7.
PubMed Abstract | **Publisher Full Text** | **Free Full Text** | **F1000 Recommendation**

20.   Rockwell RE, Boutelle K, Trunko ME, *et al.*: **An innovative short-term, intensive, family-based treatment for adolescent anorexia nervosa: case series.** *Eur Eat Disorders Rev.* 2011; **19**(4): 362–7.
PubMed Abstract | **Publisher Full Text**

21.   [F] Matthews A, Peterson CM, Peugh J, *et al.*: **An intensive family-based treatment guided intervention for medically hospitalized youth with anorexia nervosa: Parental self-efficacy and weight-related outcomes.** *Eur Eat Disord Rev.* 2019; **27**(1): 67–75.
PubMed Abstract | **Publisher Full Text** | **F1000 Recommendation**

22.   [F] Anderson KE, Byrne CE, Crosby RD, *et al.*: **Utilizing Telehealth to deliver family-based treatment for adolescent anorexia nervosa.** *Int J Eat Disord.* 2017; **50**(10): 1235–8.
PubMed Abstract | **Publisher Full Text** | **F1000 Recommendation**

23.   Zerwas SC, Watson HJ, Hofmeier SM, *et al.*: **CBT4BN: A Randomized Controlled Trial of Online Chat and Face-to-Face Group Therapy for Bulimia Nervosa.** *Psychother Psychosom.* 2017; **86**(1): 47–53.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

24.   [F] Le Grange D, Lock J, Agras WS, *et al.*: **Randomized Clinical Trial of**

Family-Based Treatment and Cognitive-Behavioral Therapy for Adolescent Bulimia Nervosa. *J Am Acad Child Adolesc Psychiatry.* 2015; **54**(11): 886–94.e2.
PubMed Abstract | **Publisher Full Text** | **Free Full Text** | **F1000 Recommendation**

25.   [F] Lock J, Robinson A, Sadeh-Sharvit S, *et al.*: **Applying family-based treatment (FBT) to three clinical presentations of avoidant/restrictive food intake disorder: Similarities and differences from FBT for anorexia nervosa.** *Int J Eat Disord.* 2019; **52**(4): 439–446.
PubMed Abstract | **Publisher Full Text** | **F1000 Recommendation**

26.   [F] Lock J, Sadeh-Sharvit S, L'Insalata A: **Feasibility of conducting a randomized clinical trial using family-based treatment for avoidant/restrictive food intake disorder.** *Int J Eat Disord.* 2019; **52**(6): 746–751.
PubMed Abstract | **Publisher Full Text** | **F1000 Recommendation**

27.   Linehan MM: **Cognitive behavioral therapy of borderline personality disorder.** New York: Guilford Press, 1993.
Reference Source

28.   Wisniewski L, Kelly E: **The application of dialectical behavior therapy to the treatment of eating disorders.** *Cogn Behav Pract.* 2003; **10**(2): 131–138.
Publisher Full Text

29.   [F] Linardon J, Fairburn CG, Fitzsimmons-Craft EE, *et al.*: **The empirical status of the third-wave behaviour therapies for the treatment of eating disorders: A systematic review.** *Clin Psychol Rev.* 2017; **58**: 125–140.
PubMed Abstract | **Publisher Full Text** | **F1000 Recommendation**

30.   Pisetsky EM, Schaefer LM, Wonderlich SA, *et al.*: **Emerging Psychological Treatments in Eating Disorders.** *Psychiatr Clin North Am.* 2019; **42**(2): 219–229.
PubMed Abstract | **Publisher Full Text**

31.   Berman MI, Boutelle KN, Crow SJ: **A case series investigating acceptance and commitment therapy as a treatment for previously treated, unremitted patients with anorexia nervosa.** *Eur Eat Disorders Rev.* 2009; **17**(6): 426–34.
PubMed Abstract | **Publisher Full Text**

32.   Parling T, Cernvall M, Ramklint M, *et al.*: **A randomised trial of Acceptance and Commitment Therapy for Anorexia Nervosa after daycare treatment, including five-year follow-up.** *BMC Psychiatry.* 2016; **16**: 272.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

33.   Juarascio A, Shaw J, Forman E, *et al.*: **Acceptance and commitment therapy as a novel treatment for eating disorders: an initial test of efficacy and mediation.** *Behav Modif.* 2013; **37**(4): 459–89.
PubMed Abstract | **Publisher Full Text**

34.   [F] Juarascio AS, Manasse SM, Schumacher L, *et al.*: **Developing an Acceptance-Based Behavioral Treatment for Binge Eating Disorder: Rationale and Challenges.** *Cogn Behav Pract.* 2017; **24**(1): 1–13.
PubMed Abstract | **Publisher Full Text** | **Free Full Text** | **F1000 Recommendation**

35.   [F] Linardon J, Kothe EJ, Fuller-Tyszkiewicz M: **Efficacy of psychotherapy for bulimia nervosa and binge-eating disorder on self-esteem improvement: Meta-analysis.** *Eur Eat Disord Rev.* 2019; **27**(2): 109–23.
PubMed Abstract | **Publisher Full Text** | **F1000 Recommendation**

36.   Fairburn CG, Cooper Z, Shafran R: **Cognitive behaviour therapy for eating disorders: a "transdiagnostic" theory and treatment.** *Behav Res Ther.* 2003; **41**(5): 509–28.
PubMed Abstract | **Publisher Full Text**

37.   National Institute for Health and Care Excellence: **Eating disorders: recognition and treatment.** NICE guideline, 2017.
Reference Source

38.   Milano W, Petrella C, Sabatino C, *et al.*: **Treatment of bulimia nervosa with sertraline: a randomized controlled trial.** *Adv Ther.* 2004; **21**(4): 232–7.
PubMed Abstract | **Publisher Full Text**

39.   Sloan DM, Mizes JS, Helbok C, *et al.*: **Efficacy of sertraline for bulimia nervosa.** *Int J Eat Disord.* 2004; **36**(1): 48–54.
PubMed Abstract | **Publisher Full Text**

40.   Fichter MM, Krüger R, Rief W, *et al.*: **Fluvoxamine in prevention of relapse in bulimia nervosa: effects on eating-specific psychopathology.** *J Clin Psychopharmacol.* 1996; **16**(1): 9–18.
PubMed Abstract | **Publisher Full Text**

41.   Milano W, Siano C, Putrella C, *et al.*: **Treatment of bulimia nervosa with fluvoxamine: a randomized controlled trial.** *Adv Ther.* 2005; **22**(3): 278–83.
PubMed Abstract | **Publisher Full Text**

42.   Leombruni P, Amianto F, Delsedime N, *et al.*: **Citalopram versus fluoxetine for the treatment of patients with bulimia nervosa: A single-blind randomized controlled trial.** *Adv Ther.* 2006; **23**(3): 481–94.
PubMed Abstract | **Publisher Full Text**

43.   Pope HG, Hudson JI, Jonas JM, *et al.*: **Bulimia treated with imipramine: a placebo-controlled, double-blind study.** *Am J Psychiatry.* 1983; **140**(5): 554–8.
PubMed Abstract | **Publisher Full Text**

44.   Hughes PL, Wells LA, Cunningham CJ, *et al.*: **Treating bulimia with desipramine. A double-blind, placebo-controlled study.** *Arch Gen Psychiatry.* 1986; **43**(2): 182–6.
PubMed Abstract | **Publisher Full Text**

45.   Mitchell JE, Groat R: **A placebo-controlled, double-blind trial of amitriptyline in bulimia.** *J Clin Psychopharmacol.* 1984; **4**(4): 186–93.
PubMed Abstract

46.   **Fluoxetine in the treatment of bulimia nervosa. A multicenter, placebo-controlled,**

double-blind trial. Fluoxetine Bulimia Nervosa Collaborative Study Group. *Arch Gen Psychiatry.* 1992; **49**(2): 139–47.
PubMed Abstract | **Publisher Full Text**

47. American Psychiatric Association: **Diagnostic and statistical manual of mental disorders (4th ed., Text Revision).** Washington, DC, 2000.
Reference Source

48. McElroy SL, Hudson JI, Mitchell JE, *et al.*: **Efficacy and safety of lisdexamfetamine for treatment of adults with moderate to severe binge-eating disorder: a randomized clinical trial.** *JAMA Psychiatry.* 2015; **72**(3): 235–46.
PubMed Abstract | **Publisher Full Text**

49. Dold M, Aigner M, Klabunde M, *et al.*: **Second-Generation Antipsychotic Drugs in Anorexia Nervosa: A Meta-Analysis of Randomized Controlled Trials.** *Psychother Psychosom.* 2015; **84**(2): 110–116.
PubMed Abstract | **Publisher Full Text**

50. F Brambilla F, Garcia CS, Fassino S, *et al.*: **Olanzapine therapy in anorexia nervosa: psychobiological effects.** *Int Clin Psychopharmacol.* 2007; **22**(4): 197–204.
PubMed Abstract | **Publisher Full Text** | **F1000 Recommendation**

51. F Bissada H, Tasca GA, Barber AM, *et al.*: **Olanzapine in the treatment of low body weight and obsessive thinking in women with anorexia nervosa: a randomized, double-blind, placebo-controlled trial.** *Am J Psychiatry.* 2008; **165**(10): 1281–8.
PubMed Abstract | **Publisher Full Text** | **F1000 Recommendation**

52. Attia E, Kaplan AS, Walsh BT, *et al.*: **Olanzapine *versus* placebo for out-patients with anorexia nervosa.** *Psychol Med.* 2011; **41**(10): 2177–82.
PubMed Abstract | **Publisher Full Text**

53. Kafantaris V, Leigh E, Hertz S, *et al.*: **A placebo-controlled pilot study of adjunctive olanzapine for adolescents with anorexia nervosa.** *J Child Adolesc Psychopharmacol.* 2011; **21**(3): 207–12.
PubMed Abstract | **Publisher Full Text**

54. F Attia E, Steinglass JE, Walsh BT, *et al.*: **Olanzapine Versus Placebo in Adult Outpatients With Anorexia Nervosa: A Randomized Clinical Trial.** *Am J Psychiatry.* 2019; **176**(6): 449–56.
PubMed Abstract | **Publisher Full Text** | **F1000 Recommendation**

55. Dalton B, Campbell IC, Schmidt U: **Neuromodulation and neurofeedback treatments in eating disorders and obesity.** *Curr Opin Psychiatry.* 2017; **30**(6): 458–73.
PubMed Abstract | **Publisher Full Text**

56. Val-Laillet D, Aarts E, Weber B, *et al.*: **Neuroimaging and neuromodulation approaches to study eating behavior and prevent and treat eating disorders and obesity.** *Neuroimage Clin.* 2015; **8**: 1–31.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

57. Dunlop KA, Woodside B, Downar J: **Targeting Neural Endophenotypes of Eating Disorders with Non-invasive Brain Stimulation.** *Front Neurosci.* 2016; **10**: 30.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

58. Berner LA, Marsh R: **Frontostriatal circuits and the development of bulimia nervosa.** *Front Behav Neurosci.* 2014; **8**: 395.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

59. Frank GK: **Altered brain reward circuits in eating disorders: chicken or egg?** *Curr Psychiatry Rep.* 2013; **15**(10): 396.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

60. O'Hara CB, Campbell IC, Schmidt U: **A reward-centred model of**

anorexia nervosa: a focussed narrative review of the neurological and psychophysiological literature. *Neurosci Biobehav Rev.* 2015; **52**: 131–52.
PubMed Abstract | **Publisher Full Text**

61. Wierenga CE, Ely A, Bischoff-Grethe A, *et al.*: **Are Extremes of Consumption in Eating Disorders Related to an Altered Balance between Reward and Inhibition?** *Front Behav Neurosci.* 2014; **8**: 410.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

62. F Foerde K, Steinglass JE, Shohamy D, *et al.*: **Neural mechanisms supporting maladaptive food choices in anorexia nervosa.** *Nat Neurosci.* 2015; **18**(11): 1571–3.
PubMed Abstract | **Publisher Full Text** | **Free Full Text** | **F1000 Recommendation**

63. Steinglass JE, Berner LA, Attia E: **Cognitive Neuroscience of Eating Disorders.** *Psychiatr Clin North Am.* 2019; **42**(1): 75–91.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

64. Connan F, Campbell IC, Katzman M, *et al.*: **A neurodevelopmental model for anorexia nervosa.** *Physiol Behav.* 2003; **79**(1): 13–24.
PubMed Abstract | **Publisher Full Text**

65. Vannucci A, Nelson EE, Bongiorno DM, *et al.*: **Behavioral and neurodevelopmental precursors to binge-type eating disorders: Support for the role of negative valence systems.** *Psychol Med.* 2015; **45**(14): 2921–36.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

66. Kaye WH, Fudge JL, Paulus M: **New insights into symptoms and neurocircuit function of anorexia nervosa.** *Nat Rev Neurosci.* 2009; **10**(8): 573–84.
PubMed Abstract | **Publisher Full Text**

67. Kaye WH, Wagner A, Fudge JL, *et al.*: **Neurocircuity of eating disorders**. In Adan R, Kaye W, editors. *Behavioral neurobiology of eating disorders.* Berlin, Heidelberg: Springer. 2010; 37–57.
Reference Source

68. McClelland J, Kekic M, Campbell IC, *et al.*: **Repetitive Transcranial Magnetic Stimulation (rTMS) Treatment in Enduring Anorexia Nervosa: A Case Series.** *Eur Eat Disorders Rev.* 2016; **24**(2): 157–63.
PubMed Abstract | **Publisher Full Text**

69. McClelland J, Kekic M, Bozhilova N, *et al.*: **A Randomised Controlled Trial of Neuronavigated Repetitive Transcranial Magnetic Stimulation (rTMS) in Anorexia Nervosa.** *PLoS One.* 2016; **11**(3): e0148606.
PubMed Abstract | **Publisher Full Text** | **Free Full Text**

70. F Lipsman N, Lam E, Volpini M, *et al.*: **Deep brain stimulation of the subcallosal cingulate for treatment-refractory anorexia nervosa: 1 year follow-up of an open-label trial.** *Lancet Psychiatry.* 2017; **4**(4): 285–94.
PubMed Abstract | **Publisher Full Text** | **F1000 Recommendation**

71. F Blomstedt P, Naesström M, Bodlund O: **Deep brain stimulation in the bed nucleus of the stria terminalis and medial forebrain bundle in a patient with major depressive disorder and anorexia nervosa.** *Clin Case Rep.* 2017; **5**(5): 679–84.
PubMed Abstract | **Publisher Full Text** | **Free Full Text** | **F1000 Recommendation**

72. Lipsman N, Woodside DB, Giacobbe P, *et al.*: **Neurosurgical treatment of anorexia nervosa: review of the literature from leucotomy to deep brain stimulation.** *Eur Eat Disord Rev.* 2013; **21**(6): 428–35.
PubMed Abstract | **Publisher Full Text**

73. McClelland J, Bozhilova N, Campbell I, *et al.*: **A systematic review of the effects of neuromodulation on eating and body weight: evidence from human and animal studies.** *Eur Eat Disord Rev.* 2013; **21**(6): 436–55.
PubMed Abstract | **Publisher Full Text**

Open Peer Review

Current Peer Review Status: ✔ ✔

Editorial Note on the Review Process

F1000 Faculty Reviews are written by members of the prestigious F1000 Faculty. They are commissioned and are peer reviewed before publication to ensure that the final, published version is comprehensive and accessible. The reviewers who approved the final version are listed with their names and affiliations.

The reviewers who approved this article are:

Version 1

1 **James Lock**
   Department of Psychiatry and Behavioral Sciences, Stanford University, Stanford, USA
   Competing Interests: No competing interests were disclosed.

2 **Anja Hilbert**
   Department of Medical Psychology and Medical Sociology, Department of Psychosomatic Medicine and Psychotherapy, University of Leipzig Medical Center, Leipzig, Germany
   Competing Interests: No competing interests were disclosed.