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Randomized Clinical Trial of Family-Based Treatment and Cognitive-Behavioral Therapy for Adolescent Bulimia Nervosa

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Abstract

Objective—There is a paucity of randomized clinical trials (RCTs) for adolescents with bulimia nervosa (BN). Prior studies suggest cognitive-behavioral therapy adapted for adolescents (CBT-A) and family-based treatment (FBT-BN) could be effective for this patient population. The objective of this study was to compare the relative efficacy of these two specific therapies, FBT-BN and CBT-A. In addition, a smaller group was randomized to a non-specific treatment (supportive psychotherapy [SPT]), whose data were to be used if there were no differences between FBT-BN and CBT-A at end of treatment (EOT).

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Ms. Bryson and Dr. Jo served as the statistical experts for this research.

Method—This two-site RCT (Chicago and Stanford) randomized 130 participants (aged 12–18 years) meeting *DSM, 4th Edition* criteria for BN or partial BN (binge eating and purging once per week for six months). Outcomes were assessed at baseline, EOT, 6 and 12 months post treatment. Treatments involved 18 outpatient sessions over 6 months. Primary outcome was defined as abstinence from binge eating and purging for 4 weeks prior to assessment, using the Eating Disorder Examination.

Results—Participants in FBT-BN achieved higher abstinence rates than in CBT-A at EOT (39% vs. 20%; $p=.040$, number needed to treat [NNT]=5) and at 6-month follow-up (44% vs. 25%; $p=.030$, NNT=5). Abstinence rates between these two groups did not differ statistically at 12-month follow-up (49% vs. 32%; $p=.130$, NNT=6).

Conclusion—FBT-BN is more effective in promoting abstinence from binge eating and purging than CBT-A in adolescent BN at EOT and 6-month follow-up. By 12-month follow-up there were no statistically significant differences between the two treatments.

Keywords

Bulimia nervosa; family-based treatment; cognitive-behavioral therapy; adolescent medicine; eating disorders

INTRODUCTION

Bulimia nervosa (BN) is a serious disorder among adolescents, with a prevalence of more than 1% and another 2–3% presenting with clinically significant bulimic symptoms.^{1,2} BN among adolescents is associated with medical sequelae such as hypokalemia, esophageal tears, gastric disturbances, dehydration, orthostasis, cardiac arrhythmias, and death.³ Psychiatric complications include depression, personality disorders, anxiety, and substance use disorders.^{4,5}

Several randomized controlled trials (RCTs) have now tested a range of treatments for adults with BN.^{6–9} Overall, results suggest cognitive-behavioral therapy (CBT) is the most efficacious approach and, therefore, the first-line treatment for adults with this disorder.⁶ However, despite the fact that bulimic behaviors typically onset during adolescence, there is a paucity of studies evaluating treatments in this age group. Several case series of bulimic adolescents suggest that family therapy^{10,11} or CBT adapted for adolescents (CBT-A)¹² is feasible and leads to clinical improvements. Two relatively modest RCTs for adolescents with BN have been published with somewhat equivocal results.^{13,14} Schmidt et al¹³ found no difference at the end of treatment (EOT) or at 6-month follow-up in rates of achieving abstinence from binge eating and purging between adolescents randomized to either a self-help version of CBT or family therapy (about 40% in both groups at follow-up), although some advantages were achieved for CBT in terms of secondary outcomes. Le Grange et al¹⁴ found that participants randomized to receive a specific form of family therapy (Family-Based Treatment–Bulimia Nervosa: FBT–BN) achieved higher abstinence rates at EOT (40%) compared to those who received a non-specific therapy (supportive psychotherapy [SPT]; 20%), but abstinence rates for both groups dropped at the six-month follow-up mark.

Taken together, these studies suggest that both FBT-BN and CBT-A are likely effective treatments for adolescents with BN.

FBT-BN and CBT-A are conceptually distinct. FBT-BN encourages parental control and management of eating disorder behaviors with no emphasis on changing pathological thinking related to shape and weight; CBT-A is primarily an individual therapy that focuses on reducing dieting and changing distorted behaviors and cognitions related to shape and weight. FBT has a substantial evidence base documenting its effectiveness for adolescent anorexia nervosa (AN),^{15–17} while CBT has a preponderance of evidence supporting its use in adults with BN.^{6–9} Hence, an adequately powered RCT of these two specific approaches for adolescents with BN could shed light not only on which treatment is more effective, but potentially on the benefits of these different strategies on differing patient groups (moderators). Based on the evidence supporting FBT for adolescents with AN, we hypothesized that FBT-BN would be superior to CBT-A for this age group, but expected that age, individual psychopathology, and family pathology would moderate the achievement of abstinence.

Although our design was powered for a comparison between two specific treatments (FBT-BN and CBT-A), as a condition of funding, a third non-specific treatment (SPT) was added to the design to allow an exploratory comparison if there were no differential treatment effects between the specific treatments by the EOT. While this third condition was included in the RCT, recruitment to this arm was designed to be at a lower rate and was not sufficiently powered for a statistically valid comparison with the other treatments. Instead, if there were no difference at the EOT between FBT-BN and CBT-A, a comparison to SPT would be hypothesis generating for future studies.

METHOD

Study Design

In this two-site study (the University of Chicago and Stanford University), 130 participants were randomized to FBT-BN, CBT-A, or SPT. To limit the number of participants in the non-specific therapy group (SPT),¹⁸ given our primary hypothesis, randomization was done in unequal proportions of 2:2:1 for FBT-BN : CBT-A : SPT. Randomization, with no stratification on baseline variables, was done by staff at the Data Coordinating Center (DCC), but separately for each site. Treatment conditions were randomly ordered before consecutive identification numbers were assigned. Families were notified of treatment assignment prior to Session 1, with participants considered entered when told their treatment allocation. Therapists—6 PhD psychologists, 1 social worker, and 1 child psychiatrist all with prior experience treating eating disorders in adolescents—conducted either FBT-BN or CBT-A, but not both, in order to limit potential therapist confounds in the specific treatments. However, all therapists also treated patients using the non-specific treatment, SPT. Therapist training in these three manualized treatments was conducted at two 2-day workshops. The first of these workshops was held prior to recruitment and the second workshop six months after the first participants were randomized. Psychotherapy experts and authors of this report (D.L.G. for FBT-BN, J.D.L. and W.S.A. for CBT-A, and D.L.G. for SPT) conducted the initial training as well as subsequent weekly supervision. All

therapists were required to satisfactorily treat a minimum of 3 pilot cases prior to being assigned randomized cases. Study treatment was provided in eating disorder clinics for children and adolescents located at each of the participating sites. The institutional review boards at both the University of Chicago and Stanford University approved this study protocol.

Sample Characteristics

Recruitment was conducted from January 2009 through December 2012 by local advertising to clinicians, organizations, and clinics treating eating disorders. Telephone screening to determine eligibility allowed for 145 participants (49% of N=296) to be invited for an assessment interview (Figure 1). The study was described to participants and parents at the time of interview in order to obtain written informed consent (assent for adolescents <18 years of age) before assessments were conducted. Participants, male and female, were eligible if between ages 12 and 18 years, living with at least one parent, and meeting criteria for *DSM-IV* BN or partial BN (binge eating and purging one time per week over six months),¹⁹ or expected body weight (EBW) >85%.²⁰ Family, for the purposes of this study, included members of the participant's household, i.e., at least one parent or adult guardian. Single, divorced, or stepparent families were eligible for the study. Participants on a stable dose of medication for two months for a co-morbid psychiatric treatment, while meeting study entry criteria, were eligible. Participants were excluded if they had a current psychotic illness or other mental illness requiring hospitalization, bipolar I disorder, depression with active suicidal thoughts and behavior, associated physical illness that necessitates hospitalization, current dependence on drugs or alcohol, current diagnosis of AN or weight less than 85% EBW, physical conditions known to influence eating or weight, previous FBT-BN, CBT or SPT for BN, or were married or emancipated minors. All study participants were required to be available for the duration of six months' treatment provided in this study.

The primary aim in this study was to compare two specific treatments (FBT-BN and CBT-A) in adolescents with clinically significant bulimic behaviors. One hundred thirty participants agreed to randomization (97% of eligible participants). One individual was later withdrawn because the participant was found not to meet study eligibility.

Participant Safety

A site-specific child and adolescent psychiatrist blind to the participant's psychological treatment managed co-morbid psychiatric conditions requiring medications. Other psychiatric co-morbidities were managed by study therapists in the context of the therapies being delivered for BN. Participants were withdrawn when clinical severity of other psychiatric problems outweighed the benefits of continuing assigned study treatment, or psychiatric hospitalization exceeded 72 hours, or medical hospitalization associated with BN exceeded 21 days in total, or more than two such hospitalizations. Participants withdrawn from the protocol were referred for appropriate treatment outside the study. The therapists and site-specific principal investigator provided emergency coverage of patients. Initial and ongoing medical oversight was provided to ensure medical stability for outpatient treatment. A site-specific pediatrician blind to patient assignment provided this oversight and

determined medical instability that would warrant hospitalization based on published criteria.²¹

Interventions

All treatments were delivered within 18 sessions over a period of six months.

Specific Interventions

Family-Based Treatment for Adolescent Bulimia Nervosa (FBT-BN) is derived from the manualized approach employed with adolescent AN,²² although it differs in some key areas.²³ For instance, FBT-BN assumes that the secrecy, shame, and dysfunctional eating patterns associated with BN negatively affect adolescent development and confuse and disempower parents. The primary treatment strategy is to engage the adolescent in a more collaborative relationship with parents in promoting behavioral change. To target BN behaviors, FBT-BN employs three stages over six months.

Cognitive-Behavior Therapy for Adolescents (CBT-A) is a manualized treatment adapted for adolescents with BN.¹² It is derived from CBT for adult BN originally developed by Fairburn et al.²⁴ Similar to CBT for adults with BN, CBT-A follows three stages over six months. Major modifications for adolescents are: 1) increased contact of therapist with adolescent in early treatment to promote therapeutic alliance; 2) collateral sessions with parents to educate parents about BN and to elicit their support of treatment using CBT; 3) use of concrete examples to illustrate points; and 4) exploration of adolescent developmental issues (e.g., autonomy concerns) in the context of BN.

Non-Specific Intervention

Supportive Psychotherapy (SPT) is a manualized treatment adapted for adolescent BN.¹⁴ It is derived from a version for adults with BN,²⁵ which in turn was derived from Fairburn's earlier work with BN.²⁶ It contains no putative active therapeutic ingredients, e.g., stimulus-control or problem-solving techniques, or instruction on changes in diet and eating patterns. Therefore, SPT is non-directive in nature and does not overlap with any specific factors or active agents that are typical of FBT-BN or CBT-A. SPT consists of three phases that are conducted over six months.

Assessments

Assessments were conducted at four time points: baseline, end-of-treatment (EOT), 6-, and 12- month follow-up. Independent and trained assessors, who were not involved in treatment and intended to be blind to treatment assignment, conducted all assessments. The primary outcome in this study was abstinence from binge eating and purging episodes (any compensatory behaviors) assessed using the Eating Disorder Examination (EDE)²⁷ at EOT. The a priori definition of abstinence rate was the proportion of participants that achieved abstinence from binge eating and purging for four weeks prior to the assessment. Previous studies suggest abstinence defined this way is the best predictor of enduring treatment effects in BN.⁶ The EDE is a standardized investigator-based interview that measures the severity of the characteristic psychopathology of eating disorders. It is a measure of present state and is exclusively concerned with the preceding four weeks. Total binge eating

episodes, total purge episodes, subjective binge eating episodes, percent EBW, age, gender, duration of illness, minority, pretreatment medication, intact family, family income, parental education, and average parental age were assessed. The following measures were used to assess other potential moderators of outcome: Beck Depression Inventory (BDI),²⁸ Family Environment Scale (FES),²⁹ Children's Yale-Brown Obsessive Compulsive Scale (CY-BOCS),³⁰ Yale-Brown-Cornell Eating Disorder Scale (YBC-EDS),³¹ Schedule for Affective Disorders and Schizophrenia for School-Aged Children (6–18 years) – Present and Lifetime Version (K-SADS-PL),³² and the Rosenberg Self-Esteem Scale (RSES).³³

Statistical Analysis

To estimate longitudinal trends and treatment effects based on these trends, we employed longitudinal mixed-effects modeling^{34,35} utilizing repeated assessments at baseline, EOT (28 weeks), 6-month (54 weeks), and 12-month (80 weeks) follow-up. Specifically, we employed a random intercept model using individually varying time scores (assessment weeks from baseline). We included all randomized individuals (intention to treat principle: FBT-BN, n=51; CBT-A, n=58) in the analyses if data from at least one of the four assessments were available. Missing data were treated as missing at random (MAR) conditional on observed information using maximum likelihood estimation,³⁶ which is the standard assumption that underlies contemporary approaches to missing data. All analyses of primary and secondary outcomes were conducted, taking into account site and site by treatment interaction effects. Mplus (V 7.3)³⁷ was utilized to conduct maximum likelihood estimation for all longitudinal mixed-effects analyses.

The study was powered to test the primary hypothesis that rate of abstinence at EOT would be different between FBT-BN and CBT-A. Using a medium effect size derived from preliminary studies^{13,14} (success rate difference = 0.25), estimated power is 0.85 (alpha=.05, two-sided). For the primary outcome, abstinence (1=yes; 0=no), we conducted mixed-effects growth modeling utilizing 3 repeated measures (EOT, 6- and 12-month follow-up), as there was no variation in the data at baseline (i.e., no baseline abstinence). We used a random intercept model with individually varying time scores (assessment weeks from baseline), treating abstinence status as a binary outcome. In addition to the standard MAR, we employed an alternative missing data assumption as a way of sensitivity analysis. In this alternative assumption, we assumed that none of the early dropouts (FBT-BN=5; CBT-A=6) would be abstinent at EOT, as early treatment dropouts are more unlikely to recover. The analyses based on two different missing data assumptions resulted in the same conclusions (comparable effect sizes with almost identical p-values). Given the similar results, we only report here the results based on the standard MAR assumption.

For the exploratory moderator analysis, we incorporated the MacArthur framework^{38,39} in the longitudinal modeling framework. We also examined five secondary outcomes (BDI, EDE Global, CY-BOCS Total, YBC Total, and %EBW) by conducting standard mixed-effects analyses utilizing all 4 repeated assessments. All 109 participants randomized to FBT-BN or CBT-A were included, as they had available data for at least one of the 4 assessment time points. We employed piecewise growth modeling (baseline to EOT and EOT to 12-month follow-up) to accommodate considerable nonlinear trends over time.

As our primary comparison between the two specific treatments (FBT-BN and CBT-A) rendered a significant finding as hypothesized, and in keeping with our original study aims, we did not conduct further comparisons involving the third treatment group (SPT). For participant characteristics as well as outcome data for SPT, please see Tables S1 and S2, available online.

RESULTS

Participant Characteristics (N=109)

Mean age of participants was 15.8 years (SD 1.5), mean percent EBW=109.4 (SD 21.7), median binge eating episodes=17.0 (interquartile range [IQR]=26.75, subjective and objective), and median purge episodes=29.0 (IQR 31.5). Most participants were female (94%) with a mean duration of illness of 18.9 (SD 17.2) months. Sixty-seven percent (n=73) of participants reported a current co-morbid psychiatric disorder, and 9% (n=10) were taking psychotropic medications at baseline. Fifty-eight percent (n=63) were from intact families, 46% (n=50) were ethnic minorities (self-reported), and 33% (n=34) had been hospitalized for BN, or medical complications associated with BN, prior to randomization (see Table 1 for descriptive statistics by center and treatment).

Treatment delivery and study retention

Treatment time did not differ between FBT-BN and CBT-A (an average of 13.6 vs. 14.7 sessions, respectively). Spearman correlation between number of sessions and abstinence rates at EOT was not significant. Study dropout (failure to complete study assessment) was 10% at EOT, 38% at 6-month follow-up, and 36% at 12-month follow-up (see Figure 1 for details). At 6-month follow-up, there was a site difference, with Chicago having a dropout rate of 43.6% (n=24) compared to a rate of 31.5% (n=17) at Stanford.

Primary and Secondary Outcomes

The results of the longitudinal analysis of the primary outcome (abstinence) are summarized in Table 2a. We conducted our analyses taking into account site and site by treatment interaction effects, although none of them were found to be significant. The results reported in Table 2 are main effects of treatment averaged across the two sites. The abstinence rate was significantly higher for FBT-BN (39.4%) compared to CBT-A (19.7%) at EOT (abstinence rate difference=19.7%, $p=.040$; NNT= 5) and at 6-month follow-up (FBT-BN=44.0%; CBT-A=25.4%; abstinence rate difference=18.5%, $p=.030$; NNT=5). The abstinence rate difference between the two treatments narrowed by 12-month follow-up (FBT=48.5%; CBT=32.0%; abstinence rate difference=16.5%, $p=.165$, NNT=6) and was no longer statistically significant. The estimated trajectories in Figure 2, based on longitudinal mixed-effects modeling, show the overall abstinence rates (i.e., % reached abstinence) in the two treatment conditions that change across four assessment points.

The results of our secondary outcome analyses are summarized in Table 2b. Among the five secondary outcomes we examined (BDI, EDE Global, CY-BOCS Total, YBC Total, and %EBW), using mixed-effect modeling, the only outcome that showed a significant group difference was BDI. Individuals under the FBT condition showed lower BDI at EOT

compared to individuals under the CBT. The other outcomes showed no significant group difference at any of the three post-treatment assessment points. The average number of binge eating episodes was 7.8 (SD=21.5) in CBT-A and 4.1 (SD=7.4) in FBT-BN at EOT, 6.7 (SD=16.7) in CBT-A and 7.5 (SD=16.8) in FBT-BN at 6-month follow-up, and 5.8 (SD=9.5) in CBT-A, and 6.7 (SD=19.0) in FBT-BN at 12-month follow-up. The average number of purging episodes was 13.2 (SD=21.5) in CBT-A and 7.6 (SD=10.9) in FBT-BN at EOT, 11.5 (SD=17.7) in CBT-A and 10.0 (SD=16.5) in FBT-BN at 6-month follow-up, and 7.0 (SD=10.8) in CBT-A and also 7.0 in FBT-BN (SD=11.4) at 12-month follow-up.

Treatment effect moderators of primary outcome

We examined 29 baseline variables as potential moderators of treatment effect (see Measures), using the same longitudinal mixed-effect model employed for the primary outcome analysis. Among the 29 variables considered, only FES conflict ($p=.048$) was identified as a treatment effect moderator.^{38,39} Participants with a lower FES conflict score responded better to FBT-BN compared to CBT-A (See Figure 3).

Non-specific predictors of primary outcome

Gender ($p=.043$), YBC Total ($p=.008$), FES cohesion ($p<.001$), intellectual-cultural orientation ($p=.015$), active-recreational orientation ($p=.003$), and organization ($p=.032$) at baseline emerged as non-specific predictors of abstinence at EOT. Regardless of treatment type, males, individuals with lower YBC Total, and those scoring higher on these FES subscales all showed higher abstinence rates at EOT.

Hospitalization during treatment phase

There were no site differences in terms of hospital rates. However, more participants were hospitalized in CBT-A ($n=12$, 21%) than in FBT-BN ($n=1$, 2%) ($W[1]=5.9$, $p=.015$). Four CBT-A participants were hospitalized more than once. Seventy-five percent (9/12) of CBT-A and 100% (1/1) of the first FBT-BN hospitalizations were in the first 8 weeks of treatment. Half of all hospitalizations were for psychiatric reasons, i.e., mostly mood disorder related (30% of all hospitalizations), with concomitant suicidality (20% of all hospitalizations). Non-psychiatric admissions were mostly due to medical instability (50% of all hospitalizations), mostly bradycardia (30% of all hospitalizations).

Treatment during follow-up

There were no differences in treatment utilization between the two treatments during the follow-up period ($n=72$). In FBT-BN, 7 (20%) participants received individual therapy, 4 (11%) medical management, 1 (3%) group therapy, 4 (11%) nutritional counseling, and 3 (9%) were hospitalized. In CBT-A, 9 (32%) participants received individual therapy, 6 (16%) medical management, 3 (8%) group therapy, 1 (3%) nutritional counseling, and 2 (5%) were hospitalized.

DISCUSSION

The results of this study support our primary hypothesis that FBT-BN would be superior to CBT-A for adolescents with BN at the EOT and six-month follow-up; however, abstinence

rates no longer differed statistically by 12-month follow-up. Of our proposed moderators, family pathology (FES conflict) emerged as a significant moderator of treatment effect. That is, participants with lower FES conflict scores responded better to FBT-BN compared to CBT-A, but there was no differentiation between these two treatments in families with higher levels of FES conflict scores. Perhaps similar to earlier findings in adolescent anorexia nervosa,⁴⁰ FBT- BN might not necessarily be the treatment of choice for high-conflict families. Of the secondary outcomes, only BDI showed a significant difference, with those receiving FBT-BN demonstrating greater improvements. Our findings underscore those of the prior RCTs for adolescents with BN,^{13,14} demonstrating that both family therapy and CBT are viable treatment options for this patient population, but suggest that abstinence occurs more rapidly in FBT-BN and with fewer hospitalizations than in CBT-A.

Strengths of this study include a relatively large sample size, manualized treatments, trained and skilled therapists, ongoing supervision by experts, and independent assessors using standardized outcome measures. Treatment attrition and study dropout during treatment were relatively low. Among the limitations of our study, however, is the loss of follow-up data by 12 months, which would need to be addressed in the design of future studies of this population. Recruitment and treatment of participants were conducted at specialist university treatment sites, which may limit the generalizability of the findings. Further, both study sites are known for research in FBT, and this perception could have affected results. However, therapists at both sites have a long history, training, and practice of CBT for adolescents with BN. Therapists treated participants in only one of the two specific conditions, while one of the principal investigators (J.D.L.) is the author of the only previously published treatment study of CBT for this patient population, and another (W.S.A.) has conducted many studies of CBT for adults with BN (e.g.,⁶). Moreover, additional efforts were made to limit any bias through use of an independent DCC, as well as cross-site training and supervision procedures. That said, these findings would be strengthened if replicated by other centers not involved in the development of either FBT or CBT.

Findings from the present study, taken together with those from previous studies of adolescents with BN,^{13,14} suggest that FBT-BN is likely a better initial treatment option compared to CBT-A for those adolescents with clinically significant bulimic behaviors. FBT-BN leads to quicker and higher sustained abstinence rates that are maintained up to 12 months post treatment associated with medium effect sizes, as well as significantly less hospitalization. It appears that, similarly to their adolescent peers with AN, adolescents with BN can benefit from an approach that actively involves their families in the treatment process. However, given that there were no statistical differences between these two treatments at 12-months post treatment, CBT-A remains a viable alternative treatment for this patient population, especially for those families who would prefer a largely individual treatment or when there is no family available to be of help. Unfortunately, our exploratory moderator analysis did not identify a patient group that showed differentially favorable response to CBT-A. Larger studies with a greater adolescent age and diagnostic range might be needed to identify such moderating groups.

There clearly remains a need for ongoing development of innovative treatments for this patient population given that less than half of patients are recovered at 12-month follow-up,

whether in FBT-BN or CBT-A. Future studies might consider utilizing CBT-E, adapted for adolescents, as this approach is the latest iteration of CBT for eating disorders now available. Alternatively, the utility of integrative cognitive-affective therapy⁴¹ or interpersonal therapy,⁶ if adapted for adolescents, or a stepped-care approach for early non-responders,⁴² could also be explored. Finally, this is only the third, though largest, RCT conducted to examine treatments for adolescents with BN. While abstinence rates of 40–45% are encouraging, strategies to enhance these approaches and develop other novel treatments for adolescents with BN are needed.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.

Consolidated Standards of Reporting (CONSORT) diagram. Note: CBT = cognitive-behavioral therapy; FBT = Family-based therapy; SPT = supportive psychotherapy.

Figure 2.

Estimated trajectories of abstinence rate using longitudinal mixed effects modeling. Note: Curves presented here are overall curves and therefore may not exactly agree with the main effect estimates presented in Table 2 that are averaged across two sites; observed n: 51 family-based therapy for bulimia nervosa (FBT-BN) and 58 cognitive-behavioral therapy adapted for adolescents (CBT-A) at baseline; both 43 at end of treatment (EOT); both 34 at 6-month follow-up (FU); 29 FBT-BN and 41 CBT-A at 12-month follow-up.

Figure 3.

Moderator effect depicted using dichotomized Family Environment Scale (FES) conflict (N = 109). Note: CBT-A = cognitive-behavioral therapy adapted for adolescents; EOT = end of treatment; FBT-BN = Family-based therapy for bulimia nervosa.

Table 1

Descriptive Statistics by Center and Treatment

	Chicago		Stanford		Total	
	CBT-A (n=30)	FBT-BN (n=25)	CBT-A (n=28)	FBT-BN (n=26)	CBT-A (n=58)	FBT-BN (n=51)
Age	15.7 (1.5)	16.1 (1.5)	15.7 (1.6)	15.8 (1.6)	15.7 (1.5)	15.9 (1.5)
Duration of illness (in months)	19.5 (14.9)	20.1 (17.4)	17.1 (14.6)	19.2 (22.3)	18.4 (14.7)	19.6 (19.9)
Global EDE	3.6 (1.3)	3.6 (1.3)	3.7 (1.4)	3.3 (1.2)	3.7 (1.3)	3.5 (1.3)
Total binge eating episodes	20.0 (25.0)	17.0 (25.0)	16.0 (33.0)	16.0 (21.0)	17.0 (29.5)	17.0 (22.0)
Total purge episodes	37.5 (35.5)	26.0 (38.5)	28.0 (43.0)	29.0 (27.5)	33.0 (37.5)	28.0 (28.0)
Percent EBW	109.9 (16.0)	113.8 (37.4)	106.7 (13.8)	107.7 (12.6)	108.3 (15.0)	110.6 (27.6)
BDI	24.3 (12.8)	23.5 (13.2)	24.5 (10.2)	22.9 (10.7)	24.4 (11.5)	23.2 (11.8)
Rosenberg Self Esteem	22.5 (7.2)	22.4 (7.5)	21.2 (4.8)	24.6 (6.0)	22.8 (6.2)	23.5 (6.8)
FES Cohesion	3.7 (2.1)	3.9 (1.6)	3.9 (1.8)	3.2 (2.2)	3.8 (1.9)	3.6 (1.9)
FES Expressiveness	2.8 (1.4)	3.0 (1.2)	3.3 (1.8)	2.6 (1.4)	3.0 (1.6)	2.8 (1.3)
FES Conflict	1.9 (1.6)	2.1 (1.6)	2.2 (1.5)	2.0 (1.6)	2.1 (1.5)	2.1 (1.6)
FES Independence	3.5 (1.1)	2.9 (1.3)	3.7 (1.5)	3.5 (.9)	3.6 (1.3)	3.2 (1.1)
FES Achievement orientation	3.4 (1.4)	3.6 (1.2)	3.7 (1.3)	4.3 (1.6)	3.6 (1.3)	3.9 (1.4)
FES Intellectual-cultural orientation	3.2 (1.2)	3.0 (1.5)	3.0 (1.6)	3.3 (1.4)	3.1 (1.4)	3.2 (1.4)
FES Active-recreational orientation	2.7 (1.4)	3.2 (1.3)	3.0 (1.8)	2.5 (1.8)	2.9 (1.6)	2.8 (1.6)
FES Moral-religious emphasize	2.4 (1.9)	2.3 (1.8)	2.4 (1.8)	2.5 (1.7)	2.4 (1.8)	2.4 (1.7)

	Chicago		Stanford		Total	
	CBT-A (n=30)	FBT-BN (n=25)	CBT-A (n=28)	FBT-BN (n=26)	CBT-A (n=58)	FBT-BN (n=51)
FES Organization ^a	2.5 (1.8)	2.6 (1.9)	3.1 (1.7)	3.4 (1.9)	2.8 (1.8)	3.0 (1.9)
FES Control	2.1 (1.6)	2.9 (1.6)	2.6 (1.8)	3.0 (1.3)	2.3 (1.6)	2.9 (1.4)
CY-BOCS Total	8.4 (10.1)	9.0 (9.9)	9.4 (9.4)	5.9 (7.9)	8.9 (9.7)	7.4 (9.0)
YBC total score	18.1 (7.9)	17.8 (7.2)	20.6 (6.4)	18.9 (6.9)	19.3 (7.3)	18.3 (7.0)
Gender % Male	n=2 7%	n=2 8%	n=1 4%	n=2 8%	N=3 5%	N=4 8%
Intact Family	n=17 59%	n=16 64%	n=16 62%	n=14 56%	N=33 60%	N=30 60%
Comorbidity	n=18 60%	n=15 60%	n=21 75%	n=19 73%	N=39 67%	N=34 67%
Minority ^b	n=8 27%	n=10 40%	n=20 71%	n=12 46%	N=28 48%	N=22 43%
Subjective binge eating only	n=12 40%	n=12 48%	n=9 32%	n=12 46%	N=21 36%	N=24 47%
On pretreatment medication	n=5 17%	n=2 8%	n=2 7%	n=1 4%	n=7 12%	n=3 6%
Income>100K	11 39%	10 44%	12 44%	9 39%	23 40%	19 37%
Parent with college degree	20 71%	15 62%	21 78%	17 68%	41 74%	32 65%
Average Parental age	47.1 (7.4)	48.7 (5.4)	48.9 (7.7)	48.7 (5.4)	48.0 (7.5)	48.7 (5.3)
Number of Hospitalizations	n=6 21%	n=4 16%	n=13 48%	n=10 39%	n=19 33%	n=14 28%

Note: Total binge eating and total purging episodes are medians and interquartile range. BDI = Beck Depression Inventory; CBT-A = cognitive-behavioral therapy adapted for adolescents; CY-BOCS = Children's Yale-Brown Obsessive Compulsive Scale; EBW = expected body weight; EDE = Eating Disorder Examination; FBT-BN = family-based treatment for bulimia nervosa; FES = Family Environment Scale; YBC = Yale-Brown-Cornell Eating Disorder Scale.

^aCenter differences $F(1,104)=4.3$ $p=.041$.

^bCenter by Treatment difference $W(1)=4.2$ $p=.040$.

Table 2

Estimated Outcomes Across Treatment Modality Based on Longitudinal Mixed Effects Modeling

a. Primary Outcome				
Primary Outcome (By week)	FBT-BN	CBT-A	Effect size^a	p-value
Abstinence				
28	39.4%	19.7%	SRD=0.197, NNT=5	.040
54	44.0%	25.4%	SRD=0.185, NNT=5	.030
80	48.5%	32.0%	SRD=0.165, NNT=6	.130

b. Secondary Outcomes				
Secondary Outcomes	FBT-BN	CBT-A	Effect size^a	p-value
BDI				
28	13.38	18.33	d=0.361	.049
54	13.07	15.35	d=0.175	.560
80	10.56	11.80	d=0.115	.669
EDE Global				
28	1.72	2.04	d=0.223	.199
54	1.49	1.68	d=0.142	.495
80	1.19	1.56	d=0.309	.119
CY-BOCS				
28	3.61	5.25	d=0.191	.268
54	5.44	6.00	d=0.075	.745
80	4.48	4.52	d=0.005	.979
YBC				
28	8.03	10.44	d=0.291	.100
54	7.33	9.42	d=0.242	.204
80	5.62	7.80	d=0.289	.133
%EBW				
28	113.54	109.73	d=0.166	.061
54	110.74	112.22	d=0.083	.575
80	111.99	109.56	d=0.147	.566

Note: Boldface data reflects statistically significant *p* values. BDI = Beck Depression Inventory; CBT-A = cognitive-behavioral therapy adapted for adolescents; CY-BOCS = Children's Yale-Brown Obsessive Compulsive Scale; EBW = expected body weight; EDE = Eating Disorder Examination; FBT-BN = family-based treatment for bulimia nervosa; YBC = Yale-Brown-Cornell Eating Disorder Scale.

^a Effect sizes: SRD= success rate difference (abstinence rate difference in this case); NNT=number needed to treat; d= Cohen's *d* = estimated group mean difference divided by estimated SD at 28, 54, 80 weeks.