



Is weight gain really a catalyst for broader recovery?: The impact of weight gain on psychological symptoms in the treatment of adolescent anorexia nervosa



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ABSTRACT

The main aims of this study were to describe change in psychological outcomes for adolescents with anorexia nervosa across two treatments, and to explore predictors of change, including baseline demographic and clinical characteristics, as well as weight gain over time. Participants were 121 adolescents with anorexia nervosa from a two-site (Chicago and Stanford) randomized controlled trial who received either family-based treatment or individual adolescent supportive psychotherapy. Psychological symptoms (i.e., eating disorder psychopathology, depressive symptoms, and self-esteem) were assessed at baseline, end of treatment, 6-month, and 12-month follow-up. Conditional multilevel growth models were used to test for predictors of slope for each outcome. Most psychological symptoms improved significantly from baseline to 12 month follow-up, regardless of treatment type. Depressive symptoms and dietary restraint were most improved, weight and shape concerns were least improved, and self-esteem was not at all improved. Weight gain emerged as a significant predictor of improved eating disorder pathology, with earlier weight gain having a greater impact on symptom improvement than later weight gain. Adolescents who presented with more severe, complex, and enduring clinical presentations (i.e., longer duration of illness, greater eating disorder pathology, binge-eating/purging subtype) also appeared to benefit more psychologically from treatment.

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Research indicates that adolescent anorexia nervosa (AN) frequently co-occurs with other psychological symptoms and disorders. For clinical and sub-clinical adolescent AN, the most common co-occurring diagnoses include mood disorders (e.g., major depression) and anxiety disorders (e.g., separation anxiety disorder, obsessive-compulsive disorder, generalized anxiety disorder, and social phobia) (O'Brien & Vincent, 2003; Touchette et al., 2010). In addition, adolescents with eating disorders report greater eating disorder psychopathology, greater depressive symptoms, and poorer quality of life than those without an eating disorder (Allen, Byrne, Oddy, & Crosby, 2013). It is widely accepted that some of these co-occurring psychological symptoms are secondary to the

malnutrition associated with AN (Keys, Brozek, Henschel, Mickelsen, & Taylor, 1950; O'Brien & Vincent, 2003). However, there is little empirical evidence on the relationship between malnutrition and psychological symptoms in AN, particularly with respect to how weight regain may impact psychological change in eating disorder and other psychopathology (Mattar, Huas, Duclos, Apfel, & Godart, 2011).

Most of the research on psychological change during treatment has studied inpatient treatment for adults with AN, generally reporting positive changes in eating disorder pathology, depression, and anxiety (e.g., Channon & de Silva, 1985; Meehan, Loeb, Roberto, & Attia, 2006; Pollice, Kaye, Greeno, & Weltzin, 1997). While these improvements are implied to be related to nutritional recovery, few studies have directly examined this relationship. The few studies available examining weight restoration and psychological symptoms reveal mixed findings. For example, one early study found that increases in weight predicted decreases in depressive symptoms (Eckert, Goldberg, Halmi, Casper, & Davis, 1982), while another study

Abbreviations: AN, anorexia nervosa; FBT, family-based treatment; AFT, adolescent-focused therapy; EOT, end of treatment; %EBW, % expected body weight; AN-BP, AN binge-eating/purging type; AN-R, AN-Ran restricting type.

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found no association between increases in weight and improvement in depression, anxiety, or eating disorder pathology (e.g., [Mattar, Thiébaud, Huas, Cebula, & Godart, 2012](#)). Another study found decreases in social anxiety and eating-related obsessionality following inpatient admission, but these decreases were not correlated with weight restoration ([Coulon, Jeammet, & Godart, 2009](#)). Other research has simply examined cross-sectional associations between nutritional status and psychological factors, with mixed findings (e.g., [Kawai et al., 2008](#); [Laessle, Schweiger, & Pirke, 1988](#)). Therefore, the relationship between weight and psychological symptoms—and more specifically the impact of weight recovery on psychological symptoms—is poorly understood.

This association is particularly relevant in adolescents with AN presenting for outpatient treatment. The clinical presentation of these individuals is often complex, and greater psychopathology (e.g., eating-related obsessionality, comorbid psychiatric symptoms) has been found to predict poorer outcome ([Eisler et al., 2000](#); [Lock, Couturier, Bryson, & Agras, 2006](#)). In light of this, clinicians are often challenged to prioritize treatment targets for adolescents who present with multiple comorbidities. In family-based treatment (FBT), which probably is the most efficacious outpatient treatment for medically stable adolescents with AN, the first goal of treatment is to promote weight restoration. The discussion of co-occurring psychological symptoms (e.g., depression, low self-esteem) is fairly limited in the early stages of FBT, and these symptoms are only addressed later in treatment when AN is better managed. FBT has been found to be more efficacious than individual adolescent-focused therapy for patients with greater eating-related obsessionality as well as those with binge-eating/purging type AN ([Le Grange, Lock, et al., 2012](#)). In addition, adolescents with greater eating-related obsessionality appear to derive greater benefit from longer FBT treatment ([Lock, Agras, Bryson, & Kraemer, 2005](#)). This suggests that FBT may be more suitable for adolescents with psychiatric comorbidities, and it theoretically promotes psychological recovery through weight gain.

While no published studies on FBT for AN have examined the relationship between change in weight and change in psychological symptoms, several of the randomized studies have noted improvement in secondary psychological symptoms during the course of treatment (e.g., [Eisler et al., 2000](#); [Le Grange, Eisler, Dare, & Russell, 1992](#); [Lock et al., 2006](#)). For example, one study found that only the delivery of conjoint FBT (compared to a separated form of FBT with the parents alone) was related to improvements in mood, obsessionality, and eating disorder symptoms, despite no differences between treatments in recovery rates as defined by body weight, return of menses, and absence of bulimic behaviors ([Eisler et al., 2000](#)). Another study that compared two types of treatments found that family treatment was superior to individual treatment with respect to weight restoration, but both treatments were equivalent with respect to improvements in eating attitudes, depressive symptoms, ego functioning, and family conflict around eating ([Robin et al., 1999](#)). Finally, although some studies report mean improvements in psychological symptoms, a statistical comparison of the two means is not provided ([Lock et al., 2005](#)). This leaves some doubts as to the efficacy of current treatments to impact psychological recovery, and to understand whether such recovery is secondary to weight gain.

The current study investigates the relationship between weight gain and overall change in psychological symptoms (i.e., eating disorder psychopathology, depressive symptoms, and self-esteem) across two treatments for adolescent AN. The main aim of this study was to examine weight gain as a predictor of psychological improvement, while controlling for other potential predictors of change (i.e., adolescent age, sex, racial/ethnic minority, duration of illness, psychiatric comorbidity, AN subtype, intact family status,

prior hospitalization, use of psychotropic medications, and treatment condition). Greater weight restoration was hypothesized to predict greater improvements in both eating disorder psychopathology and other psychological symptoms.

Methods

This multi-site study compared two manualized treatments delivered at The University of Chicago and Stanford University. The two treatments and their implementation are described in detail elsewhere ([Fitzpatrick, Moye, Hoste, Le Grange, & Lock, 2010](#); [Lock & Le Grange, 2013](#)). Briefly, Family-Based Treatment (FBT) focuses on encouraging parental control of eating-related behaviors in their child, while Adolescent-Focused Therapy (AFT) is individually based and focuses on ameliorating eating symptoms in the context of common themes in adolescent development. Both treatments were provided over a one-year period, with 24 1-h sessions in FBT, and 32 45-min sessions in AFT (24 contact hours total).

Assessment

Independent assessors conducted assessments at baseline, end of treatment (EOT), 6-month follow-up, and 12-month follow-up. Adolescent age; sex; racial/ethnic minority; % expected body weight (%EBW) for sex, age, and height as determined by [Centers for Disease Control and Prevention \(2002\)](#) growth charts; duration of illness; AN subtype [binge-eating/purging type (AN-BP) or restricting type (AN-R)]; intact family status (i.e., married/committed or separated/divorced parents), prior psychiatric hospitalization; current use of psychotropic medications; and psychiatric comorbidity (using the Schedule for Affective Disorder and Schizophrenia for School-Age Children; K-SADS; [Kaufman et al., 1997](#)) were assessed during the baseline interview only.

The Eating Disorder Examination (EDE, version 12.0) is a psychometrically reliable and valid standardized interview that was used to assess severity of eating disorder pathology at all time points ([Fairburn & Cooper, 1993](#); [Rizvi, Peterson, Crow, & Agras, 2000](#); [Rosen, Vara, Wendt, & Leitenberg, 1990](#)). It generates a global score and four subscale scores (weight concern, shape concern, eating concern, and restraint; [Cooper, Cooper, & Fairburn, 1989](#); [Cooper & Fairburn, 1987](#)). The Beck Depression Inventory (BDI) is a 21-item measure with excellent psychometric properties that was used to assess depressive symptoms ([Beck, Steer, & Brown, 1996](#); [Beck, Steer, & Garbin, 1988](#)). In addition to the four regular assessments at baseline, EOT, 6-month, and 12-month follow, the BDI was administered at sessions 1, 2, 4, 6, and 8. The Rosenberg Self-Esteem Scale (RSE) is a 10-item measure with good psychometric properties that was used to assess adolescents' overall self-esteem at all time points and sessions 1, 2, 4, 6, and 8 ([Robins, Hendin, & Trzesniewski, 2001](#); [Rosenberg, 1965, 1979](#)). Finally, weight was measured at every session and %EBW was calculated at each time point, using updated heights as appropriate.

Analyses

SPSS (version 19) was used to calculate sample descriptives. Cohen's *d* effect sizes were calculated for psychological outcomes based on differences between baseline and 12-month follow-up scores. Given the interest in change over time and the nested data structure (i.e., time nested within adolescents, nested within treatment center), slopes-as-outcome models were used to examine growth trajectories for all psychological outcomes. The parameter of greatest interest in these models is the slope coefficient, representing an interaction of the predictors (level-2) with time (level-1). This model assumed a linear model for each

individual's trajectory from baseline to 12-month follow-up, such that the slope represents rate of response. Time was coded from -2 to 2 , such that the intercept was centered at EOT and each unit of time represents 6 months. Therefore, the intercept represents the estimated value of the outcome at EOT, and the slope represents an estimate of change in outcome for each 6-month interval in time.

SuperMix Version 1.1 (Hedeker, Gibbons, du Toit, & Patterson, 2008) was used to examine the unconditional growth model for each outcome, with time as the only predictor. For the statistically significant models (i.e., models indicating a significant change in the outcome over time), intraclass correlations (ICCs) were calculated to assess the percent of variability in each outcome that is attributable to the adolescent and center levels. Subsequently, conditional multilevel growth models were used to test for predictors of outcome slope. These models appropriately examine multilevel data and can accommodate missing data. Initially, potential covariates were screened for inclusion in the final multivariable models for each outcome by examining the bivariate relationship between each variable's main and interaction effects (i.e., slope over time) on each outcome, controlling for the baseline value for each outcome. Potential covariates included the following variables at baseline: adolescent age, sex, racial/ethnic minority (*no/yes*), %EBW, duration of illness, psychiatric comorbidity (*no/yes*), AN-BP type (*no/yes*), intact family status (*no/yes*), prior hospitalization (*no/yes*), use of psychotropic medications (*no/yes*), treatment condition (*FBT/AFT*), and global EDE score (included in depression and self-esteem models only). Reference groups for dichotomous variables are italicized. The main predictor of interest—change in %EBW from baseline—was entered as a time-varying covariate. Therefore, its main effect represents the impact of change in %EBW on treatment response specifically at EOT (where the intercept is centered) rather than at the 12-month follow-up, and its interaction with time represents whether the impact of change in %EBW on outcome differs across time. For covariates, the only parameter of interest is their interaction with time, which represents whether the outcome slope differs across levels of the covariate. Any predictor that was significantly associated with the outcome at the trend level ($p < 0.10$) was then entered into a multivariable multilevel model. Follow-up analyses were conducted to illuminate the direction of significant effects for continuous covariates by examining the predictor centered at one standard deviation above and one standard deviation below the mean.

Results

Participants were predominantly female (90.9%) with a mean age of 14.4 years ($SD = 1.6$). Race/ethnicity was largely non-Hispanic White (76%, $n = 92$), but also Hispanic White (7.4%, $n = 9$), Asian (10.7%, $n = 13$), Black (0.8%, $n = 1$), and 'other' (5.0%, $n = 6$). Mean %EBW was 80.4% ($SD = 3.6$) with a mean BMI of 16.1 ($SD = 1.1$) using the Centers for Disease Control and Prevention growth charts. A minority of adolescents (17.4%, $n = 21$) had AN-BP Type. The average duration of illness was 11.3 months ($SD = 8.6$), with 44.6% ($n = 54$) of the sample reporting prior hospitalization for AN or medical problems associated with AN. Approximately one quarter of participants (24.5%, $n = 29$) met criteria for a current comorbid psychiatric disorder, as assessed by the Schedule for Affective Disorders and Schizophrenia for School-Aged Children, and 16.5% ($n = 20$) were taking psychotropic medications at baseline. Families were mostly intact (78.9%, $n = 95$) and most parents had attended some higher education (means of 15.7 and 16.2 years of education for mothers and fathers, respectively).

On average, psychological symptoms decreased from baseline to 12-month follow-up (see Table 1). The unconditional models,

Table 1
Change in psychological outcomes from baseline to 12-month follow-up.

	Baseline M (SD)	12-month FUM (SD)	Cohen's <i>d</i>
Global ED symptoms	1.77 (1.45)	0.87 (1.10)	0.599
Weight Concerns	1.67 (1.57)	1.13 (1.31)	0.333
Shape Concerns	2.05 (1.75)	1.22 (1.42)	0.425
Eating Concerns	1.22 (1.35)	0.45 (1.02)	0.526
Dietary Restraint	2.14 (1.77)	0.67 (1.09)	0.800
Depressive Symptoms	14.68 (10.05)	6.64 (8.52)	0.815
Self-Esteem	23.44 (6.77)	20.74 (7.14)	n/a

which represent change in outcome only as a result of time, indicated statistically significant reductions in global eating disorder symptoms ($B = -0.239$, $SE = 0.041$, $p < 0.001$), weight concerns ($B = -0.162$, $SE = 0.046$, $p < 0.001$), shape concerns ($B = -0.213$, $SE = 0.052$, $p < 0.001$), eating concerns ($B = -0.195$, $SE = 0.036$, $p < 0.001$), dietary restraint ($B = -0.385$, $SE = 0.045$, $p < 0.001$), and depressive symptoms ($B = -1.817$, $SE = 0.242$, $p < 0.001$). The only outcome that did not improve significantly over time was self-esteem ($B = -0.069$, $SE = 0.061$, $p = 0.284$). Therefore, no predictors of change in self-esteem were examined.

Changes over time represent large effects for dietary restraint (Cohen's $d = 0.800$) and depressive symptoms (Cohen's $d = 0.815$), moderate effects for global eating disorder symptoms (Cohen's $d = 0.599$) and eating concerns (Cohen's $d = 0.526$), and small effects for weight (Cohen's $d = 0.333$) and shape concerns (Cohen's $d = 0.425$). In addition, improvements in global eating disorder symptoms, eating concerns, and dietary restraint were clinically significant, such that the 12-month mean falls within 1 SD of community norms while the baseline mean does not (Wade, Byrne, & Bryant-Waugh, 2008). Weight and shape concern means also fell within 1 SD of community norms at 12-month follow-up, but they were within this range at baseline as well. Change in depressive symptoms also demonstrated a clinically significant reduction, such that its mean fell from the mild symptom range [14–19] at baseline to the minimal symptom range [0–13] at 12-month follow-up (Beck et al., 1996).

The ICC values from the unconditional growth models (i.e., time nested within adolescent, nested within treatment center) were small and negative at the center level across all outcomes (ICCs ranged from -0.045 to -0.002). These negative variability estimates indicated that treatment center level should not be included in analyses for any outcome. Adolescent-level factors accounted for a significant amount of variance in global EDE (62.2%), weight concerns (65.0%), shape concerns (12.0%), eating concerns (66.7%), dietary restraint (71.7%), and depressive symptoms (63.4%). Therefore, this level was included in all models.

Eating disorder symptoms

Global eating disorder symptoms

When controlling for baseline global eating disorder symptoms in bivariate analyses, only two variables were retained for the multivariable model: change in %EBW ($p < 0.001$) and treatment condition ($p = 0.075$). In the final model, change in %EBW remained a significant predictor of global eating disorder symptoms at EOT ($B = -0.015$, $SE = 0.007$, $p = 0.035$), such that faster gains in %EBW predicted significant decreases in global EDE ($B = -0.160$, $SE = 0.068$, $p = 0.018$), whereas those with average ($B = -0.027$, $SE = 0.072$, $p = 0.710$) or slower gains in %EBW ($B = 0.107$, $SE = 0.095$, $p = 0.263$) had no significant change in global EDE. The interaction with time was also significant, indicating that the impact of increased %EBW on global EDE became less pronounced over time ($B = 0.014$, $SE = 0.004$, $p < 0.001$). Treatment was not

associated with rate of change in global eating disorder symptoms in the final model ($p = 0.119$), indicating that similar psychological improvements occurred across treatment types. Time did not account for decreases in symptoms over and above other predictors in the model ($p = 0.710$). See Table 2 for a summary of all multivariable models.

Weight concerns

When controlling for baseline weight concerns in bivariate analyses, several variables were retained for the multivariable model: change in %EBW ($p = 0.017$), minority status ($p = 0.042$), and AN subtype ($p < 0.001$). In the final model, change in %EBW was no longer associated with lesser weight concerns at EOT ($B = -0.004$, $SE = 0.008$, $p = 0.634$). However, the impact of %EBW change on weight concerns differed significantly over time, such that the impact of weight restoration on weight concerns became less pronounced over time ($B = 0.011$, $SE = 0.005$, $p = 0.021$). Rate of change in weight concerns was faster for adolescents with AN-BP type compared to AN-R type ($B = -0.456$, $SE = 0.128$, $p < 0.001$). Minority status was not a significant predictor in the multivariable model ($p = 0.326$). Time did not account for decreases in symptoms over and above other predictors in the model ($p = 0.727$).

Shape concerns

When controlling for baseline shape concerns in bivariate analyses, several variables were retained for the multivariable model: change in %EBW ($p = 0.003$), treatment ($p = 0.051$), and AN subtype ($p = 0.013$). In the final model, change in %EBW was not associated with lesser shape concerns at EOT ($B = -0.006$, $SE = 0.009$, $p = 0.467$). However, the relation between %EBW change and shape concerns differed over time, such that the impact of %EBW change on shape concerns became less pronounced over time ($B = 0.016$, $SE = 0.005$, $p = 0.003$). Change in shape concerns improved significantly faster for adolescents with AN-BP type compared to AN-R type ($B = -0.334$, $SE = 0.143$, $p = 0.020$) but was not significantly different by treatment ($B = -0.183$, $SE = 0.105$, $p = 0.082$). Time did not account for decreases in symptoms over and above other predictors in the model ($p = 0.466$).

Eating concerns

When controlling for baseline eating concerns in bivariate analyses, several variables were retained for the multivariable model: change in %EBW ($p = 0.003$), psychiatric comorbidity ($p = 0.033$), and AN-BP type ($p < 0.001$). In the final model, change in %EBW remained a significant predictor of eating concerns at EOT ($B = -0.015$, $SE = 0.006$, $p = 0.018$), such that there was significant improvement in eating concerns for those with faster gains in %EBW ($B = -0.101$, $SE = 0.040$, $p = 0.012$) and no change in those with

average ($B = 0.017$, $SE = 0.060$, $p = 0.779$) or slower gains in %EBW ($B = 0.156$, $SE = 0.091$, $p = 0.089$). The impact of gains in %EBW on eating concerns lessened over time ($B = 0.010$, $SE = 0.004$, $p = 0.014$). Change in eating concerns was also faster for adolescents with AN-BP type at baseline compared to AN-R type ($B = -0.425$, $SE = 0.106$, $p < 0.001$). There was no significant effect of psychiatric comorbidity in the final model ($B = -0.124$, $SE = 0.093$, $p = 0.179$). Time did not account for decreases in symptoms over and above other predictors in the model ($p = 0.779$).

Dietary restraint

When controlling for baseline dietary restraint in bivariate analyses, several variables were retained for the multivariable model: change in %EBW ($p < 0.001$), prior hospitalization ($p = 0.023$), and purging status ($p < 0.001$). In the final model, change in %EBW remained a significant predictor of dietary restraint at EOT ($B = -0.028$, $SE = 0.008$, $p < 0.001$), such that those with faster gains in %EBW had significant reductions in dietary restraint ($B = -0.349$, $SE = 0.077$, $p < 0.001$) but those with average ($B = -0.158$, $SE = 0.083$, $p = 0.057$) or slower gains ($B = 0.033$, $SE = 0.111$, $p = 0.765$) had no significant change. The effect of gains in %EBW on dietary restraint diminished over time ($B = 0.020$, $SE = 0.005$, $p < 0.001$). Change in dietary restraint was also faster for adolescents with AN-BP subtype at baseline compared to AN-R type ($B = -0.378$, $SE = 0.133$, $p = 0.005$). History of prior hospitalization was no longer significant in the final model ($B = 0.132$, $SE = 0.099$, $p = 0.181$). Time did not significantly account for decreases in restraint over and above other predictors in the model ($B = -0.158$, $SE = 0.083$, $p = 0.057$).

Psychosocial functioning

Depressive symptoms

When controlling for baseline depression, the following variables were significant predictors of change in depression in bivariate analyses: change in %EBW ($p < 0.001$), age ($p = 0.042$), duration of illness ($p = 0.044$), psychiatric comorbidity ($p = 0.045$), and global EDE at baseline ($p < 0.001$). In the final model, change in %EBW was predictive of depressive symptoms at EOT at the trend level only ($B = -0.069$, $SE = 0.039$, $p = 0.080$), such that those with faster gains in %EBW had the greatest reduction in depressive symptoms ($B = -2.895$, $SE = 0.307$, $p < 0.001$), compared to lesser change in those with average gains ($B = -1.653$, $SE = 0.235$, $p < 0.001$) and no change for those with slower gains ($B = -0.412$, $SE = 0.309$, $p = 0.181$). The impact of %EBW change on depressive symptoms significantly decreased over time ($B = 0.149$, $SE = 0.024$, $p < 0.001$). Greater change in depressive symptoms was associated with global ED symptoms at baseline ($B = -0.610$, $SE = 0.135$,

Table 2
Summary of key parameters in six unique multivariable models predicting change in each psychological outcome.

Predictor	Global eating disorder symptoms	Weight concerns	Shape Concerns	Eating concerns	Dietary restraint	Depressive symptoms
Intercept	1.099 (0.110)***	1.284 (0.107)***	1.544 (0.140)***	0.661 (0.085)***	0.901 (0.114)***	0.228 (0.693)
Slope (time)	-0.027 (0.072)	0.025 (0.072)	0.066 (0.090)	0.017 (0.060)	-0.158 (0.083)*	-1.653 (0.235)***
Outcome at baseline	0.763 (0.036)***	0.718 (0.045)***	0.768 (0.041)***	0.682 (0.043)***	0.690 (0.034)***	0.529 (0.035)***
%EBW change	-0.015 (0.007)*	-0.004 (0.008)	-0.007 (0.009)	-0.015 (0.007)*	-0.028 (0.008)***	-0.069 (0.039)
%EBW change by time	0.014 (0.004)***	0.011 (0.005)*	0.016 (0.005)**	0.010 (0.004)*	0.020 (0.005)*	0.149 (0.024)***
Treatment by time	-0.134 (0.086)	—	-0.183 (0.105)**	—	—	—
Minority by time	—	-0.108 (0.110)	—	—	—	—
AN subtype by time	—	-0.456 (0.128)***	-0.334 (0.143)*	-0.425 (0.106)***	-0.378 (0.133)**	—
Comorbidity by time	—	—	—	-0.124 (0.093)	—	-0.343 (0.483)
Age by time	—	—	—	—	—	0.059 (0.136)
Illness duration by time	—	—	—	—	—	-0.049 (0.022)*
Global EDE by time	n/a	n/a	n/a	n/a	n/a	-0.610 (0.135)***

Note: Parameters are listed as B (SE) with the following symbols for p -values: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

$p < 0.001$) and duration of illness ($B = -0.049$, $SE = 0.022$, $p = 0.028$), such that those with greater global ED symptoms ($B = -2.536$, $SE = 0.327$, $p < 0.001$) and longer duration of illness ($B = -2.080$, $SE = 0.300$, $p < 0.001$) had faster reductions in depression compared to those with lesser symptoms ($B = -0.771$, $SE = 0.286$, $p = 0.007$) and shorter duration of illness ($B = -1.227$, $SE = 0.309$, $p < 0.001$). The passage of time also independently accounted for decreased depressive symptoms ($B = -1.653$, $SE = 0.235$, $p < 0.001$). Age ($p = 0.67$) and psychiatric comorbidity ($p = 0.48$) were not significant predictors of change in the multi-variable model.

Discussion

The main aim of the current study was to examine change in psychological outcomes for adolescents with AN who received outpatient family-based or individual treatment, and specifically the extent to which weight restoration promoted parallel improvements in psychological outcomes. Most psychological symptoms improved significantly from baseline to 12 month follow-up, regardless of treatment type. Depressive symptoms and dietary restraint were most improved, followed by moderate improvements in global eating disorder pathology and eating concerns. These improvements were each clinically significant as well, with average baseline scores in the clinical range and follow-up scores in a normative range. Effect sizes for weight and shape concerns were small, and there was no significant improvement in self-esteem, although their initial scores fell within a normative range. Close to two-thirds of the variance in psychological change was accounted for by between-person differences, regardless of time, with the exception of shape concerns, suggesting that individual differences largely accounted for change in psychological outcomes, but that within-individual factors over time largely accounted for change in shape concerns.

Weight gain emerged as a significant predictor of improved psychological outcomes, including global eating disorder pathology, eating concerns, and dietary restraint. However, the impact of weight restoration on symptoms diminished over the two-year treatment and follow-up period, revealing that earlier weight restoration had the greatest impact on symptom improvement. In contrast, depressive symptoms but not eating disorder pathology tended to abate over time even in the absence of weight gain. Several clinical variables (i.e., initial severity of eating disorder symptoms, duration of illness, and AN subtype) also predicted psychological improvement. Adolescents with greater overall eating psychopathology and longer duration of illness at baseline had faster reductions in depressive symptoms, while adolescents with AN binge-eating/purging type had faster improvements in concerns about weight, shape, and eating, as well as dietary restraint. Although these effects did not hold in multivariable analyses, prior psychiatric hospitalization and psychiatric comorbidity also predicted faster improvement in bivariate analyses. Together, these findings suggest that adolescents who present with more severe, complex, and enduring clinical presentations of AN actually benefit more psychologically from treatment. This improvement might be explained in part by regression to the mean, but it nevertheless validates the capacity of such patients to benefit from treatment.

Unfortunately, weight and shape concerns were least amenable to change and were not influenced by weight restoration. On the one hand, this suggests that weight gain does not lead to increased dissatisfaction with weight and shape in adolescents with AN; on the other hand, it also indicates that weight restoration in and of itself is not sufficient to ameliorate weight and shape concerns characteristic of AN. This is in keeping with a treatment study of

young adults with AN, finding that weight restoration was not associated with improvements in body image anxiety nor body avoidance behaviors, and indeed that individuals at higher weights had greater body image anxiety (Bamford, Attoe, Mountford, Morgan, & Sly, 2014). Another study found that body dissatisfaction in young adults with full and subthreshold AN is similar regardless of weight status (Santonastaso et al., 2009). While similar research in adolescents with AN is sparse, weight and shape concerns appear to increase with BMI percentile in adolescent girls at large, with higher body dissatisfaction in girls starting at the 50th BMI-for-age percentile (Calzo et al., 2012). While it is unclear how these findings might apply to a clinical sample, one might hypothesize that weight and shape concerns may begin to increase in adolescent girls with AN after surpassing their EBW.

Interestingly, FBT and AFT were relatively equivalent with respect to improvement in eating-related psychological symptoms, which was unexpected given that recovery (i.e., reaching 95% EBW and scoring within 1 SD of norms on the global EDE) is superior in FBT (Lock et al., 2010). Given the initial focus in FBT on weight restoration, one barrier to implementing FBT may be the perception that FBT does not adequately address comorbid symptoms. While the face validity of AFT to directly address psychological symptoms is higher, given its focus on factors that might maintain AN (Fitzpatrick et al., 2010), it was no more efficacious than FBT in impacting psychological improvement. Indeed, psychological gains were achieved with FBT in the relative absence of psychotherapeutic strategies targeting eating disorder cognitions or depressive symptoms (Lock & Le Grange, 2013). This is of great clinical relevance, supporting the theory that early weight restoration should be a high priority treatment target given its impact on psychological recovery, regardless of treatment type or whether weight gain is undertaken by the adolescent or his/her parent(s).

This is the first study to specifically examine the relationship between change in weight and psychological symptoms over two years following initiation of outpatient treatment for adolescent AN. It has several important strengths, including a relatively large sample size for a study of adolescent AN, the use of manualized treatments, assessment with well-validated measures, and multi-level analysis that accounted for the hierarchical data structure. Nevertheless, a comprehensive understanding of psychological improvement was limited by the fact that anxiety symptoms were not assessed in this study. In addition, change in eating disorder psychopathology was limited to pre- and post-treatment assessment given the burden of completing the EDE. Other within-treatment predictors were also limited, and a variety of psychotherapy process (e.g., therapeutic alliance) may have contributed to both weight gain and improvement in psychological symptoms. Finally, these results may not be generalizable to older samples or non-outpatient settings, and indeed previous studies have more often found no association between weight and psychological symptoms (Coulon et al., 2009; Kawai et al., 2008; Mattar et al., 2012) than a negative association (Eckert et al., 1982; Laessle et al., 1988) for adults with AN receiving inpatient treatment. Nevertheless, the premise behind cognitive behavior therapy is that dietary change to promote weight gain is necessary to facilitate outpatient recovery in AN (Fairburn, 2008; Garner, Vitousek, & Pike, 1997). It is unclear whether the impact of weight gain on psychological symptoms would be comparable in an older and/or more severe sample, but a recent study found that patients with severe and enduring AN demonstrated substantial improvements in both weight and psychological outcomes across two treatments, in spite of a relative de-emphasis on weight gain (Touyz et al., 2013). Therefore, weight gain may be important to recovery across ages, severity level, and treatments, but future research is needed to

directly examine this interaction, as well as to better understand how to promote weight gain in treatment.

This study highlights the importance of weight restoration as a treatment target directly associated with psychological improvement for adolescent AN, and it supports previous research emphasizing the importance of early and swift weight gain to achieve full remission in AN (Doyle, Le Grange, Celio-Doyle, Loeb, & Crosby, 2010; Le Grange, Accurso, Lock, Agras, & Bryson, 2014; Lock et al., 2006). In addition, these data refute the perception that psychological symptoms cannot improve if they are not directly targeted. Unfortunately, however, current treatments for adolescent AN are not very efficacious in reducing weight and shape concerns, and future research is needed to refine existing treatments or develop new treatments that more effectively target these symptoms. Future research is also needed to examine whether these findings are generalizable to anxiety symptoms, as well as across eating disorders and adult populations. While this study demonstrates the efficacy of both treatments with respect to psychological improvement, it does not undermine the suitability of additional treatment for comorbid symptoms, when clinically indicated after completing treatment for AN.

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