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## Relationship of food addiction to weight loss and attrition during obesity treatment

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### Abstract

**Objective**—This study prospectively examined the relationship between food addiction (FA) and weight and attrition outcomes in overweight and obese adults participating in weight loss interventions.

**Design and Methods**—Participants were 178 adults ( $51.2 \pm 11.7$  y,  $36.1 \pm 4.8$  kg/m<sup>2</sup>) in one of two outpatient weight-loss treatment programs for approximately six months. The Yale Food Addiction Scale (YFAS) assessed FA diagnosis and symptom count. The relationship between FA and weight loss and attrition was assessed.

**Results**—After controlling for treatment arm, gender and baseline weight, there was no effect of FA status on weight loss ( $p=0.17$ ) or attrition ( $p=0.37$ ). Similarly, baseline FA symptom count was not associated with weight loss ( $p=0.14$ ) or attrition ( $p=0.10$ ).

**Conclusions**—Neither FA status nor symptom count affects weight loss or attrition during weight loss treatment.

### Keywords

food addiction; weight loss; attrition

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### Conflicts of Interest Statement

MRL – no conflicts of interest to disclose

DME – no conflicts of interest to disclose

TAW – serves on the advisory boards of Novo Nordisk and Orexigen Therapeutics

EG – no conflicts of interest to disclose

GDF – Dr. Foster is a consultant with Nutrisystem, Inc.

## Introduction

The “food addiction” (FA) phenotype mirrors behaviors typically associated with addiction to drugs or alcohol (1-4). Historically, lack of consensus on the definition and measurement of FA made research on this topic difficult to meaningfully synthesize and interpret. In 2009, the development of the Yale Food Addiction Scale (YFAS) provided the first measure of FA (5). The YFAS translates the diagnostic criteria for substance dependence (6) into potential criteria for FA. Clinical characteristics include eating more than intended for longer periods of time, overeating despite known negative consequences, tolerance (consuming more to achieve desired effects), withdrawal (agitation, anxiety or other physical symptoms experienced after cutting down on certain foods), repeated attempts to cut down on consumption, increasing time spent eating or planning food-related activities, and distress or functional impairment (5).

Prevalence estimates of FA range from 11% in predominantly healthy weight undergraduates to 15.2%-19.6% in obese treatment-seeking adults (7, 8), to 42% in bariatric surgery candidates and to 57% in obese adults with binge eating disorder (BED) (5, 9-11). Despite burgeoning evidence of the presence of FA in obese populations (9-11), the clinical significance of FA in both the development and treatment of obesity remains unclear. To the best of our knowledge, only one study to date has examined the impact of FA on subsequent weight loss in overweight and obese adults (7). Burmeister and colleagues (7) found greater FA symptomatology to correlate with poorer short-term weight loss following a brief behavioral weight loss intervention. However, FA symptomatology models were not significant when they also included binge eating. The small sample size ( $n=57$ ), short intervention duration (7 weeks), and predominately Caucasian (84%) sample limit interpretation and generalizability of these findings. Further, this study did not assess the impact of a categorical FA diagnosis on weight loss or attrition. .

The purpose of this study was to prospectively examine the relationship between baseline FA status and symptom count and weight and attrition outcomes in a large sample participating in behavioral weight loss interventions. Specifically, we sought to determine if obese, treatment-seeking individuals with greater food addiction symptomatology or those with a food addiction diagnosis (status yes/no) lose significantly less weight or have greater attrition than individuals with fewer FA symptoms or no diagnosis. We hypothesized that 1) adults who met criteria for FA at baseline would experience significantly less weight loss after behavioral treatment than those without FA; 2) greater FA symptom counts at baseline would be inversely associated with weight loss; and 3) FA status and greater FA symptoms would be associated with greater attrition.

## Methods and Procedures

Participants were enrolled in one of two weight loss studies conducted at Temple University and The University of Pennsylvania between January 2010 and July 2011. Both studies recruited participants with a body mass index (BMI) 25.0-50.0 kg/m<sup>2</sup> via newspaper advertisements, flyers, and physician referrals. Participants in both studies provided written,

informed consent. The study was approved by the institutional review boards of Temple University and The University of Pennsylvania.

### Study 1 Intervention

This study examined changes in body weight and glycemic control in obese individuals with type 2 diabetes who participated in behavioral weight loss treatment over 6 months (13). One hundred participants (mean age=55.6 ± 10.6 y, BMI=35.8 ± 5.3 kg/m<sup>2</sup>, 59% African American) were randomized to a lifestyle intervention that included portion-controlled meals or to a program of diabetes self-management education with the primary goal of weight loss. Participants attended nine, 90-minute behavioral weight management group sessions led by health professionals and were instructed to consume 1250 kcal/d - 1550 kcal/d. Participants were also asked to progressively increase physical activity to 200 minutes/week.

### Study 2 Intervention

This study examined whether an enhanced behavioral treatment (EBT) that included emotion regulation and mindfulness-based skills training for emotional eaters resulted in greater weight loss and reductions in emotional eating at treatment completion (5 months) than did a standard behavioral treatment (SBT). Participants were 78 overweight or obese adults (mean age=45.6 ± 10.6 y, BMI=36.4 ± 4.2 kg/m<sup>2</sup>, 82.1% African American). Participants were randomized to either EBT or SBT and attended weekly 90-minute groups for 5 months. Participants had weekly calorie (1200-1500 kcal/d for women; 1500-1800 kcal/day for men) and exercise goals. The results of this study are not yet available.

### Measures

**Demographic information**—Participants provided self-reported demographic information from the Weight and Lifestyle Inventory (WALI) (14), including age, education and race.

**Yale Food Addiction Scale (YFAS)**—The YFAS (5) is a self-report questionnaire that assesses FA over the past year (Cronbach's alpha = 0.92) (10). We modified this scale (changed "past year" to "past month") with approval from scale developers to examine FA at baseline and at the end of treatment. The YFAS adapts the criteria for substance dependence (6) to eating behaviors: 1) greater quantity and for longer than intended; 2) desire or unsuccessful attempts to cut down; 3) large amount of time and effort to obtain, use, and recover; 4) social, occupational or recreational activities given up or reduced; 5) continued behavior despite consequences; 6) tolerance; and 7) withdrawal. For the diagnostic scoring of the YFAS (FA status yes/no), an additional criterion of clinically significant impairment is required (e.g., food and eating causes significant distress; difficulties functioning effectively because of food and eating behaviors) in addition to 3 or more of the 7 symptoms (5). We examined FA using both baseline FA status (yes/no; measured categorically as 3 or more symptoms + clinically significant distress/impairment) and FA symptom count (measured continuously, possible range of 0-7; clinically significant distress/impairment is not included in this count).

**Height and weight**—Weight was measured to the nearest 0.1 kg on a calibrated digital scale and height to the nearest 0.1 cm using a wall-mounted stadiometer. Participants were measured without shoes and while wearing light, indoor clothing. We calculated BMI (weight in kg/height in m<sup>2</sup>) using these height and weight measurements.

### Statistical Analyses

We conducted three sets of analyses: 1) intention-to-treat analyses (baseline carried forward) using general linear models that evaluated the relationship between baseline FA status (yes/no) and weight loss at the end of treatment; 2) intention-to-treat analyses (baseline carried forward) using linear regression (enter method) that evaluated the relationship between FA symptom count and weight loss; and 3) correlations, Fisher's exact and independent t-tests that examined the relationship between FA status/symptom count and attrition. Weight-related analyses controlled for treatment arm, gender and baseline weight. Differences between completers and non-completers at baseline were assessed by using independent samples t-tests and chi-square tests for categorical variables. When assumptions for parametric statistics were not met, inverse transformations or non-parametric tests were employed. A completer's analysis using general linear models and regression was conducted for sensitivity. The Brown-Forsythe was used to determine heterogeneity of variance in weight loss by FA status. Significance levels were set at  $p < .05$ .

## Results

### Sample

The sample was 178 adults ( $51.2 \pm 11.7$  y,  $36.1 \pm 4.8$  kg/m<sup>2</sup>) who participated in outpatient weight-loss treatment. The majority of participants were obese (92.1%), female (74.7%) and African American (69.1%). Sample characteristics are described in Table 1.

### Attrition

Of the 178 participants who began treatment, 154 completed the trial (86.5%). Completers were older (mean= $52.4 \pm 11.4$  y) than non-completers (mean= $44.0 \pm 10.6$  y),  $p = 0.001$  but did not differ significantly by race ( $p = 0.34$ ). Only 2.2% of males discontinued treatment compared to 17.3% of females ( $p = 0.01$ ).

### Weight Change

Participants reduced body weight by  $-4.6 \pm 5.6$  kg ( $p < 0.001$ ) at the end of treatment. Participants from Study 1 and Study 2 lost comparable weight at the end of treatment ( $-4.5 \pm 5.2$  kg versus  $-4.7 \pm 6.0$  kg,  $p = 0.86$ ). Males lost more weight than females ( $-6.8 \pm 7.5$  kg versus  $-3.8 \pm 4.6$  kg,  $p = 0.02$ ) and, therefore, we controlled for sex when examining the relation of YFAS to weight loss. No differences in weight change were found by race (AA or Other) ( $p = 0.12$ ) or age ( $p = 0.92$ ). Baseline weight correlated with weight change at the end of treatment and was controlled for in subsequent analyses ( $r = -0.22$ ,  $p = 0.004$ ).

## Weight Change, Attrition and Food Addiction

At baseline, 15.2% of participants ( $n=27$ ) met the dichotomous scoring criteria for FA status (yes/no). FA symptom count at baseline was  $2.6\pm 1.7$ . There was no effect of FA status (yes/no) on weight loss after controlling for treatment arm, sex and baseline weight,  $F(1, 173)=1.87$ ,  $p=0.17$ . Mean weight loss for FA status participants was  $-3.7\pm 4.2$  kg, while that for non-FA status participants was  $-4.8\pm 5.8$  kg (Figure 1). After controlling for treatment arm, baseline weight and sex, YFAS FA symptom count did not significantly contribute to the variance in weight change ( $\beta=-0.13$ , adjusted  $r^2=0.02$ ,  $p=0.14$ ). Variance in weight change was not significantly different by baseline FA status  $F(1, 177)=2.86$ ,  $p=0.09$ . Completer's analyses that compared weight reduction in FA ( $-4.6$  kg) and non-FA ( $-5.4$  kg) participants trended in the same direction,  $F(1, 149)=0.54$ ,  $p=0.46$ . Neither FA status ( $p=0.37$ ) nor FA symptom count ( $p=0.10$ ) at baseline were associated with attrition during treatment. Nineteen participants without FA at baseline (12.6%) and five participants with baseline FA (18.5%) did not complete treatment.

## Discussion

There were two principal findings of this study. First, the presence of FA at the start of the weight-loss program did not attenuate subsequent weight loss. Participants who met YFAS dichotomous criteria for FA prior to treatment lost comparable amounts of weight as non-FA status participants. Additionally, FA symptom counts did not significantly contribute to variance in weight loss. Burmeister et al. (7) found that higher FA symptomatology correlated with poorer weight loss. However, when FA symptomatology and binge eating scores were entered together as predictors of weight loss, FA symptoms did not significantly contribute to the variance in weight loss. Burmeister and colleagues' (7) study differed from ours in several ways, including race (predominately Caucasian versus African American), duration (7 weeks versus 5-6 months), sample size ( $n=57$  versus  $n=178$ ), and patient population (some BED versus none). Nonetheless, we also found no relationship between FA symptoms and weight loss.

Second, FA did not affect study attrition. Overall retention of participants was high (86%), and neither FA status nor symptom count at baseline was related to attrition. Clinically, our results suggest that FA is not a risk factor for ending treatment prematurely in obese adults seeking weight loss. To date, this study is the largest and longest prospective examination of FA in relation to weight loss. We also recruited a substantial proportion of African-American participants. Given our null findings regarding both weight outcomes and attrition, the significance of FA in the treatment of overweight and obesity is uncertain. Clinically, our findings indicate that FA does not negatively affect weight loss efforts. It is possible that standard weight loss interventions already treat addictive eating behaviors effectively through strategies such as self-monitoring. Alternatively, our results may indicate that FA is not clinically meaningful for obesity treatment outcomes.

There are several limitations. First, while our studies are longer than previous examinations of FA in the context of weight loss treatment, they were still of relatively short duration (5-6 months). It may be that FA exerts impact on weight loss and attrition in the long-term. Second, study participants were selected for the presence of diabetes or based on levels of

emotional eating and therefore may not be representative of all obese treatment-seekers. Future studies, with larger sample sizes, will help to clarify the relationship between FA and weight loss, and could examine changes in FA as a result of weight loss treatment. In summary, baseline FA status does not negatively affect treatment or attrition. The clinical relevance of FA in the management of obesity is unclear and requires further study.

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TAW, EG and GDF developed the study design. EG, DME, and TAW carried out this study intervention. MRL analyzed and interpreted data, conducted literature searches, and generated figures. All authors contributed to writing the manuscript and had final approval of the submitted version.

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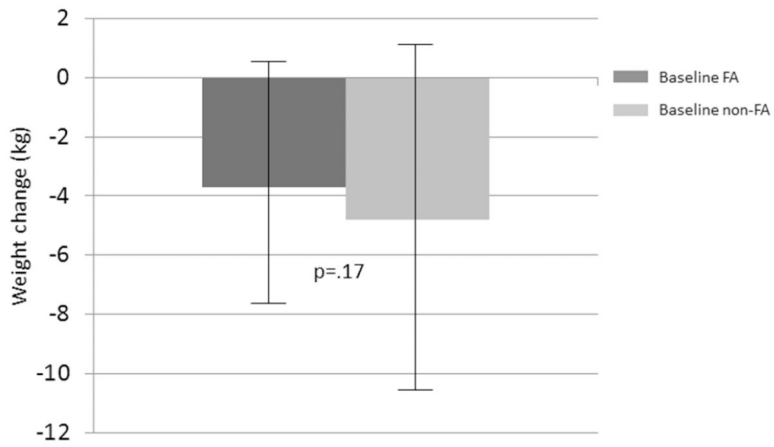
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**1. What is already known on the subject**

- Estimates of food addiction (FA) range from 15-57% among obese adults.

**2. What this study adds**

- This study examines the impact of FA status and FA symptom count on weight loss and attrition in the context of obesity treatment programs.
- This study includes a large sample of predominantly African Americans.
- FA is not associated with weight loss or attrition.



**Figure 1.** Weight change\* at the end of treatment by baseline food addiction (FA) status.  
\* Analyses controlled for treatment arm, gender and baseline weight.



**Table 1**

Sample characteristics at baseline (N=178)

	<b>Mean±SD</b>	<b>%</b>
Age (years)	51.2±11.7	
Weight (kg)	100.7±16.1	
Body Mass Index (BMI) kg/m <sup>2</sup>	36.1±4.8	
Obese (BMI ≥ 30.0 kg/m <sup>2</sup> )		92.1
Sex		
Male		25.3
Female		74.7
Race		
African American		69.1
Caucasian		25.8
Other		5.1

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