



## Research report

Pre-meal anxiety and food intake in anorexia nervosa<sup>☆,☆☆,★</sup>

Joanna E. Steinglass<sup>a,\*</sup>, Robyn Sysko<sup>a</sup>, Laurel Mayer<sup>a</sup>, Laura A. Berner<sup>a</sup>, Janet Schebendach<sup>a</sup>, Yuanjia Wang<sup>b</sup>, Huaihou Chen<sup>b</sup>, Anne Marie Albano<sup>a</sup>, H. Blair Simpson<sup>a</sup>, B. Timothy Walsh<sup>a</sup>

<sup>a</sup> New York State Psychiatric Institute, 1051 Riverside Drive, New York, NY 10032, USA

<sup>b</sup> Columbia University, 722 West 168th Street, New York, NY 10032, USA

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## ABSTRACT

Anorexia nervosa (AN) is a serious mental illness characterized by reduced caloric intake that often persists after acute weight restoration. This preliminary study assesses the relationship between pre-meal anxiety and food intake in recently weight-restored individuals with AN. We hypothesized that pre-meal anxiety is inversely related to caloric intake in AN. Caloric intake and pre-meal anxiety were measured in three laboratory-based assessments (yogurt snack, multi-item lunch, macaroni and cheese lunch). Anxiety was measured by Spielberger State-Trait Anxiety Inventory (STAI-S) administered prior to the meal. Acutely weight-restored patients with AN were compared with healthy controls (HCs). Associations between anxiety and intake were analyzed first within each meal type separately and then using a model to combine the sample. In the multi-item lunch and the macaroni and cheese lunch, AN ate significantly less than HC ( $p = 0.01$ ,  $p < 0.001$ ). Pre-meal anxiety was significantly correlated with intake among AN, but not HC. In the yogurt snack, there was no significant association between anxiety and intake among patients or controls, and the groups did not differ in caloric intake. The association between pre-meal anxiety and intake among weight-restored individuals with AN suggests a potential target for relapse prevention treatment.

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## Introduction

Anorexia nervosa (AN) is a serious psychiatric illness with a mortality rate among the highest of any psychiatric illness (Papadopoulos, Ekblom, Brandt, & Ekselius, 2009). Mortality increases over time, and is estimated to be 5% per decade of illness (Sullivan, 1995). The disorder is characterized by severe weight loss, body image distortions/overemphasis on shape and weight, and fear of “fat” or weight gain. Initial treatment focuses on restoring normal weight and structured behavioral treatment programs are generally successful in achieving this goal. However, the relapse rate after acute weight restoration is substantial, with as many as 50% of patients requiring re-hospitalization within the year after discharge (Pike, 1998). Although many psychological

symptoms improve with weight gain, often to within normal limits (Attia, Haiman, Walsh, & Flater, 1998), significant problems with food choice and caloric intake persist (Sysko, Walsh, Schebendach, & Wilson, 2005). Specifically, dietary choices made by weight-restored patients on an inpatient unit have been shown to be associated with outcome such that those who made food choices lower in energy density and diet variety, even with similar caloric intakes, were more likely to have a poor outcome in the year following discharge (Schebendach et al., 2008). Understanding the factors associated with the persistence of dysfunctional eating behavior after acute weight restoration may suggest novel targets for treatment.

The persistence of dysfunctional eating behaviors in individuals with AN may be related to anxiety (Steinglass et al., 2010). We recently proposed a model of AN linking eating behavior with anxiety. Baseline anxiety and obsessiveness lead to fear of food, avoidance of food, and rigid dieting behavior. These factors interact and lead to weight loss. Weight loss in turn increases baseline anxiety and obsessiveness and serves to perpetuate the cycle of dysfunctional eating behavior. In support of this model, a previous study by our group found that patients, even after weight restoration and improvement in many psychological symptoms, continued to significantly restrict their eating during a laboratory test meal (Sysko et al., 2005). A subsequent study demonstrated that repeated presentation of the same laboratory meal, with a

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\* Corresponding author.

E-mail address: [js1124@columbia.edu](mailto:js1124@columbia.edu) (J.E. Steinglass).

therapist present for encouragement, led to increases in total intake (Steinglass et al., 2007). To begin to address the question of the relationship between pre-meal anxiety and food intake in weight-restored individuals with AN, we combined data from three ongoing studies that each include a laboratory-based eating assessment. We hypothesized that pre-meal anxiety would be inversely related to caloric intake among individuals with AN. As a preliminary test of this hypothesis, we examined each meal study separately and then pooled these data to create one model and thereby increase power to detect an effect.

## Methods

### Subjects

Participants were recently weight-restored women with AN ( $n = 27$ ), inpatients and outpatients, and healthy controls (HC,  $n = 23$ ) enrolled in one of three ongoing eating behavior studies at the Columbia Center for Eating Disorders at the New York State Psychiatric Institute (NYSPI). Some individuals participated in more than one study (as described in more detail below). HC were healthy women with no current or prior eating disorder or any other psychiatric illness, as assessed by Structured Clinical Interview for DSM-IV (First, Spitzer, Gibbon, & Williams, 1995) and Eating Disorder Examination (Cooper & Fairburn, 1987) and no significant medical illness, as assessed by a clinical interview with an M.D. HC were recruited from the Columbia University and Medical Center campuses.

Patients with AN were included if they were between the ages of 16 and 45 years (for the multi-item lunch, the minimum age was 18 years) and met criteria for AN with or without amenorrhea (Attia & Roberto, 2009) at the time of hospital admission. Patients with AN participating in the yogurt snack and the multi-item lunch were receiving inpatient treatment on the Eating Disorders Unit at NYSPI and had achieved normal weight. Patients with AN participated in the macaroni and cheese lunch within 1 week of completing the inpatient treatment program, after hospital discharge, and were enrolled in outpatient relapse prevention treatment at the Eating Disorders Clinic. Inpatient treatment consisted of a structured, behavioral program (Attia & Walsh, 2009) and patients were weight restored to at least 90% of ideal body weight ( $BMI \approx 19.7 \text{ kg/m}^2$ ) as defined by the Metropolitan Life actuarial tables (MetropolitanLifeInsurance, 1959). Height and weight were measured by calibrated beam balance scale (Detecto, Webb City, MO). All test meals occurred in the eating behavior laboratory at the Biological Studies Unit of NYSPI. All studies were approved by the Institutional Review Board of NYSPI, and written informed consent was obtained prior to participation.

### Procedures

The three studies of eating behavior in AN are described below.

#### *Study utilizing a yogurt snack*

Inpatients with AN participated in the test snack within 1 week after weight restoration. A standardized breakfast (300 kcal) was provided to patients ( $n = 10$ ) and HC ( $n = 10$ ) at 8 a.m. and participants were asked to consume nothing else until the test snack at 10 a.m. Three patients with AN and two HC participated in a test snack at 3 p.m., and received a standardized lunch at noon consisting of 580 kcal (instead of the standardized breakfast). Participants were administered the Spielberger State-Trait Anxiety Inventory, State version (STAI-S) (Spielberger, Gorsuch, & Lushene, 1970) immediately prior to entering the testing room. After a 3 min acclimation period, a tray with a large bowl of vanilla yogurt, a large spoon and a napkin were provided to participants, who were

instructed to eat a sufficient snack. This particular instruction was intended to focus the assessment on the individual's eating-related anxiety and to mitigate anxiety around choosing whether to eat during this meal, and was developed from previous experience with laboratory meals. However, the impact of this instruction on the individual's behavior was not evaluated. The bowl contained approximately 700 g of yogurt (550 kcal, 12.9% fat, 62.8% CHO, and 24.8% protein).

#### *Study utilizing a multi-item lunch*

Inpatients with AN participated 1–2 weeks after achieving weight restoration. Patients ( $n = 23$ ) and HC ( $n = 20$ ) received a standardized breakfast (300 kcal) at 8 a.m. and did not eat or drink until the test lunch was served at 1 p.m. Participants entered the testing room, where a multi-item buffet was arranged on the table and completed the STAI-S upon viewing the food in the buffet. Participants were instructed to eat as much as they liked. The multi-item buffet consisted of Stouffers macaroni and cheese, French fries, white and wheat bread, tuna, pickles, tossed salad, condiments, fruit salad, grilled chicken, fried chicken, popcorn, candy, cookies, doughnuts, ice cream, water, soda, and juice (a total of 15,000 kcal were available; details provided upon request).

#### *Study utilizing a macaroni and cheese lunch*

Patients with AN were acutely weight restored as inpatients and participated in testing within 1 week of hospital discharge. Test lunch occurred at noon. Patients ( $n = 11$ ) and HC ( $n = 10$ ) were instructed to eat a standardized breakfast (300 kcal) at 8 a.m. and not to eat or drink between breakfast and the lunch test meal at 12 p.m. Compliance with the standardized breakfast procedure was ascertained verbally prior to the test meal. Participants were administered the STAI-S immediately prior to entering the testing room. The participant was served a tray with a large bowl of macaroni and cheese (Stouffer's, heated according to package instructions), an 8 oz bottle of water, a fork, a large spoon, and a napkin. The participant was instructed to eat a sufficient lunch. The bowl contained 1000 g of macaroni and cheese (1557 kcal, 42.2% fat, 40.2% CHO, and 17.5% protein).

For all test meals, patients were not informed of the caloric content of the meal. Intake was calculated by measuring the weight of the food (Acculab 7200 balance, readability 0.1 g) before and after the meal and calculating calories consumed based on kcal/g weight of the foods.

Individuals completed additional self-report psychological assessments of anxiety and depression, including the Spielberger State-Trait Anxiety Inventory, Trait version (STAI-T) (Spielberger et al., 1970), the Beck Anxiety Inventory (BAI) (Beck, Epstein, Brown, & Steer, 1988), and the Beck Depression Inventory (BDI) (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961).

### Data analysis

Continuous demographic and clinical measures in AN and HC groups were compared by two-sample *t*-test. Pearson correlation coefficients were calculated between anxiety measures (STAI-S) and intake for AN and HC and were compared by applying Fisher's *Z*-transformation (Kleinbaum, Kupper, Nizam, & Muller, 2007). Anxiety measures in AN were compared across three meal types by ANOVA.

To increase power, these data were combined to create a statistical model in which the relationship between pre-meal anxiety and caloric intake could be tested. Generalized estimating equation (GEE) (Liang & Zeger, 1986) was used to model the relationship between mean anxiety measures and intake, adjusting for age, BMI and meal type. Correlation between repeated measures of anxiety scores on the same subject (some subjects participated in more than one meal type) was accounted for by

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