



Computerized measurement of anticipated anxiety from eating increasing portions of food in adolescents with and without anorexia nervosa: Pilot studies



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ABSTRACT

Dieting and excessive fear of eating coexist in vulnerable individuals, which may progress to anorexia nervosa [AN], but there is no objective measure of this fear. Therefore, we adapted a computer program that was previously developed to measure the satiating effects of foods in order to explore the potential of food to induce anxiety and fear of eating in adolescent girls. Twenty four adolescents (AN) and ten healthy controls without eating disorders rated pictures of different types of foods in varying sized portions as too large or too small and rated the expected anxiety of five different portions (20–320 kcal). Two low energy dense (potatoes and rice) and two high energy dense (pizza and M&Ms) foods were used. The regression coefficient of line lengths (0–100 mm) marked from “No anxiety” to “this would give me a panic attack”, regressed from portions shown, was the measure of “expected anxiety” for a given food. The maximum tolerated portion size [kcal] (MTPS), computed by method of constant stimulus from portions shown, was significantly smaller for high energy dense foods, whereas the expected anxiety response was greater, for all foods, for patients compared to controls. For both groups, expected anxiety responses were steeper, and maximum tolerated portion sizes were larger, for low, than high, energy dense foods. Both maximum tolerated portion size and expected anxiety response were significantly predicted by severity of illness for the patients. Those who had larger maximum tolerated portion sizes had smaller anticipated anxiety to increasing portion sizes. Visual size had a greater influence than energy content for these responses. This method could be used to quantify the anxiety inducing potential of foods and for studies with neuro-imaging and phenotypic clarifications.

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1. Introduction

Patients with Anorexia Nervosa (AN) are extremely fearful of any attempt to encourage weight gain, and they are noted for denial of many of their symptoms (Halmi, 2007). The creation of a non-threatening objective test to measure the extent of their fearfulness/anxiety specifically towards food would be a most helpful assessment of the patients' conditions before, during, and after treatment. Therefore this study was undertaken to develop methods to generate these measurements and as such is the first study, we know of, to do so.

Clinicians and family members have observed over many decades that patients with anorexia nervosa (AN) are preoccupied

with the calorie content and portion size of foods (Halmi, 2007). There is also functional evidence (Ellison et al., 1998) that patients with AN have a fear of eating high-calorie foods, which may be characterized as a food phobia (Kleinfeld, Wagner, & Halmi, 1996). Hence, these observations provide the rationale for regarding AN in part as a food phobia and developing new cognitive-behavioral techniques for treating AN. Although many aspects of eating behavior, food preferences and aversions have been systematically studied in AN patients, there are surprisingly few studies comparing visual presentation of portion sizes and the energy density of foods on anxiety responses. However, two studies suggest that patients with anorexia perceive small portions of food to be larger than controls do (Milos et al., 2013), and rated energy dense food items 12% larger compared to controls' perceptions (Yellowlees, Roe, Walker, & Ben-Tovim, 1988).

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In related studies, anxiety ratings were elicited in AN patients with pictorial stimuli of food, but not to food-word stimuli (Nikendei et al., 2008). The authors suggested that the patients concentrated more on the physical features of pictures than on semantic information. Previous studies demonstrated that AN patients dislike high-fat foods and often avoid high carbohydrate foods while preferring sweet taste (Drewnowski, Halmi, Pierce, Gibbs, & Smith, 1987; Drewnowski, Pierce, & Halmi, 1988; Nikendei et al., 2008; Sunday, Einhorn, & Halmi, 1992).

Since cooperation and compliance with assessments and treatment are common problems with AN patients (Crisp & Kalucy, 1974) we thought it worthwhile to devise a measurement in which patients would readily engage and would also indicate an anxiety response to both the energy density and portion size of foods commensurate with severity of illness. We adapted the computerized tasks developed by Brunstrom (Brunstrom & Rogers, 2009; Brunstrom, Shakeshaft, & Scott-Samuel, 2008) so that instead of matching portions for equivalence of satiation, portions were matched in the participant's mind for the maximum that participants could tolerate eating without distress, and that portion was designated the "maximum tolerated portion size (MTPS)" (see also "methods" for further explanation). In addition we measured expected anxiety responses with a computerized visual analog scale as portion sizes increased using foods with different energy densities and nutrient compositions.

We expected that patients would choose smaller MTPSs and show increased expected anxiety as portions increased than controls, and that high energy dense foods would drive expected anxiety higher, and portion size lower, than low energy dense foods, per unit energy, in patients compared to controls. Because these were pilot studies, we could not determine effect size or variability, and therefore we could not set power level in advance, but we report these with statistical inference to demonstrate the potential of the methods, and to provide sufficient data for verification in future studies. Any significance level should be interpreted mainly as a potential testable hypothesis for the future.

2. Methods

2.1. Participant selection

Twenty-three females and one male (identified as letter "D" on Figs. 3 and 4) with AN between the ages of 12–18 were recruited from a concurrent NIH Family Therapy Study (Principal Investigator- KH) and the Outpatient Services of the Westchester Division of the New York-Presbyterian Hospital, between October 2, 2008 and June 16, 2010. All patients met DSM-IV (the manual in use at that time) diagnosis for AN determined by the Structured Clinical Interview (First, Gibbon, Spitzer, & Williams, 1996) administered by a PhD Clinical psychologist trained and approved in the assessment for the NIH study. Ten healthy adolescent controls (two males, identified with letters "a" and "e" on Figs. 3 and 4) with an average age of 14.6 ± 2.63 were obtained between August 16, 2010 and January 22, 2012, from community news advertisements and determined free of DSM-IV diagnostic criteria by a structured interview from a MA psychologist, trained and certified for the DSM-IV interview (First et al., 1996).

Informed consent and assent for minors was obtained in written form from all potential participants and their parents. The study was approved by the Institutional Review Board of Weill-Cornell Medical College.

2.2. Assessment

The Yale-Brown-Cornell Eating Disorder Scale (Mazure, Halmi,

Sunday, Romano, & Einhorn, 1994) was used to assess the severity of eating disorder symptomatology. This scale is based on the structure and format of the Yale-Brown Obsessive–Compulsive Scale, which assesses type and severity of obsessive–compulsive symptomatology. The YBC-EDS is a semi-structured, clinician-administered interview. Four scores are obtained from the YBC-EDS: preoccupations, rituals, total (the sum of preoccupations and rituals scores), and motivation to change (the sum of the resistance, insight, and desire for change scores for both preoccupations and rituals). The YBC-EDS was selected as an assessment in this particular study because it is a good indicator of participant stress and anxiety level. Many questions relate specifically to anxiety level associated with typical eating disorder preoccupations, as well as related anxiety, if prevented from performing eating disorder rituals. Nevertheless it does not assess anxiety, per se. Rather, it is a comprehensive measure of many factors besides food preoccupations and rituals contributing to illness severity in AN, and to motivation to change. Both current and highest experienced severity were recorded, but only the current severity is reported in this paper. Recent studies revealed that the YBC-EDS predicts treatment completion (Halmi et al., 2005) and post-treatment relapse (Halmi et al., 2002). The sensitivity of the YBC-EDS to changes after psychotherapy was established when its scores were significantly different in those with good versus poor global outcome after therapy (Jordan et al., 2009).

The YBC-EDS was not given to controls because we were only interested in determining whether severity of illness in the AN as measured on the YBC-EDS could predict behavior responses to maximum tolerated portions and increasing expected anxiety to increasing portions. Also we did not want to introduce the controls to many of the signs and symptoms of AN that are present on the YBC-EDS, for fear that this might alter their responses or upset them in some way. Furthermore in persons without ED as determined by interview, it is rare to find any pathology on the YBC-EDS (Mazure et al., 1994).

2.3. Overall procedure

Four categories of pictured foods were tested based on findings from previous investigations of AN patients food cognitive sets and preferences. We compared energy-dense high fat foods (See Table 1 for composition and energy density of foods pictured) with and without sweet taste (M&M's and Pizza) with bland tasting high carbohydrate, less energy-dense foods (potatoes & rice). These foods are also common components of the American diet.

Participants were positioned in front of a computer screen and asked to participate in the following tasks, which were conducted in the order stated below. There were short breaks between each task so that the experimenter could explain them to the participant.

The order of food presentation within tasks was randomized for all tasks except MTPS for which the order was counterbalanced by means of Latin Squares for each group of four participants. Each task for a particular food was completed before the next food was shown. For ideal and typical portion size tests each food was shown twice, once starting with display of the largest portion, the second time starting with the smallest in random order:

2.4. Maximum tolerable portion size

This variable was measured using a variant of the method of constant stimuli (previously developed at The University of Bristol (Brunstrom et al., 2008)). In this version participants were shown a picture of the same food over 56 trials on a computer screen. The portion size of the food changed according to an algorithm described below as the participant responded to the question: **"Imagine you were going to eat ALL of this food. Would this**

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