Appetite 105 (2016) 298–305

Contents lists available at ScienceDirect

Appetite

journal homepage: www.elsevier.com/locate/appet

Impact of short-term refeeding on appetite and meal experiences in new onset adolescent eating disorders

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ARTICLE INFO

Article history:
Received 23 October 2015
Received in revised form
2 May 2016
Accepted 31 May 2016
Available online 2 June 2016

Keywords:
Anorexia nervosa
Hunger
Satiety
Re-feeding

ABSTRACT

Restrictive eating disorders (ED) are increasing and represent a serious risk to the health of adolescent females. Restrictive ED in youth are often treated through aggressive short-term refeeding. Although evidence supports that this intervention is the "gold standard" for improving ED outcomes in youth, little research has specifically probed appetite and meal-related responses to this type of intensive, short-term refeeding in newly diagnosed individuals. Information about appetite and meal-related dysfunction could provide valuable insights regarding treatment-interfering features of ED in both acute inpatient and longer-term outpatient treatment. The purpose of this study was to evaluate the hunger, fullness, olfactory, and gustatory responses of adolescents with newly-diagnosed restrictive ED and to probe how and when these responses are altered by refeeding. Using a quasi-experimental ecologically valid methodology, this study described and compared profiles of hunger, fullness, olfactory, and gustatory responses in adolescent females ($n = 15$) with newly diagnosed restrictive ED at hospital admission (i.e., severe malnutrition) and after medical refeeding, in comparison to healthy controls ($n = 15$). Results showed that newly diagnosed (i.e., malnourished) adolescents with ED showed significantly different meal-related experiences than controls. Refeeding improved some of these differences, but not all. Following refeeding, females with ED continued to show lower hunger, greater fullness, and lower pleasantness of smell ratings compared to controls. Unpleasantness of taste ratings maladaptively increased, such that females who were re-fed reported more aversive scents than pre-treatment. Profiles of meal-related responses were also identified and compared between groups. The applicability of these findings are discussed within the context of critical periods of change during refeeding treatment and potentially promising intervention targets that might enhance treatment outcomes for adolescents with newly onset, restrictive ED.

Eating disorders (ED) are a serious concern among adolescent and young adult women, ranking as the third most common chronic disorder, behind obesity and asthma (Fisher et al., 1995; Golden, 1997; Medicine, 1995a, 1995b; Rohde, Stice, & Marti, 2015; Smink, van Hoeken, & Hoek, 2013). ED rates are on the rise, particularly among children and adolescents, without discrimination of race or social classes, in progressively younger populations throughout the United States and the world (Crago, Shisslak, & Estes, 1996; Forman-Hoffman, 2004; Golden, 1997; Reijonen, Pratt, Patel, & Greydanus, 2003; Walcott, Pratt, & Patel, 2003).

With respect to etiology, interdisciplinary approaches uniquely characterize the onset and maintenance mechanisms of ED as dynamic and multi-systemic. The neurobiological approach is one such theory which conceptualizes ED as an interaction of neurobiology, neuropsychology, and psychopathology (Frampton, Hutchinson, Watkins, & Lask, 2012). Within this model, the etiology of ED is posited as an underlying abnormality, dysfunction or disconnection of brain circuitry that regulates behavior, structural and functional differences in the brain, cognition, emotion,

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http://dx.doi.org/10.1016/j.appet.2016.05.037
0195-6663/

appetite, and visual processing (Frampton et al., 2012; Phillipou, Rossell, & Castle, 2014).

Neurobiological research provides a framework for studying appetite dysfunction in individuals with restrictive ED (e.g., anorexia nervosa) (Roessner, Bleich, Banaschewski, & Rothenberger, 2005). Andersen and colleagues assessed patients with AN-R (anorexia nervosa-restricting type), AN-BP (anorexia nervosa-binge/purge subtype), and BN (bulimia nervosa) on their visual analog ratings of hunger and fullness before and after a meal within one week of admission to an inpatient eating disorders treatment center and at discharge. All ED patients had lower hunger and higher fullness compared to healthy controls. Although their ratings of hunger increased and fullness decreased at discharge, they remained considerably different than healthy controls (Andersen, Stoner, & Rolls, 1996). Significant differences in smell and taste responses are reported in patients with restrictive ED including decreased odor identification and discrimination, and decreased gustatory sensitivity (Aschenbrenner, Scholze, Joraschky, & Hummel, 2008; Schreder et al., 2008). Aschenbrenner et al. (2008) found that gustatory and olfactory function, critical elements of pre-digestive functioning, are significantly impaired in individuals with restrictive ED but not in individuals with other types of ED diagnoses (Aschenbrenner et al., 2008). These findings suggest that gustatory and olfactory dysfunction are directly associated with hunger, malnutrition, and low-weight status. (Aschenbrenner et al., 2008; Dazzi, Nitto, Zambetti, Loriedo, & Ciofalo, 2013; Rapps et al., 2010). Subtle differences in dietary restraint have consistently predicted impaired olfactory sensitivity (Stafford, Tucker, & Gerstner, 2013) that is reversible with weight restoration. Yet, because weight restoration is a gradual and often protracted process, taste-related deficits may maintain or compromise ED recovery given that dysfunctional appetite-related sensory processing may negatively influence eating behavior (Aschenbrenner et al., 2008).

Hunger, satiety, olfactory, and gustatory changes associated with restrictive ED may render it difficult for individuals to comply with the considerable dietary intake expected during nutritional restoration. This presents a conflict for the adolescent patient, for whom re-nourishment is the gold standard treatment of new onset ED (Le Grange, Accurso, Lock, Agras, & Bryson, 2014; Lock et al., 2010; Roessner et al., 2005; Vocks, Herpertz, Rosenberger, Senf, & Gizewski, 2011). Disruption of these sensory processes may interfere with the enjoyment and reinforcement value of food, thereby hindering the individuals' ability to select recovery-promoting foods and consume expected quantities. Whereas previous research supports the use of supplementation-based olfaction enhancement for improved weight restoration (Su & Birmingham, 2002), it is generally agreed upon that the best way to modify olfactory dysfunction is through controlled weight gain (Roessner et al., 2005). However, the treatment implications are that the sensory changes associated with restrictive ED can actively discourage weight gain.

Despite existing findings regarding sensory changes in individuals with ED, questions remain about the impact of these changes on appetite and treatment outcomes for individuals with ED. No study to date has assessed sensory changes in ED over the course of the short-term refeeding process during an inpatient admission. Thus, the purpose of this study was to evaluate the hunger, fullness, smell, and taste responses in adolescents with newly-diagnosed ED. We hypothesized that the meal-related experiences of adolescents with ED would closely approximate those of healthy controls at the conclusion of refeeding.

1. Method

This study was approved by a hospital-based Institutional Review Board and conducted in accordance with current ethical standards for human subjects research. Written consent and assent was obtained from all participants and/or their caregivers before initiation of study procedures and participants were compensated for their time and effort. This study aimed to outline responses to a meal in adolescent females with newly diagnosed restrictive ED at two separate timepoints: 1) admission for newly diagnosed ED [ED-Admission] and 2) after nutritional treatment for malnutrition [ED-Refed] (Fig. 1). This research also aimed to evaluate the similarities and/or differences between these profiles for adolescent ED and typical adolescents (i.e., healthy controls).

Extending prior research, this study used a quasi-experimental paradigm (i.e., experience sampling; (Trull & Ebner-Priemer, 2009) to evaluate the following meal-related experiences: a) hunger, b) fullness, c) taste, and d) smell. Experience sampling allows the instantaneous assessment of changes in subjective affective, cognitive, and behavioral experiences of participants in response to contextual stimuli (e.g., mealtime) (Trull & Ebner-Priemer, 2009). In contrast to extant cross-sectional investigations, this study measured meal perception profiles over time for each group to examine changes at specific timepoints within each group as well as overall profile differences between groups.

1.1. Participants

Between August 2012 and June 2013, adolescent females aged 13 through 20 with a newly diagnosed restrictive ED (i.e., anorexia nervosa or eating disorder not otherwise specified; ED Group: $n = 15$) were identified through the inpatient medical team, who asked potentially eligible adolescents and their guardians for permission to contact the study staff[1]. Study staff then approached patients within 24 h of admission. Inclusion criteria for the ED group included: 1) diagnosis of a restrictive ED that was confirmed by a valid measure of eating disorder pathology (see Method); 2) ED was newly diagnosed or newly presenting (duration of $\leq$6 months); 3) patient required hospital admission for medical stabilization related to malnutrition; 4) patient evidenced a significant change in body weight that represents a deviation from prior growth or stable body weight, a significant percentage of body weight lost, and/or change in body mass index (BMI) percentiles for age. Participants in the ED group received inpatient refeeding treatment (American Psychiatric Association, 2006), and gained an average of 0.80 kg after an average of 6.40 days of treatment.

A healthy control group ($n = 15$) consisting of lean adolescent females was recruited as the study was interested in evaluating group differences that were not confounded by differences in weight/nutritional status. Controls were matched to ED group on age (±6 months ED girls' age), age at menarche (age at menarche ± 12 months of ED girl's age at menarche), race, weight (BMI percentile within 20% of ED match), and socioeconomic status (SES). Inclusion criteria for the control group included: 1) may not be currently diagnosed with an ED (as confirmed by a valid measure of ED pathology (Eating Disorders Diagnostic Scale) (Stice, Telch, & Rizvi, 2000); 2) low BMI percentile for age and height; 3) Stable body weight (no increase or decrease in body weight equal to 5% of current weight or greater during 1-month prior to enrollment).

Exclusion criteria for both study groups included: 1) English not the primary language; 2) significant past medical history (e.g., Type

[1] To prevent coercion, members of the study staff were excluded from recruitment when they were active members of the inpatient medical team.