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The association of addictive-like eating with food intake in children

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ABSTRACT

Objectives: The potential role of an addictive process in problematic eating is a growing area of interest and debate. Children are more vulnerable to the negative effects of addictive substances than adults and may be at increased risk for addictive-like eating behavior. No prior study has evaluated the association of addictive-like eating with objectively measured eating behavior in adults or children. We examined the association between "food addiction" and observed food consumption among children and whether age moderated this association.

Method: Seventy children participated in an observed dinner meal, completed a dietary recall interview, and answered the Yale Food Addiction Scale for Children (YFAS-C), a questionnaire assessing symptoms of "food addiction". Children's total calories ordered, calories consumed at dinner, calories consumed post-dinner, and a total of calories consumed at dinner and post-dinner were calculated along with their BMI percentile. We used generalized estimated equation models to investigate the relationship between the YFAS-C and food consumption.

Results: Elevated "food addiction" symptoms, but not BMI percentile, were positively associated with an increased amount of calories consumed at dinner and post-dinner. Age significantly moderated the relationship between YFAS-C and caloric intake, with only younger children exhibiting this association.

Conclusions: As the first study of objectively measured eating behavior, we found addictive-like eating scores in children were positively associated with the total amount of calories consumed. Among younger children, "food addiction" was more strongly associated with the total calories consumed than BMI percentile, highlighting the importance of assessing behavioral phenotypes when evaluating caloric intake. This association between addictive-like eating and caloric intake among younger, but not older children may be due to differences in inhibitory control and dietary restraint.

1. Introduction

The potential role of an addictive process in problematic eating is an area of growing scientific interest and ongoing debate. Animal studies demonstrate that rats given highly processed foods or intermittent access to sugar demonstrate neurobiological and behavioral indicators of addiction (i.e. tolerance, withdrawal, binging, dopaminergic downgrading) (Avena, Rada, & Hoebel, 2008; Johnson & Kenny, 2010). Neuroimaging studies in adult humans suggest overlapping neurobiological systems are activated by both drugs of abuse and highly palatable food (i.e. foods with added refined carbohydrates and fats) (Volkow, Wang, Tomasi, & Baler, 2013). Individuals with problematic eating-related (e.g. binge eating disorder, obesity) and addictive behaviors exhibit similar patterns of neural reactivity to food or drug cues, respectively (Balodis et al., 2013; Stice, Spoor, Ng, & Zald, 2009; Tang, Fellows, Small, & Dagher, 2012). However, there is not a scientific consensus on whether "food addiction" is a valid concept (Avena, Gearhardt, Gold, Wang, & Potenza, 2012; Ziauddeen, Farooqi, & Fletcher, 2012) and additional research is needed. In particular, little is known about how addictive-like eating may present in children and whether "food addiction" is associated with objectively measured caloric intake.

The Yale Food Addiction Scale (YFAS) is currently the only psychometrically validated assessment tool that to operationalize "food addiction" (Gearhardt, Corbin, & Brownell, 2009). The YFAS

Abbreviations: BMI, Body Mass Index; DSM-IV, Diagnostic and Statistical Manual of Mental Disorders IV; GEE, Generalized Estimating Equation; YFAS, Yale Food Addiction Scale; YFAS-C, Yale Food Addiction Scale for Children.

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applies the diagnostic criteria of substance dependence based upon the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) (American Psychiatric Association, 2000) to the consumption of highly palatable foods (Gearhardt et al., 2009) (see Table 1 in the Supplement materials). Elevated scores on the YFAS have been associated with increased impulsivity, higher body mass index (BMI), stronger cravings for high-fat foods in adults, and more frequent self-reported episodes of binge eating (for a review see Meule & Gearhardt) (Meule & Gearhardt, 2014). Additionally, in adults, elevated YFAS scores have been linked to genetic profiles and neural response patterns implicated in addiction (Davis et al., 2011; Gearhardt et al., 2011).

Although research on whether an addictive process may contribute to problematic food consumption in adults is growing, research in children is limited. Based on the addiction literature, children are more vulnerable to the negative effects of addictive substances than adults (Lisdahl, Gilbart, Wright, & Shollenbarger, 2013). Addictive substances are more deleterious to children, in part, by disrupting the normative development of neural and psychological processes (Brown, Tapert, Granholm, & Delis, 2000; Tapert, Caldwell, & Burke, 2004). Thus, if certain foods are addictive, children relative to adults might be at increased risk for addictive-like eating behavior. Consistent with this hypothesis, a qualitative study of messages written by overweight/obese 8-to-21 year olds on an intervention website observed that responders frequently described their relationship with food in a manner that was consistent with the DSM-IV criteria for substance dependence and 66% of participants reported feeling addicted to food (Pretlow, 2011). Merlo and colleagues (Merlo, Klingman, Malasanos, & Silverstein, 2009) reported that 33% of children receiving treatment at a pediatric lipids clinic reported that they were “sometimes” or “often” addicted to food. Further, children with higher scores on the children's version of the YFAS (YFAS-C) have increased BMIs, greater self-reported levels of emotional eating, and lower satiety responsiveness (Gearhardt, Roberto, Seamans, Corbin, & Brownell, 2013). In adolescents with overweight and obesity, YFAS “food addiction” is associated with more self-reported binge eating, elevated food cravings, and higher attentional and motor impulsivity (Meule, Hermann, & Kubler, 2015).

This initial evidence provides preliminary support for the concept of addictive-like eating in children and adolescents. However, no prior study has examined whether “food addiction” is related to objectively measured eating behavior in children or adults. As addiction is associated with an increased desire for and consumption of the addictive substance (Santangelo, Barone, Trojano, & Vitale, 2013), we would predict that elevated “food addiction” in children would be associated with greater caloric intake. To address this gap in the literature, the goal of the current study was to examine the association of the YFAS-C with observed food consumption among children while controlling for BMI percentile, age, sex and race/ethnicity. Further, to investigate potential developmental differences, we conducted an exploratory analysis to test whether age moderated the association between the YFAS-C and observed food consumption.

Table 1
Participant demographics.

	N(%)	*M*	*SD*
Age (years old)		8.24	2.70
Sex			
Male	40 (57.10%)		
Female	30 (42.90%)		
BMI		20.39	6.18
BMI Percentile		71.41	31.8
Weight Category			
Underweight	3(4.84%)		
Normal Weight	27 (43.55%)		
Overweight	9 (14.52%)		
Obese	23 (37.09%)		
Ethnicity			
White	39 (55.70%)		
African American	20 (28.60%)		
Hispanic	4 (5.70%)		
Other	7 (10.00%)		

2. Material and methods

2.1. Participants

One-hundred-seventeen children were recruited from the New Haven, Connecticut community with their parents to participate in a consumer market research study on family dining preferences and eating habits. The initial aim of the study was to look at impact of menu conditions on eating behavior and the YFAS-C was not included at the beginning of data collection, as the scale had not yet been developed. The YFAS-C was added to the questionnaire battery when it became available and 70 children completed the YFAS-C. As shown in Table 1, the sample was racially and ethnically diverse. The average age of participants was 8.34 years ($SD = 2.7$; range 4–16 years of age) and 42.9% were female. Of the 70 children, the majority ($n = 41$) had at least one sibling who also completed the YFAS-C in the study. The Yale University Institutional Review Board approved this study. Parental guardians provided informed consent, and the children provided verbal assent.

2.2. Study procedures

Families were recruited for a consumer market research study on dining preferences and eating habits. Participants arrived at 5:30pm and participated in a focus group-like activity answering questions about their restaurant preferences. At the midpoint of the protocol, participants were asked to order dinner from a restaurant menu and eat a meal provided at no cost. They were told they could not take home leftovers and were not allowed to share food. Participants returned the next day to complete a dietary recall interview. Parents and children were asked to abstain from eating after 3pm on the first day of the study to standardize hunger levels. Participants were debriefed about the study aims at the completion of the protocol.

Although not the focus of this paper, the initial aim of the data collection was to examine how calorie information on restaurant menus impacted parents' and children's eating behavior. Families were randomized to one of three calorie labeling conditions: 1) a menu without calorie labels; 2) a menu with calorie labels and a label stating that the recommended daily caloric requirement for adults; or 3) a menu with calorie labels and labels stating the recommended daily caloric requirements for adults as well as children of different age ranges.

All menus displayed items from Au Bon Pain (including salads, sandwiches, beverages, and desserts) and a non-chain restaurant (including appetizers, entrees, and desserts such as mozzarella sticks, pizza, hamburgers, and cheesecake). The menus had a kid's menu section with items such as chicken fingers, sandwiches, salads, and vegetables. Calorie information was obtained from Au Bon Pain's website and the caloric content of items from the other restaurant was estimated by weighing the food with an Ohaus digital scale accurate up to +0.1 g and using the Food Processor SQL (esha Salem, OR) calorie content database. Unbeknownst to participants, their food was weighed before serving and again once they were done eating. To calculate total calories consumed, the weight of each plate collected after the meal was subtracted from