Food craving as a mediator between addictive-like eating and problematic eating outcomes

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ABSTRACT

Background: There is growing interest and debate about whether an addictive process contributes to problematic eating outcomes, such as obesity. Craving is a core component of addiction, but there has been little research on the relationship between addictive-like eating, craving, and eating-related concerns. In the current study, we examine the effect of both overall food craving and craving for different types of food on the relationship between addictive-like eating symptoms and elevated body mass index (BMI) and binge eating episodes.
Methods: In a community sample ($n = 283$), we conducted analyses to examine whether overall craving mediated the association between addictive-like eating and elevated BMI, as well as binge eating frequency. We also ran separate mediational models examining the indirect effect of cravings for sweets, fats, carbohydrates, and fast food fats on these same associations.
Results: Overall food craving was a significant partial mediator in the relationships between addictive-like eating and both elevated BMI and binge eating episodes. Cravings for sweets and other carbohydrates significantly mediated the relationship between addictive-like eating and binge eating episodes, while cravings for fats significantly mediated the relationship between addictive-like eating and elevated BMI.
Conclusions: Craving appears to be an important component in the pathway between addictive-like eating and problematic eating outcomes. The current results highlight the importance of further evaluating the role of an addictive process in problematic eating behaviors and potentially targeting food cravings in intervention approaches.

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1. Introduction

The theory that certain foods can trigger an addictive process has recently gained attention (Avena, Rada, & Hoebel, 2008; Davis & Carter, 2009; Gearhardt, Corbin, & Brownell, 2009; Gold, Graham, Cocores, & Nixon, 2009; Ifland et al., 2009; Pelchat, 2002), although it remains controversial (Avena, Gearhardt, Gold, Wang, & Potenza, 2012; Ziauddeen, Farooqi, & Fletcher, 2012; Ziauddeen & Fletcher, 2013). Food and drug rewards appear to act on similar neural pathways (Berridge, Ho, Richard, & DiFeliceantonio, 2010; Volkow, Wang, Fowler, & Telang, 2008). Rats exhibit behaviors resembling symptoms of addiction in response to sugar consumption (Avena et al., 2008; Colantuoni et al., 2001; Rada, Avena, & Hoebel, 2005). Craving appears to play an important role in compulsive use across addictive substances, predicting negative outcomes such as increased use and earlier relapse in alcohol, cocaine, and tobacco use (Bottlender & Soyka, 2004; Donny, Griffin, Shiffman, & Sayette, 2008; Epstein, Marrone, Heishman, Schmittner, &

Preston, 2010; Flannery, Poole, Gallop, & Volpicelli, 2003; Oslin, Cary, Slaymaker, Colleran, & Blow, 2009; Weiss et al., 2003). Examining the association of addictive-like eating and food craving is important in evaluating the "food addiction" hypothesis. The Yale Food Addiction Scale (YFAS) was developed to assess addictive-like eating in humans by applying *DSM-IV-TR* substance dependence criteria to the consumption of certain foods (Gearhardt et al., 2009). YFAS "food addiction" symptoms are related to elevated craving (Gearhardt, Rizk, & Treat, 2014; Meule & Kübler, 2012), as well as elevated BMI and more frequent binge eating episodes (Davis et al., 2011; Gearhardt, Boswell, & White, 2014). Food craving appears to be associated with eating related problems, such as binge eating and elevated body mass index (BMI) (Greeno, Wing, & Shiffman, 2000; Waters, Hill, & Waller, 2001; White & Grilo, 2005). However, fat and sugar cravings appear to have different associations with "food addiction" (Gearhardt, Rizk, & Treat, 2014) and obesity (Drewnowski, Kurth, Holden-Wiltse, & Saari, 1992).

To our knowledge, no prior studies have investigated whether higher food craving may be a pathway through which addictive-like eating is associated with eating-related problems and whether this differs by the type of food that is craved. In the current study, we aim to test food craving as a mediator between addictive-like eating and both

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BMI and binge eating episodes. Additionally, we examine whether cravings for different types of foods (sweets, carbohydrates, fats, and fast food fats) may differentially mediate these associations.

2. Methods

2.1. Participants

The study was approved by the Yale Institutional Review Board. Participants ($n = 283$) were drawn from a sample of 420 community volunteers and were included in this study if they provided complete data on key study measures. Participants were on average 34.9 years old (range 18–69). The sample was 15.9% male ($n = 45$) and 83.0% female ($n = 235$), and 3 participants did not report gender. The racial/ethnic distribution for the study sample was: 73.1% Caucasian, 9.5% Hispanic, 7.8% African American, 4.9% Asian, and 3.9% "other." Two participants did not report race/ethnicity. The participants' body weight ranged from underweight to severely obese (BMI range 14.75 to 66.07) with the average BMI in the overweight category (M = 28.44, SD = 9.00).

2.2. Assessments and measures

Participants provided basic demographic information and completed a battery of self-report measures. Self-reported height and weight were used to compute participant BMI (kg/m^2).

The *Yale Food Addiction Scale* (Gearhardt et al., 2009) measures signs of "addiction" toward certain types of food (e.g. high in fat, high in sugar) based on the criteria for substance dependence as stated in the *DSM-IV-TR* (American Psychiatric Association, 2000). The YFAS "symptom count" score reflects the number of addiction-like criteria (ranging 0–7) endorsed. In the current sample, the YFAS exhibited adequate internal consistency ($\alpha = .77$). The mean YFAS symptom count score in the current sample was 3.02 (SD = 2.00).

The *Food Craving Inventory* (FCI) (White, Whisenhunt, Williamson, Greenway, & Netemeyer, 2002) is a 28-item measure that assesses the frequency of cravings for specific foods. The FCI yields a score of total food craving, as well as four subscales measuring cravings for high fats (e.g., bacon), carbohydrates/starches (e.g., bread), sweets (e.g., cookies), and fast food fats (e.g., hamburgers). Total and subscale scores each have a possible range of 1–5. In the current sample, the FCI exhibited excellent internal consistency ($\alpha = .95$). The mean total craving score in the current sample was 2.09 (SD = .83). Mean subscale scores were as follows: fats (M = 1.75, SD = .88), fast food fats (M = 2.36, SD = .99), sweets (M = 2.32, SD = .99), and carbohydrates (M = 1.91, SD = .90).

The *Eating Disorder Examination Questionnaire* (EDE-Q), a well-established measure of eating disorder psychopathology (Fairburn & Beglin, 1994; Luce & Crowther, 1999), was used to assess the number of binge eating episodes. The item used asked participants on how many times in the past 28 days they had experienced a binge eating episode (i.e., eaten an unusually large amount of food and felt a loss of control while doing so). In the current sample, the number of binge eating episodes reported ranged from 0–28, with a mean of 2.60 (SD = 5.18)

2.3. Statistical analyses

Binge eating episodes were skewed, thus we removed four outliers (SD > 2). Age was significantly correlated with BMI ($r = .303$, $p < .001$) and was included as a covariate in all analyses.

To test the hypothesized meditational models (e.g. addictive-like eating symptoms ➔ food craving ➔ BMI), we followed the guidelines described by Baron and Kenny (1986). To further examine any mediational effects, we employed the bootstrapping method with 10,000 samples described by Preacher and Hayes (2008). We used the completely standardized indirect effect (ab_{cs}) described by Preacher

and Kelley (2011) to compare the effect sizes of statistically significant indirect effects. Effect sizes can be interpreted as small (.01), medium (.09) or large (.25) (Kenny, 2014).

3. Results

3.1. Addictive-like eating and BMI

Addictive-like eating was significantly associated with both BMI and food craving (i.e., FCI–Total score), and food craving was significantly associated with BMI (see Fig. 1). Food craving was a significant partial mediator between addictive-like eating and BMI ($B = .46$, SE = .24, 95% CI = .03–.99, $ab_{cs} = .11$).

3.2. Addictive-like eating and binge eating episodes

Food craving was a significant partial mediator between addictive-like eating and binge eating episodes ($B = .29$, SE = .14, 95% CI = .06–.62, ($ab_{cs} = .12$) (see Fig. 2).

3.3. Food cravings for specific food types

3.3.1. Fats

Fats craving was a significant partial mediator between addictive-like eating behaviors and BMI illustrated through both regression analysis ($\beta = .155$, $p = .018$, adj. $R^2 = .215$) and bootstrapping ($B = .31$, SE = .19, 95% CI = .01–.75, $ab_{cs} = .08$).

Craving for fats did not significantly predict the number of binge eating episodes when addictive-like eating was included in the model ($\beta = .108$, $p = .067$, adj. $R^2 = .356$) and did not significantly mediate the relationship according to bootstrapping ($B = .18$, SE = .10, 95% CI = −.04 to .34, $ab_{cs} = .05$).

3.3.2. Fast food fats

Craving for fast food fats did not significantly predict BMI when addictive-like eating was included ($\beta = .098$, $p = .135$, adj. $R^2 = .203$) and did not significantly mediate this relationship according to bootstrapping ($B = .21$, SE = .14, 95% CI = −.04 to .52, $ab_{cs} = .05$). Craving for fast food fats also did not significantly predict the number of binge eating episodes when addictive-like eating was included in the model ($\beta = .097$, $p = .095$, adj. $R^2 = .354$), and did not significantly mediate this relationship according to bootstrapping ($B = .11$, SE = .07, 95% CI = −.01 to .27, $ab_{cs} = .04$).

3.3.3. Sweets

Craving for sweets did not significantly predict BMI when addictive-like eating was included in the model ($\beta = .134$, $p = .067$, adj. $R^2 = .207$) and did not significantly mediate this relationship according to bootstrapping ($B = .35$, SE = .20, 95% CI = −.04 to .77, $ab_{cs} = .09$).

Sweets craving was a significant partial mediator between addictive-like eating behaviors and number of binge eating episodes illustrated
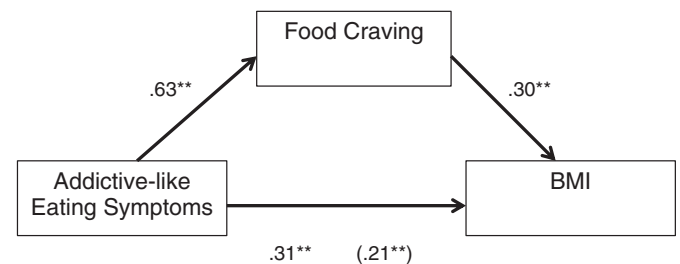

Fig. 1. Standardized regression coefficients for the relationship between addictive-like eating and BMI as mediated by food craving. The standardized regression coefficient between addictive-like eating and BMI controlling for food craving is in parentheses. *p < .05, **p < .01.