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Food addiction in children: Associations with obesity, parental food addiction and feeding practices

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ABSTRACT

Food addiction research in children is limited, and to date addictive-like eating behaviors within families have not been investigated. The aim of this study is to understand factors associated with addictive-like eating in children. The association between food addiction in children with obesity, parental food addiction, and parental feeding practices (i.e., restriction, pressure to eat, monitoring) was investigated. Parents/primary caregivers (aged ≥ 18 years) of children aged 5–12 years, recruited and completed an online cross-sectional survey including demographics, the Yale Food Addiction Scale (YFAS), and the Child Feeding Questionnaire (CFQ). Parents, reporting on themselves and one of their children, were given a food addiction diagnosis and symptom score according to the YFAS predefined criteria. The total sample consisted of 150 parents/primary caregivers (48% male) and 150 children (51% male). Food addiction was found to be 12.0% in parents and 22.7% in children. In children, food addiction was significantly associated with higher child BMI z-scores. Children with higher food addiction symptoms had parents with higher food addiction scores. Parents of FA children reported significantly higher levels of *Restriction* and *Pressure to eat* feeding practices, but not *Monitoring*. Children with elevated YFAS-C scores may be at greater risk for eating-related issues.

1. Introduction

There has recently been a resurgence of interest in the addictive aspects of overeating (Meule, 2015). In animal models, consumption of high-fat, high-sugar foods leads to biological (i.e., dopaminergic downgrading) and behavioral (i.e., enhanced motivation) signs of addiction (Johnson & Kenny, 2010; Brown, Kupchik, Spencer, et al., 2015). While there is no agreed upon definition of addictive-like eating in humans, the Yale Food Addiction Scale (YFAS) is the only existing validated measure designed to assess food addiction (Gearhardt, Corbin, & Brownell, 2009). The YFAS applies the criteria for substance dependence based on the Diagnostic and Statistical Manual of Mental Disorders (DSM) IV (American Psychiatric Association, 2000) to the consumption of highly palatable foods (e.g., ice cream, chocolate, pizza). The YFAS has two scoring options: 1) a continuous summary of the number of symptoms endorsed and 2) a dichotomous diagnostic threshold based on the DSM IV criteria (i.e., three or more symptoms and clinically significant impairment/distress). In adults, food addiction has been associated with biological (e.g., reward dysfunction) (Gearhardt et al., 2011; Davis et al., 2013) and behavioral (e.g., cravings, impulsivity) (Murphy, Stojek, & MacKillop, 2014; Meule & Kübler, 2012; Meule & Gearhardt, 2014) factors implicated in addictive disorders. Further, food addiction in adults is associated with elevated body mass index (BMI) (Pursey, Stanwell, Gearhardt, Collins, & Burrows, 2014a) and increased visceral adiposity (Pursey, Gearhardt, & Burrows, 2016).

However, there has been limited research on food addiction in children (Burrows & Meule, 2015). If certain foods are capable of triggering an addictive response, children may be at greater risk than adults for experiencing adverse consequences as their neural and psychological systems are still developing (Tapert, Caldwell, & Burke, 2005; Brown, Tapert, Granholm, & Delis, 2000). Whereas the initial use of drugs of abuse (e.g., alcohol, cannabis) typically occurs during adolescence and early adulthood (Johnston, O'Malley, Bachman, & Schulenberg, 2012; Degenhardt, Chiu, Sampson, et al., 2008), consumption of potentially addictive foods (e.g., candy, cake, sugar-sweetened beverages) is more likely to occur during early childhood (Pan et al., 2014; Nickelson, Lawrence, Parton, Knowlden, & McDermott, 2014). Although highly palatable foods may have a lower addictive potential than other substances, the repeated consumption of these foods early in development may increase the risk of deleterious outcomes. Thus, it is important to understand whether food addiction may occur in childhood and its association with other eating-related issues.

Emerging evidence suggests that addictive processes exist in relation to dietary intakes and eating behaviors in children. In a previous qualitative study symptoms associated with addiction including tolerance and cravings were frequently reported with 66% of children

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identifying addiction as a contributor to their eating problems (Pretlow, 2011). In additional studies, children (Merlo, Klingman, Malasanos, & Silverstein, 2009) and adolescents (Laurent & Sibold, 2016; Meule, Hermann, & Kubler, 2015) have reported that they often felt addicted to food. The Yale Food Addiction Scale for Children (YFAS-C) was created to provide a developmentally appropriate way to assess for addictive-like eating in children (Gearhardt, Roberto, Seamans, Corbin, & Brownell, 2013a). The YFAS-C measures the same symptoms as the original YFAS, but at a lower reading level and with questions reframed to be more relatable to children and adolescents (e.g., referencing school, peers, and parents). Few studies have investigated YFAS food addiction in children. One study in a community sample of 75 children ranging in age from 4 to 16 years old, the average number of food addiction (FA) symptoms endorsed was two and a prevalence of FA 7.2% (Gearhardt et al., 2013). An additional study in children 9-14y (n = 65) identified a lower prevalence of FA of 4% (Laurent & Sibold, 2016) while another study of overweight and obese adolescents seeking weight-loss treatment found that 38% of participants met the YFAS food addiction threshold and endorsed and average of three symptoms (Meule et al., 2015). Gearhardt and colleagues found that children who endorsed more symptoms of addictive-like eating had lower satiety responsiveness, increased emotional eating and higher BMI (Gearhardt et al., 2013).

There are specific concerns in using questionnaires about dietary intakes and behaviors in children, which are related to child cognitive development and capacity to concentrate, and may influence their ability to both recall foods and estimate portion sizes (Livingstone, Robson, & Wallace, 2004) For these reasons child dietary behaviors are commonly reported by a proxy, usually parents,(Livingstone et al., 2004) and most commonly by the mother (Burrows, Martin, & Collins, 2010) who is regarded as the gatekeeper of food provision within the family environment. Specifically, children younger than 12 years may lack the insight or awareness to accurately report on their eating behaviors with parents of younger children previously shown to be more accurate (Burrows et al., 2013). Asking parents to report on their children's addictive-like eating behaviors may provide a useful approach to assessing food addiction earlier in development.

It is plausible that parental attributes may be associated with an increased likelihood of addictive-like eating in children. Children of parents with substance use disorders (SUDs) are more likely to exhibit problematic patterns of substance use (Merikangas, Stolar, Stevens, et al., 1998). This increased familial risk is likely due to a multitude of contributors, including genetic and environmental factors (McGue, Elkins, & Iacono, 2000; Goldman, Oroszi, & Ducci, 2005; Weinberg, 2001). In the context of food addiction, no prior research has examined whether there is an association between parents' and children's addictive-like eating. Further, as food addiction is associated with obesity in adults (Pursey, Collins, Stanwell, & Burrows, 2015), it is also possible that parents with a higher BMI may have children with more food addiction symptoms. If children of parents with food addiction or obesity are more prone to experience addictive-like eating, this highlights an important at-risk group that may benefit from early intervention.

Another factor that may be associated with higher food addiction in children is parental feeding practices. Parental feeding practices represent a caregivers' approach to maintaining or modifying children's behavior with respect to eating (Birch & Fisher, 1995). The Children's Feeding Questionnaire (CFQ) is the most commonly used measure to assess these feeding-related parental practices (Birch et al., 2001; Collins, Duncanson, & Burrows, 2014). The CFQ examines several different aspects of feeding practices, with the majority of existing research focused on three: (Meule, 2015) Restriction (e.g., restriction of children's access to "junk" foods), (Johnson & Kenny, 2010) Pressure to eat (e.g., pressuring child to eat more food at mealtimes), and (Brown et al., 2015) Monitoring (e.g., overseeing children's food consumption). More restrictive feeding practices have generally been associated with higher BMI in cross-sectional studies, however, longitudinal studies are less consistent (Shloim, Edelson, Martin, & Hetherington, 2015). Although some studies have found that restrictive feeding practices were associated with future obesity risk (Dev et al., 2013), other studies found no association (Gubbels, Kremers, Stafleu, et al., 2011; Webber, Hill, Cooke, Carnell, & Wardle, 2010) and one study found that restriction was protective against future unhealthy weight gain in younger children (Campbell, Andrianopoulos, Hesketh, et al., 2010). Thus, it is unclear whether restrictive parental feeding practices may cause problematic eating patterns or are reactions to the child's existing high-risk eating tendencies (Shloim et al., 2015). Pressure to eat has generally been associated with lower child BMI, which may reflect parental responses to children with weaker appetites and less enjoyment of eating (Wehrly, Bonilla, Perez, & Liew, 2014). Monitoring appears to be the feeding practice that shows the weakest association with child BMI (Shloim et al., 2015), although there is some evidence that monitoring may be protective against unhealthy weight gain (Gubbels et al., 2011). There has been no prior research examining whether certain parental feeding practices are more likely to occur with children with more addictive-like eating.

In the current study, we aim to more fully understand the factors associated with addictive-like eating in children based on parental report. In a community sample, we hypothesize that children with elevated YFAS-C scores (i.e., symptom count and diagnostic threshold) will have higher BMI z-scores and will be more likely to be obese. Next, we hypothesize that children with higher food addiction scores will have parents with more addictive-like eating behavior and higher BMI. Finally, we will investigate whether food addiction in children is associated with certain parental feeding practices (i.e., restriction, pressure to eat, monitoring).

2. Methods

2.1. Participants

Parents/primary caregivers of 5 to 12 year-old children, were recruited through Amazon Mechanical Turk (MTurk, http://www.mturk.com). MTurk is an online market place, which is becoming an increasingly popular mechanism for recruiting participants and collecting survey data for scientific research online (Paolacci & Chandler, 2014; Buhrmester, Kwang, & Gosling, 2011; Schleider & Weisz, 2015). Recent findings suggest MTurk offers a viable alternative for data collection and MTurk workers are slightly more demographically diverse than standard Internet samples (Paolacci & Chandler, 2014; Shapiro, Chandler, & Mueller, 2013). Furthermore, the data yielded are often of similar reliability to more traditional convenience sampling techniques (Paolacci & Chandler, 2014; Paolacci, Chandler, & Ipeirotis, 2010). All data gathered via Qualtrics online survey software are encrypted (Transport Layer Security) and password protected.

2.2. Measures

The survey used in this study was piloted with University of Michigan staff and employees prior to implementation on MTurk (n = 6), with minor modifications made to improve readability, modification of some of the food names to align with local naming conventions, for example, capsicum was changed to pepper. The survey was loaded into Qualtrics online survey software, then listed on the HIT page of MTurk and made available to U.S. residents for a 3-day period from February 18–20, 2015. Participants were recruited and resided in the U.S. and were compensated US$0.50 for survey completion.

The final survey consisted of 146 items and was completed by the parent/primary caregiver reporting on both themselves (demographics, addictive eating behaviors and parental feeding practices) and one of their children, known as the index child (demographics and addictive eating behaviors; dietary intake). To determine eligibility, participants interested in the study completed a 2-item qualifying questionnaire as

part of the linked survey. The inclusion criteria for the study were: (a) over the age of 18 years, and (b) have a child aged 5 to 12 years. The survey took approximately 15–20 min to complete and included the following measures:

2.2.1. Demographics

Parents/primary caregivers were asked to report on their: age and sex, child's age and sex, number of children in the household, household income, race/ethnicity and cultural background. Additional information was obtained regarding their smoking status and their diet quality was measured by a validated diet quality score the Australian Recommended Food Score (Marshall, Watson, Burrows, Guest, & Collins, 2012) which was modeled to reflects alignment to dietary guidelines and is modeled on the US Recommended Food Score (Kant, 1996). Parents reported their own height and weight, as well as their children's. These self-reported height and weight values were used to calculate Body Mass Index (BMI) using standardized equations. Despite some error particularly with higher BMIs, online self-reported height and weight have shown to have moderate to high agreement between self-reported and measured anthropometric data in adults (Pursey, Burrows, Stanwell, & Collins, 2014b) and children (Wang, Patterson, & Hills, 2002). For child data, values were transformed into BMI z-scores; a measure of relative weight adjusted for the child's age and sex; using the LMS (lambda, mu, and sigma) method (Pan & Cole, 2007). Based on the World Health Organization (WHO) guidelines of fixed exclusion ranges BMI z-scores lower than −4.0 or higher than +5.0 were considered to be biologically implausible values and excluded from the analysis (World Health Organization (WHO), 1995) Typically these values (outliers) are the result of misreporting, rather than from true growth extreme. Children's BMI z-score were categorized according to the WHO BMI-for-age (5–19 years) cut-off points and parents BMI categorized according to the WHO adult cut-off points (World Health Organization (WHO), 2015a).

A total of 163 parents/primary caregivers completed the online survey, of these 13 were excluded from analysis. Three surveys contained reporting errors (one implausible parent age value and two missing child height measurements), and 10 contained child height and weight measures yielding invalid BMI z-scores (biologically implausible values (World Health Organization (WHO), 1995). The final sample comprised 150 parents/primary caregivers, 78 mothers (52.0%) and 72 fathers (48.0%). Six of these identified as the primary caregiver and subsequently were classified as mother or father according to sex. Parents were between the ages of 21 and 64 years, with a mean age (Mean ± SD) of 35.2 ± 8.7 years (Table 2). The participants primarily self-identified as White (79.3%). The mean BMI (Mean ± SD) for parents was 26.9 ± 6.3 kg/m^2 (range 18.1 to 51.8 kg/m^2, males 27.2 ± 4.4 kg/m^2, females 26.9 ± 6.3 kg/m^2). A total of 43.3% were classified as of healthy weight, 31.3% overweight, 24% obese and 1.3% underweight.

The 150 index children, selected by parents, comprised an approximately equal spread of genders (76 male, 74 female). The mean age of children was (Mean ± SD) of 8.2 ± 2.3 years. Children had a mean BMI z-score (Mean ± SD) of 1.1 ± 1.9 (range − 3.9 to 4.5, males 1.4 ± 2.0, females 0.8 ± 1.7) with 38.7% of children classified as healthy weight, 32.7% obese, 22.0% overweight and 6.7% as underweight.

2.2.2. Food addiction scores

Food addiction scores for parents were determined using the abbreviated standardized adult version of the YFAS (mYFAS) (Flint et al., 2014). The mYFAS consists of 9 core questions based on seven symptoms and the two additional criteria (Flint et al., 2014). It has been shown to have similar validity and psychometric properties as the original YFAS (Flint et al., 2014) the brief version was used in this study to reduce participant burden. The YFAS-C, developed in 2013, is a 25-item modified version of the YFAS and contains more age-appropriate activities and a lowered reading level (Gearhardt et al., 2013). It has been validated for use in children, from a range of ethnic backgrounds, aged 4 to 16 years old (Gearhardt et al., 2013). The YFAS-C exhibits similar psychometric properties to the original YFAS (Kuder Richardson α = 0.86) (Gearhardt et al., 2009, 2013). In the current study, parents were asked to provide self-report data on their children's addictive-like eating behavior (Kuder Richardson α = 0.94 for parental report YFAS-C). For the YFAS-C in this study the word 'I' was replaced with 'your child' with pronouns changed from reporting on oneself to reporting on one's child. For the purpose of this study both symptom scores and diagnosis were used. A 'diagnosis' of food addiction was given when three or more symptoms plus clinically significant impairment or distress was present (Gearhardt et al., 2009).

2.2.3. Parental feeding practices

Parent's feeding practices were assessed using the Child Feeding Questionnaire (CFQ) (Birch et al., 2001). The CFQ is a 31-item parental self-report measure, designed to assess parental beliefs and attitudes regarding child-feeding practices (Birch et al., 2001). Previous research has shown the CFQ to be a valid and reliable instrument for use with parents of children, aged 5 to 12 years, from different ethnic and socioeconomic backgrounds (Cronbach's α = 0.70–0.92)(Birch et al., 2001; Arredondo et al., 2006; Anderson, Hughes, Fisher, & Nicklas, 2005). The questionnaire uses a five point Likert frequency scale, including responses ranging from never (=1) to always (=5) or disagree (=1) to agree (=5) (Birch et al., 2001). The CFQ assesses parental feeding practices, in this study the focus will be specifically on: *Restriction* (8 items), *Pressure to eat* (4 items), and *Monitoring* (3 items). A score for each of the parental feeding practices was calculated from the mean score of the items relating to that domain.

The procedures employed in this study were approved by the ethics committees at the University of Michigan, USA and the University of Newcastle, Australia (Ethics Approval no. H-2015-0101).

2.3. Statistical analyses

The results were assessed for normality; using descriptive statistics. Chi-square, *t*-tests and ANOVAs were used to investigate differences in the frequency of endorsement of food addiction symptoms, FA diagnosis and relationships with demographic variables, child feeding practices and weight status for both parents and children. The association between parental feeding practices (*Restriction*, *Pressure to eat*, *Monitoring*) and children's food addiction symptoms were investigated in separate linear regression models. Children's BMI z-scores were added as a covariate to the models, and the findings regarding *Restriction and Pressure to eat* did not change. However, the inclusion of this covariate did alter the association between children's food addiction symptoms with *Monitoring*, thus both the simplified model and the BMI covariate model will be reported. Significance level was set at $p = 0.05$. Due to the number of variables tested, an adjusted p-value for the data in this study and was calculated using a Bonferroni correction factor by dividing the p-value by the number of tested variables (i.e., $n = 22$). The adjusted p-value for dietary data was therefore set at $p = 0.002$. All analysis was undertaken using SPSS.

3. Results

3.1. Children and parental food addiction frequencies

Table 1 includes the frequency of food addiction symptoms and FA diagnosis for both parents and children. Eighteen parents (12.0%; 5 male,13 female) and 34 children (22.7%; 18 male, 16 female) met the FA diagnostic threshold. The mean food addiction symptom score (Mean ± SD) was 1.1 ± 1.8 for parents and 2.2 ± 2.1, for children, respectively. Children had higher frequencies for all of the food addiction symptoms, except parents reported had higher levels of endorsement for continued use despite negative consequences. Further, children

Table 1
Food addiction diagnoses, symptom scores and the frequency of symptoms for parents and children.

Food addiction symptoms	Parent[a] (n = 150)	Child[b] (n = 150)	Test statistic (t or χ^2)	p value
Substance taken in greater quantity and for longer than intended	11 (7.3%)	53 (35.3%)	29.33	<0.001
Great time and effort to obtain, use and recover from substance	21 (14.0%)	49 (32.7%)	13.92	<0.001
Persistent desire or unsuccessful repeated attempts to quit	20 (13.3%)	53 (35.3%)	18.49	<0.001
Continued use despite consequences	40 (26.7%)	20 (13.3%)	8.06	<0.01
Important life activities given up or reduced	27 (18.0%)	71 (47.3%)	27.63	<0.001
Tolerance	36 (24.0%)	32 (21.3%)	0.30	0.58
Withdrawal	16 (10.7%)	53 (35.3%)	23.33	<0.001
Clinically significant impairment or distress	31 (20.7%)	39 (26.0%)	1.19	0.28
Total: food addiction diagnoses[c]	18 (12.0%)	34 (22.7%)	5.79	0.02[c]
Total: symptom score	1.1 ± 1.8	2.2 ± 2.1	22.86	<0.001

Data are Mean ± SD or n (%).
[a] Adults' food addiction assessed by mYFAS (9 items).
[b] Children YFAS-C (25 items).
[c] YFAS food addiction diagnosis: endorsement of ≥3 symptoms + criterion met for clinical impairment or distress.

and parents did not differ in the frequency of endorsement for tolerance or impairment/distress.

3.2. Children food addiction and demographics

No significant associations were identified between children's food addiction symptoms and children FA with any of the demographic variables assessed including: child's age, race/ethnicity, familial income, family size and overall family dietary quality (all p values > 0.09). Parents did report that male children (M = 2.55, SD = 2.00) exhibited greater food addiction symptoms than female children (M = 1.85, SD = 2.11) ($t(1148) = 4.36$, p = 0.039). However, FA diagnosis did not differ between boys and girls ($\chi^2(1) = 0.091$, p = 0.76). Results of food addiction by parental dyads are shown in Table 2. Children's food addiction symptoms were negatively associated with parental age ($r = -0.23$, p < 0.01) and child FA diagnosis was significantly associated with having younger parents ($t(1148) = 2.98$, p = 0.03).

3.3. Children food addiction and BMI

Table 3 includes the association of children's FA diagnosis with child BMI z-scores and weight category. In children, FA diagnoses were significantly associated with higher child BMI z-scores. The mean BMI z-score in the FA group was more than three times that of the NFA group, 2.4 ± 1.4 compared to 0.7 ± 1.8 (p ≤0.01). A significantly higher proportion of children in the FA group were classified as obese (67.6%) compared to the NFA group (22.4%). A moderate, positive association was found between children's food addiction symptoms and BMI z-scores ($t(1148) = 6.29$, $\beta = 0.46$, p < 0.001). Parental BMI was not associated with children's FA diagnosis (p = 0.40) or food addiction symptoms (p = 0.50). However, there was a trend-level association between parental weight category and child FA diagnosis (p = 0.06) with parents of children with FA having an obesity rate of 32.3% relative to 21.6% for children without FA.

Table 2
Food addiction (FA) diagnosis and symptom by parental dyads.

FA diagnosis	Father/son (n = 43)	Father/daughter (n = 29)	Mother/son (n = 33)	Mother/daughter (n = 45)
No	31	23	27	35
Yes	12	6	6	10
p value	0.04	0.02	<0.001	<0.001
Mean ± SD FA symptoms	2.79 ± 2.03	1.97 ± 2.16	2.24 ± 1.95	1.78 ± 2.09

3.4. Children food addiction and parental food addiction

The occurrence of parental FA was 17.6% and 10.3% for FA and NFA children, respectively. However, this difference was not statistically significant ($\chi^2(1) = 1.33$, p = 0.25). A positive association was identified between parent and child food addiction symptoms, $t(1148) = 5.00$, $\beta = 0.38$, p < 0.001 and this remained significant when controlling for parent and child BMI.

3.5. Children food addiction and parental feeding practices

Table 4 includes mean scores for each of the parental feeding practices by child FA status. Parents of FA children reported a significantly higher level of *Restriction* (p < 0.001) and *Pressure to eat* (p = 0.01) feeding practices, but not *Monitoring* (p = 0.29). Food addiction symptoms were significantly associated with both *Restriction* ($t(1148) = 5.28$, $\beta = 0.40$, p < 0.001) and *Pressure to eat* ($t(1148) = 4.34$, $\beta = 0.34$, p < 0.001), but the association with *Monitoring* was at a trend-level ($t(1148) = 1.96$, $\beta = 0.16$, p = 0.052). When controlling for child BMI z-score, *Restriction* and *Pressure to eat* remained significantly associated with children's food addiction symptoms (all p < 0.001). However, *Monitoring* became significantly associated with child food addiction symptoms ($t(2147) = 2.37$, $\beta = 0.17$, p = 0.02) only after children's BMI z-score was included in the model.

4. Discussion

The current study investigated the association between addictive-like eating in children with obesity, BMI z-scores, parental food addiction, parental BMI, and parental feeding practices. As children may be more vulnerable to the negative effects of addictive substances than adults (Tapert et al., 2005; Brown et al., 2000), it is important to evaluate the food addiction concept early in development. This may be especially important, as eating-related issues developed during childhood can increase the risk of lifelong adverse eating outcomes (e.g., obesity, binge eating) (Venn, Thomson, Schmidt, & Cleland, 2007; Finkelstein, Graham, & Malhotra, 2014).The current study adds to the limited literature on food addiction in children based on parental report, which may be particularly important for younger children who may have limited awareness and ability to report their own eating patterns (Burrows et al., 2013). Further, the current study included a larger sample size than prior studies evaluating food addiction in children (Gearhardt et al., 2013) and included both mothers and fathers.

On average, parents reported that children experienced two symptoms of food addiction, which is similar to the level found in a prior study of the YFAS-C (Gearhardt et al., 2013). However, in the current sample, the food addiction diagnostic threshold of the YFAS-C was

Table 3
Anthropometrics by classification of child food addiction status.

Characteristics	Total sample (n = 150)	Food addicted (n = 34)	Not food addicted (n = 116)	Test statistic (t or χ^2)	p value
Child characteristics					
BMI z-score	1.1 ± 1.9	2.4 ± 1.4	0.7 ± 1.8	5.01	<0.001
BMI z-score category[a]					
Healthy weight	58 (38.7%)	4 (11%)	54(46.6%)	27.60	<0.001
Overweight (> + 1 SD)	33 (22.0%)	7 (20.6%)	26(22.4%)		
Obese (> + 2 SD)	49 (32.7%)	23 (67.6%)	26(22.4%)		
Thinness (<−2 SD)	10 (6.7%)	0 (0%)	10 (8.6%)		
Parental characteristics					
BMI (kg/m^2)	26.9 ± 6.3	26.5 ± 5.9	26.9 ± 6.4	0.69	0.40
BMI category[b]					
Underweight (<18.5)	2 (1.3%)	1 (2.9%)	1 (0.9%)	10.48	0.06
Healthy weight (18.50–24.99)	65 (43.3%)	17(50%)	48(41.4%)		
Overweight (25.00–29.99)	47 (31.3%)	5(14.7%)	42(36.2%)		
Obese (>30.00–34.99)	36 (24.1)	11(32.3%)	25 (21.6%)		

Data are Mean ± SD or n (%).
[a] WHO BMI-for-age (5–19 years) –cut-offs (World Health Organization (WHO), 2015b).
[b] World Health Organization (WHO) BMI adult cut-off points (World Health Organization (WHO), 2015c).

met by 22.7% of children which is higher than existing studies assessing food addiction in children recruited from the community (range 4% to 7.2%) (Laurent & Sibold, 2016; Gearhardt et al., 2013). However an additional study in adolescence (n = 50) with mean age 16.5 years who were seeking weight loss treatment, prevalence of food addiction was reported as high as 38% as assessed by the standard YFAS (Meule et al., 2015). The prevalence rate in the current study was unexpected and may reflect differences in the study sample. For example, 54.7% of children in the current study were overweight/obese relative to 33.3% of children in the prior study with 7% FA and 38% overweight/obese in the study with 4% FA (Gearhardt et al., 2013). Additional differences may be related to parental versus self-report versions of the YFAS-C. As the level of symptoms endorsed across existing studies is similar (ranging from 2 to 3 symptoms), a greater endorsement of clinically significant impairment or distress was the main contributor to the higher level of FA in the current study. Parents may be more aware that their children's eating behaviors are problematic, and thus may be more likely to endorse the impairment/distress criterion.

The current study replicates the previous finding that food addiction symptoms in children are associated with elevated BMI and a greater likelihood of overweight/obesity (Gearhardt et al., 2013). This is consistent with prior research in adults, which has found an association between food addiction and obesity (Pursey et al., 2014a). The prior research on YFAS-C found that children with higher scores were more prone to eat in response to emotions and to be less sensitive to satiety signals, which may contribute to increased BMI (Gearhardt et al., 2013). BMI was used in this study as a measure of adiposity however is not as sensitive a measure as other measures of weight status such as body composition so may not reflect true weight status in the study population (Rothman, 2008).

Children's food addiction symptoms were also moderately associated with parental food addiction symptoms. This is consistent with an elevated likelihood of problematic substance use in the children of parents with a substance use disorder (Merikangas et al., 1998). In addiction many factors are implicated in this familial pattern, including genetic contributions, prenatal exposure to the substance, parental modeling of substance use, and access to the substance in the child's environment (McGue et al., 2000; Weinberg, 2001). These factors could also contribute to the association between children and parental food addiction symptoms and future research is needed to evaluate potential mechanisms. However, unlike the food addiction symptom score, there was no association between children's and parent's FA diagnosis. We may have been underpowered to detect the association of children's and parent's FA diagnosis FA in a non-clinical sample. Additional research in clinical samples with higher levels of food addiction in both children and parents will be an important future research direction. Notably, food addiction in children was not associated with parental BMI an exhibited only a trend-level association with parental weight category. Thus, to understand the association between parent's and children's food addiction it is important to not rely on body weight as a proxy for addictive-like eating.

Another factor associated with children's food addiction symptoms and diagnosis was parental feeding practices. Parental feeding practices reflect a caregivers approach to maintaining or modifying children's eating behavior (Birch & Fisher, 1995). Parental feeding practices likely reflect the attributes of the parent (e.g., parenting style, attitudes, and beliefs) and the child (e.g., food responsiveness, picky eating, disinhibition) (Shloim et al., 2015). In the current study, food addiction in children was associated with greater restrictive feeding practices, which is indicated by attempts to restrict or limit access to “junk” food. Cross-sectional studies find that restrictive parental feeding practices are associated with elevated BMI in children (Shloim et al., 2015) and greater snack food intake (Fisher & Birch, 1999a; Fisher & Birch, 1999b; Larsen et al., 2015; Birch, Fisher, & Davison, 2003). However, longitudinal studies find a mixed association of restrictive feeding practices with future weight gain (Shloim et al., 2015). It is unclear whether parental feeding practices may cause overeating or are a response to a child's tendency to overeat. In the current study, it is plausible that the association between restrictive parental feeding practices and children's food addiction reflects parental attempts to reduce excess food consumption for children who are more motivated by food and less responsive to satiety signals. It is also possible that restrictive attempts by parents to manage eating could exacerbate eating problems in children with more food addiction symptoms. Thus, future research is needed to understand the causal relationship between children's addictive-like eating and restrictive feeding practices. Specifically studies with longitudinal designs that begin early in development would be helpful to understand the temporal

Table 4
Association of food addiction diagnoses [food addicted (FA) and non-food addicted (NFA)] with parental feeding practices.[a]

Variable	FA Children	NFA Children	Test statistic (t)	p value
Number of participants	34 (22.7%)	116 (77.3%)		
Restriction[a]	3.48 ± 0.75	2.98 ± 0.93	3.22	<0.001
Pressure to eat[a]	2.99 ± 1.09	2.45 ± 1.01	2.61	0.01
Monitoring[a]	3.63 ± 0.85	3.45 ± 1.00	1.07	0.29

Data are Mean ± SD or n (%).
[a] Possible score range = 1 to 5.

relationship between restrictive feeding practices and the development of children's addictive-like eating behavior.

Children's food addiction was also associated with pressure to eat feeding practices. This finding was unexpected, given that this feeding practice is more associated with lower BMI and picky eating styles (Wehrly et al., 2014). However, the pressure to eat subscale of the CFQ focuses on mealtime consumption (Birch et al., 2001). Thus, parents of children with higher food addiction scores may try to restrict their children's consumption of "junk foods," while pressuring them to eat at mealtimes. This is consistent with findings from Wehryl and colleagues (Wehrly et al., 2014) that parental restriction of unhealthy foods and pressure to eat healthy foods were correlated and that both of these factors were positively associated with children's BMI. Animal models of addictive-like eating find that exposure to highly palatable foods (e.g., M&Ms, cheesecake) lead to neural adaptations in reward-related circuitry that is associated with less motivation for nutritious (but less palatable) chow (Johnson & Kenny, 2010). Children with more addictive-like eating may be more motivated to consume highly rewarding snack foods, but less interested in consuming the foods served at mealtimes if they are less palatable. Future research is needed to investigate the association of food addiction in children with food preferences.

The parental feeding practice of monitoring had the weakest association with children's food addiction. Monitoring was not associated with the diagnostic version of the YFAS-C and the association with the food addiction symptoms only reached significance when BMI z-scores were included as a covariate in the model. Monitoring may be protective against eating-related problems (Gubbels et al., 2011), which suggests it may be beneficial for children with more addictive-like eating. An increase in monitoring may alert parents/caregivers to potentially problematic behaviors earlier rather than before they are well established, although future research is needed given the weak associations between monitoring and children's food addiction in the current study.

Food addiction in children differed by gender and parental age. Male children had significantly higher food addiction symptoms than female children, although there were no gender differences regarding FA diagnosis. In adults, FA symptoms and diagnosis are more likely to be elevated in females than males (Pursey et al., 2014a). Further, eating disorders are typically higher in females than males (American Psychiatric Association, 2013). However, the gender difference in disordered eating typically does not become apparent until adolescence due to a combination of environmental (e.g., increased body image pressures particularly on females) and biological (e.g., pubertal hormonal changes) factors (Klump et al., 2006; Rolls, Federoff, & Guthrie, 1991). Given the relatively young age of the current sample, it will be important for future studies to investigate gender differences in food addiction symptoms during adolescence. However, with increasing child age and independence shown in food choice and dietary behaviors during adolescence assessing food addiction in both children and adolescence poses a number of issues including: use of child report and parental proxy report for younger children. Existing questions in the YFAS-C such as 'eating more than intended' may be problematic as children may have difficulty in interpreting 'intended' and parents may not know children's intentions. The association of younger parental age with higher food addiction in children was unexpected, given food behaviors would likely be more dynamic and change with respect to child age not parental age. Future research is needed to understand what may be driving this association.

Additionally, the degree of food addiction was elevated in children relative to their parents. The FA diagnostic threshold was met by 22.7% of children relatively to 12.0% of parents. Similarly, on average, children had two food addiction symptoms, whereas parents endorsed one food addiction symptom. There are a number of potential explanations for this higher level of food addiction found in children. First, food addiction was assessed differently for parents (mYFAS) and children (YFAS-C). Thus, differences related to the scales (e.g., number of questions, response options) may contribute to this different level of endorsement. However, it is possible that the elevated food addiction in children relative to adults may be related to developmental differences. Executive control functioning (e.g., inhibitory control, planned action) is less developed in children than in adults (Casey, Jones, & Hare, 2008; Spear, 2000; Steinberg, 2007). These factors may lead children to be more likely to exhibit addictive-like eating than adults. Future research is needed to investigate how addictive-like eating occurs across the lifespan and whether food addiction in children tracks into adulthood.

Although the current study contributes to the few studies on food addiction in children, it is important to consider its limitations. First, the current study is cross-sectional, thus it does not allow for conclusions concerning cause and effect and while statistical significance may have been identified these results, may not be considered clinical significant. Future research utilizing longitudinal designs will be necessary to investigate whether addictive-like eating patterns in children may be a risk factor for excessive weight gain. The current study used a parent-report version of the YFAS-C. Parental report for younger children's dietary behaviors is common practice this is due to cognitive and recall abilities, for these reasons parents may have greater insight about the nature of their children's eating behavior. However, parents may not be aware of some of their children's eating problems (e.g., eating patterns at school, sneaking food). The current study relies on self-report data that was collected online and would have been strengthened it were confirmed by face-to-face interviews, but this was not feasible in the current study. Future research would benefit from examining the concordance between the parent-report and child-report version of the YFAS-C. Third, convenience sampling method was used which has the potential to introduce response and self-selection biases. Fourth, the current sample self-reported as predominantly White therefore the results may not be generalizable to other ethnicities and future research should seek to replicate the current findings, extending the investigation to larger, more diverse samples of individuals.

In summary, the current study adds to the limited literature on addictive-like eating in children. Children with elevated YFAS-C scores based on parental report have elevated BMI z-scores and are more likely to be obese. Children with higher food addiction symptoms were more likely to have parents with greater food addiction symptoms. Parental feeding practices, especially restriction and pressure to eating, were more likely to occur with children with greater food addiction. Further research is needed to understand how addictive-like eating unfolds over the course of development and its association with long-term negative health outcomes.

Conflict of interest

The authors declare no conflicts of interest.

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