RESEARCH ARTICLE

Associations of Food Addiction in a Sample Recruited to Be Nationally Representative of the United States

Erica M. Schulte* [ID] & Ashley N. Gearhardt [ID]

Department of Psychology, University of Michigan, Ann Arbor, MI, USA

Abstract

The current study investigated the prevalence of food addiction and its associations with obesity and demographic factors in a sample recruited to be more nationally representative of the United States than previous research. Individuals ($n = 1050$) were recruited through Qualtrics' qBus, which sets demographic quotas developed using the United States census reference population. Participants ($n = 986$) self-reported food addiction, measured by the modified Yale Food Addiction Scale 2.0, height, weight, age, gender, race and income. Food addiction was observed in 15% of participants, with greater prevalence in individuals who were younger, Hispanic and/or reported higher annual income. Food addiction prevalence was higher in persons who were underweight or obese, relative to normal weight or overweight. Food addiction was associated with higher body mass index in women and persons who were older, White and/or reported lower income. Identifying the scope of food addiction and individual risk groups may inform public policy initiatives and early intervention efforts. Copyright © 2017 John Wiley & Sons, Ltd and Eating Disorders Association.

*Correspondence Erica M. Schulte, Department of Psychology, University of Michigan, 2257 East Hall, 530 Church Street, Ann Arbor 48109, MI, USA.

Email: eorenste@umich.edu

Introduction

Food addiction reflects the theory that some individuals may experience an addictive-like response to foods high in fat and/or refined carbohydrates like sugar, akin to a substance-use disorder (Ahmed, Avena, Berridge, Gearhardt, & Guillem, 2013; Davis et al., 2011; Gearhardt, Davis, Kuschner, & Brownell, 2011). In support, studies in animals and humans have demonstrated biobehavioural indicators of addiction in response to foods high in fat and/or refined carbohydrates (Avena, Rada, & Hoebel, 2008; Gearhardt, Yokum, et al., 2011; Johnson & Kenny, 2010; Oswald, Murdaugh, King, & Boggiano, 2011; M. J. Robinson et al., 2015). However, the theory remains controversial, particularly because research aiming to identify the addictive agent in food (e.g., added sugar) is in its nascent stages (Ziauddeen & Fletcher, 2013), and the unique clinical utility of the construct is debated (Davis, 2013; D. G. Smith & Robbins, 2013). There also exist alternative perspectives suggesting that food addiction is better conceptualized and measured as a behavioural addiction to the act of eating (Hebebrand et al., 2014; Ruddock, Christiansen, Halford, & Hardman, 2017).

While there is no agreed upon definition of food addiction, the phenotype is most frequently measured in humans by the Yale Food Addiction Scale (YFAS). Importantly, as food addiction is not a clinical diagnosis recognized by the Diagnostic and Statistical Manual (DSM) (American Psychiatric Association, 2013), the term 'food addiction' in the current manuscript will

henceforth reflect the classification made by the YFAS. The YFAS is a self-report measure that adapts the DSM criteria for substance-use disorders to evaluate addictive-like consumption of foods high in fat and/or refined carbohydrates (Gearhardt, Corbin, & Brownell, 2009, 2016). The YFAS has been associated with clinically relevant features, such as frequency of binge eating episodes, weight cycling, obesity, and short-term abstinence from binging-purging in persons with bulimia nervosa following intervention (Davis et al., 2011; Gearhardt, Boswell, & White, 2014; Granero et al., 2014; Hilker et al., 2016; Schulte & Gearhardt, 2017). However, many previous studies of food addiction have consisted of small samples or samples with limited generalizability to the national population (e.g., clinical samples, undergraduates, overrepresentation of females and White individuals). These limitations present a challenge in estimating the scope of food addiction and its relation to individual characteristics (e.g., gender and race) (Pursey, Stanwell, Gearhardt, Collins, & Burrows, 2014).

In convenience and general population samples, the reported prevalence of food addiction has ranged from approximately 5% to 57%, with a weighted mean estimate of 19.9% (Pursey et al., 2014). Only one study, in a German sample, has employed online, quota-based techniques to recruit a more nationally representative sample and observed a food addiction prevalence of 7.9% (Hauck, Weiss, Schulte, Meule, & Ellrott, 2017). This approach warrants replication in the United States, where rates of obesity are notably higher than Germany (Mensink et al., 2013; Ogden,

Carroll, Kit, & Flegal, 2014). Thus, assessment of food addiction in a more nationally representative sample may allow for a more accurate point prevalence estimation in the United States and allow for comparison of prevalence between countries.

Previous studies have also examined which groups of individuals may have elevated food addiction prevalence. YFAS food addiction appears to be more prevalent in females (Gearhardt et al., 2016; Hauck et al., 2017; Pedram et al., 2013; Pursey et al., 2014) and younger individuals (Flint et al., 2014; Hauck et al., 2017; Schulte & Gearhardt, 2017). Findings regarding the association of YFAS food addiction with racial identification have been mixed (Pursey et al., 2014), with studies observing higher prevalence of food addiction in individuals identifying as White (Flint et al., 2014), Hispanic (Schulte & Gearhardt, 2017), and African-American (Eichen, Lent, Goldbacher, & Foster, 2013). Further, income appears to be associated with eating-related problems and obesity (Singh, Kogan, Van Dyck, & Siahpush, 2008; Sobal & Stunkard, 1989; Wardle, Waller, & Jarvis, 2002) but has not been investigated fully with respect to food addiction.

In addition, an important health outcome associated with YFAS food addiction is obesity (Flint et al., 2014; Hauck et al., 2017; Meule & Gearhardt, 2014; Pedram et al., 2013; Pursey et al., 2014). Given the neurobiological and behavioural similarities observed between obesity and substance-use disorders, it has been suggested that food addiction may be a clinically meaningful phenotype within obesity (Davis et al., 2011; D. G. Smith & Robbins, 2013; Volkow & Wise, 2005). While there appears to be a link between YFAS food addiction and increased body mass index (BMI) in previous studies using convenience or general population samples (Pursey et al., 2014), the majority of existing studies investigated samples overrepresented with women, individuals who are White and limited age ranges (Pursey et al., 2014). Thus, replication is needed in a sample more representative for age, gender and race. Further, a more representative sample may highlight groups of individuals where addictive-like eating may be most significantly associated with obesity.

Thus, using a sample more representative of the United States population than prior research, the current study has three aims. First, the prevalence of food addiction and its associations with individual characteristics (age, gender, race and income) will be assessed. Second, the association between food addiction with BMI and weight class (underweight, normal weight, overweight and obese) will be investigated. Third, the present approach will explore whether the association between food addiction and BMI differs based on individual characteristics (age, gender, race and income). Examining which persons have the highest prevalence of food addiction and strongest association of food addiction with obesity may aid in identifying populations that may benefit most from intervention approaches that address features of addiction (e.g., craving management) or public policy initiatives (e.g., restricting marketing to vulnerable groups).

Materials and methods

The University of Michigan Health and Behavioural Sciences Institutional Review Board approved the current study (HUM00117661) as exempt from ongoing review.

Participants

Participants were recruited through Qualtrics' qBus, an omnibus survey sent out to 1050 individuals. Individuals were compensated by Qualtrics with points that can be redeemed for incentives (e.g., gift cards). Quotas are set based on the United States Census data for gender, race, household income and geographic region, and the survey remains open until quota groups are filled.

Analyses were conducted with 986 individuals, after excluding 48 respondents who had nonsensical data (e.g., reporting age as '1234') and 16 for reporting BMI < 10 or >75. A wider range of BMI was permitted in the present study to allow for representation across weight classes, and the present sample paralleled the frequency of 'extreme obesity' (BMI > 40) in other nationally representative samples [current sample frequency: 6.4%; frequency in National Health and Nutrition Examination Survey dataset: 6.3% (Fryar, Carroll, & Ogden, 2012)]. Gender, race and income were similar to the 2010 United States census reference population (www.census.gov) (see Table 1). Participants were 51.2% female, with an average age of 44.91 ($SD = 16.27$). Self-reported racial identification was 68.4% White, 12.7% African American, 12.6% Hispanic, 3.2% Asian and 3.1% Other. Average self-reported BMI was 27.53 ($SD = 7.38$), with the following weight class categorizations: 4.7% underweight (BMI < 18.5), 37.5% normal weight (BMI = 18.5–24.9), 30.4% overweight (BMI = 25.0–29.9) and 27.4% obese (BMI > 30). Participants' median income was $50 000–$74 999.

Table 1 Sample demographic characteristics versus United States census data

	Current sample $n = 986$	Census data (2010)	Chi-squared p-value
Age	<18: 0% (due to consent)	<18: 24.0%	<0.01**
	18–24: 10.0%	18–24: 9.9%	1.00
	25–44: 35.7%	25–44: 26.6%	0.17
	45–64: 33.4%	45–64: 26.4%	0.28
	65+: 14.8%	65+: 13.0%	0.10
Gender	Male: 48.8%	Male: 49.2%	1.00
	Female: 51.2%	Female: 50.8%	1.00
Race	White: 68.4%	White: 63.7%	0.55
	Black: 12.7%	Black: 12.6%	1.00
	Hispanic: 12.6%	Hispanic: 16.3%	0.55
	Asian: 3.2%	Asian: 4.8%	0.47
	Other: 3.1%		n/a
Income	< $25 000: 18.6%	< $25 000: 25.8%	0.24
	$25 000–$49 999: 23.1%	$25 000–$49 999: 24.7%	0.87
	$50 000–$74 999: 19.8%	$50 000–$74 999: 17.7%	0.72
	$75 000–$99 999: 13.1%	$75 000–$99 999: 11.4%	0.66
	> $100 000: 25.5%	> $100 000: 20.4%	0.31
Geographic Region	Northeast: 17.0%	Northeast: 17.9%	0.85
	Midwest: 22.0%	Midwest: 21.7%	1.00
	West: 23.3%	West: 23.3%	1.00
	South: 37.6%	South: 37.1%	1.00

Note:
**$p < 0.01$.

Measures

Modified Yale Food Addiction Scale 2.0

The abbreviated form of the current version of the YFAS, the modified Yale Food Addiction Scale 2.0 (mYFAS 2.0) (Schulte & Gearhardt, 2017) was used to measure the 11 indicators of and threshold for food addiction in the current sample. The psychometric performance and scoring methods of the mYFAS 2.0 are detailed in the validation paper (Schulte & Gearhardt, 2017). In the current study, the mYFAS 2.0 exhibited excellent reliability ($\alpha = .97$).

Body mass index and demographics

Body mass index was calculated using self-reported height and weight. Further, participants self-reported several demographic variables: age, gender (male or female), racial identification (White/Caucasian, Black/African American, Hispanic/Latino, Asian or Other) and annual household income.

Data analytic plan

All study variables were first examined for outliers and skewness (<2). Consistent with the three study aims, correlations, analysis of variance tests, t-tests and chi-square tests were first utilized to examine the relationship between mYFAS 2.0 scores and demographic variables (age, gender, race and income). Effect sizes (η^2_p) were calculated and reported to indicate the magnitude of the finding in a manner that is independent from sample size. Effects can be considered small at $\eta^2_p = 0.01-0.06$, medium at $\eta^2_p = 0.06-0.14$ and large at $\eta^2_p > 0.14$ (Richardson, 2011) η^2_p. Tukey's honestly significant difference tests were used to follow up significant analysis of variance omnibus tests. Second, univariate general linear modelling investigated the associations of mYFAS 2.0 with (i) BMI and (ii) weight class (underweight, normal weight, overweight and obese). Third, multivariate general linear modelling was used to explore the main effects and interactions of mYFAS 2.0 and the four individual characteristics (age, gender, race and income) on BMI. Given that all main effects and interactions were significant in this multivariate model, separate models assessing the main effects and interactions of each demographic variable with mYFAS 2.0 are presented for ease of interpretation. As prior literature has observed opposite associations between age with YFAS and BMI (Flint et al., 2014; Hauck et al., 2017), all analyses examining the association of mYFAS 2.0 scores with BMI included age as a covariate.

Results

Modified Yale Food Addiction Scale 2.0

The average number of food addiction symptoms endorsed on the mYFAS 2.0 was 1.81 ($SD = 3.18$) and ranged from 0 to 11. Further, 15.0% of participants met the diagnostic threshold score for mYFAS 2.0 food addiction (1.0% mild, 2.4% moderate and 11.6% severe). Table 2 details the average mYFAS 2.0 symptoms and prevalence for all demographic characteristics.

Modified Yale Food Addiction Scale 2.0 with demographics

Age was significantly negatively associated with the mYFAS 2.0 symptom ($r = -.28$, $p < 0.001$) and diagnostic scores ($t(984)$

Table 2 Prevalence of food addiction in the current sample

	mYFAS symptom score M, SD	mYFAS diagnostic score prevalence
Age*		
18–24 ($n = 99$)	2.25, 3.28	18.18%
25–34 ($n = 235$)	2.77, 3.83	22.55%
35–44 ($n = 177$)	2.88, 4.00	26.55%
45–54 ($n = 142$)	1.22, 2.41	9.86%
55–65 ($n = 187$)	0.84, 2.00	6.42%
65+ ($n = 146$)	0.51, 1.24	2.74%
Gender		
Male ($n = 481$)	1.94, 3.40	15.80%
Female ($n = 505$)	1.69, 2.96	14.26%
Weight Class*		
Underweight ($n = 46$)	4.96, 4.95	45.65%
Normal weight ($n = 370$)	1.66, 3.21	12.16%
Overweight ($n = 300$)	1.23, 2.66	10.00%
Obese ($n = 270$)	2.13, 2.97	19.26%
Race*		
White ($n = 674$)	1.45, 2.90	11.72%
African American ($n = 125$)	1.68, 2.76	16.80%
Hispanic ($n = 124$)	3.96, 4.20	32.26%
Asian ($n = 32$)	2.41, 3.52	15.63%
Other ($n = 31$)	1.06, 2.29	9.68%
Income*		
$< \$25\,000$ ($n = 183$)	1.40, 2.37	10.38%
$\$25\,000–\$49\,999$ ($n = 228$)	1.65, 2.83	14.47%
$\$50\,000–\$74\,999$ ($n = 195$)	1.22, 2.51	9.74%
$\$75\,000–\$99\,999$ ($n = 129$)	3.09, 4.24	24.81%
$> \$100\,000$ ($n = 251$)	2.06, 3.63	17.93%

Note:

*Significant differences ($p < 0.01$) in YFAS scores for each demographic characteristic are indicated.

$= 48.66$, $p < 0.001$, $\eta^2_p = 0.05$), with individuals meeting the diagnostic threshold being younger ($M = 36.51$, $SD = 11.39$) than those who did not ($M = 46.39$, $SD = 16.55$). mYFAS 2.0 symptom and diagnostic scores did not significantly differ by gender (ps > 0.21). Self-reported racial identification (White, African-American, Hispanic, Asian and other) was significantly associated with the mYFAS 2.0 symptom count score ($F(4981) = 18.27$, $p < 0.001$, $\eta^2_p = 0.07$), with individuals who identified as Hispanic endorsing more mYFAS 2.0 symptoms than those who reported being White, African American or other race (ps < 0.01). These findings were replicated using the mYFAS 2.0 diagnostic score. The mYFAS 2.0 symptom count score was positively correlated with income ($r = .10$, $p = 0.001$), as was the mYFAS 2.0 diagnostic score ($p < 0.05$). Table S1 provides the correlations between all continuous study variables.

Modified Yale Food Addiction Scale 2.0, body mass index and weight class

Modified Yale Food Addiction Scale 2.0 symptom count became significantly related to BMI ($F(11973) = 6.22$, $p < 0.001$, $\eta^2_p = 0.07$) when age was included as a covariate. The mYFAS 2.0 diagnostic score was also associated with BMI ($F(1983) = 11.34$, $p = 0.001$, $\eta^2_p = 0.01$). The relationship between mYFAS 2.0 and

BMI only becoming significant when including age as a covariate seems to reflect a steeper drop-off in obesity prevalence, relative to food addiction prevalence, after age 44 (see Figure 1).

Weight class categorization (underweight, normal weight, overweight and obese) was significantly associated with the mYFAS 2.0 symptom count score (F(3981) = 18.05, $p < 0.001$, $\eta_p^2 = 0.05$). Post hoc analyses revealed a quadratic relationship, such that underweight individuals endorsed more mYFAS 2.0 symptoms than all other weight classes (ps < 0.001), and obese individuals reported significantly greater mYFAS 2.0 symptoms than normal weight ($p = 0.006$) and overweight persons ($p = 0.001$). This pattern of results was also observed for the mYFAS 2.0 diagnostic score. Figure 2 models the prevalence of the mYFAS 2.0 diagnostic score across weight classes.

Modified Yale Food Addiction Scale 2.0, body mass index and demographics

Age, modified Yale Food Addiction Scale 2.0 and body mass index

There were significant main effects for mYFAS 2.0 symptom count (F(11962) = 3.12, $p < 0.001$, $\eta_p^2 = 0.03$) and age (F(1962) = 29.17, $p < 0.001$, $\eta_p^2 = 0.03$) on BMI. There was also a significant interaction between mYFAS 2.0 symptom count and age (F(11962) = 4.31, $p < 0.001$, $\eta_p^2 = 0.05$), where elevated symptom count was associated with higher BMI in older individuals (those above the sample mean of 44.91) (r = .32, $p < 0.001$) but not younger individuals (those below the sample mean of 44.91) ($p = .25$). This pattern of results was replicated with the mYFAS 2.0 diagnostic score.

Gender, modified Yale Food Addiction Scale 2.0 and body mass index

Modified Yale Food Addiction Scale 2.0 symptom count (F(11961) = 6.07, $p < 0.001$, $\eta_p^2 = 0.07$) and gender (F(1961) = 8.93, $p = 0.003$, $\eta_p^2 = 0.01$) were significantly related to BMI. There was a significant interaction between mYFAS 2.0 symptom count and gender (F(11961) = 3.77, $p < 0.001$, $\eta_p^2 = 0.04$),
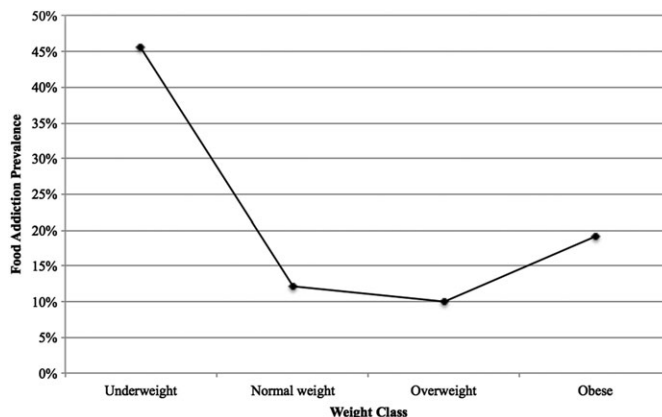

Figure 2. Food addiction prevalence by weight class

where elevated symptom count was associated with higher BMI in women (r = .20, $p < 0.001$) but not men ($p = 0.07$) (Figure S1). These findings were also observed for the mYFAS 2.0 diagnostic score.

Race, modified Yale Food Addiction Scale 2.0 and body mass index

There was a significant main effect of racial identification (F(4933) = 4.90, $p = 0.001$, $\eta_p^2 = 0.02$) but not mYFAS 2.0 symptom score ($p = .51$) on BMI. There was a significant interaction between mYFAS 2.0 symptom score and racial identification (F(36933) = 1.75, $p = 0.004$, $\eta_p^2 = 0.06$), with elevated mYFAS 2.0 symptom score being associated with higher BMI among those who identified as White (r = 0.12, $p = 0.002$). However, for persons who identified as Hispanic, elevated mYFAS 2.0 symptom score was associated with lower BMI at trend-level significance (r = −.17, $p = 0.06$), and for those who reported being African American, Asian or other race, no significant relationship between mYFAS 2.0 symptom score and BMI was found (ps > .20) (Figure
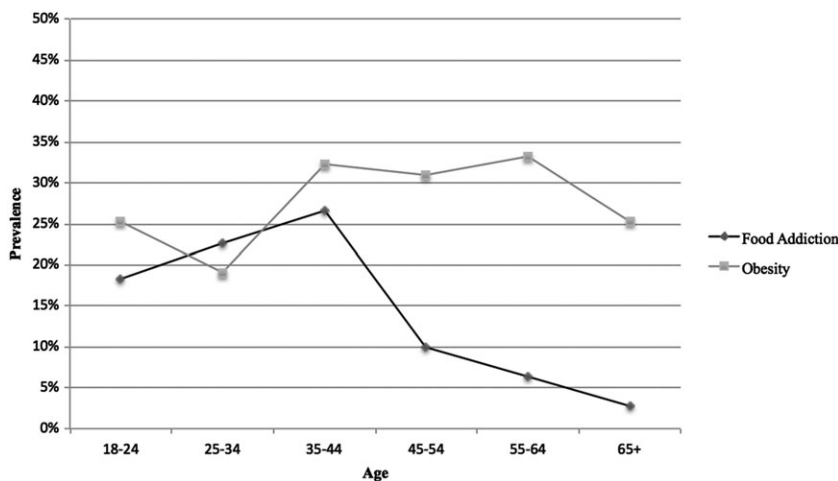

Figure 1. Age and prevalence of modified Yale Food Addiction Scale 2.0 food addiction and obesity

S2). These findings were replicated using the mYFAS 2.0 diagnostic score.

Income, modified Yale Food Addiction Scale 2.0 and body mass index

Significant main effects were observed for mYFAS 2.0 symptom count ($F(11928) = 5.44$, $p < 0.001$, $\eta_p^2 = 0.06$) and income ($F(4928) = 10.37$, $p < 0.001$, $\eta_p^2 = 0.04$) on BMI. There was a significant interaction for mYFAS 2.0 symptom score and income ($F(41928) = 2.61$, $p < 0.001$, $\eta_p^2 = .10$) with greater mYFAS 2.0 symptom scores being related to increased BMI only for those who reported an annual household income $< \$25\,000$ ($r = .38$, $p < 0.001$) and $\$25\,000–\$49\,999$ ($r = .13$, $p = 0.05$) (Figure S3). No significant relationship between mYFAS 2.0 symptom score and BMI was found for those who reported an annual household income between $\$50\,000–\$74\,999$, $\$75\,000–\$99\,999$, or $>\$100\,000$ ($ps > .14$). These findings were replicated using the mYFAS 2.0 diagnostic score.

Discussion

Prevalence of food addiction

In a sample more representative of the United States than previous research, 15.0% of individuals met the mYFAS 2.0 criteria for food addiction. This point-prevalence estimate is similar to previous research in the United States assessing food addiction with the YFAS 2.0 or mYFAS 2.0 in online community samples (Gearhardt et al., 2016; Schulte & Gearhardt, 2017). Notably, the observed prevalence is nearly double the 7.9% estimate in a more nationally representative German sample (Hauck et al., 2017), which may be related to significantly higher obesity rates (Mensink et al., 2013; Ogden et al., 2014) and density of highly processed foods (e.g., fast foods) (Jeffery, Baxter, McGuire, & Linde, 2006; Maddock, 2004) in the United States Notably, the current prevalence estimate of food addiction in the United States appears to be comparable to substance-use disorders where the substance is legal [e.g., alcohol: 13.9% (Grant et al., 2015), tobacco: 20.0% (Chou et al., 2016)].

Association of Food Addiction with body mass index and weight class

Paralleling findings from the more nationally representative German sample (Hauck et al., 2017), individuals who were underweight or obese exhibited greater rates of food addiction than those who were normal weight or overweight. While elevated rates of addictive-like eating in the obese weight class support theoretical perspectives that addictive-like eating may be a phenotype of obesity (Davis et al., 2011; Pedram et al., 2013), elevated symptoms and prevalence of food addiction in individuals who were underweight necessitate further examination. One possible explanation may be that the YFAS is susceptible to differences in interpretation. For example, self-reported endorsement of consuming highly processed foods in greater quantities than intended may vary based on a person's intention (e.g., intending to consume three slices of pizza versus none). For individuals who are underweight and report food addiction, other factors (e.g., dieting and caloric deprivation) may mimic the behavioural indicators of addiction (e.g., consuming more than intended may originate from violation of dietary rules, intense craving may result from

homeostatic drive for food in starved state). Further, rates of food addiction have been found to be higher among individuals with anorexia nervosa binge/purge type relative to restrictive type (Granero et al., 2014). Thus, examination of whether underweight individuals with food addiction are engaging in objective or subjective overeating may be necessary. Akin to substance-use disorders, the food addiction theory posits that individuals objectively, compulsively overeat highly processed foods. The development of an interview-style assessment of food addiction may be useful for evaluating whether an individual is exhibiting the addictive-like overconsumption of highly processed foods that the YFAS aims to operationalize.

Age

In line with previous findings, food addiction was associated with younger age (Flint et al., 2014; Hauck et al., 2017; Schulte & Gearhardt, 2017), paralleling developmental trends in both eating disorders (Woodside & Garfinkel, 1992) and substance-use disorders (Kessler et al., 2005). The current cross-sectional findings suggest that food addiction rates seem to increase until ages 35–44 before declining rapidly after age 45. This may reflect a cohort effect related to changes in the food environment in the past few decades (e.g., greater portion sizes and accessibility of highly processed foods) (Gearhardt, Grilo, DiLeone, Brownell, & Potenza, 2011) or neurobiological changes in the dopaminergic system across the lifespan that may result in diminished reward responsiveness to addictive substances (Bannon et al., 1992; Dowling, Weiss, & Condon, 2008; Giros, Jaber, Jones, Wightman, & Caron, 1996). Additionally, given that food addiction prevalence appears to peak in developmental years associated with child bearing and child rearing, future research may investigate possible associations between addictive-like eating and familial influences (e.g., number of children and marital status). Further, longitudinal research is needed to evaluate the trajectory of food addiction prevalence across the lifespan.

Notably, the association between BMI and food addiction only became significant after controlling for age, as age was negatively related to food addiction and positively associated with BMI, demonstrating that age may be a key factor to assess when examining the association between food addiction and obesity. Further, food addiction was associated with higher BMI in older but not younger individuals. It may be that younger persons with addictive-like eating behaviour have biological protective factors (e.g., higher metabolism) or behavioural strategies (e.g., dieting and restrained eating) that contribute to weight control. Longitudinal research is needed to examine the temporal nature of these relationships, such as whether there is a steeper weight gain trajectory for younger individuals with food addiction.

Gender

In contrast to previous studies (Gearhardt et al., 2016; Hauck et al., 2017; Pedram et al., 2013; Pursey et al., 2014), food addiction was not related to gender in the present work. However, the association between food addiction and BMI did differ by gender, with elevated food addiction symptoms being associated with higher BMI for women but not men. The positive relationship between addictive-like eating and obesity in women is consistent with previous research (Flint et al., 2014), although

the lack of this association for men is surprising. Given that food addiction may particularly implicated in obesity for women, relative to men, screening for addictive-like eating in women with obesity may inform treatment needs and possibly improve outcomes like body weight.

Race

Akin to prior work using the mYFAS 2.0 (Schulte & Gearhardt, 2017), Hispanic individuals reported higher rates of addictive-like eating behaviour relative to those who identified as White or African American. Findings related to the prevalence of related eating pathology (e.g., binge eating) in Hispanic individuals, relative to other racial groups, are mixed (Cachelin, Veisel, Barzegarnazari, & Striegel-Moore, 2000; Fitzgibbon et al., 1998; T. N. Robinson et al., 1996; J. E. Smith & Krejci, 1991), although depressive symptomology has been particularly related to binge eating for Hispanic individuals (Fitzgibbon et al., 1998). From an addiction perspective, use of a substance to cope with negative affect is characteristic of individuals with substance-use disorders (Cooper, 1994), and recent research suggests that eating to cope with emotional states is linked to food addiction (Joyner, Schulte, Wilt, & Gearhardt, 2015). Thus, one extension of the current findings may be to elucidate mechanisms (e.g., emotion dysregulation) that may differentially contribute to addictive-like eating for various racial groups.

Further, there was a positive association between food addiction and BMI for White persons, whereas the reverse relationship was observed for Hispanic participants. This finding first suggests that addictive-like eating may be particularly associated with obesity among White individuals. As such, early identification and treatment of food addiction indicators in this group may impact outcomes like obesity. In contrast, although Hispanic persons reported the most elevated indicators of food addiction, addictive-like eating was associated with lower body weight in this group. This is somewhat consistent with prior work demonstrating more severe binge eating in Hispanic relative to White and African American individuals but also greater engagement in fasting-excessive dieting and use of diuretics for weight control (Fitzgibbon et al., 1998; J. E. Smith & Krejci, 1991). Future research may evaluate whether other disordered eating behaviours (e.g., compensatory behaviours) interact with food addiction and body weight among Hispanic persons.

Income

Elevated rates of food addiction among individuals with greater income parallel greater rates of substance-use disorders in adults of higher socioeconomic classes (Humensky, 2010; Wohlfarth & van den Brink, 1998). Additionally, it may be that these persons are more sensitive in self-reporting eating-related problems, as prior work has also observed that individuals of higher socioeconomic status are more aware of American body ideals and more likely to perceive overweight (Paeratakul, White, Williamson, Ryan, & Bray, 2002; Wardle et al., 2004). In contrast, self-reporting addictive-like eating behaviour may be more challenging in lower socioeconomic groups, where consumption of highly processed foods may be more frequent due in part to these foods being easily accessible and affordable (Bowman, Gortmaker, Ebbeling, Pereira, & Ludwig, 2004; Fernandez-Alvira

et al., 2014; Konttinen, Sarlio-Lahteenkorva, Silventoinen, Mannisto, & Haukkala, 2013), and overconsumption of these foods may be viewed as normative (Malika, Hayman Jr., Miller, Lee, & Lumeng, 2015). This may be comparable to the issues of self-reporting drinking behaviour within a population where frequent alcohol consumption is normative or socially desirable (e.g., college students) (Baer & Carney, 1993; Baer, Stacy, & Larimer, 1991; Del Boca & Darkes, 2003).

There was also a positive association between food addiction and BMI among individuals from the two lowest annual income groups, whereas no relationship was observed for higher income groups. The convenience and affordability of highly processed foods may motivate their selection among individuals in low-income communities (Inglis, Ball, & Crawford, 2005; Konttinen et al., 2013), as well as possible limited access to minimally processed foods like fruits and vegetables (Ball, Timperio, & Crawford, 2009), in a manner that may increase body weight. Thus, public policy initiatives that increase the availability and affordability of a wider variety of foods may be beneficial for lower income socioeconomic groups, such as subsidizing fruits, vegetables and lean proteins.

Limitations

While this study employed techniques to collect a sample more nationally representative of the United States than prior research, there were demographic differences. Age was restricted to older than 18 due to consent, and the percentage of individuals with obesity was lower than prior research (Ogden et al., 2014). Further, the standardized demographic questions used by Qualtrics assessed race in a different way than the United States census. For the census, individuals report being either Hispanic or non-Hispanic then separately select their racial identification, whereas in the current approach, participants simply selected the most appropriate racial identification from the five choices (White, African American, Hispanic, Asian or other). Further, all data was participants' self-report, which may be subject to greater bias, particularly with respect to height and weight. Additionally, Qualtrics limited the number of questions that could be included and certain variables that may contribute to the observed relationships (e.g., eating disorder symptomology and dietary restraint) were unable to be accounted for. Broadly, the associations described warrant replication to support that the present findings did not result from Type I or Type II errors. In particular, the sample size was large, and most effect sizes ranged from small to moderate. It will be important for future research to investigate the clinical significance of these findings. In addition, while the current study permitted recruitment of individuals from all regions of the United States, an in-lab investigation of food addiction with diverse individual characteristics may strengthen the present findings. Lastly, the nature of all observations was cross-sectional, and longitudinal research is essential for investigating the temporal associations between the variables to better assess risk factors and intervention opportunities.

Conclusions

Overall, the present study elucidates the prevalence of food addiction and its relationship to weight class in the United States and identifies which groups of individuals may be at

elevated risk for addictive-like eating and for whom food addiction may be most related to obesity. Identifying the scope of food addiction and the individuals at greatest risk may inform which public policy initiatives may be effective (e.g., zoning requirements for fast food restaurants in low-income communities) and motivate early identification of food addiction in certain groups (e.g., screening of addictive-like eating in younger persons).

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