Eating and Weight Disorders - Studies on Anorexia, Bulimia and Obesity (2021) 26:1503–1509
https://doi.org/10.1007/s40519-020-00957-w

ORIGINAL ARTICLE

Examining the construct validity of food addiction severity specifiers

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Received: 13 April 2020 / Accepted: 7 July 2020 / Published online: 28 July 2020

Abstract

Purpose Food addiction (FA) is related to greater body mass index (BMI), eating-disorder psychopathology, food craving, and psychosocial impairment. Less is known regarding the utility of the FA severity specifiers, as measured by the number of symptoms endorsed on the Yale Food Addiction Scale (YFAS 2.0).

Methods Participants ($N = 1854$) were recruited from Amazon Mechanical Turk to complete an online survey on eating behaviors. Participants completed self-report measures assessing FA, eating-disorder psychopathology (Eating Disorder Examination Questionnaire), and food craving (Food Craving Inventory). Based on the YFAS 2.0 specifiers, participants were classified into four FA groups: No FA ($n = 1643$), mild ($n = 40$), moderate ($n = 55$), and severe ($n = 116$).

Results There were significant differences found in age, sex, BMI, and frequency of objective binge-eating episodes (OBEs) among the FA groups. Using ANCOVA, adjusted for multiple comparisons and covariates (e.g., BMI, sex, OBEs), the No FA group reported significantly lower levels of shape concern ($\eta^2 = 0.05$; $p < 0.001$), weight concern ($\eta^2 = 0.04$; $p < 0.001$), eating concern ($\eta^2 = 0.15$; $p < 0.001$), and global eating-disorder psychopathology ($\eta^2 = 0.06$; $p < 0.001$) than mild, moderate, or severe FA groups. The No FA group reported significantly lower levels of dietary restraint ($\eta^2 = 0.01$; $p < 0.01$) than mild and severe FA groups. The severe FA group reported higher food craving scores ($\eta^2 = 0.02$; $p < 0.001$) compared to the No FA group.

Conclusion Our findings parallel the severity specifiers literature for eating and substance use disorders by also indicating the limited utility of severity specifiers based on symptom count. Future research should investigate alternative targets for discriminating among levels of FA.

Level of evidence Level V, cross-sectional descriptive study.

Keywords Food addiction · Binge eating · Obesity · Disordered eating

Introduction

The controversial construct of food addiction posits that certain foods (e.g., highly palatable, calorically dense, processed foods) might have addictive properties. Food addiction is not a formally recognized diagnosis within the Diagnostic and Statistical Manual of Mental Disorders (*DSM*) or the International Classification of Diseases, yet public attention and scientific interest in this construct has increased substantially since the Yale Food Addiction Scale (YFAS) development [1]. Food addiction (as assessed by the YFAS) is related to greater disordered eating, food cravings, impulsivity, body mass index (BMI), and psychosocial impairment in both clinical and non-clinical samples [2–5]. The YFAS was originally developed to standardize symptoms of food addiction consistent with the seven symptoms comprising the *DSM-IV-TR* substance dependence criteria and clinically significant distress and/or impairment [6].

Several changes to the diagnostic classification of substance use disorders in the *DSM fifth edition* (*DSM-5*) led to the updated YFAS 2.0 [7]. The YFAS 2.0 aligned with broader changes within the substance-related and other addictive disorders category in the *DSM-5*, including adding a criterion related to cravings, removing the criterion related to legal problems, and adding three severity

The article is part of the Topical Collection on Food and addiction.

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specifiers (mild, moderate, or severe). The diagnostic scoring of the YFAS 2.0 includes endorsement of at least two symptoms and clinically significant distress and/or impairment, establishing a clinical-threshold or "food addiction diagnosis." Additionally, continuous scoring of the YFAS 2.0 is based on the number of symptoms endorsed and includes the severity specifiers of mild, moderate, or severe.

Prior studies have compared individuals who meet, to those who do not meet, the clinical-threshold for food addiction, and examined clinical correlates of the food addiction continuous scores (i.e., symptom counts without distress and/or impairment [8]. Much less is known, however, regarding the clinical utility of the *DSM-5* adopted severity specifiers (i.e., symptom counts with distress and/or impairment) of mild, moderate, or severe. Previously, researchers hypothesized that treatment adaptations might be necessary for individuals with food addiction after observing BMI categories differences among those with mild, moderate, and severe food addiction groups [9]. Interestingly, few participants endorsed mild ($n=9$, 2.4%) or moderate ($n=10$, 1.9%) food addiction levels in the YFAS 2.0 validation study, and few differences were found among the severity specifier groups (i.e., mild vs. moderate vs. severe), though perhaps due to low power [7]. Yet individuals with severe food addiction reported a greater number of binge-eating episodes compared to those with mild or moderate food addiction. Additionally, individuals with binge-eating disorder (BED) were more likely to be classified with at least mild (92%) food addiction compared to those without BED (6%), and individuals with BED categorized with moderate/severe food addiction endorsed higher eating-disorder psychopathology, depression, and anxiety compared to the mild group [10]. Due to small sample sizes, however, participants in the moderate and severe categories were collapsed and potential differences among the three severity groups (i.e., mild vs. moderate vs. severe) were unexamined [10]. One additional study considered symptom counts, though not all participants met FA criteria, and found differences in grey matter volume between those with two or fewer symptoms and those with four or more symptoms [11]. Thus, due to small samples, subthreshold samples, and combined severity specifier groups, there is a gap in the literature on the construct validity of the YFAS 2.0 proposed three severity groups.

The aim of the present study was to evaluate the clinical significance of the proposed three severity specifiers of the YFAS. Based on previous findings examining the continuous/diagnostic scoring of the YFAS, we hypothesized that participants within higher food addiction severity (i.e., severe) would endorse more severe eating-disorder psychopathology and food cravings after adjusting for relevant covariates.

Methods

Participants ($N=1854$) were recruited from the Amazon Mechanical Turk website to complete an online survey on eating and healthcare attitudes. Participants were eligible if they were 18 years or older and spoke English. Comparisons suggest that the psychometric properties of data from Mechanical Turk participants do not differ in reliability or validity from participants recruited using traditional sources [12]. In the present study participants were paid 0.50 cents, consistent with prior investigations using Mechanical Turk.

Most participants identified as female (67.6% $n=1253$) and 32.4% ($n=601$) identified as male. The racial-ethnic distribution of the sample was: 80.3% White/Caucasian, 7.0% Black/African American, 7.7% Asian, 1.8% more than one race, 0.9% American Indian or Alaska Native, 2.2% "Other," and 0.2% Native Hawaiian or Pacific Islander, and 91.3% identified as non-Hispanic, while 8.7% identified as Hispanic. The average age was 36.7 years old (SD = 12.2) and the average BMI of the sample was 27.6 kg/m^2 (SD = 6.9). This study received approval from the University Institutional Review Board and all participants provided electronic informed consent.

Measures

Self-reported current height and weight were used to calculate BMI (kg/m^2).

The Modified Yale Food Addiction Scale 2.0 (mYFAS 2.0; [13]) is a 13-item abbreviated version of the YFAS 2.0 [6], a self-report measure examining symptoms of food addiction based on the *DSM-5* criteria for substance-related and addictive disorders, modified to examine eating behaviors. The mYFAS 2.0 is scored dimensionally, based on the total number of symptoms endorsed, as well as dichotomously, corresponding to a food addiction "diagnosis" consisting of endorsing two or more symptoms and clinically significant distress and/or impairment during the past 12 months [6]. Those who meet the YFAS-defined clinical-threshold of food addiction are categorized as having a mild (i.e., 2–3 symptoms), moderate (i.e., 4–5 symptoms), or severe (i.e., ≥ 6 symptoms) level of food addiction severity based on the number of symptoms endorsed. Psychometrically, the mYFAS 2.0 has a one-factor structure and demonstrated good reliability and validity [13]. In the present study the Cronbach's alpha for the mYFAS 2.0 was 0.94.

The Eating Disorder Examination Questionnaire—Version 17 (EDE-Q; [14]) is a measure of eating-disorder psychopathology and overeating behaviors during the past 28 days. The subscales of the EDE-Q include restraint, eating concern, shape concern, weight concern, and a global score. Behaviors measured by this scale include objective binge-eating episodes (i.e., eating an unusually large amount of food, such as a large pizza in one sitting, while feeling a sense of loss of control; this corresponds to the *DSM-5* definition of a binge-eating episode), and purging/compensatory behaviors (i.e., vomiting, laxative misuse, compulsive exercise). Current Cronbach's alpha for the EDE-Q subscales were as follows: restraint (0.83), eating concern (0.84), shape concern (0.89), weight concern (0.85).

The Food Craving Inventory (FCI; [15]) is a 28-item self-report measure that assesses general and specific food cravings. Participants rated how often each food was craved over the past month on a 5-point Likert scale ranging from 1 (never) to 5 (always/almost every day). The FCI has four subscales: high fat foods, sweets, complex carbohydrates/starches, and fast-food fats. Though a small minority of items were found to cross-load, data support construct validity among individuals with obesity as well as individuals with obesity and BED [16]. The current Cronbach's Alpha for the FCI was 0.93.

Statistical analyses

Nominal variables were summarized with frequencies and proportions. Interval and ordinal variables were summarized with means and standard deviations. The relationship between food addiction severity and possible confounds was examined utilizing analysis of variance or chi-square goodness of fit tests, as appropriate for the distribution of the data. The distribution of objective binge-eating episodes displayed significant kurtosis and positive skew. A log transformation was used to improve the normalcy of the distribution. Analysis of covariance was used to test for differences among food addiction severity groups in reported eating-disorder psychopathology and food cravings, while adjusting for sex, age, BMI, and objective binge-eating episodes. Partial eta-squared (η^2) was calculated to determine effect sizes and the following interpretation was used: small (0.01–0.09), medium (0.10–0.24), and large ($\geq$0.25) [17].

Results

The YFAS symptom mean was 1.56 (SD = 2.50) and 11.4% of the total sample met the YFAS-defined clinical-threshold of food addiction ($n = 211$). Among those with food addiction, 19% were categorized as mild ($n = 40$), 26% were categorized as moderate ($n = 55$), and 55% were categorized as severe ($n = 116$).

An ANOVA revealed significant differences in age among the YFAS severity groups (see Table 1). Tukey's post hoc tests indicated that individuals with severe food addiction were significantly younger when compared to the No food addiction group. Significant differences were also found in BMI among the YFAS severity groups. Tukey's post hoc tests indicated that individuals with mild and severe food addiction reported a significantly higher BMI compared to those with No food addiction (both $p < 0.001$). Significant differences also were found in objective binge-eating episodes among the YFAS severity groups. Tukey's post hoc

Table 1 Means and standard deviations of demographic variables overall by Yale Food Addiction Scale Severity Group

	No FA ($n = 1643$)	Mild FA ($n = 40$)	Moderate FA ($n = 55$)	Severe FA ($n = 116$)	Test statistic	p value	Effect size η^2	Post hoc
Age, mean (SD)	36.90 (12.30)	38.15 (11.88)	35.96 (11.66)	33.23 (10.81)	F (3, 1850) = 3.53	0.014	$\eta^2 = 0.006$	Severe < No FA
Female, no. (%)	1099 (87.71%)	36 (2.87%)	41 (3.27%)	77 (6.15%)	χ^2 (3, $N = 1854$) = 10.83	0.013	$\Phi = 0.076$	No FA, severe < mild
White, no. (%)[a]	1537 (88.59%)	38 (2.19%)	52 (3.00%)	108 (6.22%)	χ^2 (3, $N = 1854$) = 0.27	0.966	$\Phi = 0.012$	N/A
Body mass index	27.16 (6.61)	32.02 (9.25)	29.56 (6.51)	30.78 (8.96)	F (3, 1850) = 17.22	< 0.001	$\eta^2 = 0.027$	No FA < mild, severe
OBEs[b]	1.38 (3.37)	2.75 (3.15)	5.20 (4.84)	9.11 (7.81)	F (3, 1850) = 166.75	< 0.001	$\eta^2 = 0.213$	All

Comparison of nominal/ordinal variable by race/ethnicity compared column proportions using z test with Bonferroni correction and group differences for interval variables used One-Way ANOVA, with Tukey's post hoc testing and Bonferroni correction for multiple comparisons

FA food addiction, *OBEs* objective binge-eating episodes, *All* no FA, mild FA, moderate FA, severe FA groups all differed

[a]Chi-square analysis for white vs. not white

[b]Analysis of covariance testing used the natural log of objective binge days; mean and standard deviation reported in original units for ease of interpretation

tests indicated all groups differed significantly from one another, with binge-eating episodes significantly increasing based on food addiction severity. Chi-squared tests revealed significant differences for food addiction severity group by sex. More women were categorized as having mild food addiction as compared to those with No food addiction and severe food addiction. There were no significant differences among the YFAS severity groups by race.

Given the significant differences among YFAS severity groups in age, sex, and BMI, we adjusted for these variables and multiple comparisons, using a Bonferroni correction, in all subsequent analyses. ANCOVAs revealed significant differences among groups on all measures of eating-disorder psychopathology and food craving. Post hoc analyses revealed that the No food addiction group reported significantly lower levels of global eating-disorder psychopathology (effect sizes using partial eta-squared: $\eta^2 = 0.16$), restraint ($\eta^2 = 0.29$), shape concern ($\eta^2 = 0.12$), weight concern ($\eta^2 = 0.13$), and eating concern ($\eta^2 = 0.15$) than mild, moderate, or severe food addiction groups. Those in the severe food addiction group also reported significantly higher eating concern scores than mild and moderate food addiction severity groups ($\eta^2 = 0.29$). The No food addiction group reported lower FCI scores compared to the moderate and severe food addiction groups, and those in the severe food addiction group reported greater scores than mild and moderate food addiction groups ($\eta^2 = 0.08$).

When we included objective binge-eating episodes as a covariate, however, effect sizes were reduced. Table 2 characterizes differences in clinical variables of interest by YFAS severity group, while adjusting for age, sex, BMI and objective binge episodes. ANCOVAs revealed omnibus significant differences among groups on all measures of eating-disorder psychopathology and food craving. Effect sizes using partial eta-squared (η^2) were generally small (range 0.01–0.15). Post hoc analyses revealed that the No food addiction group reported significantly lower levels of global eating-disorder psychopathology, eating concern, shape concern, and weight concern than mild, moderate, or severe food addiction groups (see Table 2 for means, standard deviations and effect sizes). The No food addiction group reported significantly lower levels of restraint than mild and severe food addiction groups. Finally, the severe food addiction group reported significantly higher FCI scores compared to the No food addiction group, yet no other differences emerged.

Discussion

The current study explored the correlates of the three food addiction severity specifiers using an online, community-based sample. Similar to previous research [7, 10], there

Table 2 Adjusted means and standard errors of clinical variables by YFAS Severity Group

	No FA ($n = 1643$) Adj. M (SE)	Mild FA ($n = 40$) Adj. M (SE)	Moderate FA ($n = 55$) Adj. M (SE)	Severe FA ($n = 116$) Adj. M (SE)	ANCOVA F	Effect size η^2	Post hoc
EDE-Q global	1.78 (0.03)	2.82 (0.17)	2.75 (0.14)	2.68 (0.11)	F (3, 1846) = 41.97**	0.06	No FA < all
Restraint	1.73 (0.04)	2.38 (0.23)	2.22 (.20)	2.17 (0.15)	F (3, 1846) = 5.97**	0.01	No FA < mild; severe
Eating concern	0.90 (0.02)	1.99 (0.15)	2.10 (0.13)	2.40 (0.09)	F (3, 1846) = 105.69**	0.15	No FA < all
Shape concern	2.38 (0.04)	3.72 (0.22)	3.56 (0.19)	3.20 (0.14)	F (3, 1846) = 30.24**	0.05	No FA < all
Weight concern	2.10 (0.03)	3.17 (0.20)	3.14 (0.17)	2.93 (0.13)	F (3, 1846) = 28.41**	0.04	No FA < all
Food Craving Inventory	2.21 (0.02)	2.34 (0.11)	2.38 (0.09)	2.65 (0.07)	F (3, 1842) = 14.17**	0.02	No FA < severe

All analyses were adjusted for age, BMI, sex, and objective binge-eating episodes

EDE-Q Eating Disorder Examination Questionnaire, *FA* food addiction, *Adj M* Adjusted mean, *SE* standard error, *All* mild, moderate, severe groups

*$p < 0.01$, **$p < 0.001$

were robust differences between those with and without food addiction. There were few significant differences, however, among individuals with mild, moderate, and severe food addiction on unhealthy dietary restraint, body image concerns, eating concerns, or food craving, and subsequent analyses controlling for binge-eating episodes further minimized the number of significant differences among mild, moderate, and severe food addiction groups. As the field shifts towards considering treatment for food addiction [18], an understanding of the clinical utility of food addiction severity specifiers under the current nosology is crucial for guiding decisions about treatment engagement and treatment matching. Though replication and extension are required, these data support treatment for any individuals meeting criteria for food addiction as opposed to targeted treatment for those with moderate or severe food addiction.

Of the overall participant group, 11.4% of individuals met criteria for food addiction, which is slightly lower than recent meta-analytic results estimating the clinical-threshold of food addiction as 16.2% [19]. This estimate, however, included treatment seeking populations, which have higher rates of food addiction [19]. For example, the meta-analysis included studies of individuals diagnosed with either bulimia nervosa or BED reported food addiction rates as high as 89.1% and 87.2%, respectively [20]. The most common severity level in the current sample was severe (55.0%) followed by moderate (26.0%) and mild (19.0%) food addiction. This is consistent with prior research that suggests that those who endorse lower levels of food addiction symptoms are less likely to meet the threshold for clinically significant distress or impairment [7]. Demographically, individuals in the severe food addiction group were younger than individuals from all other groups, and individuals with mild food addiction were more likely to be female as compared to those with either No food addiction or severe food addiction. In contrast to a previous study, which found significant differences in BMI among all subgroups (no, mild, moderate, and severe food addiction), the only significant differences observed in the current sample included significantly higher BMI for those with mild or severe food addiction as compared to those with No food addiction [9]. No other subgroups differed significantly. More research is needed to further explore these discrepancies though, the prior study may be less generalizable as the sample was limited to those with type 2 diabetes.

There were differences among all groups on the number of binge-eating episodes. The number of binge episodes was expected to differ significantly across group as food addiction and binge eating are highly correlated [21, 22]. Similarly, a recent study found significant differences in binge-eating symptom severity when comparing all three food addiction severity groups [23]. Significant work examined the overlapping and distinct features of BED and food addiction, and converging evidence suggests that individuals with both BED and food addiction may represent a more severe variant of BED [21, 24], or alternatively a distinct pattern of disordered eating [25]. To reduce the confounding effect of BED, and accordingly increase confidence that group differences were related to food addiction severity, the number of binge-eating episodes were controlled for in the final set of analyses. Ultimately, results largely mirrored the initial findings that did not adjust for objective binge-eating episodes, though effect sizes were attenuated.

There were few differences in eating-disorder psychopathology and food craving when comparing food addiction severity groups, yet our findings replicated prior research of robust differences comparing those with and without food addiction [8, 26]. In contrast with most studies [10, 26], however, differences in unhealthy dietary restraint were found when comparing those without food addiction to those in the mild or severe severity of food addiction. It is important to note that the effect size was small, yet replication of these findings is warranted.

When considering the *DSM-5* severity specifiers broadly, two diagnostic groups are of particular relevance—those with BED and substance use disorders. In a community sample of individuals with BED, there was limited support for the severity specifiers, and few participants were categorized as having severe or extreme severity BED [27]. In a clinical treatment-seeking sample, there was some support for the utility of severity specifiers, as differences in eating-disorder psychopathology and depression emerged; however, small effect sizes were observed [28]. For substance use disorders, some research suggests statistically significant differences among groups, but a fully dimensional model is not consistently supported. For example, Ehlers and colleagues [29] found that the course of alcohol use disorders differed for those with mild, as compared with those with moderate or severe alcohol use disorder, with only the later progressing to harmful alcohol-related consequences at largely the same rate. Conversely, in a comprehensive study utilizing the National Epidemiologic Survey on Alcohol and Related Conditions data, Lane and colleagues [30] found evidence of significant heterogeneity in impairment and clinical correlates within severity levels, depending on the combinations of symptoms endorsed. The authors argue "Findings suggest severity indices are at best imprecise and, potentially, misleading. These problems are likely inherent in traditional polythetic approaches to diagnosis and almost certainly applicable to other disorders" (p. 819) [30]. In combination, findings suggest limited support for classifying severity according to symptom counts.

Study findings should be considered within the context of several limitations. First, these data can only speak to the non-significant relationship among self-reported food addiction severity and unhealthy dietary restraint, body image concerns, eating concerns, and food craving. Although eating disorder psychopathology is one of the most robust food addiction correlates [19], there may be other clinically significant associations with non-eating related constructs, such as depression. Second, the sample was non-treatment seeking, online community sample that was predominantly White and female, which may limit generalizability of findings. Regarding sex, some research suggests potential differences in the relationship between severity indicators and food addiction expression [31] as well as the correlates of impairment for food addiction between men and women [32]. Another limitation is that height and weight were self-reported by participants; prior research suggests that self-reported and measured weights are highly correlated [33], yet some evidence suggests that individuals tend to underreport weight and overestimate height, which might result in miscalculated BMIs [34]. Additionally, there were relatively fewer participants with mild or moderate food addiction, thus replication of these findings within a larger sample is warranted. Finally, these findings are cross-sectional, and accordingly, cannot speak to the prognostic validity of the severity specifiers, a primary aim in refining the classification of substance use disorders [35].

The findings, as well as limitations, suggest salient future directions, including testing the association between food addiction severity and other clinical correlates (e.g., depression) as well as functional impairments (e.g., difficulties at work or in relationships). Further, replication and extension with diverse samples would allow for testing moderating effects of important demographic characteristics, such as sex. Importantly, examination of the food addiction severity specifiers with clinical samples (e.g., individuals with BED) is also warranted. Finally, additional types of validity and psychometric properties should be investigated, including testing the sensitivity and the specificity of the proposed cut-points and exploring predictive validity with respect to treatment outcomes [36]. Nonetheless, these data provide important preliminary support to think critically about using and applying food addiction severity specifier across research and clinical contexts.

What is already known on this subject?

Food addiction is related to greater body mass index, eating-disorder psychopathology, food craving, and psychosocial impairment. Less is known regarding the utility of the severity specifiers (i.e., mild, moderate, and severe severity), as measured by the number of symptoms endorsed on the Yale Food Addiction Scale.

What does this study add?

Robust differences in eating-disorder psychopathology and food cravings were found between those with and without food addiction. Few differences among mild, moderate, and severe food addiction groups were found. These findings support treatment for any individuals meeting criteria for food addiction as opposed to targeted treatment for those with moderate or severe food addiction.

Author contributions The authors contributions were as follows—AAW, MMC, VI, and RDB designed the research; AAW and MMC performed the statistical analysis; AAW, MMC, VI, and RDB contributed to interpretation of the data; AAW and MCC drafted the manuscript and all authors contributed to revisions of the manuscript. AAW, MMC, and RDB had full access to all of the data in the study and take responsibility for the integrity and accuracy of the data analysis.

Funding This research was supported, in part, by NIH Grants: K23-DK092279 and T32 DA019426-15.

Compliance with ethical standards

Conflict of interest The authors Wiedemann, Carr, Ivezaj, and Barnes report no conflicts of interest. Dr. Ivezaj reports broader interests including Honoraria for Journal Editorial Role and lectures.

Ethics approval This study received approval from the University Institutional Review Board at the Yale School of Medicine. The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

Consent to participate All participants provided electronic informed consent.

Consent for publication Not applicable.

Code availability Not applicable.

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