Development of the Yale Food Addiction Scale Version 2.0

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Parallels in biological, psychological, and behavioral systems have led to the hypothesis that an addictive process may contribute to problematic eating. The Yale Food Addiction Scale (YFAS) was developed to provide a validated measure of addictive-like eating behavior based upon the diagnostic criteria for substance dependence. Recently, the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; *DSM–5*) was released, which included significant changes to the substance-related and addictive disorders (SRAD) section. In the current study, the YFAS 2.0 was developed to maintain consistency with the current diagnostic understanding of addiction and to improve the psychometric properties of the original YFAS. In a sample of 550 participants, 14.6% met criteria for food addiction. The YFAS 2.0 demonstrated good internal consistency, as well as convergent, discriminant, and incremental validity. Elevated scores on the YFAS 2.0 were associated with higher rates of obesity and more severe pathological eating (e.g., binge eating). The YFAS 2.0 also appeared to capture a related, but unique construct relative to traditional eating disorders. In a separate sample of 209 participants, the YFAS and YFAS 2.0 were directly compared. Both versions of the YFAS were similarly associated with elevated body mass index, binge eating, and weight cycling. However, exceeding the food addiction threshold was more strongly associated with obesity for the YFAS 2.0 than the original YFAS. Thus, the YFAS 2.0 appears to by a psychometrically sound measure that reflects the current diagnostic understanding of addiction to further investigate the potential role of an addictive process in problematic eating behavior.

Keywords: food addiction, obesity, binge eating, eating disorders, substance dependence

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Problems related to excess food consumption, such as obesity, continue to be a major public health concern (Mokdad, Marks, Stroup, & Gerberding, 2004). Parallels in the biological, psychological, and behavioral factors implicated in addiction and problematic eating have led to the hypothesis that an addictive process may contribute to excess food consumption (Avena, Rada, & Hoebel, 2008; Gold, Frost-Pineda, & Jacobs, 2003; Volkow, Wang, Tomasi, & Baler, 2013). The Yale Food Addiction Scale (YFAS; Gearhardt, Corbin, & Brownell, 2009) is currently the only validated measure to operationalize addictive-like eating behavior. The YFAS applies the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; *DSM–IV*) criteria for substance dependence (American Psychiatric Association, 2000) to the consumption of highly palatable foods. Elevated scores on the YFAS are associated with obesity, binge eating, impulsivity, craving,

attentional biases for food cues, adverse bariatric surgery outcomes, and medical conditions (e.g., diabetes; Meule & Gearhardt, 2014; Pursey, Stanwell, Gearhardt, Collins, & Burrows, 2014). Addictive-like eating based on the YFAS has also been related to patterns of neural response implicated in substance use disorders (Gearhardt, Yokum, et al., 2011), differential response to a dopamine agonist (Davis, Levitan, Kaplan, Kennedy, & Carter, 2014), and higher loadings on the genetic dopamine multilocus profile (Davis et al., 2013). Thus, the application of addiction-related diagnostic criteria to eating behavior appears to provide a useful assessment strategy for investigating the validity of the food addiction concept.

However, the *DSM–5* was recently released, which included significant changes to the substance-related and addictive disorders (SRAD; previously called substance use disorders) section (American Psychiatric Association, 2013). Substance abuse and substance dependence were combined to reflect a single substance use disorder, the legal consequences diagnostic criterion was removed, and craving was added (Hasin, Fenton, Beseler, Park, & Wall, 2012; Hasin et al., 2013). A continuum of severity was also applied to the substance-related disorder diagnosis ranging from mild (2–3 symptoms), to moderate (4–5 symptoms), to severe (6 or more symptoms; see Table 1 for SRAD *DSM–5* criteria; American Psychiatric Association, 2013).

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To maintain consistency with the current diagnostic understanding of addiction and ensure that measures of food addiction reflect these changes, we aimed to develop the YFAS 2.0 to reflect the SRAD diagnostic criteria in *DSM–5* (e.g., the addition of craving, the merging of abuse and dependence criteria, the use of a diagnostic continuum of severity). The current study evaluates the psychometric properties of this new measure (YFAS 2.0), including the factor structure and internal consistency. We also examine the convergent validity of the YFAS 2.0 by examining its association with indicators of more compulsive patterns of eating that are associated with the original YFAS: greater impulsive eating, elevated body mass index (BMI), increased weight cycling, and frequent binge eating episodes (Davis, 2013b; Meule & Gearhardt, 2014; Murphy, Stojek, & MacKillop, 2014; Pursey et al., 2014). We also investigate discriminant validity by examining the association between the YFAS 2.0 and dietary restraint (i.e., the intention to restrict food for weight loss purposes), which has been found to have little or no association with the original YFAS (Gearhardt, White, Masheb, & Grilo, 2013; Gearhardt et al., 2012). Prior research on the relationship of the YFAS with other eating disorders suggests that they are related, but do not entirely overlap (Davis, 2013a; Gearhardt, Boswell, & White, 2014). Therefore, we examine the relationship between YFAS 2.0 food addiction and eating disorder diagnoses (e.g., binge eating disorder [BED], bulimia nervosa [BN]). We also examine incremental validity by investigating whether the YFAS 2.0 accounts for unique variance in BMI above and beyond the frequency of binge eating. Finally, in a separate sample of participants, we investigate the relationship between the original YFAS and the YFAS 2.0 and the association of both scales with BMI, binge eating, weight cycling, and weight class. We predict that, consistent with other SRADs, the *DSM–5* diagnostic criteria used in the YFAS 2.0 will comprise a single factor and that the prevalence of food addiction will be higher using the YFAS 2.0 compared with the original YFAS. Although we expect a higher prevalence, we hypothesize that the YFAS 2.0 will maintain similar psychometric properties to the original YFAS. Specifically, higher scores on the YFAS 2.0 are expected to be associated with more eating-related problems, but not with greater dietary restraint. Finally, we hypothesize that the YFAS 2.0 will be related to, but will not entirely overlap with other eating disorders, and will account for variance in BMI above and beyond other established measures of eating-related problems.

Study 1

Method

Participants. Research procedures complied with the American Psychological Association's ethical standards and received approval from the University of Michigan Institutional Review Board. A total of 614 participants were recruited using the Mechanical Turk (MTurk) worker pool for a study on eating behaviors. Although MTurk does not provide a nationally representative sample, prior research on MTurk has demonstrated that the pool of available MTurk workers is large and diverse and can appropriately replace or supplement traditional convenience samples (Paolacci & Chandler, 2014). Of the 614 participants who initiated the study, 550 (89.6%) completed the survey, which is consistent with the typical dropout rate for online surveys (Hoerger, 2010).

Participants who failed any of the three "catch" questions used to assess attention to survey content ($n = 8$) were excluded from analyses. Additionally, participants who reported currently being pregnant ($n = 6$) were excluded, as this may significantly impact body weight and eating behavior. Participants included in the analyses had an average age of 33.84 ($SD = 12.01$, range = 18 thru 81 years old); 77.6% were Caucasian, 6.7% were Asian American, 6.5% were African American, 3.9% were Hispanic, and 5.2% were from other races/ethnicities. Slightly more women (54.1%) than men (45.7%) completed the survey. Overall, the vast majority of participants had at least a high school degree (99.4%), and 54.8% had completed at least some college. The average self-reported BMI was 26.67 ($SD = 6.76$); and 3.9% were underweight (BMI < 18.5), 44.4% were normal weight (BMI between 18.5 and 24.9), 29.1% were overweight (BMI between 25.0 and 29.9), and 22.6% were obese (BMI ≥ 30).

Measures.

Demographics. Participants were asked to provide information about basic demographics including gender, race/ethnicity, age, marital status, and education level.

BMI. Self-reported height and weight were used to compute participants' BMI (kg/m2). Because self-reported height and weight may underestimate BMI (Connor Gorber, Tremblay, Moher, & Gorber, 2007; Taylor et al., 2006), we applied a formula developed by Connor Gorber, Shields, Tremblay, and McDowell (2008) that is based on the level of discrepancy between self-reported and directly assessed BMI in a nationally representative sample. The results did not differ when the adjusted BMI variable was used, thus the results reported reflect the use of the unadjusted BMI variable for ease of interpretation.

Eating Disorder Diagnosis Scale. The Eating Disorder Diagnosis Scale (EDDS; Stice, Telch, & Rizvi, 2000) is a brief self-report scale that assesses symptoms of anorexia nervosa (AN), bulimia nervosa (BN), and BED, such as the frequency of binge eating episodes and compensatory behaviors (Stice et al., 2000). The EDDS provides suggested diagnoses for these disorders based on *DSM–IV* criteria, but also assesses information that allows diagnoses to be computed based on changes in the *DSM–5* (e.g., lowered threshold for binge frequency). Thus, in the current study, the EDDS was computed to reflect *DSM–5* diagnoses for these disorders. The EDDS was also used to examine frequency of binge eating, which is defined as consuming an unusually large amount of food, and experiencing a loss of control. The EDDS has been found to have good validity and reliability and strong convergence with eating disorder diagnoses based on clinical interviews (Stice et al., 2000). The average weekly frequency of binge eating as indicated by the EDDS was positively skewed (skewness statistic >2). Log transformation was successful in normalizing the distribution. Because results did not differ when the log-transformed variable was used, analyses using the nontransformed binge eating variable are reported for ease of interpretation.

Three Factor Eating Questionnaire. The Three Factor Eating Questionnaire (TFEQ; Stunkard & Messick, 1985) is a 51-item measure that is composed of three subscales: disinhibition, hunger, and dietary restraint. The TFEQ disinhibition and hunger subscales appear to reflect one underlying impulsive eating factor (Collins, Lapp, Helder, & Saltzberg, 1992), which is theoretically related to addictive-like eating (Murphy et al., 2014). The TFEQ subscales have been found to have good internal consistency (Stunkard &

Messick, 1985) and predictive validity (Lähteenmäki & Tuorila, 1995). Based on Cronbach's alpha, the dietary restraint (.73), disinhibition (.79), and hunger subscales (.84) all had adequate internal consistency reliability in the current study.

Questionnaire of Eating and Weight Patterns-Revised. The Questionnaire of Eating and Weight Patterns-Revised (QEWP-R; Spitzer, Yanovski, & Marcus, 1993) assesses current and past eating/weight patterns. In the current study, the QEWP-R question that measures highest lifetime BMI (excluding pregnancy) and the question that assesses history of weight cycling (repeated periods of losing and regaining weight excluding periods of weight loss due to sickness) were used. The QEWP-R has received strong support for its reliability and validity (Brody, Walsh, & Devlin, 1994; Nangle, Johnson, Carr-Nangle, & Engler, 1994).

Catch questions. Three catch questions were included at the end of the survey to identify participants who were not attending to the content of the survey. An example catch question is "While watching television, have you ever had a fatal heart attack?" Any response other than "Never" would indicate that the participant was not closely reading the questions.

Procedures.

Measurement development. The YFAS 2.0 is designed to reflect the assessment of addictive-like eating behavior based upon the SRAD diagnostic criteria in the *DSM–5*. The YFAS specifically references the consumption of foods high in fat and/or refined carbohydrates (e.g., sugar, white flour), as these foods are implicated more in food cravings (White, Whisenhunt, Williamson, Greenway, & Netemeyer, 2002) and eating binges (Allison & Timmerman, 2007) than more nutritious, less processed foods (e.g., fruits, vegetables).

The YFAS 2.0 includes two scoring options: (a) a continuous symptom count that reflects the number of diagnostic criteria met by the participant and (b) a diagnosis of food addiction based on the number of symptoms and clinically significant impairment or distress. The diagnostic scoring option reflects the same criteria required for a SRAD diagnosis in *DSM–5* (American Psychiatric Association, 2013). Based on changes in *DSM–5,* the YFAS 2.0 was designed to provide cutoffs for mild (two to three symptoms), moderate (four to five symptoms), and severe (six or more symptoms) forms of the disorder. The original YFAS assessed only substance dependence diagnostic criteria (not substance abuse criteria). With the combining of the dependence and abuse criteria in *DSM–5,* questions that were not on the original YFAS (e.g., *DSM–5* abuse criteria), but reflect *DSM–5* diagnostic criteria for substance use disorders, were added (i.e., recurrent use in physically dangerous situations, use resulting in failure to fulfill major role obligations, continued use despite social or interpersonal problems). The entirely new diagnostic criterion of craving was also added. To increase the utility of the scale in samples with lower education levels, the reading difficulty of the YFAS 2.0 was lowered to a sixth-grade reading level based on Flesch-Kincaid grade-level readability scores, the SMOG Index, and the Automated Readability Index. Additional changes to the original YFAS included removal of the term "withdrawal" (although the concept of withdrawal was retained), the consistent use of past tense wording for all items, rewording of some questions to improve clarity, and an increased number of response options to more clearly distinguish between different levels of symptom endorsement. The pool of potential questions for the YFAS 2.0 was reviewed by nine experts in the addiction, obesity, eating pathology, psychopathology, and measurement development fields. Experts were asked to provide feedback on item content and wording, which was reviewed by the authors and incorporated into the YFAS 2.0. After making revisions based on this feedback, 35 questions reflecting the *DSM–5* diagnostic criteria for addiction remained (see online supplementary materials for the full scale). All questions on the YFAS 2.0 are continuous. To reflect diagnostic thresholds, a cutoff for each question was established to allow for determination of a diagnosis and severity level using Receiver Operator Characteristic (ROC) curves (see online supplementary materials for additional information and scoring instructions). ROC curves were not used to identify thresholds for the impairment/distress questions included in the diagnostic scoring option. The same cutoffs from the original YFAS were maintained, as the threshold for these questions both appear to be reasonable for determining clinical significance (i.e., two to three times a week or more) and retaining the same threshold increases consistency across studies using the YFAS and the YFAS 2.0.

Each of the 11 diagnostic criteria (see Table 1) was considered to be met if one or more of the relevant questions for each criterion met the threshold. Two different summary scores were created; a symptom count (0–11) and a diagnosis with severity level (mild, moderate, severe). The symptom count scoring option for the YFAS 2.0 was computed by summing the 11 diagnostic criteria (scores ranging from 0 to 11). Based on the *DSM–5* diagnosis for SRADs, mild food addiction was indicated by meeting two to three criteria, moderate food addiction reflected presence of four to five criteria, and severe food addiction was defined as meeting six or more criteria. All food addiction diagnoses also required the presence of clinically significant impairment or distress (assessed by separate items).

Results

Factor structure and reliability. A confirmatory factor analysis (CFA) for dichotomous data was conducting using the Mplus statistical package (Múthen & Múthen, 1998–2011) to examine whether the YFAS 2.0 had the same single factor solution as the original YFAS and the *DSM–5* SRAD criteria. Items assessing impairment and distress were not included in the CFA as they reflect clinical significance of the full syndrome rather than indicators of individual criteria. The confirmatory fit index (CFI = 0.958) and the Tucker Lewis Index (TLI = 0.974) indices suggested good fit for the one-factor model, but the root-mean-square error of approximation (RMSEA) suggested less than optimal fit (.108). All criteria had factor loadings for the single factor of .77 or higher, and Kuder–Richardson α (.90) suggested good internal consistency reliability. Given the marginal RMSEA values, we also examined a two-factor solution that examined dependence (plus craving) and abuse criteria as two separate factors. Consistent with Gillespie, Neale, Prescott, Aggen, and Kendler's (2007) examination of the factor structure of substance use disorder symptoms, the two factor solution did not result in noticeably improved fit (CFI = .962, TLI = .975, RMSEA = .098), and the two factors were very highly correlated (>.90). Thus, in line with prior research (Gillespie et al., 2007), a one-factor solution was retained for the YFAS 2.0.

Table 1
DSM–5 *SRAD Diagnostic Indicators and Prevalence (n = 536)*

SRAD diagnostic indicators	Met criteria	Did not meet criteria
Consumed more than planned	103 (19.3%)	432 (80.7%)
Unable to cut down or stop	134 (25.0%)	402 (75.0%)
Great deal of time spent	100 (18.7%)	434 (81.3%)
Important activities given up	64 (11.9%)	472 (88.1%)
Use despite physical/emotional consequences	126 (23.5%)	410 (76.5%)
Tolerance	93 (17.4%)	443 (82.6%)
Withdrawal	159 (29.7%)	377 (70.3%)
Craving	109 (20.3%)	427 (79.7%)
Failure in role obligation	115 (21.5%)	421 (78.5%)
Use despite interpersonal/social consequences	104 (19.4%)	432 (80.6%)
Use in physically hazardous situations	133 (24.8%)	403 (75.2%)
Impairment or distress	85 (15.9%)	451 (84.1%)

Note. SRAD = substance-related and addictive disorders. The impairment or distress indicator is only used in the diagnostic computation (not the symptom summary score).

The average number of symptoms met was 2.38 (SD = 3.19, range = 0–11), and the percentage of participants who met the threshold for each diagnostic criterion (e.g., withdrawal, craving) ranged from 11.9% to 29.7% (see Table 1). For the diagnostic cutoff (i.e., threshold met for two or more diagnostic criteria plus impairment or distress), 14.6% of participants met the food addiction criteria. For the diagnostic scoring option, 1.7% were classified as mild (two to three symptoms), 1.9% were classified as moderate (four to five symptoms), and 11.0% were classified as severe (six or more symptoms) based on *DSM–5* criteria. A smaller percentage of participants met the impairment/distress criteria in the mild (12.5%) and moderate (19.6%) symptom range than the severe symptom range (61.5%).

Demographic associations. Age, race/ethnicity, and education level were not associated with either the number of total food addiction symptoms endorsed (all p values > .086) or the likelihood of meeting the food addiction diagnostic threshold (all p values > .502). In contrast, gender was significantly associated with addictive-like eating symptoms with women, on average, reporting a higher number of symptoms (M = 2.71, SD = 3.33) than men (M = 1.96, SD = 2.95), $t(1,533)$ = 7.35, p = .007, η^2 = .01). The food addiction diagnosis also differed significantly by gender, $\chi^2(3)$ = 9.04, p = .029, φ = .13. Based on standardized residuals, this gender difference was driven by a larger proportion of women than men in the moderate (80.0% women) and severe (69.0% women) food addiction categories, respectively.

Convergent validity. Convergent validity of the scale was established by examining associations between scores on the YFAS 2.0 and other measures relevant to problematic eating behaviors (TFEQ disinhibition, TFEQ hunger, current BMI, highest lifetime BMI, and frequency of binge eating episodes). The YFAS 2.0 symptom count scores were significantly correlated with all of these measures (ranging from .24 to .63; see Table 2). Individuals reporting more frequent weight cycling (a weight loss and regain of 20 pounds or more excluding pregnancy) endorsed significantly higher YFAS 2.0 symptom count scores, $F(3, 532)$ = 8.56, p < .001, η^2 = .15. The same associations were found between these eating-related constructs and the diagnostic version of the YFAS 2.0 (all p < .001; see Table 3). Participants who met the threshold for moderate or severe food addiction also reported more frequent weight cycling, $\chi^2(9)$ = 61.55, p < .001, φ = .35.

Food addiction scores differed by weight class, $F(2, 512)$ = 25.12, p < .001, η^2 = .09. Scores were significantly higher in overweight (M = 2.51, SD = 3.24) relative to normal weight participants (M = 1.50, SD = 2.56; p = .004). Obese participants reported significantly more food addiction symptoms (M = 3.88, SD = 3.55) than either normal weight or overweight participants (p = .001). Food addiction diagnosis rates also increased by weight class with obese participants 4.54 times more likely to meet

Table 2
Association of YFAS 2.0 Symptom Count With Convergent Measures

	YFAS 2.0 symptom	TFEQ hunger	TFEQ disinhibition	Current BMI	Highest BMI	Binge frequency
YFAS 2.0 symptom	1					
TFEQ hunger	.55**	1				
TFEQ disinhibition	.57**	.72**	1			
Current BMI	.26**	.26*	.37**	1		
Highest BMI	.24**	.26*	.29**	.90**	1	
Binge frequency	.63**	.42**	.49**	.17**	.16**	1

Note. YFAS = Yale Food Addiction Scale; TFEQ = Three Factor Eating Questionnaire; BMI = body mass index; Binge frequency = average number of binge eating episodes per week over the last 3 months.
* $p \leq .05$.   ** $p \leq .01$.

Table 3
Association of YFAS 2.0 Diagnosis With Convergent Measures

	No FA (*n* = 458) *M* (*SD*)	Mild FA (*n* = 9) *M* (*SD*)	Moderate FA (*n* = 10) *M* (*SD*)	Severe FA (*n* = 59) *M* (*SD*)	Test stat (*F*)	*p* value	Pairwise[a] difference	Effect size (η^2)
TFEQ hunger	6.02 (*SD* = 3.65)	10.11 (*SD* = 2.15)	8.80 (*SD* = 3.52)	10.32 (*SD* = 2.64)	30.12	<.001	1 < 2,3,4	.15
TFEQ disinhibition	6.32 (*SD* = 3.46)	10.44 (*SD* = 2.35)	9.60 (*SD* = 3.81)	11.27 (*SD* = 2.75)	42.64	<.001	1 < 2,3,4	.19
BMI	25.92 (*SD* = 5.78)	27.69 (*SD* = 6.66)	34.51 (*SD* = 13.86)	30.99 (*SD* = 9.36)	15.65	<.001	1 < 3,4	.08
Highest BMI	28.88 (*SD* = 7.37)	30.29 (*SD* = 7.15)	36.23 (*SD* = 12.88)	34.74 (*SD* = 10.13)	12.11	<.001	1 < 4	.06
Binge frequency	1.32 (*SD* = 2.23)	3.33 (*SD* = 4.90)	2.50 (*SD* = 4.20)	5.46 (*SD* = 3.68)	48.03	<.001	1 < 2,3,4; 2,3 < 4	.21

Note. FA = food addiction; TFEQ = Three Factor Eating Questionnaire; BMI = body mass index; Binge frequency = average number of binge eating episodes per week over the last 3 months.
[a] All reported pairwise differences *p* < .05 (Bonferonni corrected), 1 = *No FA*, 2 = *Mild FA*, 3 = *Moderate FA*, 4 = *Severe FA*.

the threshold relative to normal weight participants, $\chi^2(6) = 42.49$, $p < .001$, $\varphi = .29$ (see Figure 1).[1]

Discriminant validity. Discriminant validity was assessed by evaluating correlations between YFAS 2.0 scores and dietary restraint. As predicted, the YFAS 2.0 symptom count scores were not significantly correlated with TFEQ dietary restraint ($r = .051$, $p = .234$). This pattern of results was replicated with the diagnostic version of the YFAS 2.0 exhibiting no significant association with dietary restraint, $F(3, 532) = 1.89$, $p = .130$, $\eta^2 = .01$.

Examination of overlap between eating disorder diagnoses and YFAS 2.0 food addiction suggested that these constructs are related but distinct. Based on the EDDS, 435 participants (81.2%) did not meet *DSM–5* criteria for AN, BN, or BED. Four participants (.07%) met the criteria for AN, 61 participants (11.5%) met criteria for BN, and 36 participants (7.0%) met criteria for BED. One participant (25%) with AN also met the food addiction threshold. The rates of overlap with the YFAS 2.0 were slightly lower for BN than BED, with 42.6% of participants with BN and 47.2%% of participants with BED also meeting criteria for a food addiction diagnosis. Of the 78 participants with a food addiction diagnosis, 34 (43.6%) did not meet criteria for AN, BN, or BED.

Incremental validity. Incremental validity was assessed using hierarchical multiple regression. YFAS scores were entered along with binge eating frequency as predictors of BMI. Binge eating frequency was entered into step one of the regression model with YFAS 2.0 symptom count scores entered in step two. Binge eating frequency was a significant predictor of BMI in step one of the model, $t = 4.05$, $\beta = .17$, $p < .001$, accounting for 3.0% of the variance. However, when YFAS 2.0 symptom count was entered into the model, binge eating was no longer a significant predictor, $t = .367$, $\beta = .02$, $p = .714$, and YFAS 2.0 symptom count score was a significant predictor, $t = 4.48$, $\beta = .24$, $p < .001$, accounting for an additional 3.5% of the variance in BMI. Similar results were found for the diagnostic version of the YFAS 2.0. After controlling for variance accounted for in step one, the diagnostic version of the YFAS was a significant predictor at step two of the model, $t = 5.04$, $\beta = .24$, $p < .001$, accounting for 4.4% of the remaining variance in BMI.

Study 2

Method

Participants. A total of 224 participants were recruited using the MTurk worker pool. Of those who initiated the study, 100%

completed the survey. Participants who failed any of the three catch questions ($n = 7$) or reported a BMI that was lower than is plausible (e.g., 8.06, 9.24; $n = 6$) were excluded from analyses. Additionally, participants who reported currently being pregnant ($n = 3$) were excluded as this may significantly impact body weight and eating behavior. The participants included in the analyses had an average age of 35.87 ($SD = 12.29$, range = 18–66 years old); 70.8% were Caucasian, 8.1% were African American, 7.2% were Asian American, 5.7% were Hispanic, and 8.2% were from other races/ethnicities. More women (61.2%) than men (38.8%) completed the survey. Overall, the vast majority of participants had at least a high school degree (99.5%), and 63.2% had completed at least some college. The average self-reported BMI was 28.03 ($SD = 7.31$); and 3.3% were underweight (BMI < 18.5), 36.8% were normal weight (BMI between 18.5 and 24.9), 28.7% were overweight (BMI between 25.0 and 29.9), and 31.1% were obese (BMI ≥ 30).

Measures. Participants completed the following questionnaires assessed in Study 1: YFAS 2.0, self-reported height and weight (used to compute BMI), EDDS, QEWP-R, demographics, and catch questions. Participants were also asked to complete the original 25-item YFAS. The order in which the YFAS and YFAS 2.0 were presented was randomized across participants.

Results

The YFAS 2.0 had better internal consistency (Kuder–Richardson $\alpha = .92$) than the original YFAS (Kuder–Richardson $\alpha = .74$). The average number of symptoms endorsed was 2.19 ($SD = 1.71$) for the original YFAS and 1.92 ($SD = 3.09$) for the YFAS 2.0 (see online supplementary materials). Based on the YFAS 2.0, 15.8% of participants met the threshold for food addiction. Regarding severity, 2.4% met the mild criteria, 1.9% met the moderate criteria, and 11.5% met the severe threshold. Based on the original YFAS, 10.0% met the threshold for food addiction. The YFAS and YFAS 2.0 had 91.5% agreement on identifying participants without food addiction and 51.5% agreement in identifying participants with food addiction. Four of 21 participants who met the food addiction threshold based on the original YFAS did not qualify for food addiction on the YFAS 2.0. Sixteen participants who did not meet the criteria based on the original

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[1] Due to the small number of participants in the underweight category (Study 1, $n = 21$; Study 2, $n = 7$), weight class analyses only compared normal weight, overweight, and obese groups.
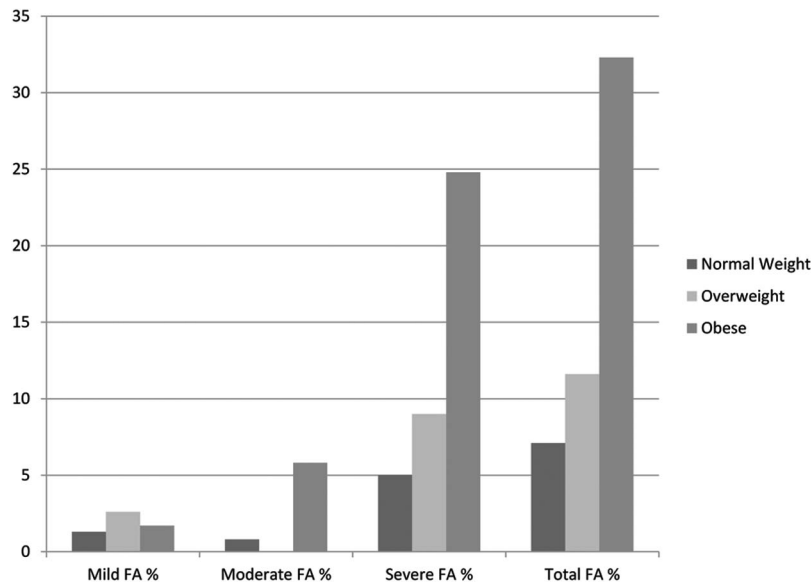
Figure 1. Food addiction (FA) prevalence by weight class.

YFAS met the YFAS 2.0 threshold for food addiction. Of the 16 new cases of food addiction, 25.0% ($n = 4$) met for mild food addiction, 12.5% ($n = 2$) met for moderate food addiction, and 62.5% ($n = 10$) met for severe food addiction on the YFAS 2.0. The symptom count versions of the original YFAS and YFAS 2.0 were highly correlated ($r = .78$, $p < .001$).

Binge eating frequency was significantly related to the original YFAS ($r = .60$, $p < .001$) and the YFAS 2.0 ($r = .68$, $p < .001$), as was weight cycling (original YFAS $r = .33$, $p < .001$; YFAS 2.0 $r = .33$, $p < .001$). Higher BMI was also significantly associated with higher scores on both the original YFAS ($r = .28$, $p < .001$) and the YFAS 2.0 ($r = .22$, $p < .001$). Both the original YFAS, $F(2, 199) = 5.96$, $p = .003$, $\eta^2 = .06$, and the YFAS 2.0, $F(2, 199) = 3.77$, $p = .025$, $\eta^2 = .04$, symptom count scores significantly differed by weight class. For both versions of the scale, obese participants (Original YFAS $M = 2.75$, $SD = 1.81$; YFAS 2.0 $M = 2.57$, $SD = 3.45$) endorsed more food addiction symptoms than normal weight participants (Original YFAS $M = 1.78$, $SD = 1.48$, $p = .002$; YFAS 2.0 $M = 1.22$, $SD = 2.52$, $p = .028$).

Regarding the diagnostic scoring option, participants who met the threshold for food addiction reported more frequent binge eating than those who did not for both versions of the scale (Original YFAS $F(2, 207) = 77.20$, $p < .001$, $\eta^2 = .27$; YFAS 2.0 $F(2, 207) = 53.20$, $p < .001$, $\eta^2 = .20$). The same pattern was found for more frequent weight cycling for both versions of the scale (Original YFAS $F(2, 207) = 25.23$, $p < .001$, $\eta^2 = .11$; YFAS 2.0 $F(2, 512) = 29.79$, $p < .001$, $\eta^2 = .13$). BMI was significantly higher for participants who met the food addiction threshold (Original YFAS $M = 31.10$, $SD = 8.05$; YFAS 2.0 $M = 32.47$, $SD = 8.83$) than those who did not meet the food addiction criteria (Original YFAS $M = 27.69$, $SD = 7.17$; YFAS 2.0 $M = 27.10$, $SD = 7.17$) for both versions of the scale (Original YFAS $p = .043$, $\eta^2 = .02$; YFAS 2.0 $p < .001$, $\eta^2 = .07$). Food addiction prevalence did not differ by weight class for the original YFAS,

$\chi^2(2) = 2.19$, $p = .34$, $\varphi = .10$. However, food addiction as assessed by the YFAS 2.0 did significantly differ by weight class, $\chi^2(2) = 7.53$, $p = .023$, $\varphi = .19$. For the YFAS 2.0, obese participants had a higher prevalence of food addiction (24.6%) than overweight (16.7%) or normal weight (7.8%) participants.

Discussion

The concept of food addiction continues to gain attention in the research literature (Meule & Gearhardt, 2014; Pursey et al., 2014), and the YFAS is the only validated measure to operationalize addictive-like eating behavior. In the current study, a new version of the YFAS was developed to reflect changes to the SRAD criteria in *DSM–5* and to further improve the psychometric properties of the measure. There is a risk that introducing a new measure of addictive-like eating while there remains debate about whether food addiction is a valid concept will increase the difficulty of replicating prior findings. However, operationalizing food addiction using only *DSM–IV* diagnostic criteria does not reflect changes in our understanding of what is indicative of an SRAD (i.e., the addition of craving, the combination of abuse and dependence, the application of a severity spectrum). Given that the original YFAS captured only symptoms of dependence (not abuse), it is critical to develop a revised version of the YFAS that captures the full range of symptoms comprising SRADs in the *DSM–5*. A revised measure of the YFAS with a lower threshold corresponding to *DSM–5* will also identify individuals with less severe symptoms of which may facilitate prevention efforts and allow for a more thorough understanding of the full public health impact of food addiction. Finally, to most effectively compare and contrast food addiction to SRAD disorders, it is important to maintain consistency in the assessment approach across addictive behaviors. The development of the YFAS 2.0 based on *DSM–5* criteria will allow for a more direct comparison of food addiction to other SRADs in future studies.

The diagnostic threshold for food addiction (i.e., two or more symptoms plus clinically significant impairment/distress) was met by 14.6.% of participants in Study 1 and 15.8% of participants in Study 2. This is slightly lower than the percentage (18.9%) of participants who met criteria for an eating disorder (i.e., AN, BN, BED) in Study 1. Severe food addiction (i.e., six or more symptoms) was more common (Study 1: 11.0%; Study 2: 11.5%) than moderate (Study 1: 1.9%, Study 2: 1.9%; i.e., four to five symptoms) or mild (two to three symptoms; Study 1: 1.7%; Study 2: 2.4%) classifications. Participants with lower levels of symptom endorsement were less likely to meet the threshold for clinically significant impairment or distress, which accounted for the higher prevalence of severe food addiction.

Compared with the original YFAS, 5.8% more participants met the food addiction threshold on the YFAS 2.0. This increase in prevalence reflects, in part, the fact that the original YFAS assessed only food dependence (not abuse), whereas the YFAS 2.0 assesses food addiction based on the *DSM–5*, which combines the dependence and abuse criteria from *DSM–IV*. The result is the addition of four new SRAD diagnostic criteria and a lowering of the symptom threshold for an SRAD diagnosis from three to two symptoms in *DSM–5*. There has been considerable concern in the scientific community that rates of substance use disorders will increase dramatically with the introduction of the *DSM–5* (Urbina, 2012), and empirical evaluations have suggested that prevalence will, in fact, increase (Agrawal, Heath, & Lynskey, 2011; Mewton, Slade, McBride, Grove, & Teesson, 2011). In addition, even when the same criteria are used to assess alcohol use disorders (AUDs) over time, rates appear to have increased since the development of the original YFAS. For example, a recent study based on national epidemiologic data found that rates of past-year AUDs increased from 8.5% in 2001 to 12.7% between 2012 and 2014 when using *DSM–IV* criteria for both assessments (Grant et al., 2015). This increase was further enhanced when using *DSM–5* criteria for the 2012–2014 assessment (13.9% prevalence). The magnitude of this overall increase (61.2%) is similar to the increase from the original YFAS to the YFAS 2.0 (58.0%). Despite the increase in food addiction prevalence, the original YFAS and YFAS 2.0 were similarly associated with elevated BMI, binge eating, and weight cycling. Further, the YFAS 2.0 food addiction threshold, but not the original YFAS, was associated with obesity. Thus, the YFAS 2.0 relative to the original YFAS is comparably or more strongly associated with indicators of excess food consumption (e.g., binge eating, obesity). However, further research is needed to evaluate whether the less severe food addiction classifications capture clinically meaningful eating problems. This issue has been raised in studies of other addictive behaviors based on *DSM–5*. For example, in a study of nicotine use disorder based on *DSM–5* criteria, Chung, Martin, Maisto, Cornelius, and Clark (2012) found that the low severity category (two to three symptoms) was not consistently related to other measures of nicotine dependence. Thus, future research that aims to identify participants with clinically significant levels of addictive-like eating may consider using only the moderate and severe food addiction diagnostic thresholds. In contrast, research designed to be sensitive to lower levels of addictive-like eating (e.g., public health studies screening for individuals at high risk) may choose to include the mild food addiction diagnostic category.

Consistent with the original YFAS, the YFAS 2.0 appears to load onto a single factor and has good internal consistency reliability. Convergent and incremental validity for the YFAS 2.0 were evident based on associations between food addiction and theoretically related eating-related problems. Participants endorsing more addictive-like eating had higher current BMI, higher lifetime BMI, greater likelihood of obesity, and were more likely to regain lost weight. Food addiction was also related to increased levels of impulsive eating and more frequent binge eating episodes. Further, the YFAS 2.0 accounted for variance in elevated BMI above and beyond binge eating frequency.

Regarding discriminant validity, the YFAS 2.0 was not significantly associated with dietary restraint (i.e., the intention to restrict food consumption), suggesting that, as hypothesized, these are distinct constructs. Another concern regarding discriminant validity is the potential overlap with eating disorders. The diagnostic criteria for binge episodes in eating disorders share many characteristics with an addictive phenotype (e.g., loss of control, continued use despite negative consequences); however, there are also notable differences. For example, addiction and eating disorder perspectives differ in what constitutes loss of control over use; substance use disorders include the assessment of withdrawal, tolerance, and craving; and eating disorders emphasize the importance of shape and weight concern (Gearhardt, White, & Potenza, 2011). In the current study, slightly less than half of participants with an eating disorder diagnosis met criteria for food addiction, which suggests that these constructs are related, but do not entirely overlap. Further, approximately half of participants with a food addiction diagnosis did not meet criteria for AN, BN, or BED. Thus, the YFAS 2.0 appears to capture a related, but unique construct relative to traditional eating disorders. Individuals with addictive-like eating who do not meet criteria for a traditional eating disorder may be diagnosed with an unspecified eating disorder, which may contribute to the high prevalence of this type of eating disorder diagnosis (Fairburn & Bohn, 2005).

Although the current study provides important information about the psychometric properties of a new measure to assess addictive-like eating based on *DSM–5* criteria, there are several limitations of the study that should be considered. Although the samples had a wide age range and a relatively equal gender distribution, the samples were not nationally representative. The rates of disordered eating endorsed in the samples were relatively high, which may reflect greater eating-related problems among participants who respond to an opportunity to participate in a study on eating behaviors. The use of a nationally representative sample in future studies will be important to accurately estimate the prevalence of food addiction. The current study is also cross-sectional, which precludes any causal interpretations. Further, BMI and eating disorder diagnoses were based on self-report, which increases the likelihood of misclassification. Examining the association of the YFAS 2.0 with objectively measured height and weight and eating disorders based on diagnostic interviews will be important. Finally, the current study was based on self-report data. It will be essential for future research to develop a diagnostic interview version of the YFAS 2.0 and to investigate the association of the YFAS 2.0 with more objective indicators of addiction.

Despite these limitations, the current study has important implications for future research on addictive-like eating. The YFAS 2.0, which applies *DSM–5* SRAD criteria to the consumption of highly

palatable foods, appears to be a psychometrically sound tool to further evaluate the hypothesis that an addictive process may contribute to problematic eating for some individuals. Food addiction as assessed by the YFAS 2.0 is related to more severe eating pathology (e.g., binge eating, weight cycling) and obesity. Although the YFAS 2.0 provides an important tool for operationalizing addictive-like eating behavior based on the current diagnostic understanding of SRADs, the development of a self-report measure is not sufficient to draw conclusions about the validity of the food addiction hypothesis. It is essential for future research to investigate whether food addiction based on the YFAS 2.0 is associated with biological (e.g., neural response, genetic polymorphisms), cognitive (e.g., attentional biases), and behavioral (e.g., cue reactivity) mechanisms implicated in other addictive disorders. It is also essential to investigate whether the assessment of food addiction based on the YFAS 2.0 has clinical utility in predicting prognosis and treatment response for eating-related problems (e.g., obesity, binge eating). Finally, it is important to further evaluate the YFAS 2.0 from a public health perspective. In addition to individuals requiring treatment, there may be widespread subclinical responses to highly rewarding foods that stimulate addictive-like overeating in a manner that is sufficient to result in adverse outcomes (e.g., excessive weight gain). Given that the foods most commonly implicated in addictive-like eating (e.g., highly processed) are easily accessible, heavily marketed, and inexpensive, environmentally focused initiatives will likely be important in reducing the potential public health consequences of food addiction. In sum, the development of a psychometrically sound measure of addictive-like eating that reflects the current diagnostic understanding of addiction provides an important foundation for a more rigorous evaluation of whether an addictive process may be contributing to problematic eating behavior (e.g., obesity, binge eating), which may inform clinical and public health approaches.

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