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ORIGINAL CONTRIBUTIONS

Validation of the Yale Food Addiction Scale 2.0 Among a Bariatric Surgery Population

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Abstract

Introduction Addictive eating, a highly debated problematic eating behavior, may contribute to obesity and impede the success of individuals seeking bariatric surgery. The original Yale Food Addiction Scale (YFAS) was validated for use among patients who underwent bariatric surgery; however, the YFAS was revised to reflect changes in substance use criteria in the DSM-5. The purpose of this study was to validate the use of the revised measure, the YFAS 2.0, among patients pursuing bariatric surgery.

Methods A retrospective chart review was conducted of 314 patients who underwent pre-surgical psychological evaluation for bariatric surgery. Information gathered included symptoms of addictive eating (YFAS 2.0), emotional eating (Emotional Eating Scale; EES), and a history of substance use and binge eating.

Results In this sample, 27.3% met criteria for "food addiction" according to the YFAS 2.0. Of those, more than half met criteria for severe food addiction. The YFAS 2.0 was related to all factors of the EES: anger/frustration ($p < .001$); anxiety ($p < .001$); and depression ($p < .001$). There was no relationship between the YFAS 2.0 and a history of substance use. The YFAS 2.0 accounted for significant variance in history of binge eating after controlling for emotional eating ($p < .001$; $Exp(B) = 1.30$).

Conclusions Results were similar to a prior validation of the YFAS among a bariatric population, and the updated YFAS 2.0 may be useful in assessing addictive eating among bariatric surgery candidates to further explore the concept of "food addiction."

Keywords Bariatric surgery · Food addiction · Yale food addiction scale 2.0 · YFAS 2.0 · Validation

Introduction

Two-thirds of the population in the USA struggle to maintain a healthy body weight (body mass index [BMI] = > 25) [1, 2]. Problematic eating behaviors, such as binge eating and overeating, may contribute to the maintenance of obesity in some individuals [3], and experts in obesity research and treatment need effective tools to assess the psychological aspects of obesity. Food addiction, which is not a formal diagnosis in the Diagnostic and Statistical Manual of Mental Disorders [4], is currently debated among researchers regarding whether or not it is a novel construct of problematic eating behaviors [5]. Individuals who endorse experiencing food addiction may express that they eat more food than planned, eat past hunger, avoid places or activities due to fear of overeating, or have unsuccessful attempts at reducing consumption of certain foods [6]. Some studies report significant overlap between symptoms of food addiction and binge eating [7, 8], while others argue that there are specific physiological correlates of addictive eating that make this construct more similar to a subtype of a substance use disorder [5, 6, 9]. Although similar areas of the brain are activated in patients with addictive eating behaviors and substance dependence [6, 9], evidence is mixed regarding whether or not individuals who report symptoms of addictive eating may respond to certain foods similar to other substances of abuse. Among individuals seeking bariatric surgery, addictive eating was not found to be related to substance use [10].

The concept of food addiction was first assessed with the development of the Yale Food Addiction Scale (YFAS) [11]. The original YFAS is a self-report measure that detects symptoms of addictive eating behaviors, reflecting Diagnostic and Statistical Manual IV – Text Revision (DSM-IV-TR) criteria

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for substance use disorders [12]. The original YFAS measure was validated among a general, young adult population as well as among individuals who binge eat and bariatric surgery patients [10, 11, 13]. The Yale Food Addiction Scale was recently revised (YFAS 2.0) to reflect the changes made to substance use disorder criteria in the updated Diagnostic and Statistical Manual 5 (DSM-5) [4, 6]. Therefore, validation of the YFAS 2.0 is needed if researchers and clinicians intend to continue to use this measure among patients seeking bariatric surgery. The YFAS 2.0 was developed and validated among a population who may or may not have endorsed difficulties with weight management [6]; however, patients seeking bariatric surgery are unique in that all weight loss surgery candidates meet criteria for morbid obesity. It may be difficult to differentiate symptoms and behaviors related to addictive eating among bariatric surgery patients, given the higher prevalence of those meeting YFAS 2.0 criteria for significant food addiction among this population [14, 15].

The current study aims to validate the use of the YFAS 2.0, a measure of addictive eating, among a bariatric surgery population in a similar manner to its use among other populations [6]. This study also aims to validate the YFAS 2.0 in a similar manner in which the original YFAS was used among patients seeking bariatric surgery [10].

Method

Participants and Procedure

A retrospective chart review was conducted on patients (N = 314) who underwent a psychological evaluation prior to bariatric surgery at a local Midwestern hospital between July of 2016 and January of 2017. Data collected from electronic charts were from the pre-surgical psychological evaluation, which consisted of questionnaires and semi-structured clinical interview.

Measures

Clinical Interview The routine, pre-surgical semi-structured clinical interview assessed demographic variables (e.g., age, race, education level, employment status, and marital status), weight history and eating behaviors, social support and social history, and psychiatric and substance abuse history. In the current study, information was collected on variables hypothesized to be related to addictive eating to determine whether convergent validity was present (e.g., eating behaviors and psychological variables) as well other forms of addiction thought to be unrelated to addictive eating to evaluate discriminant validity (e.g., history of problematic alcohol use or regular tobacco, marijuana, or other substance use). Variables to assess convergent and discriminant validity were chosen based on their similarity to variables used in the original YFAS validation study among a bariatric population [10].

Patient history of binge eating and purging as well as current and past substance use was evaluated in the semi-structured clinical interview aligned with DSM-5 diagnostic criteria. Regarding the assessment of binge eating, participants were asked if they have (1) ever eaten a larger amount of food than most would within a limited period of time (i.e., 2-h or less) and (2) felt a lack of control over their eating during this time. Patients were also queried about associated symptoms of binge eating (i.e., rapid eating, eating till uncomfortably full/past physical hunger, eating alone, or experiencing guilt after a binge). Regarding compensatory behaviors, patients were asked if they have ever used self-induced vomiting, laxatives, diuretics, or excessive exercise in order to avoid weight gain. Clarifying questions were asked if warranted to determine alignment with DSM-5 diagnostic criteria. Regarding substance use (alcohol, tobacco, and illicit drugs), patients were asked when they last used each substance, average amount and frequency of use, and maximum frequency and amount of use. If patients endorsed a history of tobacco or illicit substance use (any use other than "trying once"), this was considered "endorsed." Problematic alcohol use was coded as "endorsed" if patients reported ever having committed the legal offense of driving while intoxicated or under the influence of alcohol, experiencing negative consequences to drinking (i.e., loss of consciousness, bodily harm, tolerance/withdrawal, or difficulty cutting back), a history of treatment for alcohol use (residential, outpatient, or support groups), or reported history of consuming of 5+ drinks (men) or 4+ drinks (women) in one sitting on a regular basis (i.e., monthly or more).

Yale Food Addiction Scale 2.0 The Yale Food Addiction Scale 2.0 (YFAS 2.0) [6] is a revision of the original Yale Food Addiction Scale and measures addictive eating behaviors that reflect the updated DSM-5 criteria for a substance use disorder. In the DSM-IV-TR, substance use disorders were categorized as disorders of "abuse" or "dependence" and the original YFAS was developed based on the criteria for substance dependence. The YFAS 2.0 includes additional items, changes in wording, and additional item response options that address diagnostic issues found with the original YFAS [6, 8]. Furthermore, the threshold for meeting criteria for addictive eating lowered, similar to the threshold for meeting DSM-5 criteria for a substance use disorder, and four additional criteria were added to the YFAS 2.0 [16]. The YFAS 2.0 is a 35-item self-report measure that utilizes an 8-point Likert scale to measure how often a patient engages in each addictive eating behavior from "never" to "every day." The YFAS 2.0 has high reliability (α = .90) and displayed convergent, discriminant, and incremental validity among a general population. Although "food addiction" is not a formal diagnosis in the DSM-5, the YFAS 2.0 produces a diagnostic score and this

variable was used throughout the study to represent those who did or did not meet YFAS 2.0 criteria for clinically significant food addiction. Furthermore, a total symptom count (0–11) is calculated and those endorsing "clinically significant food addiction" are categorized as mild (2–3), moderate (4–5), or severe (6+).

Emotional Eating Scale The Emotional Eating Scale (EES) [17] lists 25 emotions that are categorized into three domains: anger/frustration (11 items), anxiety (9 items), and depression (5 items). A 5-point Likert scale from 1 ("no desire to eat") to 5 ("an overwhelming urge to eat") is used to produce a continuous score of emotional eating intensity, with higher scores indicating that a particular emotion has a stronger influence on eating behaviors. Coefficient alphas for the anger, anxiety, and depression subscales are 0.78, 0.78, and 0.72, respectively.

Hospital Anxiety and Depression Scale Patients were administered the Hospital Anxiety and Depression Scale (HADS) [18, 19]. The HADS is a 14-item self-report measure assessing symptoms of anxiety and depression occurring over the past week. This scale was chosen because it is validated for use among patients with medical comorbidities. A score of 8 or higher in either domain is considered clinically significant, with higher scores indicating greater symptom severity. This measure has adequate internal consistency for the anxiety ($\alpha = .77$) and depression subscales ($\alpha = .76$) and has been used among bariatric surgery populations [20–23].

Statistical Analyses

Frequency analyses were conducted on demographics variables, as well as all psychological and eating variables, including anxiety, depression, history of binge eating and purging, emotional eating, and addictive eating. Regarding convergent and discriminant validity, parametric and non-parametric correlations were utilized to assess the relationships between the YFAS 2.0 and emotional eating, history of binge eating and purging, anxiety, depression, and substance use. Non-parametric tests were used when unequal variances were detected (i.e., significant Levene's test of equal variances). Independent samples *t* tests were used to compare means between dichotomous groups (e.g., emotional eating scores between those who did and did not meet YFAS 2.0 criteria for food addiction) and chi-square tests were utilized to assess differences among categorical variables (i.e., history of binge eating/purging, history of substance use, and meeting YFAS 2.0 criteria for food addiction). Finally, a logistic regression analysis was conducted to determine the unique variance in binge eating accounted for by the YFAS 2.0 symptom count above and beyond emotional eating (all 3 subscales of the EES).

Results

Demographics

Patients had a mean age of 46.51 years ($SD = 10.44$) with a mean BMI of 46.95 ($SD = 8.16$) at the pre-surgical psychological evaluation. Patients in the dataset were predominantly female, but diverse in race (Table 1).

Frequencies and Reliability

On the YFAS 2.0, 27.4% met criteria for clinically significant food addiction ($n = 86$). Among those meeting criteria for food addiction, over half met criteria for severe food addiction (Table 1). A smaller number of patients reported a history of binge eating or purging (Table 1).

Table 1 Demographic variables and sample average eating behavior and substance use scores

	M	*SD*
Age	46.51	10.44
BMI at evaluation	46.95	8.16
YFAS 2.0 symptom count (0–11)	2.68	3.10
EES		
Anger/frustration (11–55)	18.63	8.27
Anxiety (9–45)	16.50	6.53
Depression 5–25)	10.80	4.48
HADS		
Anxiety (0–21)	4.83	3.44
Depression (0–21)	4.28	3.36
	N	%
Gender		
Female	260	82.8
Male	54	17.2
Race/ethnicity		
Black/African American	145	46.2
White	139	44.3
Hispanic/Latinx	14	4.5
Middle Eastern	4	1.3
YFAS 2.0		
Diagnostic score positive	86	27.4
Mild	18	20.9
Moderate	21	24.4
Severe	47	54.7
Binge eating history	42	13.4
Purging history	23	7.3
Problematic/regular substance use		
Alcohol	30	9.5
Tobacco	126	40.0
Marijuana	40	12.7
Other Substances	17	5.4

Furthermore, strong internal consistency on the YFAS 2.0 was found in this sample ($\alpha = 0.94$).

Convergent Validity

Both the YFAS 2.0 symptom count (i.e., total number endorsed) and clinically significant food addiction (i.e., does/does not endorse) were significantly related to all 3 factors of emotional eating (Table 2). Those endorsing YFAS 2.0 symptoms of food addiction reported higher rates of eating in response to negative emotions. The number of YFAS 2.0 symptoms and endorsement of clinically significant food addiction were also both positively related to anxiety and depression as measured by the HADS (Table 2). Those who reported history of binge eating and purging also reported more YFAS 2.0 symptoms of food addiction compared with those who reported no history of binge eating (Table 2). Those meeting the YFAS 2.0 criteria for food addiction were more likely to have a history of binge eating (Table 2). Of the 42 individuals (13.4%) who reported a history of binge eating, 26 of the 42 (61.9%) were also more likely to meet the YFAS 2.0 criteria for food addiction. Additionally, those meeting the YFAS 2.0 criteria for food addiction were also more likely to have a history of purging (Table 2). Of the 23 individuals who reported a history of purging (7.3%), 12 of the 23 (52.2%) also endorsed meeting criteria for food addiction.

BMI was not related to the number of food addiction symptoms, emotional eating, or a history of binge eating or purging (Table 2). Similarly, there was no difference in BMI between those who did and did not endorse YFAS 2.0 criteria for food addiction (Table 2).

Table 2 Relationships of YFAS 2.0 symptom count and diagnostic classification with measures that support convergent and discriminant validity

	Symptom count	Food addiction diagnosis
Convergent validity		
EES		
Factor 1 - anger	$r = .52$**	$U = 5854$**
Factor 2 - anxiety	$r = .51$**	$U = 5795.5$**
Factor 3 - depression	$r = .51$**	$t = 8.35$**
HADS		
Anxiety	$r = .39$**	$U = 5936.5$**
Depression	$r = .28$**	$t = 6.29$**
Binge history	$t = 5.80$**	$X^2 = 28.50$**
Purge history	$t = 3.28$**	$X^2 = 7.48$*
Discriminant validity		
Alcohol use	$t = 1.17$	$X^2 = 1.36$
Tobacco use	$t = 1.21$	$X^2 = 1.17$
Marijuana use	$t = 1.51$	$X^2 = 2.58$
Other substance use	$t = 2.38$*	$X^2 = 1.65$

Values were the result of correlations, parametric, and nonparametric t tests, and chi-square tests of independence; *EES*, Emotional Eating Scale; *HADS*, Hospital Anxiety and Depression Scale; *$p < .05$, **$p < .01$

Discriminant Validity

There were no differences in the number of symptoms on the YFAS 2.0 between patients who did and did not endorse a history of regular or problematic drinking, tobacco use, or marijuana use (Table 2). A small number of individuals endorsed use of substances other than alcohol, tobacco, or marijuana ($n = 17$); there was a difference in the number of YFAS 2.0 food addiction symptoms between those patients and patients who denied other substance use (Table 2). Finally, no significant relationships were found between those meeting the YFAS 2.0 criteria for food addiction and regular or problematic alcohol use, tobacco use, marijuana use, nor other substance use (Table 2).

Incremental Validity

The EES accounted for unique variance in reported history of binge eating (Table 3). The YFAS 2.0 symptom count was included as a predictor in the model to determine if the YFAS 2.0 accounted for significant variance in history of binge eating after controlling for emotional eating. The model remained significant when including the number of symptoms of YFAS 2.0 food addiction as an independent variable, and food addiction provided significant incremental change in prediction (Table 3). As patients reported a greater number of symptoms of food addiction, they were more likely to have a history of binge eating ($Exp(B) = 1.30$).

Discussion

The YFAS 2.0 was developed to assess for the construct of "food addiction" in a manner that translates to the DSM-5 criteria for substance use disorders. This study sought to validate the use of the YFAS 2.0 among patients undergoing evaluation for bariatric surgery. Compared with a general population [6], a higher percentage of participants in this study reported clinically significant YFAS 2.0 symptoms of food addiction. Among patients who endorsed clinically significant food addiction, approximately half were in the severe range. Individuals sampled in the initial YFAS 2.0 validation also endorsed a higher percentage of clinically significant food addiction on the YFAS 2.0 compared with the original YFAS [6, 11]. Although those in the initial validation with significant food addiction were also more likely to endorse symptoms in the severe range [6], our sample of patients seeking bariatric surgery demonstrated higher overall endorsement of food addiction, which was expected as this sample

Table 3 Incremental contribution of the YFAS 2.0 symptom count over the Emotional Eating Scale in accounting for unique variance in history of binge eating

	B	*SE*	*Exp(B)*	R^2	− 2 Log likelihood
Block 1				.05	230.99
EES anger	.07**	.03	1.07		
EES anxiety	− .07**	.04	.93		
EES depression	.08**	.06	1.08		
Block 2				.10	213.36
EES anger	.06	.04	1.06		
EES anxiety	.11*	.04	.90		
EES depression	.05	.06	1.05		
YFAS 2.0 symptom count	.26**	.06	1.30		

*$p < .05$, **$p < .01$

consisted only of patients with morbid obesity. Furthermore, a higher prevalence of clinically significant food addiction was found in the current study compared with a similar sample of individuals pursuing bariatric surgery who were given the original YFAS (27.4% versus 16.9%, respectively) [22]. The overall higher rates of individuals meeting YFAS 2.0 criteria for food addiction may be related to the removal of separate "abuse" and "dependence" diagnoses from DSM-IV to DSM-5 substance use disorder criteria. The original YFAS criteria were based on substance dependency alone; thus, the threshold to meet criteria for food addiction on the YFAS 2.0 is lower.

Results from this study suggest that the YFAS 2.0 has similar construct validity among a bariatric population as the original YFAS does among this population. Specifically, convergent validity was present given the relationship of the YFAS 2.0 to emotional eating, binge eating, and purging, as well as symptoms of anxiety and depression. Regarding BMI and food addiction, there was likely not a relationship due to a lack of variability with BMI among this bariatric surgery population, who were required to have a BMI of at least 35 in order to qualify for bariatric surgery. Although previous research found a relationship between food addiction symptoms and BMI among a population with a wide range of BMIs [6], this relationship may not exist when BMIs only fall in the obese range. This should be considered when using the YFAS 2.0 as a tool for pre-surgical bariatric evaluations. Meeting YFAS 2.0 criteria for food addiction should be considered in the context of other patient variables, such as eating disordered behavior and general psychiatric history.

Neither symptom count nor meeting criteria for clinically significant food addiction were associated with problematic drinking nor regular tobacco or marijuana use, supporting discriminant validity for the YFAS 2.0. This finding was similar to the findings in the original YFAS validation among a bariatric surgery population [10]. Although there was not a relationship between clinically significant food addiction and substance use in general, there was an unexpected relationship between the YFAS 2.0 symptom count and report of substance use other than alcohol, tobacco, or marijuana (e.g., cocaine use, prescription drug use, etc.). However, this finding may have been influenced by a small number of patients endorsing other substance use.

Finally, the YFAS 2.0 demonstrated incremental validity in that it accounted for variance in binge eating above and beyond emotional eating. In addition to the pre-surgical relationships found in this study, addictive eating alone has been found to be associated with post-surgical weight loss, binge eating, and problematic eating behaviors among a similar population assessed in the current study [23]. However, this relationship has not been supported in studies of other samples and given the importance of researching variables pre-bariatric surgery that may impact weight loss post-surgery, pre-surgical addictive eating needs to be reliably assessed with valid measures to better clarify the mixed findings on the relationship between pre-surgical "food addiction" and post-surgical outcomes [23–25].

Despite promising findings regarding the validity of the YFAS 2.0 with a bariatric surgery population, this study has limitations. Retrospective chart review of clinical interview was utilized to measure variables in the current study. As a result of using clinical interview data, some variables were coded dichotomously and therefore conclusions cannot be drawn about patients who may fit within specific subgroups (i.e., patients with binge eating disorder versus those with less severe binge eating). Furthermore, not having additional data from other validated constructs may have impacted the internal validity of the study. However, this limitation was unavoidable given that the current study was a retrospective chart review and additional measures could not be included in the evaluations from which the data were drawn.

Clinical interview may have also led to underreporting of binge eating, compensatory weight loss behaviors, and substance use due to patient motivation for bariatric surgery clearance. Indeed, only a small proportion of patients endorsed difficulties in these areas. Therefore, in order to utilize these variables in assessing convergent and discriminant validly, similar to the original validation of the YFAS among a

bariatric population [10], we used current or past problematic substance use, current binging, and current purging to relate to current addictive eating.

The biological evidence that food and drug addiction are similarly experienced continues to be debated in the literature [5]. Ways in which food addiction differs from binge eating continue to be studied. Further study will help researchers decide if food addiction is a component of binge eating, or in fact, alters brain functioning, and rewards systems in a similar way as drugs of abuse.

Despite this debate, results from the current study parallel findings from the original validation of the YFAS among a bariatric surgery population [10, 13] and suggest that the YFAS 2.0 is a valid measure to assess addictive eating among patients seeking bariatric surgery. The current study's findings are important if we are to continue to research the concept of "food addiction," its relationship to weight management, and those most impacted by the obesity epidemic.

Compliance with Ethical Standards

Informed Consent Informed consent was waived by the IRB, given the retrospective nature of the study.

Human and Animal Rights The study was performed in accord with the ethical standards of the Declaration of Helsinki.

Conflict of Interest The authors declare that they have no conflict of interest.

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