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ORIGINAL ARTICLE

Psychometric properties of the Italian Yale Food Addiction Scale in overweight and obese patients

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Abstract
Aim To assess the dimensionality and psychometric properties of an Italian version of the Yale Food Addiction Scale (YFAS) in a sample of obese/overweight patients attending low-energy diet therapy.
Methods Participants were 300 overweight and obese patients who were admitted to a private medical center in Rome, Italy. Controls were 300 (231 women and 69 men) adults from the general population. All of the participants were administered the YFAS and the binge eating scale (BES).
Results The one-factor model of the YFAS reported in previous studies did not fit the data [$\chi^2_{209} = 466.69$, $p < 0.001$, root mean square error of approximation (RMSEA) = 0.07; 90 % CI: 0.06/0.08; comparative fit index (CFI) = 0.91; weighted root mean square residual (WRMR) = 1.40]. Through item analysis, it was suggested that five items (items #10, #11, #22, #24, and #25) with low item–total correlations should be removed from the measure. A 16-item one-factor model revealed a better fit to the data ($\chi^2_{104} = 174.56$; $p < 0.001$; RMSEA = 0.05; 90 % CI: 0.04/0.07; CFI = 0.96), although the WRMR was slightly higher than that suggested as an indicator of good fit (WRMR = 1.01). The YFAS-16 had satisfactory internal consistency; it was able to discriminate obese patients from controls and strongly correlated with BES scores.
Conclusion The YFAS-16 assesses all of the "symptoms" represented in the original version and has satisfactory psychometric properties, although the percentage of food addiction diagnoses according to the YFAS-16 is lower than the percentage of diagnoses according to the original version of the questionnaire.

Keywords Yale Food Addiction Scale · Obesity · Overweight · Structural equation modeling

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Introduction

The construct of "food addiction" (FA) has been introduced in the last decades to better understand abnormal eating patterns among obese and overweight individuals [1, 2]. In fact, a large body of literature has documented the parallelism between addictive behaviors and obesity in both

humans and animals [2–10]. Gearhardt et al. [11] recently validated the Yale Food Addiction Scale (YFAS) to measure FA symptomatology and discriminate between individuals with and without addictive eating patterns according to the *Diagnostic and Statistical Manual of Mental Disorders 4th edition, text revision* (DSM-IV-TR) substance dependence criteria [12]. The YFAS includes dichotomous and Likert scale items and provides two scoring alternatives: a symptom count version and a diagnostic version. A categorical diagnostic cutoff is met when three symptoms and clinically significant impairment or distress from eating are present [11].

The YFAS has been widely used to investigate FA prevalence. FA has been reported to range from 41.5 to 72.2 % in obese people with binge eating disorder (BED) [4, 13, 14], between 15.2 and 53.7 % among patients attending weight loss surgery programs [15–17], and between 15.2 and 25 % among overweight [body mass index (BMI) of 25.0–29.9] and obese (BMI $\geq$ 30) patients seeking weight loss treatments [4, 17, 18]. In the general population, FA prevalence has been estimated to be around 5.4 % [19].

The YFAS was initially validated in US undergraduate students showing a single factor structure and satisfactory internal consistency ($\alpha = 0.86$) [11]. Further, supporting its construct validity, the YFAS total score was positively associated with neural activation of brain regions involving the reward system (i.e., amygdala, anterior cingulate cortex) in response to anticipated intake of palatable food [20]. A unidimensional structure and good psychometric properties were also replicated in German university students [21], in a small sample of obese candidates for bariatric surgery [15] and in a small sample of obese patients with BED [13]. Moreover, the YFAS was reported to have satisfactory convergent validity with measures assessing disordered eating patterns (e.g., binge eating and emotional eating) and satisfactory divergent validity with measures assessing substance use disorders [11, 16]. Finally, it was observed that YFAS scores are associated positively with BMI [19] and negatively with weight loss interventions [18].

All of these findings suggest the importance of using the YFAS during the assessment of overweight and obese patients. However, there are no studies which have investigated the psychometric properties of the YFAS in a large sample of obese and overweight patients attending weight loss interventions. Thus, the aim of the current study was to assess the psychometric properties of an Italian version of the YFAS in a sample of obese/overweight patients attending low-energy diet therapy. Dimensionality of the YFAS was investigated by means of structural equation modeling (SEM). In line with two previous studies [11, 21], we included individual items in the factor model (22 out of 25, not including the clinical significance questions as described in previous research [11]). This procedure is different from the approach used in a recent study [13], where the authors submitted the seven dichotomous composite "symptoms" to confirmatory factor analysis after grouping individual items as suggested by the authors of the YFAS [11]. We decided to submit items to factor analysis and not the composite "symptoms" because this procedure allows evaluating whether all the items included in the YFAS are equally able to measure the latent common construct, i.e., food addiction. This is especially important because this is the first study to investigate the psychometric characteristics of the Italian version of the YFAS. Consistent with prior studies [11, 13, 21], we hypothesized a unidimensional structure for the YFAS.

Subjects and methods

Subjects

The participants were 300 (246 women and 54 men) overweight and obese patients (BMI $\geq$ 25 kg/m^2) who were admitted to one private medical center in Rome (Italy), specializing in the treatment of obesity [22]. The patients were assessed between May 2011 and April 2014. At the start of the study 63.7 % of the patients were not on dietary restriction, while all the others had been restricting their diets for less than a month. Dietary restriction was assessed during the intake visit by the physician in charge, who evaluated the basal metabolic rate with the use of bioimpedenzometry and a 24-h recall of food intake. Inclusion criteria were ages of 18 or older and a BMI of 25 kg/m^2 or higher. Exclusion criteria were the presence of major disorders of the central nervous system (e.g., epilepsy, dementia, or Parkinson's disease), any psychotic symptoms (hallucination, delusions, or negative symptoms), or major mood disorders (e.g., bipolar disorder and major depressive disorder), and the presence of any condition affecting the ability to complete the assessment, including the denial of informed consent. During the intake visit the patients were asked screening questions according to a checklist prepared for a previous study [23] and based on the DSM-IV-TR [12] criteria to identify the presence of mood disorders and other psychiatric conditions. Information about organic comorbidities was extracted from the medical records. Ninety-five point four percent of the patients agreed to participate in the study, and 97.2 % of those who agreed to participate in the study completed the assessment. The mean age of the patients was 43.55 years (SD = 11.27, range = 18/73 years), while the average BMI was 32.15 kg/m^2 (SD = 6.46, range = 25/62.50). Controls were 300 (231 women and 69 men) adults from the Italian general population. The mean age of the controls

was 41.74 years (SD = 13.27, range = 22/81 years), while the average BMI was 23.13 kg/m^2 (SD = 6.46, range = 16/38.05). The same inclusion/exclusion criteria were used for controls with the exception of BMI limits. The controls were recruited through advertisements posted in established community groups (e.g., universities and community organizations operating in Rome and Central Italy). Groups did not differ in sex ($p = 0.08$) or age ($p = 0.07$); however, the patients had a significantly higher mean BMI ($p < 0.001$). Patients and controls participated in the study voluntarily, did not receive payment, and provided written informed consent. All the subjects who agreed to participate in the study completed the protocol anonymously.

Measures

The YFAS [11] is a 25-item self-report measure of addictive eating behaviors with high fat/sugar foods, originally developed according to substance dependence criteria in the DSM-IV-TR [12]. Sixteen items are rated on a 5-point Likert-type scale (from 0–never to 4–four or more times or daily; e.g., *"I find that when I start eating certain foods, I end up eating much more than planned"*), eight items are dichotomous (No/Yes; e.g., *"My food consumption has caused significant psychological problems such as depression, anxiety, self-loathing, or guilt."*), and in the last item respondents have to rate the number of times they tried to cut down or stop eating certain foods in the last years, choosing from five alternatives (one or fewer times, two times, three times, four times, and five or more times). Then, scores on Likert-type items are dichotomized according to specific cutoffs developed by the authors of the questionnaire [11]. According to the authors of the YFAS, the items fall under specific criteria that resemble the symptoms for substance dependence as stated in the DSM-IV-TR [12] and operationalized in the Structured Clinical Interview for DSM-IV Axis I Disorders [24]. The symptom *"substance taken in larger amount and for longer period than intended"* is assessed by three items (items number 1–3; e.g., *"I find myself continuing to consume certain foods even though I am no longer hungry."*), *"persistent desire or unsuccessful attempts to quit"* is assessed by four items (items number 4, 22, 24, and 25; e.g., *"Not eating certain types of food or cutting down on certain types of food is something I worry about."*), *"much time/activity to obtain, use, recover"* is assessed by three items (items number 5, 6, and 7; e.g., *"I spend a lot of time feeling sluggish or fatigued from overeating."*), *"activities given up or reduced"* is assessed by four items (items number 8, 9, 10, and 11; e.g., *"There have been times when I avoided professional or social situations because I was not able to consume certain foods there."*), *"use continues despite knowledge of adverse consequences"* is assessed by one item (item number 19; *"I kept consuming the same types of food or the same amount of food even though I was having emotional and/or physical problems."*), *"tolerance"* is assessed by two items (items number 20, and 21; e.g., *"Over time, I have found that I need to eat more and more to get the feeling I want, such as reduced negative emotions or increased pleasure."*), *"withdrawal symptoms and substance taken to relieve withdrawal"* is assessed by three items (items number 12, 13, and 14; e.g., *"I have found that I have elevated desire for or urges to consume certain foods when I cut down or stop eating them."*), and *"impairment or distress"* is assessed by two items (items number 15, and 16; e.g., *"My behavior with respect to food and eating causes significant distress."*). Three more items (items number 17, 18, and 23) are not scored because they are primers for other questions [11].

We translated and adapted the Italian version of the YFAS. One author (MF) translated the original English version and a second researcher (MI) blindly back-translated the measure to the source language. The back-translated version was submitted to one of the authors of the YFAS (Dr. Ashley Gearhardt) [11], who found no discrepancies with the original version of the questionnaire.

The binge eating scale (BES) is a 16-item questionnaire assessing binge eating severity as well as the feelings and thoughts associated with such behavior. It assesses both behavioral and cognitive/emotional manifestations of binge eating. When rating each item, the respondent has to choose between three or four response statements of increasing severity for each question. In the derivation sample, the BES successfully discriminated among persons judged by trained interviewers to have or not have binge eating problems [25]. The scores ranged from 0 to 46. Individuals with scores less than 18 were considered not to be engaging in significant binge eating; individuals with scores 18–26 were likely engaging in binge eating behavior; and individuals with scores of 27+ were determined to be engaging in clinically significant binge eating behavior [25]. These categories were chosen to be consistent with previous research and were shown to have a 98 % concordance rate with diagnoses made by a semi-structured interview [26]. Furthermore, the BES was reported to have satisfactory internal consistency [25] and validity [27]. In the present study, a validated Italian version of the scale was used [28].

Statistics

Structural equation modeling was employed using Mplus 6.0 [29]. We used a mean- and variance-adjusted weighted least square (WLSMV) estimator with a polychoric correlation matrix. Model fit was assessed using the following indices: (1) the root mean square error of approximation

(RMSEA), a measure of absolute fit; values between 0.05 and 0.08 are indicative of good adequacy of the model and those below 0.05 deemed strong evidence of absolute fit [30, 31]; (2) the comparative fit index (CFI); values greater than 0.95/0.96 for this indicator are indicative of good model fit; and (3) the weighted root mean square residual (WRMR); Yu [32] recommends that a model with a WRMR of less than 1.0 indicates good fit; and 4) the Chi squared (χ^2) test; p values greater than 0.05 indicate that the model is an adequate fit to the data, although the χ^2 test over-rejects true models for large samples.

For each item, we reported the standardized lambda coefficients (λ) expressing the relationships between the factor and its observed variables (used to measure the validity of the indicator; that is, how well they measure the latent dimension) and the squared multiple correlation coefficients (R^2; tests reliability: how much variance in the item is accounted for by the model).

We also assessed the YFAS at the item level, reporting discriminate validity (i.e., ability to discriminate between obese/overweight patients and controls), corrected item–total correlations (r_c), and Cronbach's alpha if an item was deleted. An item should be considered problematic if it does not discriminate groups of subjects, or has $r_c < 0.3$, or Cronbach's alpha did not decrease when the item was deleted.

As measures of reliability, we reported Cronbach's alphas (α), and inter-item mean indices of correlation (r_{ii}) for internal consistency. Convergent validity with the BES was evaluated by calculating Pearson's r indices of correlations. Incremental validity of the YFAS in predicting BMI over the BES was evaluated by means of linear regression analysis, which was performed using the full sample to allow greater variability of the BMI.

Results

Models' fit

Fit statistics for the SEM models are reported in Table 1. The one-factor model for the 22-item (three items are not scored because they are primers for other questions [11]) version of the YFAS as reported in previous studies did not fit the data ($\chi^2_{209} = 466.69$, $p < 0.001$, RMSEA = 0.07; 90 % CI: 0.06/0.08; CFI = 0.91; WRMR = 1.40), and Mplus warned that items #1 and #2 were almost perfectly correlated (r of 0.99). Thus, we created a new item parcel from items #1 and #2 (this item parcel had a score of 1 when items #1 or #2 had a score of 1, and a score of 0 in all other cases). Then, we reran the analysis substituting items #1 and #2 with the item parcel. However, the fit statistics did not improve ($\chi^2_{189} = 413.87$, $p < 0.001$, RMSEA = 0.07; 90 % CI: 0.06/0.08; CFI = 0.87; WRMR = 1.35).

Analysis of items indicated that all the items except for item #24 were able to differentiate overweight/obese patients from controls, although five items (items #10, #11, #22, #24, and #25) had $r_c < 0.30$ and Cronbach's alpha did not decrease when the item was deleted (Table 2). Thus, we employed a reduced one-factor structural equation model with the remaining 16 items. This model had better fit to the data ($\chi^2_{104} = 174.56$; $p < 0.001$; RMSEA = 0.05; 90 % CI: 0.04/0.07; CFI = 0.96), although the WRMR was slightly higher than that suggested as an indicator of good fit (WRMR = 1.05). All items loaded significantly on the common factor ($p < 0.001$) with R^2 ranging between 0.25 and 0.80 (Table 3; Fig. 1).

Psychometric properties of the Italian YFAS-16

Reliabilities and descriptive statistics for the YFAS-16 and the BES are reported in Table 4. The Cronbach's alpha coefficient was 0.85 for the Italian YFAS-16. The diagnosis of food addiction was able to differentiate overweight/obese patients from controls ($p < 0.001$). Furthermore, the YFAS score was strongly correlated with BES total scores ($r = 0.68$; $p < 0.001$). In the linear regression analysis, both the YFAS-16 score ($\beta = 0.18$; $t = 3.30$; $p < 0.001$) and the BES ($\beta = 0.36$, $t = 6.73$, $p < 0.001$) were significantly associated with BMI, accounting for 25 % of the variance of the data.

Table 1 Fit statistics for the alternative models

	Chi Square	Root mean square error of approximation (RMSEA) (90 % CI)	Comparative fit index (CFI)	WRMR (weighted root mean square residual)	Degree of freedom
One-factor model (22 items)	466.69*	0.07 (0.06/0.08)	0.91	1.40	209
One-factor model (21 items, items 1 and 2 merged)	413.87*	0.07 (0.06/0.08)	0.87	1.35	189
One-factor model (16 items)	174.56*	0.05 (0.04/0.07)	0.96	1.01	104

Estimator: mean- and variance-adjusted weighted least square

* Significant for $p < 0.001$

Table 2 Item analysis

	Controls ($n = 300$) (%)	Obese/overweight patients ($n = 300$) (%)	p	Corrected item–total correlation	Cronbach's alpha if item is deleted
Yale 1|2	2.3	12.0	<0.001	0.48	0.82
Yale 3	1.0	6.4	<0.001	0.48	0.83
Yale 4	1.0	8.5	<0.001	0.37	0.83
Yale 5	2.7	16.7	<0.001	0.48	0.82
Yale 6	2.0	9.2	<0.001	0.52	0.82
Yale 7	2.3	10.5	<0.001	0.55	0.82
Yale 8	1.7	15.0	<0.001	0.51	0.82
Yale 9	0.7	6.4	<0.001	0.53	0.82
Yale 10	3.7	9.8	0.01	0.24	0.83
Yale 11	3.7	8.4	0.05	0.19	0.84
Yale 12	0.3	9.6	<0.001	0.48	0.83
Yale 13	1.7	17.2	<0.001	0.54	0.82
Yale 14	2.7	15.9	<0.001	0.53	0.82
Yale 15	2.3	26.9	<0.001	0.59	0.82
Yale 16	2.0	12.1	<0.001	0.44	0.83
Yale 19	12.3	45.1	<0.001	0.48	0.82
Yale 20	3.3	27.9	<0.001	0.34	0.83
Yale 21	11.7	43.9	<0.001	0.38	0.83
Yale 22	29.0	73.6	<0.001	0.20	0.84
Yale 24	48.0	42.5	0.10	0.24	0.84
Yale 25	19.1	59.7	<0.001	0.25	0.84

Cronbach's alpha for the total scale = 0.83

Discussion

We investigated the psychometric properties of an Italian version of the YFAS. Structural equation modeling indicated that the original one-factor model with 22 items investigated by Gearhardt et al. [11] in undergraduates did not fit the data, and analysis of items suggested the need to remove five items (items #10, #11, #22, #24, and #25) from the scale and create a new item parcel from items #1 and #2. A new one-factor model with the remaining 16 items had better fit to the data, with only the WRMR statistic suggesting a non-perfect fit of the model. Our results are similar to those reported by Meule et al. [15], who investigated the psychometric properties of the YFAS in a small sample of obese patients attending bariatric surgery. The authors pointed out that their results supported a one-factor structure, but also suggested that items #22, #24, and #25 could be problematic given their low factor loadings and low item–total correlations. These items, investigating the persistent desire or repeated unsuccessful attempts to reduce or stop consuming certain foods, did not sufficiently discriminate between food-addicted and non-addicted obese individuals [15]. This probably reflects the evidence that recidivism is high and weight cycling (i.e., repetitive loss and regain) is a prevalent phenomenon in the history of obese patients [33]. Indeed, although weight loss interventions for overweight and obese individuals are commonplace, only approximately 20 % of individuals are successful in maintaining long-term weight loss [34].

In contrast with Meule et al. [15], our results indicated that also items #10 and #11 were problematic. The discrepant results found between our study and previous works [11, 15] could be due to several factors that may influence the validity of scores from an instrument administered in different ethnic and cultural settings [35, 36]. In fact, cross-cultural adaptations of measures may be affected by different types of biases. For example, cultural and ethnic factors may influence eating habits and patterns and the construct of FA may not be equivalent across ethnic groups (i.e., construct bias). Moreover, the translation procedures of items may have contributed to some slight differences in the meanings of the items (i.e., items bias) [36]; however, we used a back-translation process and one of the authors of the original version of the YFAS did not find any discrepancies between the Italian and the original version of the questionnaire. The hypothesis that cultural and ethnic factors could have influenced eating habits and patterns reported in our study may be supported by the results reported in Flint et al. [37], who developed a brief version of the YAFS (mYFAS) for use in large epidemiologic cohorts. Although the authors included in the mYFAS only nine items (item number 2, 4, 5, 9, 12, 15, 16, 19, and 21) which are all included in our version of the questionnaire, they reported that the percentage of patients diagnosed as having

Table 3 Standardized factor loadings (standard errors): one-factor model with 16 items

Items	Yale Food Addiction Scale	R^2	Items	Yale Food Addiction Scale	R^2
Item 1/2	0.82* (0.05)	0.67	Item 12	0.80* (0.06)	0.63
Item 3	0.83* (0.08)	0.70	Item 13	0.79* (0.05)	0.63
Item 4	0.67* (0.08)	0.44	Item 14	0.78* (0.06)	0.61
Item 5	0.75* (0.06)	0.56	Item 15	0.79* (0.05)	0.62
Item 6	0.85* (0.05)	0.72	Item 16	0.66* (0.08)	0.43
Item 7	0.90* (0.04)	0.80	Item 19	0.69* (0.06)	0.48
Item 8	0.73 (0.06)	0.54	Item 20	0.50* (0.08)	0.25
Item 9	0.86* (0.07)	0.74	Item 21	0.53* (0.05)	0.28

* $p < 0.001$

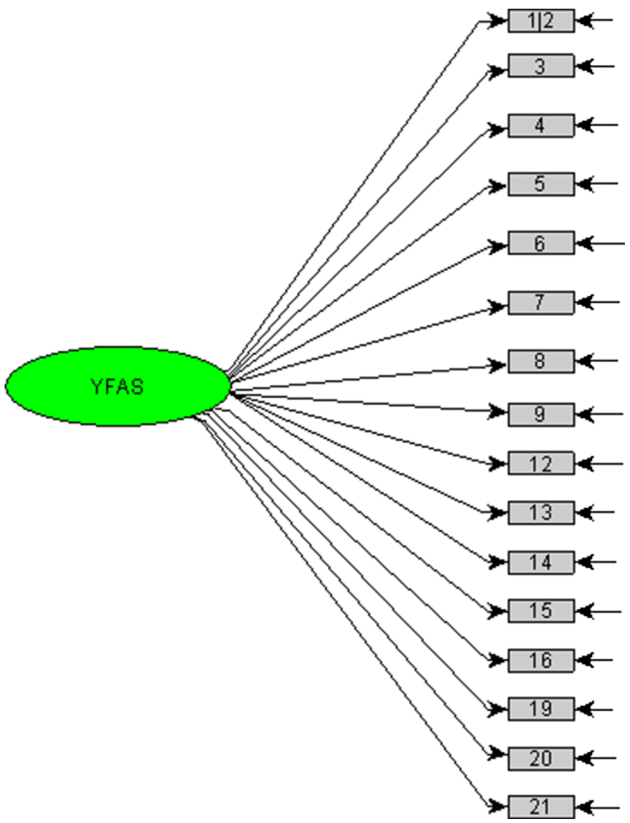

Fig. 1 Factor model for the YFAS-16

food addiction with the mYFAS was not different from those diagnosed with the original version. Given the similarity in the item composition of the mYFAS and the YFAS-16, it is possible that the differences in FA percentages could reflect cultural differences already observed in other addictive eating patterns [38, 39] (i.e., food craving).

Nevertheless, the divergent results among the three studies may also be associated with the different populations under investigation: undergraduate students in the original study [11], obese candidates for bariatric surgery in Meule et al.'s study [21], and obese and overweight patients seeking nutritional treatments in our study. For instance, although both patients included in our sample and those investigated by Meule and colleagues were considered obese, the mean BMI of the sample in the Meule et al.'s study was higher than the mean BMI of our sample (mean BMI was, respectively, 50.64 ± 8.99 and 32.15 ± 6.46 kg/m^2). Indeed, problematic items assess the decrease or withdrawal of important social, occupational, or recreational activities, and it should be noted that being morbidly obese (BMI ≥ 40.00 kg/m^2) is associated with more negative psychosocial consequences [40].

The new version of the scale supported by the present results was composed of only 16 items (items number 10 and 11 assessing *"activities given up or reduced"*, and items 22, 24 and 25 assessing *"persistent desire or unsuccessful attempts to quit"* were deleted, while items 1 and 2 assessing *"substance taken in larger amount and for longer period than intended"* were used to create a new parceled variable), all loading on a single latent common factor. Notwithstanding, all the "symptoms" measured in the original version of the YFAS were still measured in the YFAS-16. In the original version of the YFAS, Gearhardt, Corbin, and Brownell [11] introduced seven symptomatic features of abuse (substances taken in larger amount and for longer period than intended; persistent desire or repeated unsuccessful attempts to quit; much time/activity to obtain, use, or recover; reductions in the engagement of important social, occupational, or recreational activities; continuing use despite knowledge of adverse consequences; tolerance and withdrawal symptoms) and one dimension assessing the clinical significance. The "symptoms" were assessed through 1 (use continues despite knowledge of adverse consequences) to 4 items (important social, occupational, or recreational activities reduced; persistent desire or repeated unsuccessful attempts to quit). In the YFAS-16, two "symptoms" were measured by only one item (vs. only one dimension of the original version), three "symptoms" by two items (vs. two symptomatic dimensions of the original version), three "symptoms" by three items, and none by four items (vs. two "symptoms" of the original version). Nevertheless, the YFAS-16 had satisfactory internal consistency and good discriminant validity (the diagnosis of food addiction according to our 16-item version of the YFAS was able to differentiate overweight/obese patients from controls) and concurrent validity with the BES. Furthermore, in a linear regression analysis, both the YFAS score and the BES score were predictive of BMI in our sample, suggesting incremental validity of YFAS scores in predicting increased BMI. This is consistent with a previous finding reporting that FA is closely associated with binge eating [4, 13, 14] and BMI [19].

Table 4 Descriptive statistics and reliability indices

	Controls ($n = 300$) (%)	Obese/overweight patients ($n = 300$) (%)	p	Cronbach's alpha	Inter-item mean correlation
Substance taken in larger amount and for longer period than intended (criterion 1)	3.3	15.3	<0.001	–	–
Original 22-item version	3.3	15.3	<0.001		
Persistent desire or repeated unsuccessful attempts to quit (criterion 2)	1.0	8.3	<0.001	–	–
Original 22-item version	78.0	91.0	<0.001		
Much time/activity to obtain, use, recover (criterion 3)	5.3	23.3	<0.001	–	–
Original 22-item version	5.3	23.3	<0.001		
Important social, occupational, or recreational activities given up or reduced (criterion 4)	1.7	16.7	<0.001	–	–
Original 22-item version	6.7	25.0	<0.001		
Use continues despite knowledge of adverse consequences (e.g., failure to fulfill role obligation, use when physically hazardous) (criterion 5)	12.3	44.3	<0.001	–	–
Original 22-item version	12.3	45.1	<0.001		
Tolerance (criterion 6)	14.7	51.7	<0.001	–	–
Original 22-item version	14.7	51.7	<0.001		
Withdrawal (criterion 7)	4.3	24.7	<0.001	–	–
Original 22-item version	4.3	24.7	<0.001		
Impairment (criterion 8)	3.3	31.0	<0.001	–	–
Original 22-item version	3.3	31.0	<0.001		
YFAS food addicted	1.7	21.0	<0.001	–	–
YFAS food addicted (22 items' version)	11.0	52.3	<0.001		
YFAS score–*M* (SD)	0.43 (0.80)	1.84 (1.79)	<0.001**	0.85	0.29
BES–*M* (SD)	4.88 (5.23)	14.10 (8.80)		0.89	0.35
BES > 17	3.4	33.2	<0.001	–	–

YFAS Yale Food Addiction Scale, *BES* binge eating scale

** $t_{598} = -12.54$

However, comparing the percentages of patients diagnosed as having food addiction according to the original version of the YFAS and those diagnosed by the YFAS-16, we found differences in both patients (52.3 vs. 21.0 %) and controls (11.0 vs. 1.7 %). Specifically, the frequencies of symptoms number 2 (persistent desire or repeated unsuccessful attempts to quit) and number 4 (important social, occupational, or recreational activities given up or reduced), and the frequencies of food addiction diagnoses were significantly lower for the 16-item version than for the original version. These discrepancies might suggest equally that the YFAS-16 tends to underestimate the prevalence of food addiction or that the original version tends to overestimate it but, without an independent diagnosis of food addiction, it is impossible to know which of the two versions deviate the most from the true prevalence. However, consistent with what has been suggested by Meule et al. [15], research is needed to further assess the validity of some dichotomous items of the YFAS. In our study, the characteristics of food addiction measured by item number 24 (*"I have been successful at cutting down or not eating these kinds of food"*) was unexpectedly more prevalent in controls from the general population than in obese/overweight patients, although prior research has indicated this last group to be at higher risk of FA than the general population [4, 17–19].

We have to consider our results in light of some issues inherent in the design of the study. First, we administered only self-reported measures, which are susceptible to social desirability bias [41, 42]. Second, our results may not be valid for other groups of patients (e.g., bariatric surgery patients). Third, we did not administer measures of depression, which has been found to be closely related to FA [4, 11, 13, 18]. Finally, the diagnostic sensitivity and specificity of the YFAS-16 were not assessed because a valid and reliable instrument for the diagnosis of food addiction was not available at the time of this study. Indeed, none of the YFAS versions that were used in

previous studies was compared with a golden-standard diagnostic instrument and the true diagnostic properties are thus unknown for all of them. To our knowledge, this study is the first to investigate the psychometric properties of the YFAS in a large sample of obese/overweight patients attending weight loss treatments.

Conclusions

Clinicians should evaluate symptoms of food addiction when assessing overweight and obese patients seeking weight loss treatment because addictive eating behaviors are associated with poor adherence, relapses and, ultimately, worse outcomes. The Italian YFAS-16 could help clinicians to easily identify patients at risk for food addiction and to address them with tailored treatments for addictive disorders. The YFAS-16 could be used also for research purposes in correlational studies and in weight loss treatments trials to investigate predictors of poor outcomes. Future studies should also focus on the evaluation of other psychometric properties of the YFAS-16, such as test–retest reliability, and on the assessment of its sensitivity and specificity in detecting food addiction in both clinical and community populations. Finally, future investigations should assess the fit of the YFAS-16 and of other versions of the questionnaire to the new Diagnostic and Statistical Manual of Mental Disorders 5th edition [43] substance abuse criteria.

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