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ORIGINAL ARTICLE

Validation of the Italian Yale Food Addiction Scale in postgraduate university students

Gian Mauro Manzoni[1,2] · Alessandro Rossi[1,4] · Giada Pietrabissa[1,3] · Giorgia Varallo[1] · Enrico Molinari[1,3] · Eleonora Poggiogalle[5] · Lorenzo Maria Donini[5] · Giulietta Tarrini[6] · Nazario Melchionda[6] · Carla Piccione[7] · Giovanni Gravina[8] · Gianluigi Luxardi[9] · Emilia Manzato[10] · Romana Schumann[11] · Marco Innamorati[12] · Claudio Imperatori[12] · Mariantonietta Fabbricatore[12] · Gianluca Castelnuovo[1,3]

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Abstract

Purpose This study was aimed to examine the structural and construct validity of the Italian version of the Yale Food Addiction Scale in a multisite sample of postgraduate students.

Methods Two hundred and fifty-six subjects (78.1% females) aged from 18 to 53 years (mean = 23.93, SD = 4.96) and attending different postgraduate university programs at multiple Italian universities completed the Italian YFAS, the Italian Binge Eating Scale (BES), the Italian Eating Attitudes Test-26 and the Italian Dutch Eating Behavior Questionnaire (DEBQ) online through Qualtrics.

Results Confirmatory Factor Analysis showed that the single-factor model of the Italian YFAS including all original items had adequate fit indexes ($\chi^2 252 = 454.183$; $p < 0.001$; normed $\chi^2 = 1.802$; RMSEA = 0.056; 90% CI 0.048–0.076; CFI = 0.761; WRMR = 1.592). However, item analysis revealed that item#25 had zero variance (all subjects were assigned the same score after item dichotomization) and item#24 had a low factor loading, and were thus removed. Furthermore, item#10 and item#11 showed to be almost perfectly correlated ($r = 0.998$) and were thus parceled. The resulting 19-item single-factor model revealed a better fit to the data ($\chi^2 152 = 235.69$; $p < 0.001$; normed $\chi^2 = 1.556$; RMSEA = 0.046; 90% CI 0.034–0.058; CFI = 0.858; WRMR = 1.236) and its internal consistency was acceptable (KR-20 = 0.72). Also, a single-factor model including the seven diagnostic symptoms was tested and showed adequate fit values ($\chi^2 20 = 41.911$; $p < 0.003$; normed $\chi^2 = 2.09$; RMSEA = 0.065; 90% CI 0.037–0.093; CFI = 0.946; WRMR = 1.132). Statistically significant and small-to-high correlations were found with all convergent measures, in particular with the BES.

Conclusion The Italian 19-item YFAS resulted to be a valid and reliable tool for the assessment of food addiction in postgraduate students.

Level of evidence Level V, descriptive study.

Keywords Food addiction · YFAS · Validity · University students

Introduction

Over recent years, the clinical and scientific perspectives on addictive disorders have extended to include excessive and repetitive behavioral patterns that appear comparable to substance use disorders [1, 2]. In addition to gambling, internet gaming, sex addiction, exercise addiction and shopping addiction [3], food addiction (FA) has also gained attention. It was defined as an abnormal pattern of overconsumption of food in association with symptoms descriptively similar to those of substance dependence, i.e., loss of control, tolerance, withdrawal and impulsivity [4], and has been investigated as a new etiological hypothesis underlying obesity [5–8]. Several neurobiological parallelisms have been observed between food addiction and substance use disorder [9–12]. For example, neuronal circuits modulated by dopamine were shown to be activated by both drugs and hyper-palatable foods, and both conditions resulted to

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✉ Gian Mauro Manzoni
gm.manzoni@auxologico.it

Extended author information available on the last page of the article

exhibit both a reduced availability of dopamine D2 receptors and a decreased metabolism in prefrontal regions involved in inhibitory control [13–15].

One of the most used self-report measures of FA is the Yale Food Addiction Scale (YFAS). It was originally developed on the basis of the DSM-IV-TR substance dependence criteria [4] and, even though the changes of the substance use disorder in the DSM 5, but, given the overlap with the DSM-5 criteria for the substance use disorder, it can still be applied [5, 6].

The YFAS was firstly validated in a non-clinical sample ($N=353$) of undergraduate college students [4] and demonstrated both a single-factor structure and an adequate internal consistency ($\alpha=0.86$). To support its construct validity, Gearhardt et al. [16] used a sample of lean to obese women and found out that higher scores on the YFAS symptoms count were associated with patterns of neuronal activation similar to those observed in drug addiction, i.e., elevated neural activation of the reward circuitry in response to anticipated food intake.

The psychometric properties of the YFAS were later assessed in a sample of obese adults ($N=81$) with binge eating disorder and the single-factor structure was further confirmed [17].

Meule et al. [18] made available the German version of the YFAS and assessed its psychometric proprieties in a study involving non-clinical subjects. A one-factor structure was still found and internal consistency, as well as convergent and divergent correlations, resulted to be comparable to the ones reported for the original version [4]. Both the factor structure and the internal consistency of the German YFAS were further replicated in a sample of obese candidates ($N=96$) for bariatric surgery [19].

Like the original and the German versions, the French translation of the YFAS was also first validated in a sample of non-clinical subjects ($N=553$) [20]. The one-factor structure explained a high proportion of variance, which is consistent with the original results [4], and the internal consistency of both the symptoms count and the diagnostic scores were replicated. Furthermore, a high convergent validity with measures of binge eating was showed [20].

The Spanish version of YFAS was developed and validated by Granero et al. [21] in a merged sample ($N=207$) of adults with an eating disorder ($N=125$) and non-clinical controls ($N=82$). Results showed a good internal structure of the one-dimensional solution ($\alpha=0.95$) and suggested that the YFAS discriminates between individuals with an eating disorder and healthy controls.

Chen et al. [22] developed the Chinese version of the YFAS and tested its psychometric properties in a sample of female normal school students ($N=950$). Internal consistency resulted to be adequate for both the symptoms count and the diagnostic scores, which correlated significantly with the Eating Attitudes Test and the Binge Eating Scale. On the contrary, no or small correlations were found with the Behavioral Inhibition System/Behavioral Activation System and the Regulatory Emotional Self-efficacy [22].

Innamorati et al. [23] translated the YFAS into Italian language and investigated its psychometric properties in a merged sample of overweight/obese patients ($N=300$) and healthy controls ($N=300$). The one-factor model did not fit the data and the analysis of items supported the development of a new 16-item version of the questionnaire. The YFAS-16 showed a satisfactory internal consistency ($\alpha=0.85$) and good discriminant as well as concurrent validity [23].

The aim of the current study was to examine some psychometric properties of the full-length Italian version of the YFAS in a sample of postgraduate students. In particular, we sought to assess its structural validity, internal consistency and convergent validity.

Methods

Sample and procedure

Participants were 256 postgraduate university students (78.9% of females; one did not indicate his/her own gender on the demographic form) aged from 18 to 53 years (mean = 23.87, SD = 4.98) and attending different postgraduate university programs at multiple Italian universities. They were enrolled during classes by academic teachers who are members of the Italian Society for the study of Eating Disorders (SIS-DCA) and who were invited to collaborate to the study at the VIII annual meeting of the Society.

Students who accepted to participate and provided their e-mail addresses were sent an e-mail including a Qualtrics link to the online questionnaires, which were administered after obtaining their digital informed consent.

Measures

Participants completed first a demographic form (gender, age and BMI) and were then asked to fill in the following self-report questionnaires.

YFAS

The Italian translation of the YFAS that was used in the present study was obtained by Innamorati et al. [23] and can be requested to the corresponding author. It consists of 25 items originally developed by Gearhardt et al. [4] according to the DSM-IV-TR substance dependence symptoms criteria, as operationalized in the Structured Clinical Interview for DSM-IV Axis I Disorders [24]. Specifically, the YFAS investigates: (A) "substance taken in larger amount and

for longer period than intended"; (B) "persistent desire or unsuccessful attempts to quit"; (C) "much time/activity to obtain, use, recover"; (D) "activities given up or reduced", (E) "use continues despite knowledge of adverse consequences"; (F) "tolerance"; (G) "withdrawal symptoms and substance taken to relieve withdrawal"; (H) "impairment or distress". Twenty items have a 5-point Likert response scale (three out of them—item#17, item #18 and item #23—are primers), while eight items (from item #17 to item #24) are dichotomous. The YFAS has two scoring options: (a) a continuous score—symptom count—that indicates the number of food addiction symptoms that have been met and (b) a diagnostic score which provides a diagnosis of food addiction when the subject presents at least three symptoms and reports clinically significant impairment and/or distress [4].

BES

The Binge Eating Scale (BES), originally developed by Gormally et al. [25] and translated into Italian language by Ricca et al. [26], measures binge eating severity by investigating the frequency of thoughts, feelings and behaviors associated with Binge Eating Disorder. It consists of 16 items that are groups of three or four statements increasing in severity. For each item, subjects have to choose the statement that best describes his/her condition. The original BES was reported to have satisfactory internal consistency and to discriminate well between clinical and non-clinical individuals [25], showing also an extremely high concordance with the interview-based diagnosis of Binge Eating Disorder [27]. Several studies explored its factorial structure and found two different components (feelings/cognitive and behavioral) [25, 28–31]. Marek et al. [29] tested also a bi-factor model, which showed a better fit to the data than the two-factor model. This result was further confirmed by Imperatori et al. (2015), who assessed the factorial structure of the Italian version of the BES in a large sample of overweight patients. In this study, Cronbach's alphas were 0.870, 0.784 and 0.774 for the BES Total scale, the Cognitions/feelings scale and the Behaviors scale, respectively.

EAT-26

The Eating Attitudes Test-26 (EAT-26), originally developed by Garner et al. [32] and translated into Italian language by Dotti and Lazzari [33], is a measure of core symptoms, worries and usual behaviors concerning eating disturbances and/or eating disorders (ED). It consists of 26 items that compose 3 different subscales: "dieting" (avoidance of fatty foods and preoccupation with losing weight), "bulimia" (bulimic tendencies) and "oral control" (food intake mode and its control). Items are rated on a six-point Likert scale ranging from "never" to "always", where higher scores suggest a more severe symptomatology [32, 33]. An oblique three-factor solution was found for both the original version [32] and the Italian translation [33], which showed also high internal and test–retest reliabilities. Furthermore, the Italian EAT-26 showed good convergent, discriminant and criterion-related validity with other measures of ED symptomatology [33]. In this study, Cronbach's alphas were 0.857, 0.854, 0.609 and 0.551 for the total scale, the Dieting scale, the Bulimia scale and the Oral Control scale, respectively.

DEBQ

The Dutch Eating Behavior Questionnaire (DEBQ), originally developed by Van Strien et al. [34] and translated into Italian language by Dakanalis et al. [35], is composed of 33 items rated on a 5-point Likert scale (ranging from "never" to "very often") and grouped into 3 subscales: "emotional eating" (13 items), "external eating" (10 items) and "restrained eating" (10 items). The "Emotional eating" scale measures the tendency to use food as a way of coping with psychological problems and/or to alleviate the subject from distress; the "external eating" scale measures the frequency of eating in response to external stimuli such as the sight and smell of food; finally, the "restrained eating" scale measures the frequencies of restrictive conscious behavior of food intake [34]. Both the original and the Italian versions were reported to have a strong three-factor structure, high internal consistency and high test–retest reliability after a 4-week period [34–37]. Moreover, the Italian DEBQ proved to be invariant across sex, BMI and age [35]. In this study, Cronbach's alphas were 0.927, 0.925, 0.881 and 0.737 for the total scale, the Restrained Eating scale, the Emotional Eating scale and the External Eating scale, respectively.

Statistical analysis

All questionnaires were first scored according to their respective scoring procedures. With respect to the YFAS, item#1 to item#16 and item #25 were dichotomized using the thresholds proposed by Gearhardt et al. in their first article [4]. After dichotomization, item#25 (How many times in the past year did you try to cut down or stop eating certain foods altogether?) resulted to have zero variance, because all participants were assigned the same score (zero) and was thus excluded from all the following analyses. All items' descriptive statistics after dichotomization are reported in Table 1.

The factorial structure of the Italian YFAS was then assessed by means of Confirmatory Factor Analysis (CFA). The original model including also the item primers (item#17, item#18, item#23) was tested first. After evaluating their factor loadings, item primers were excluded from all following analyses and a refining approach was then used.

Table 1 Descriptive statistics of all Italian YFAS items

	Mean		SD		Skewness (SE)		Kurtosis (SE)	
	Original	Transformed	Original	Transformed	Original	Transformed	Original	Transformed
Item 1	1.81	0.02	0.941	0.124	−0.122 (0.152)	7.857 (0.152)	−0.587 (0.303)	60.209
Item 2	1.28	0.02	1.035	0.139	0.321 (0.152)	6.985 (0.152)	−0.626 (0.303)	47.159
Item 3	0.33	0.02	0.634	0.124	2.113 (0.152)	7.857 (0.152)	4.483 (0.303)	60.209
Item 4	1.04	0.03	1.218	0.174	0.783 (0.152)	5.420 (0.152)	−0.672 (0.303)	27.592
Item 5	0.79	0.04	0.851	0.203	0.958 (0.152)	4.534 (0.152)	0.520 (0.303)	18.704
Item 6	1.84	0.03	1.097	0.174	−0.226 (0.152)	5.420 (0.152)	−0.881 (0.303)	27.592
Item 7	0.59	0.04	0.889	0.203	1.466 (0.152)	4.534 (0.152)	1.540 (0.303)	18.704
Item 8	0.17	0.04	0.573	0.203	4.021 (0.152)	4.534 (0.152)	17.345 (0.303)	18.704
Item 9	0.20	0.02	0.568	0.124	3.235 (0.152)	7.857 (0.152)	10.542 (0.303)	60.209
Item 10	0.16	0.04	0.528	0.203	3.862 (0.152)	4.534 (0.152)	17.199 (0.303)	18.704
Item 11	0.14	0.04	0.547	0.194	4.574 (0.152)	4.786 (0.152)	21.997 (0.303)	21.073
Item 12	0.17	0.01	0.508	0.108	3.519 (0.152)	9.128 (0.152)	13.334 (0.303)	81.961
Item 13	0.55	0.05	0.884	0.220	1.777 (0.152)	4.116 (0.152)	2.839 (0.303)	15.062
Item 14	0.82	0.04	0.882	0.203	1.059 (0.152)	4.534 (0.152)	1.035 (0.303)	18.704
Item 15	0.53	0.05	0.907	0.220	1.872 (0.152)	4.116 (0.152)	3.117 (0.303)	15.062
Item 16	0.27	0.02	0.727	0.152	3.043 (0.152)	6.337 (0.152)	9.656 (0.303)	38.461
Item 17	0.21	0.21	0.409	0.409	1.425 (0.152)	1.425 (0.152)	0.032 (0.303)	0.032
Item 18	0.11	0.11	0.308	0.308	2.584 (0.152)	2.584 (0.152)	4.714 (0.303)	4.714
Item 19	0.14	0.14	0.344	0.344	2.127 (0.152)	2.127 (0.152)	2.545 (0.303)	2.545
Item 20	0.11	0.11	0.313	0.313	2.518 (0.152)	2.518 (0.152)	4.374 (0.303)	4.374
Item 21	0.15	0.15	0.360	0.360	1.946 (0.152)	1.946 (0.152)	1.802 (0.303)	1.802
Item 22	0.57	0.57	0.497	0.497	−0.270 (0.152)	−0.270 (0.152)	−1.943 (0.303)	−1.943
Item 23	0.71	0.71	0.452	0.452	−0.957 (0.152)	−0.957 (0.152)	−1.092 (0.303)	−1.092
Item 24	0.26	0.74	0.438	0.438	1.114 (0.152)	−1.114 (0.152)	−0.765 (0.303)	−0.765
Item 25	0.27	0.00	0.445	0.000	1.045 (0.152)	–	−0.915 (0.303)	–

Original original response scale, *transformed* dichotomization of the item as argued in Gearhardt et al. [4] and Meule and Gearhardt [5]

Given that several items showed high positive skewness and kurtosis values (see Table 1), the Robust Weighted Least Squares estimator (WLSMV) [38, 39] was used to estimate the models' parameters. Factor loadings were tested for statistical significance, while the models' fits to the data were assessed using the following fit indices: (a) the normed χ^2 (χ^2/degrees of freedom), (b) the Comparative Fit Index (CFI), (c) the Root Mean Square Error of Approximation (RMSEA) and (d) the Weight Root Mean square Residual (WRMR) [40]. The normed χ^2 is considered an easily, but never formally announced, computed measure of fit [41, 42], and a value of 3 or less is indicative of good fit for dichotomous items [43, 44]. CFI designates the amount of variance and covariance accounted for by the model compared to a baseline model without sample size dependence; values higher than 0.90 are considered good/adequate [45]. The RMSEA expresses fit per degrees of freedom of the model, with values less than 0.08 suggesting an acceptable model fit [45] and values less than 0.05 indicating a good fit [46]. The WRMR measures the (weighted) average differences between the sample and the estimated population variances and covariances; a cut-off value close to 1 is supposed to be good [38]. The factorial structure of the YFAS was further assessed with the seven dichotomous "symptoms" to confirm the conceptual model of food addiction.

Kuder–Richardson's alpha was used to measure the internal consistency of the YFAS with dichotomized items; values equal or higher than 0.7 are indicative of acceptable to high scale reliability [47].

The Pearson product-moment correlation coefficient was used to examine the intercorrelations between the YFAS symptom count and the hypothesized convergent measure. The strength of correlations was interpreted using the Cohen's benchmarks: <0.10, trivial; 0.10 to 0.30, small; 0.30 to 0.50, moderate; >0.50, large. In addition, the Chi square test was performed to assess the associations between the YFAS diagnostic score and the other measures' clinical thresholds.

Mplus 7.0 [38] was used to run all CFAs, while all the other statistical analyses were run with the SPSS software (version 20.0, SPSS Inc., Bologna, Italy).

Results

Sample characteristics

Participants' body mass index (BMI) ranged from 15.6 to 45.9 [mean = 21.65; SD = 3.06; Skewness = 2.5 (SE = 0.15); Kurtosis = 15.78 (SE = 0.31)]. In particular, 216 individuals (81.2%) had a BMI that fall into a normal weight range (from 18.5 to 24.9) according to the World Health Organization (WHO) BMI classification. Twenty-four participants (9.8%) were underweight (BMI < 18.5) and 25 (9.8%) were overweight (BMI > 25). For 3 individuals (1.2%), it was not possible to compute BMI, because they reported neither weight nor height. The sample BMI was compared with the WHO underweight and overweight cut-off criteria, and one sample's *t* test revealed that the study sample was neither underweight (BMI = 18.4; $t = 16.51$; $p < 0.001$) nor overweight (BMI = 25; $t = -17.45$; $p < 0.001$) on average.

Structural validity

The original model including item primers (Model 1) showed an almost acceptable fit to the data (see Table 2). Even if the Chi-square statistic resulted to be statistically significant [χ^2 (252) = 454.183; $p < 0.001$], the CFI was far from acceptability (CFI = 0.761) and the WRMR value was higher than the suggested cut-off (WRMR = 1.592), both the RMSEA [0.056; 90% CI 0.048–0.076; p(RMSEA < 0.05) < 0.116] and the normed χ^2 (1.802) were indicative of an adequate fit. As depicted in Table 2, all items' loadings were statistically significant (p values from 0.006 to < 0.001) and ranged from 0.201 (item #24) to 0.908 (item #9 and item#13) (mean = 0.652; SD = 0.161). Explained variances (R^2) varied from 0.041 (item #24) to 0.825 (item #13) (mean = 0.449; SD = 0.193).

However, Mplus warned that items #10 and item #11 were almost perfectly correlated ($r = 0.99$). An item parcel was thus created by combining item#10 and item#11 (this item parcel has a score of 1 when items #10 or #11 has a score of 1 and a score of 0 in all other cases). In addition, item#24 was discarded due to its very low factor loading (0.201).

A second single-factor model (model 2) including the item parcel "item#10/11" and excluding both the item primers and item#24 was thus specified and tested. The Chi square statistic resulted to be statistically significant [χ^2 (152) = 235.690, $p < 0.001$] and the CFI showed a marginal non-adequate fit (0.858). Also, the WRMR resulted to be higher than the suggested cut-off (1.236), while both the RMSEA [0.046; 90% CI 0.034–0.058; p (RMSEA < 0.05) < 0.689] and the normed χ^2 (1.556; < 3) were suggestive of a good fit. As reported in Table 2, all items' loadings were statistically significant (all p values < 0.001) and ranged from 0.404 (item #21) to 0.930 (item #9) (mean = 0.679; SD = 0.156). Explained variances (R^2) varied from 0.163 (item #21) to 0.865 (item #9) (mean = 0.485; SD = 0.209). Internal consistency was acceptable (Kuder–Richardson's alpha = 0.72). Model 2 was thus elected as the best structure for the Italian YFAS in this study and both the symptom counts and the diagnostic scores that were used in the following analyses were computed according to it.

The model including the seven diagnostic symptoms (Model 3) showed an adequate fit to the data. Even if the Chi square statistic was still statistically significant [χ^2 (20) = 41.911, $p = 0.003$], the RMSEA [0.065; 90% CI 0.037–0.093; p (RMSEA < 0.05) < 0.166], the CFI (0.946) and the normed χ^2 (2.09) revealed a good model fit. The WRMR resulted to be marginally higher than the suggested cut-off (1.132). As depicted in Table 2, all items' loadings were statistically significant (from $p = 0.049$ for criterion B to $p < 0.001$ for the other criteria) and ranged from 0.087 (criterion B) to 0.912 (criterion D) (mean = 0.679; SD = 0.156). Explained variance (R^2) varied from 0.008 (criteria B) to 0.832 (criteria D) (mean = 0.478; SD = 0.289).

Convergent validity

Statistically significant and moderate-to-large correlations were found between the 19-item YFAS symptom counts and the total scores of the BES ($r = 0.636$; $p < 0.001$), the EAT-26 ($r = 0.534$; $p < 0.001$) and the DEBQ ($r = 0.550$; $p < 0.001$). Also, the correlations with the subscales of all questionnaires resulted to be statistically significant (Table 3). Furthermore, the Chi square test showed statistically significant associations between the diagnostic scores and both the BES [χ^2 (1) = 32.079; $p < 0.001$] and the EAT-26 [χ^2 (1) = 13.866; $p < 0.001$] clinical thresholds (the DEBQ scales have no clinical cut-off).

Prevalence of FA symptoms and FA diagnosis according to the italian 19-item YFAS

The absolute number of FA symptoms that were met by study participants ranges from 0 to 7 (mean = 1.48; SD = 1.12; median = 1). The lowest endorsement rate is for "Substance taken in larger amount and for longer period than intended" (criteria A—4.7%), while the highest is for "Persistent desire or repeated unsuccessful attempts to quit" (criteria B—84.4%). The diagnostic threshold for FA was met by 4.3% of participants ($n = 11$). Three or more symptoms were endorsed by more participants ($n = 22$; 7.7%), but they did not met the clinical impairment criterion. Descriptive statistics are displayed in Table 4.

Table 2 Factor loadings, explained variances (R^2) and fit indexes of the three Italian YFAS models

	Model 1		Model 2		Model 3	
	Loadings	R^2	Loadings	R^2	Loadings	R^2
Criteria (A)					0.853	0.727
Item 1	0.503	0.253	0.539	0.291		
Item 2	0.645	0.416	0.663	0.440		
Item 3	0.433	0.187	0.436	0.190		
Criteria (B)					0.087	0.008
Item 4	0.599	0.358	0.637	0.406		
Item 22	0.722	0.521	0.440	0.194		
Item 24[a]	0.201	0.041	–	–		
Item 25[b]	–	–	–	–		
Criteria (C)					0.775	0.600
Item 5	0.555	0.308	0.652	0.425		
Item 6	0.671	0.450	0.761	0.579		
Item 7	0.473	0.223	0.597	0.357		
Criteria (D)					0.912	0.832
Item 8	0.767	0.588	0.830	0.689		
Item 9	0.908	0.824	0.930	0.865		
Item 10[c]	0.646	0.417	–	–		
Item 11[c]	0.658	0.433	–	–		
Item 10/11[c]	–	–	0.651	0.424		
Criteria (E)					0.438	0.192
Item 19	0.770	0.592	0.770	0.593		
Criteria (F)					0.630	0.397
Item 20	0.699	0.489	0.720	0.519		
Item 21	0.458	0.210	0.404	0.163		
Criteria (G)					0.849	0.722
Item 12	0.681	0.464	0.854	0.730		
Item 13	0.908	0.825	0.906	0.821		
Item 14	0.809	0.654	0.814	0.663		
Criteria (H)					0.591	0.349
Item 15	0.702	0.492	0.566	0.320		
Item 16	0.704	0.496	0.740	0.547		
Item primers[d]					–	–
Item 17 [d]	0.819	0.671	–	–		
Item 18 [d]	0.587	0.345	–	–		
Item 23[d]	0.736	0.541	–	–		
χ^2 (*df*)	χ^2 (252) = 454.183*		χ^2 (152) = 235.690*		χ^2 (20) = 41.911**	
χ^2/df	1.802; < 2		1.551; < 2		2.09; < 3	
RMSEA (90% CI)	0.056 (0.048/0.064)		0.046 (0.034/0.058)		0.065 (0.037/0.093)	
p(RMSEA ≤ 0.05)	$p = 0.116$		$p = 0.689$		$p = 0.166$	
CFI	0.761		0.858		0.946	
WRMR	1.592		1.236		1.132	

*Significant for $p < 0.001$; **Significant for $p = 0.003$

[a]Item #24 has been excluded after Model 1 and because of its starting low estimate standardized factor loading

[b]Item #25 was excluded from CFA because of its zero variance (see Table 1)

[c]Due to an almost perfect correlation between item #10 and #11 ($r = 0.99$) we created a new item parcel from these items

[d]Item primer—not scored in the final model

Table 3 Means, standard deviations and correlations between the Italian 19-item YFAS symptom count and the BES, the EAT26 and the DEBQ scales and subscales

	M	SD	YFAS
YFAS	1.54	1.24	–
BES Total Score	8.57	6.13	0.636
Cognitions/feelings	3.43	2.92	0.628
Behaviors	5.14	3.65	0.565
EAT.26 total ccore	11.22	8.15	0.534
Dieting	5.46	5.83	0.512
Bulimia	3.74	1.62	0.540
Oral control	2.02	2.45	0.200
DEBQ total score	0.78	0.48	0.550
Restrained eating	0.82	0.69	0.368
Emotional eating	0.57	0.63	0.518
External eating	1.02	0.53	0.360

All correlations are significant at $p < 0.001$

Discussion

The present study is the first to examine the factorial structure, internal consistency and convergent validity of the Italian version of the YFAS [48] in a multisite sample of postgraduate university students.

Only four previous studies assessed the psychometric properties of the YFAS in non-clinical samples. All of them are first validations of the original [4], German [18], French [20] and Chinese [22] versions. Three out of them used an exploratory approach to assess the YFAS factorial structure [4, 18, 20] and found support for a single-factor solution. Both Gearhardt et al. [4] and Brunault et al. [20] discarded item#24 (I have been successful at cutting down or not eating these kinds of food), because of its low factor loading, while Meule et al. [18] decided to retain it and also item#11 despite their factor loadings resulted to be low as well. Item primers were not included in any factor analysis and only the study of Gearhardt et al. [4] excluded the clinical significance questions.

Only Chen et al. [22] used a confirmatory approach and found that the full-length Chinese YFAS (with the exception of item primers) did not fit their data. Fit indexes did not improve even after removing item#24 due to its non-significant explained variance. They removed also item #22 and item#25, because of their low R^2 values and the resulting single-factor model showed a better fit to the data. Also, the model including the diagnostic symptoms was tested and showed the best fit indexes [22].

A confirmatory approach was applied also in the present study. The first model (Model 1) included all items (item#25 was excluded a priori due to its zero variance) and was specified to evaluate the factor loadings of the item primers, which resulted to be medium-to-high. The following model (Model 2) was redefined by excluding the item primers and also item#24 due to its low factor loading, and by including an item parcel combining item#10 and item#11 because of their almost perfect correlation. The last model (Model 3) was specified on the basis of Model 2 but using the seven diagnostic symptoms.

Results showed that Model 2 was the most supported by the CFA fit indexes, which resulted to be acceptable also for Model 3. Item#22 did not show to be problematic as occurred in Chen et al.'s study [22] and a further difference with their model is the parceling of item#10 and item#11. These discrepancies could be due to the cultural and ethnic differences between the two samples, and also to the significant differences in age and BMI. In fact, Chen et al.'s sample had a significantly lower mean age (16.47 vs. 23.8; $p < 0.001$) and the overlap between age ranges is very small (14–19 vs. 18–53). Chen et al.'s sample had also a significantly lower BMI (19.87 vs. 21.65 vs.; $p < 0.001$).

The internal consistency of the Italian 19-item YFAS resulted to be acceptable and all the correlations/associations with the convergent measures, i.e., BES, EAT-26 and

Table 4 Endorsement rates for the Italian 19-item YFAS "symptoms"

Symptom criteria		NOT met symptom criterion	Met symptom criterion
(A)	Substance taken in larger amount and for longer period than intended	244 (95.3%)	12 (4.7%)
(B)	Persistent desire or repeated unsuccessful attempts to quit	40 (15.6%)	216 (84.4%)
(C)	Much time/activity to obtain, use, recover	233 (91.0%)	23 (9.0%)
(D)	Important social, occupational, or recreational activities given up or reduced	236 (92.2%)	20 (7.8%)
(E)	Use continues despite knowledge of adverse consequences (e.g., failure to fulfill role obligation, use when physically hazardous)	221 (86.3%)	35 (13.7%)
(F)	Tolerance (marked increase in amount; marked decrease in effect)	202 (78.9%)	54 (21.1%)
(G)	Characteristic withdrawal symptoms; substance taken to relieve withdrawal	238 (93.0%)	18 (7.0%)
(H)	Use causes clinically significant impairment or distress	240 (93.8%)	16 (6.3%)

DEBQ, were statistically significant and moderate-to-high. This last result is consistent with the first study of Gearhardt et al. [4], who found a significant correlation with the EAT-26, the study of Chen et al. [22], who found very similar correlations with the BES and the EAT-26, and also with the study of Brunault et al. [20], who found a comparable non-parametric correlation with the BES.

According to the Italian 19-item YFAS diagnostic scores, 4.3% of the study participants received a FA diagnosis, which is lower than the prevalence rates found in the other studies on non-clinical samples. Indeed, the prevalence rate was 11.4% in the study of Gearhardt et al. [4], 9.2% in the study of Chen et al. [22], 8.8% in the study of Meule et al. [18] and 8.7% in the study of Brunault et al. [20]. This difference may depend not only on the peculiar characteristics of the different samples, but may also be due to the different measurement models that were used to compute the YFAS scores.

One important limitation of this study is that some psychometric properties, such as test–retest reliability, discriminant validity and criterion validity, were not assessed. One further limitation is that females are over-represented in the study sample. This prevents the generalization of findings to males and prevented also the assessment of a measurement property that has not been yet assessed in any previous study, that is the YFAS measurement invariance between males and females.

In conclusion, even though a second edition of the YFAS (YFAS 2.0) was recently created in response to the new DSM-5 diagnostic criteria for substance use disorders [49] and its Italian version has been already developed [50], the overlap with the previous DSM-IV criteria [5, 6] enables the Italian 19-item YFAS to be still used for screening purposes both in community health practice and research. For example, it can be applied to the detection of post-graduate university students with FA symptoms to offer them a psychological consultation at the university health center or to address them to an external eating disorders facility. It could also be used as a diagnostic and continuous outcome measure in both clinical practice and clinical research, but only in combination with a clinical interview. Indeed, no study has yet assessed its responsiveness to change and results could thus be misleading.

Compliance with ethical standards

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all participants included in the study prior to accessing the survey.

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Affiliations

Gian Mauro Manzoni[1,2] · Alessandro Rossi[1,4] · Giada Pietrabissa[1,3] · Giorgia Varallo[1] · Enrico Molinari[1,3] · Eleonora Poggiogalle[5] · Lorenzo Maria Donini[5] · Giulietta Tarrini[6] · Nazario Melchionda[6] · Carla Piccione[7] · Giovanni Gravina[8] · Gianluigi Luxardi[9] · Emilia Manzato[10] · Romana Schumann[11] · Marco Innamorati[12] · Claudio Imperatori[12] · Mariantonietta Fabbricatore[12] · Gianluca Castelnuovo[1,3]

1 Istituto Auxologico Italiano IRCCS, Psychology Research Laboratory, Via Luigi Cadorna, 90, Piancavallo, Oggebbio, VCO, Italy

2 Faculty of Psychology, eCampus University, Novedrate, Como, Italy

3 Department of Psychology, Catholic University, Milan, Italy

4 Interdepartmental Center for Family Research, Department of Philosophy, Sociology, Education, and Applied Psychology, Section of Applied Psychology, University of Padova, Padua, Italy

5 Department of Experimental Medicine, Sapienza University, Rome, Italy

6 Department of Internal Medicine, University Alma mater, Bologna, Italy

7 Center for Eating Disorders, S. Rossore Clinic, Pisa, Italy

8 Center for Eating Disorders, ASL Tuscany Nord West, Pisa, Italy

9 Center for Eating Disorders, ASL5 West Friuli, Pordenone, Italy

10 Eating and Weight Disorders Centre, Private Hospital Salus, Ferrara, Italy

11 Gruber Center for Eating Disorders, Bologna, Italy

12 Department of Human Sciences, European University of Rome, Rome, Italy