Addiction & Health

https://ahj.kmu.ac.ir
10.22122/ahj.2022.196410.1283
Vol. 14, No. 3, 2022, 175-184

Original Article

Validation and Psychological Properties of the Persian Version of DSM 5 Yale Food Addiction Scale 2.0 (PYFAS 2.0) in Non-clinical Population

Mohammad Niroumand Sarvandani[1], Masoud Asadi[2], Farideh Khosravi[3], Ashley N. Gearhardt[4], Mohammadsadegh Razmhosseini[5], Maryam Soleimani[6], Fahimeh Mohseni[7], Behzad Garmabi[8], Raheleh Rafaiee[9*]

[1]Student Research Committee, School of Medicine, Shahroud University of Medical Sciences, Shahroud, Iran
[2]Department of Psychology and Educational Sciences, Faculty of Humanities, Arak University, Arak, Iran
[3]Student Research Committee, School of Health, Mashhad University of Medical Sciences, Mashhad, Iran
[4]Department of Psychology, University of Michigan, Ann Arbor, Michigan, United States
[5]Department of Clinical Psychology, Faculty of Psychology and Education, Kharazmi University, Tehran, Iran
[6]Department of Psychology and Counseling, Faculty of Humanities, University of Hormozgan, Bandar Abbas, Iran
[7]Center for Health Related Social and Behavioral Sciences Research, Shahroud University of Medical Sciences, Shahroud, Iran
[8]Study and Treatment of Circadian Rhythms Research Center, Shahroud University of Medical Sciences, Shahroud, Iran
[9]Department of Neuroscience, School of Advanced Technologies in Medicine, Mazandaran University of Medical Sciences, Sari, Iran

Abstract

Background: The Yale Food Addiction Scale version 2.0 (YFAS 2.0) is used for the assessment of food addiction (FA). This research intended to evaluate the validity of the Persian translation of the questionnaire and to investigate the psychological properties and the association between FA and anthropometric indices.

Methods: In a sample of 473 nonclinical participants, FA, binge eating, and objectively measured anthropometric indices were assessed. Internal consistency, convergent, and validity of the PYFAS 2.0 were examined. Also, the factor structure (confirmatory factor analysis following the 11 diagnostic indicators in addition to the significant distress) and the construct of the scale were evaluated.

Findings: The frequencies of mild, moderate, and severe FA based on PYFAS 2.0 were 0.2%, 10%, and 5.5%, respectively. The findings supported a one-factor structure. The confirmatory factor analysis revealed a good construct validity (RMSEA = 0.043, $\chi^2 = 76.38$, df = 41, χ^2 (CMIN)/df = 1.862, GFI = 0.975, AGFI = 0.957, IFI = 0.986, RFI = 0.958, ECVI = 0.319, TLI = 0.978). For both the diagnostic and symptom count versions, the PYFAS 2.0 presented acceptable internal consistency (IC) (Kuder-Richardson 20 = 0.99 and McDonald omega = 0.91).

Conclusion: The PYFAS 2.0 was a psychometrically sound instrument in an Iranian non-clinical population. This questionnaire can be used to study FA in Persian non-clinical populations. Future research should study the psychometric characteristics of this scale in high-risk groups.

Keywords: Food addiction, Binge eating, Obesity, Validation, Psychological properties

Citation: Niroumand Sarvandani M, Asadi M, Khosravi F, Gearhardt AN, Razmhosseini M, Soleimani M, et al. Validation and psychological properties of the persian version of dsm 5 yale food addiction scale 2.0 (Pyfas 2.0) In non-clinical population. *Addict Health*. 2022;14(3):175-184. doi:10.22122/ahj.2022.196410.1283

Received: July 11, 2021, **Accepted**: June 26, 2022, **ePublished**: July 29, 2022

Introduction

Food addiction (FA) is certainly not a groundbreaking idea that arose as of late. Scientists have been pondering this question for decades that can people be dependent on certain foods.[1] But the global pandemic of obesity and psychological and physical problems, as well as the economic pressures that it has brought to societies have led researchers to pay more attention to this concept over the past 20 years.[2] With increasing clarification of the causes, consequences, and mechanisms of obesity, patterns of similar mechanisms of addictive disorders and excessive food consumption emerged and attracted the attention of researchers in the fields of basic and behavioral sciences.[3-5]

Studies at the cellular and molecular levels show that the behavioral changes induced by FA are comparable to those induced by addictive drugs.[6] In addition, the results of some studies show that highly palatable foods have a higher reinforcing value than drugs.[7] Investigations on animals revealed that palatable foods can surpass the rewards of drug even in drug-addicted rats. Increased consumption of foods may even reduce the self-drug

***Corresponding Author:** Raheleh Rafaiee, Department of Neuroscience, School of Advanced Technologies in Medicine, Mazandaran University of Medical Sciences, Sari, Iran. Email: rahelerafaie@gmail.com

administration.[8,9] Many laboratory studies have presented cases of plasticity in the reward system after access to highly palatable foods.[10] Neurobehavioral alterations following eating palatable food have been compared to those seen after drug use. Some researchers have proposed that deregulation of eating may be comparable to addiction.[11,12]

The negative consequences of excessive consumption of palatable foods, such as obesity,[13] hypertension,[14] cardiovascular disease,[15] and type II diabetes,[16,17] has raised major concerns in the health policymaking of different countries.[18] This has also led to the concept of FA as to be a potential explanatory factor for excess consumption of highly palatable foods.[19] To provide a study to invested FA in humans, the Yale Food Addiction Scale (YFAS) has been originally designed by Gearhardt in 2009. The original YFAS applies the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR) of substance dependence to apply to excess consumption of highly palatable foods.[20] This scale was rapidly translated into other languages and made available to researchers and therapists in several countries. The YFAS 2.0 has been translated into German,[21] French,[22] Italian,[23] Turkish,[24] Spanish,[25] Korean,[26] Arabic,[27] Japanese,[28] and Malay languages.[29] In 2016, the YFAS 2.0 was newly created to coincide with the substance-related and addictive disorders indicator in DSM-5 to evaluate repeated patterns of addictive eating, which leads to clinically notable distress. This scale assesses main presentations like loss of control, longing, withdrawal, and toleration. To keep coherence with the DSM-5 model, substance addiction and dependence indicators were integrated, and a continuum of severity of diagnosis was included.[30]

The present research intended to evaluate the psychometric characteristics of the Persian translation of YFAS 2.0 (PYFAS 2.0) in a sample of normal people using the factor structure (confirmatory factor analysis, CFA), internal consistency (IC), and construct validity. It was also aimed to determine the association of anthropometric indices with FA and to identify the most important factors affecting FA using structural equation modeling (SEM).

Methods

In the present cross-sectional research, data were collected using a paper-based questionnaire survey with anthropometric measurements. After the study was ethically approved, data were collected from September 2017 to March 2018. This study was performed by available sampling method. The data collection centers were selected in health centers in some areas of Shahroud, where the volunteers were assessed. All Persian-language-speaking participants with a minimum age of 18 years who were willing to participate in the study, were included. Fifteen participants were excluded because of incomplete information recording.

Regarding the appropriate sample size when conducting a factor analysis, an exact minimum sample size cannot be easily calculated analytically, and it is believed that a larger sample size is better for the accuracy and stability of the solutions. In the literature, the suggested sample size required to conduct a factor analysis varies considerably, and the ratio of measured variables to subjects ranges from large ratios of 1:10 to 1:2. In the experience of experts, a sample size of 300 is considered good, 500 is considered very good, and 1000 or more is considered excellent.[31] According to the various recommended sample sizes for conducting factor analysis, the sample size of the present study was considered appropriate (n = 473).

In order to collect data and anthropometric indices, four senior nursing students, who were enrolled for student work, were trained by an anatomist in the correct methods of measuring anthropometric indices. They performed the measurements in the centers, and some of the collected data were randomly double-checked by the anatomist for assurance.

PYFAS 2.0

The PYFAS 2.0 contains 35 items intended to evaluate the eating behaviors during the past year. Each item of the scale was rated based on an 8-point Likert scale ranging from zero (not at all) to seven (always). This scale contains the dimension of clinical impairment/discomfort, as well as 11 diagnostic indicators: (1) food consumption higher than the defined threshold; (2) continuous temptation or frequently failed efforts to stop consuming food; (3) consume significant time or activity taking or consuming food or improving food habits; (4) renounce or decreasing major social, professional, or recreational functions related to food consumption; (5) persistent food consumption in spite of understanding unfavorable outcomes; (6) increasing toleration; (7) withdrawal presentations; (8) persistent eating in spite of interpersonal or social problems; (9) failing in performing important function responsibilities due to eating habits (unsuccessful adaptation with obligations); (10) craving even in stressful situations; and (11) powerful desire for particular foods (craving). Each criterion is dichotomously scored according to a threshold established using the YFAS 2.0 validation article. Two techniques are developed for scoring YFAS 2.0: Diagnostic threshold (when at least two signs are observed, FA is diagnosed, in addition to important dysfunction or discomfort) and symptom count (frequency of FA signs during the past year, scoring from 0 to 11). FA is mild if two or three signs plus clinically important dysfunction/discomfort, moderate if four or five signs plus significant dysfunction/discomfort, and severe if six or more signs plus considerable dysfunction/discomfort are observed.[30]

The translated Persian version of YFAS 2.0 was in

accordance with the International Test Commission Guidelines for translating and adapting test. Two out of three translators were qualified specialists in psychiatry, psychology, and addiction, and the other one was qualified in nutrition sciences. All translators were native Persian speakers. Next, an expert panel consisting of two epidemiologists, one specialist in addiction studies, one specialist in social medicine, one psychiatrist, and one nutritionist, was formed. All three versions translated by the translators were discussed in this panel. Finally, after six sessions, the necessary corrections were made, and the final translation was designed to be comprehensible, fluent, and translucent with cross-cultural features. The entire research team confirmed the final version. In a blind-backward process, the translated scale was back-translated into English by a translator, who was not familiar with YFAS 2.0. The back-translated version was sent to a native English speaker, who was a Ph.D. student in English literature, as well as a questionnaire designer to compare the translations. Both confirmed the translation after correcting two minor problems. Eventually, the translated scale was piloted on a sample comprised of 10 participants to ensure that the scale instructions were understandable to the participants.[32]

Variables for convergent and discriminant validity

Binge Eating Scale (BES)

It comprises 16 questions designed to evaluate the intensity of binge eating according to behavioral, affective, and cognitive signs (cutoff=18). Its total score ranges from 0 to 46 and the higher the score, the more will be the tendency to binge eating.[33] The IC of the Persian version of the BES was very acceptable ($\alpha = 0.85$).[34]

Physical anthropometric measurements

Anthropometric criteria are a set of quantitative indicators to evaluate the body composition. The main anthropometric components include height, weight, body mass index (BMI), and body circumferences. Height, weight, minimum waist circumference (WC), abdominal circumference (AC), hip circumference, and neck circumference (NC) were estimated using standard techniques. In summary, all sizes were taken barefooted with minimum clothes. When measuring height, the individuals were requested to stand on a plane surface with the head in the Frankfort horizontal level. Weight was measured while the participant stood still over the center of the scale with bodyweight distributed between the feet. Waist circumference was measured at two anatomical sites: At the highest anterior extension of the abdomen (AC) and at the natural waist (defined as the smallest area of the trunk, named MWC).

Hip circumference and NC were measured at the level of the maximum extension of the hip and at the midline of the neck, respectively. In men with laryngeal prominence (Adam's apple), the NC was measured just below the prominence. In general, the NC is a useful primary screening instrument for overweight/obese individuals. In men and women, NC ≥ 35.5 cm was used and an NC ≥ 32 cm was examined as the cut-off points for overweight/obesity.

Statistical Analyses

CFA was used to assess the single-factor structure for the PYFAS 2.0 diagnostic criteria. Clinically significant impairments/loadings were not considered in this CFA analysis. Numerous fit criteria contain various dimensions of fit.[35,36] The Chi-square test was used to assess the fit of the model. Besides, degrees of freedom ratio ($\chi 2$/df), $\chi 2$(CMIN)/df, the root mean square error (RMSE) of approximation (RMSEA), the goodness of fit index (GFI), adjusted goodness of fit index (AGFI), incremental fit index (IFI), normed fit index (NFI), relative fit index (RFI), Tucker–Lewis index (TLI), and the expected cross-validation index (ECVI) were used as incremental fit criteria to estimate enhancements compared to the competing models. To evaluate the reliability, the IC of the 11 PYFAS 2.0 was estimated with Kuder-Richardson alpha (KR-20)[37] and McDonald's omega.[38] Convergent and discriminant validity were evaluated using the chi-square test, independent *t* test, and analysis of variance (ANOVA).

The chi-square test was used to evaluate the association of categorical variables including BMI, other anthropometric variables, and binge eating with PYFAS. The effect size was measured using following formulas for Cramér's V and eta squared (η^2) and $df^* = \min(r - 1, c - 1)$, and n is the total number of observation.

$$v = \sqrt{\frac{x^2}{n \cdot df^*}}, \quad \eta^2 = SS_{effect} / SS_{effect} + SS_{error}$$

Data were analyzed by SPSS version 25.0.[39,40] In addition, Microsoft Excel was used to calculate the reliability coefficient of Kuder–Richardson (KR-20) alpha and JASP: Graphical Statistical Software for Common Statistical Designs[41] to calculate McDonald's omega.

Results

Participant's information

Four hundred seventy-three subjects were included in the factor analysis. Most of the subjects were women (59%, n = 279). The mean age (standard deviation) was 29.21 (10.5) years. 54% were single, and 44% were married (Table 1). In addition, 55% of them had a normal BMI (i.e., 18.5-24.9 kg/m^2). Moreover, 95% had no history of physical diseases and 13% had history of smoking. There was no addicted member in 88% of the subjects' families.

PYFAS 2.0-diagnosed FA prevalence

As shown in Table 1, a total of 39 (approximately 6.2%) participants were classified as FA (15 males and 15

Table 1. Descriptive statistics of the total sample and comparative evaluation of the participants with the absence/presence of PYFAS 2.0-diagnosed FA

Characteristics	Overall sample (N = 473)	FA absent (n = 443)	FA present (n = 30)	Statistical test	*P* value
Age (y), mean ± SD	29.21 (± 10.5)	29 (± 10.2)	30.7 (± 13.8)	T = 0.859	0.391
Gender, No. (%)					
Male	194 (41)	179 (40)	15 (50)	$\chi^2 = 1.07$	0.340
Female	279 (59)	264 (60)	15 (50)		
Year of education, No. (%)					
1-10	72 (15)	64 (14)	8 (27)	$\chi^2 = 10.44$	0.015*
11-15	208 (44)	203 (46)	5 (17)		
16-20	27 (6)	24 (5)	3 (10)		
21-24	166 (35)	152 (34)	14 (47)		
Marital status, No. (%)					
Married	207 (44)	193 (44)	14 (47)	$\chi^2 = 0.743$	0.863
Single	256 (54)	240 (54)	16 (53)		
Divorced	8 (2)	8 (2)	0 (0)		
Widow	2 (0)	2 (0)	0 (0)		
Disease history, No. (%)					
No	447 (95)	419 (95)	28 (93)	$\chi^2 = 0.084$	0.676
Yes	26 (5)	24 (5)	2 (7)		
Smoking status, No. (%)					
Yes	61 (13)	53 (12)	8 (27)	$\chi^2 = 5.40$	0.042
No	412 (87)	390 (88)	22 (73)		
Family addiction, No. (%)					
No	416 (88)	390 (88)	26 (87)	$\chi^2 = 1.050$	0.773
Yes	57 (12)	53 (12)	4 (13)		
BES, No. (%)					
Non-binging	366 (77)	341 (77)	25 (83)	$\chi 2 = 1.10$	0.576
Moderate binging	80 (17)	77 (17)	3 (10)		
Severe binging	27 (6)	25 (6)	2 (7)		
Current BMI (kg/m^2), No. (%)					
16.0-16.90	11 (2)	10 (2)	1 (3)	$\chi^2 = 8.92$	0.112
17.0-18.40	35 (7)	30 (7)	5 (17)		
18.50-22.90	174 (37)	168 (38)	6 (20)		
23.0-24.90	89 (19)	80 (18)	9 (30)		
25.0-29.90	134 (28)	126 (28)	8 (27)		
30 and above	30 (6)	29 (7)	1 (3)		
Anthropometric parameters, mean ± SD					
Neck circumference	37.2 (± 6.5)	37.1 (± 6.2)	38 (± 10.5)	T = 0.707	0.480
Abdominal	86.1 (± 13.7)	86 (± 13.6)	87.5 (± 14.8)	T = 0.582	0.561
Hip circumference	98.7 (± 13)	98.7 (± 12.9)	98 (± 13.7)	T = 0.272	0.786
Waist circumference	81.8 (± 12.7)	82 (± 12.6)	79.4 (± 15)	T = 1.05	0.292
PYFAS 2.0-diagnosed FA, No. (%)					
No FA	443 (94)	443 (100)	0 (0)	$\chi^2 = 473$	< 0.001
Mild FA	1 (0.22)	0 (0)	1 (0.2)		
Moderate FA	3 (1)	0 (0)	3 (0.6)		
Severe FA	26 (5)	0 (0)	26 (5.5)		

BMI, body mass index; FA, food addiction; BES, Binge Eating Scale; SD, standard deviation.
Participants were compared with and without food addiction using parametric mean comparison tests (independent *t* test) and chi-square tests.
*Significant $P < 0.05$

females): 1 (0.2%) received a mild (0 males and 1 female), 3 (10%) received a moderate (1 male and 2 females), and 26 (5.5%) received a severe (14 males and 12 females) FA diagnosis by PYFAS 2.0.

Confirmatory factor analysis and internal consistency

The symptom count component of the translated Persian YFAS 2.0 scale was first assessed using exploratory factor analysis, followed by SEM. The two-factor model had acceptable fit indices ($\chi2 = 76.54$, df (degrees of freedom) = 46; $\chi2$(CMIN)/df = 1.66, $P = 0.003$; comparative fit index (CFI) = 0.988; IFI = 0.988; RMSE of the approximation (RMSEA = 0.038 (0.022–0.052); ECVI = 0.298; TLI = 0.983), but because most factor loadings of the second factor were negative and lower than 0.40, the one-factor solution was adopted.

CFA was used to evaluate the factorial structure of PYFAS 2.0. One-factor model was significant with the following goodness of fit indicators: $\chi2 = 76.38$, df = 41; $\chi2$ (CMIN)/df = 1.862; CFI = 0.986; GFI = 0.975; AGFI = 0.957; IFI = 0.986; RFI = 0.958; RMSEA = 0.043; ECVI = 0.319; and TLI = 0.978. Significant outputs of the χ^2 test show that the model with a lower χ^2 has a higher fit. Nevertheless, similar to the likelihood ratio, this test also has some limitations, in a way that, sizable samples with insignificant differences provide significant results.[42] Therefore, the χ^2 difference test was only applied to find significant enhancements.

Although there are discrepancies, a χ^2/df ratio of < 3 demonstrates acceptable fit,[43] a RMSEA ≤ 0.06, respectively indicates acceptable fit,[44] and RMSEA ranging from 0.08 and 0.10 demonstrates normal fit, and RMSEA above 0.10 reveals weak fit.[45,46] TLI ≥ 0.90 and CFI ≥ 0.90 are considered acceptable.[44,45,47] The lower the ECVI, the better would be the fit[48])GFI > 0.90,[49] NFI > 0.90, CFI > 0.95(.[44] All diagnostic criteria had factor loadings higher than 0.50 (Table 2). The IC of PYFAS 2.0 was acceptable (KR-20 = 0.99, McDonald omega = 0.91). Moreover, Cronbach's alpha of the Persian version of the BES was obtained 0.87, which is very good.

Analyzing items

The items with the smallest factor loadings also have the lowest item–total correlation (Table 3). In the present study, except for item 7, the rest of the items had a correlation higher than 0.30.

Convergent and discriminant validity

For convergent validity, a significant correlation between current BMI, anthropometric parameters, and BES with the PYFAS was not found. The effect size was small-Cramér's V for the correlation between BMI, anthropometric parameters and BES and the PYFAS 2.0 (Table 4). For convergent validity, current BMI, anthropometric parameters (except WC), and BES were not significantly correlated with the presence of PYFAS2.0-diagnosed FA. The effect size was small-η2 for the correlation among BMI, anthropometric parameters, and BES and the PYFAS 2.0 (Table 5). There was no significant association between the BES and PYFAS 2.0-diagnosed FA (Table 6).

Table 2. Factor loadings for the multiple-factor structure of the Persian Yale Food Addiction Scale 2.0 (PYFAS 2.0)

Diagnostic criteria	Met criteria	Did not meet criteria	Factor loading [a]
Criterion 1: Consumed more than intended	19 (63)	44 (10)	0.561*
Criterion 2: Unable to cut down or stop	17 (57)	46 (10)	0.583*
Criterion 3: Great deal of time spent	16 (53)	35 (8)	0.563*
Criterion 4: Important activities given up	28 (93)	125 (28)	0.614*
Criterion 5: Use despite physical/ emotional consequences	19 (63)	38 (9)	0.678*
Criterion 6: Tolerance	16 (53)	32 (7)	0.604*
Criterion 7: Withdrawal	27 (90)	59 (13)	0.781*
Criterion 8: Use despite interpersonal/ social problems	27 (90)	122 (28)	0.646*
Criterion 9: Failure in role obligation	22 (73)	93 (21)	0.580*
Criterion 10: Use in physically hazardous situations	27 (90)	88 (20)	0.680*
Criterion 11: Craving	17 (57)	37 (8)	0.687*
Criterion 12: Impairment/distress	30 (100)	0 (0)	0.588*

Data are presented as number (%)
* $P < 0.001$, [a] P value calculated with confirmatory factor analysis.

Discussion

The present research aimed to measure the psychometric characteristics of PYFAS 2.0 and to evaluate its reliability and construct validity in a sample comprised of health subjects. The findings indicated an acceptable IC and good construct validity in the presence of PYFAS 2.0-diagnosed FA. Six percent of participants in this study had FA, which is comparable to the results of studies conducted on Italian (5.7%),[50] French (8.7%),[22] Danish (9.0%),[51] German (10%),[52] Malay (10.4%),[29] Arabic (11%),[27] Spanish (3.3%),[25] and Japanese (3.3%) people.[28] It should be noted that most of these studies were done with available sampling; estimates of prevalence should be interpreted with caution.

Based on the findings, it can be argued that a sole factor solution for the PYFAS 2.0 provides the best goodness-of-fit in CFA. It was also found sufficient IC and a single-factor solution for the PYFAS in the CFA. The optimal sole factor structure was obtained after removing item number seven, which was included in the "Great deal of time spent" criterion. The findings of this study showed CFI = 0.986, RMSEA = 0.043, and all diagnostic criteria had factor loadings higher than 0.50. In similar studies, Brunault et al reported the psychometric characteristics of the French version of the YFAS 2.0 (CFI = 0.887, RMSEA = 0.083).[22] In

Table 3. Item statistics for the Persian Yale Food Addiction Scale 2.0 (PYFAS 2.0) (N = 473)

Criteria and Items of the PYFAS 2.0	Mean	SD	Item–total correlation	If Item Dropped	
				McDonald's ω	Cronbach's α
Criterion 1: Consumed more than intended					
Item 1	0.05	0.22	0.34	0.93	0.93
Item 2	0.05	0.22	0.38	0.93	0.93
Item 3	0.09	0.29	0.53	0.93	0.93
Criterion 2: Unable to cut down or stop					
Item 4	0.06	0.24	0.36	0.93	0.93
Item 25	0.05	0.22	0.38	0.93	0.93
Item 31	0.05	0.22	0.42	0.93	0.93
Item 32	0.05	0.21	0.46	0.93	0.93
Criterion 3: Great deal of time spent					
Item 5	0.07	0.25	0.50	0.93	0.93
Item 6	0.05	0.23	0.44	0.93	0.93
Item 7	0.03	0.16	0.21	0.93	0.93
Criterion 4: Important activities given up					
Item 8	0.15	0.36	0.57	0.93	0.93
Item 10	0.22	0.42	0.64	0.93	0.93
Item 18	0.15	0.36	0.56	0.93	0.93
Item 20	0.12	0.33	0.55	0.93	0.93
Criterion 5: Use despite physical/emotional consequences					
Item 22	0.10	0.30	0.56	0.93	0.93
Item 23	0.06	0.24	0.52	0.93	0.93
Criterion 6: Tolerance					
Item 24	0.07	0.26	0.52	0.93	0.93
Item 26	0.06	0.24	0.47	0.93	0.93
Criterion 7: Withdrawal					
Item 11	0.08	0.28	0.60	0.93	0.93
Item 12	0.07	0.26	0.58	0.93	0.93
Item 13	0.10	0.30	0.63	0.93	0.93
Item 14	0.09	0.29	0.60	0.93	0.93
Item 15	0.04	0.21	0.42	0.93	0.93
Criterion 8: Use despite interpersonal/social problems					
Item 9	0.21	0.41	0.61	0.93	0.93
Item 21	0.09	0.28	0.52	0.93	0.93
Item 35	0.22	0.41	0.61	0.93	0.93
Criterion 9: Failure in role obligation					
Item 19	0.12	0.33	0.42	0.93	0.93
Item 27	0.20	0.40	0.64	0.93	0.93
Criterion 10: Use in physically hazardous situations					
Item 28	0.09	0.29	0.55	0.93	0.93
Item 33	0.18	0.39	0.70	0.93	0.93
Item 34	0.15	0.35	0.66	0.93	0.93
Criterion 11: Craving					
Item 29	0.09	0.29	0.66	0.93	0.93
Item 30	0.07	0.26	0.59	0.93	0.93
Criterion 12: Impairment/distress					
Item 16	0.05	0.21	0.48	0.93	0.93
Item 17	0.04	0.19	0.42	0.93	0.93

their study, all factor loadings were higher than 0.32. Khine et al reported Japanese version of YFAS 2.0 (CFI = 0.904, RMSEA = 0.065) that the diagnostic criteria (except one) had the minimum factor loadings of 0.41.[28]

The association between the BES and YFAS 2.0 scores was not significant, and the inconsistent findings may be due to selective reporting of significance and positive results to publish and avoid reporting non-significant findings in published studies. Regarding the convergent validity, it was not found a significant relationship between current BMI and anthropometric parameters (other than WC) and PYFAS and symptom count, which might not be consistent with the theory of a non-linear association between FA and BMI. In Italian[50] and Spanish[25] validation studies of the YFAS 2.0, it was reported that FA is considerably associated with BMI. In the present study, the core anthropometric elements like height, weight, BMI, and body circumferences were examined based on the standard methods by a trained assistant researcher, and this can be regarded as one of the strengths of the present research. However, some similar studies have obtained such information via self-report. This issue also can be related to the small share of obese participants in this study, which means a lower range for BMI, which has faded the association with PYFAS 2.0. The result of the present study is consistent with the result of the Japanese (J-YFAS 2.0) study of validation of the YFAS 2.0.[28]

Previous research has indicated a higher prevalence of FA among women than men in non-clinical populations.[53] However, the results of this study do not confirm the findings of previous research, which may be related to cultural differences. In this regard, Hauck et al assessed the frequency and association of addictive-like food consumption behaviors in Germany and reported that these behaviors were addictive- not correlated with gender, education, or living area.[54]

The comorbidity of FA with other addictions is not well documented. Research on the Spanish version of YFAS 2.0 indicated an association between gambling addiction[55] and FA. However, many questions remain regarding the comorbidity of FA with other types of drug addiction. The findings of a previous study suggested a relationship between current FA and history of smoking. This research demonstrated a significant association among current smoking and FA. Consistent with the results of the present study, Chao et al[56] showed that current smokers had more cravings for high-fat diets and fast food. A set of biological, psychological, and sociocultural factors may play a role in this comorbidity. [57] Therefore, some genotypes predispose people to dependence on different substances simultaneously. A previous study showed that differences in nicotinic acetylcholine receptors are related to multiple substance dependence phenotypes.[58]

Changes in neuroplasticity processes following intermittent access to sugar have also been likened to

Table 4. Associations of BMI, the binge eating and anthropometric parameters with the absence/presence of PYFAS 2.0-diagnosed FA

	FA absent (n = 443)	FA present (n = 30)	Chi-square/T test (df)	*P* value	Effect size (V)
Current BMI (kg/m²)					
16.0-16.90	10 (%2)	1 (%3)			
17.0-18.40	30 (%7)	5 (%17)			
18.50-22.90	168 (%38)	6 (%20)			
23.0-24.90	80 (%18)	9 (%30)	$\chi2 = 8.92$ (5)	0.112	0.137
25.0-29.90	126 (%28)	8 (%27)			
30 and above	29 (%7)	1 (%3)			
Anthropometric parameters					
Neck Circumference	37.1 (±6.2)	38 (±10.5)	T = 0.707 (471)	0.480	0.003
Abdominal	86 (±13.6)	87.5 (±14.8)	T = 0.582 (471)	0.561	0.002
Hip circumference	98.7 (±12.9)	98 (±13.7)	T = 0.272 (471)	0.786	0.001
Waist circumference	82 (±12.6)	79.4 (±15)	T = 1.05 (471)	0.292	0.006
BES					
Non-binging	341 (%77)	25 (%83)			
Moderate binging	77 (%17)	3 (%10)	$\chi2 = 1.10$ (2)	0.576	0.048
Severe binging	25 (%6)	2 (%7)			

Participants were compared with and without food addiction using parametric mean comparison tests (independent t-test) and chi-square tests.

Table 5. Associations of BMI, the binge eating and anthropometric parameters with the PYFAS 2.0-diagnosed FA symptom count (n = 473)

	FA symptom Count	F-value	*P* value	Effect Size (η^2)
Current BMI (kg/m²)				
16.0-16.90	2.5 (±2 .4)			
17.0-18.40	3.3 (±1.9)			
18.50-22.90	3 (±2.2)	1.257	0.281	0.013
23.0-24.90	3.4 (± 2.6)			
25.0-29.90	2.9 (± 1.8)			
30 and above	2.2 (±1.4)			
Anthropometric Parameters				
Neck circumference	-0.021	0.206	0.650	0.001
Abdominal	-0.027	0.333	0.564	0.001
Hip circumference	-0.019	0.177	0.674	0.001
Waist circumference	-0.104	5.15	0.024	0.011
BES				
Non-binging	3.1 (± 2.1)			
Moderate binging	2.9 (±2.1)	0.490	0.613	0.002
Severe binging	2.8 (± 1.5)			

Analysis of variance was used. FA symptom counts are shown as mean (standard deviation)
BMI, body mass index; FA, food addiction; BES, Binge Eating Scale.

Table 6. Associations of binge eating with the absence/presence of the PYFAS 2.0-diagnosed FA

	FA Present (n = 30)	FA Absent (n = 443)	t-value	*P* value[a]	Effect Size (d)
BES, Mean ± SD	(8.53 ± 8.6)	(10.56 ± 8.68)	1.24	0.216	0.003

BMI, body mass index; FA, food addiction; BES, Binge Eating Scale.
[a] T test was used.

changes observed following drug abuse.[59] Research on maternal pregnancy showed that high-fat diets can increase preproenkephalin, mu-opioid receptors, and dopamine transporters in the nucleus accumbens and prefrontal cortex.[60] Human neuroimaging studies have also confirmed the results of animal investigations. The insula, hippocampus, and caudate are areas of the brain involved in drug craving. Changes in functional magnetic resonance imaging signals have been identified in these areas by exposing individuals to craving tasks.[61,62] Gearhardt et al reported that the scores of YFAS were associated with enhanced activity of the amygdala and medial orbitofrontal cortex when the individual anticipated the intake of a chocolate milkshake.[63] In general, all indicators of addiction, such as escalation in intake during the initial phase, withdrawal symptoms following the removal of food, and craving behaviors during abstinence have been observed in FA.

This study has a number of limitations. First, most of the participants in this study were young people with a normal weight, which influences the results in the relationship of BMI and PYFAS 2.0-diagnosed FA. Second, the study sample does not represent the general population of the country. For more generalizability, it is suggested to perform studies with larger sample sizes on subjects that are more balanced concerning sociodemographic factors.

Conclusion

It was demonstrated that the PYFAS 2.0 is an appropriate psychometrically instrument, which can be applied to evaluate patients with addiction-related signs in young people. The present study validated PYFAS 2.0 in a

Persian-language-speaking population. Therefore, this scale can be used in other Persian-language-speaking countries, such as Afghanistan and Tajikistan.

Acknowledgements
The authors wish to thank all the participants in this project. Also, they thank the manager of the Health Related Social and Behavioral Sciences Research Center in Shahroud University of Medical Sciences for their sincere cooperation.

Authors' Contributions
MNS contributed to conceptualization, methodology, and funding acquisition. MA and FK contributed to formal analysis. ANG contributed to methodology, writing-review and editing. MS and FM contributed to data curation, resources. MR and BG contributed to software, resources. RR performed supervision, validation, investigation, writing-original draft preparation.

Conflict of Interests
The authors declare that they have no conflict of interests.

Ethical Approval
The present study was performed in accordance with the Declaration of Helsinki and the ethical guidelines for medical and health research of the Iranian Ministry of Health and Medical Education and the Ministry of Science, Research, and Technology. The approval was obtained from the Ethics Committee of Shahroud University of Medical Sciences, Iran (Ethical code: IR.SHMU.REC.1396.45). Before the study, written informed consent was obtained from all subjescts to participate in the present study.

Funding
This study was funded by a special project of Shahroud University of Medical Sciences (Grant no: 950140). The present work was not taken from a dissertation. The present study complies with the applicable laws and regulations in Iran.

References

1. Gold MS, Graham NA, Cocores JA, Nixon SJ. Food addiction? J Addict Med. 2009;3(1):42-5. doi: 10.1097/ADM.0b013e318199cd20.
2. Smith DG, Robbins TW. The neurobiological underpinnings of obesity and binge eating: a rationale for adopting the food addiction model. Biol Psychiatry. 2013;73(9):804-10. doi: 10.1016/j.biopsych.2012.08.026.
3. Carter A, Hendrikse J, Lee N, Yücel M, Verdejo-Garcia A, Andrews ZB, et al. The neurobiology of "food addiction" and its implications for obesity treatment and policy. Annu Rev Nutr. 2016;36:105-28. doi: 10.1146/annurev-nutr-071715-050909.
4. Hebebrand J, Albayrak Ö, Adan R, Antel J, Dieguez C, de Jong J, et al. "Eating addiction", rather than "food addiction", better captures addictive-like eating behavior. Neurosci Biobehav Rev. 2014;47:295-306. doi: 10.1016/j.neubiorev.2014.08.016.
5. Hashemi Y, Zarani F, Heidari M, Borhani K, Shakiba S. Psychometric properties of the Persian internet addiction test-social networking sites version: dimensionality assessment of social networking site addiction. Addict Health. 2021;13(2):95-105. doi: 10.22122/ahj.v13i2.289.
6. Brown RM, Kupchik YM, Spencer S, Garcia-Keller C, Spanswick DC, Lawrence AJ, et al. Addiction-like synaptic impairments in diet-induced obesity. Biol Psychiatry. 2017;81(9):797-806. doi: 10.1016/j.biopsych.2015.11.019.
7. Temple JL. Behavioral sensitization of the reinforcing value of food: what food and drugs have in common. Prev Med. 2016;92:90-9. doi: 10.1016/j.ypmed.2016.06.022.
8. Townsend EA, Beloate LN, Huskinson SL, Roma PG, Freeman KB. Corn oil, but not cocaine, is a more effective reinforcer in obese than in lean Zucker rats. Physiol Behav. 2015;143:136-41. doi: 10.1016/j.physbeh.2015.03.002.
9. Lenoir M, Serre F, Cantin L, Ahmed SH. Intense sweetness surpasses cocaine reward. PLoS One. 2007;2(8):e698. doi: 10.1371/journal.pone.0000698.
10. Guegan T, Cutando L, Ayuso E, Santini E, Fisone G, Bosch F, et al. Operant behavior to obtain palatable food modifies neuronal plasticity in the brain reward circuit. Eur Neuropsychopharmacol. 2013;23(2):146-59. doi: 10.1016/j.euroneuro.2012.04.004.
11. Kalon E, Hong JY, Tobin C, Schulte T. Psychological and neurobiological correlates of food addiction. Int Rev Neurobiol. 2016;129:85-110. doi: 10.1016/bs.irn.2016.06.003.
12. Ahmadian-Moghadam H, Akbarabadi A, Toolee H, Sadat-Shirazi MS, Khalifeh S, Niknamfar S, et al. Correlation among the behavioral features in the offspring of morphine-abstinent rats. Addict Health. 2019;11(4):262-75. doi: 10.22122/ahj.v11i4.253.
13. Monteiro CA, Moubarac JC, Levy RB, Canella DS, Louzada M, Cannon G. Household availability of ultra-processed foods and obesity in nineteen European countries. Public Health Nutr. 2018;21(1):18-26. doi: 10.1017/s1368980017001379.
14. Mendonça RD, Lopes AC, Pimenta AM, Gea A, Martinez-Gonzalez MA, Bes-Rastrollo M. Ultra-processed food consumption and the incidence of hypertension in a Mediterranean cohort: the Seguimiento Universidad de Navarra project. Am J Hypertens. 2017;30(4):358-66. doi: 10.1093/ajh/hpw137.
15. Moreira PV, Baraldi LG, Moubarac JC, Monteiro CA, Newton A, Capewell S, et al. Comparing different policy scenarios to reduce the consumption of ultra-processed foods in UK: impact on cardiovascular disease mortality using a modelling approach. PLoS One. 2015;10(2):e0118353. doi: 10.1371/journal.pone.0118353.
16. Popkin BM. Nutrition transition and the global diabetes epidemic. Curr Diab Rep. 2015;15(9):64. doi: 10.1007/s11892-015-0631-4.
17. Fardet A. Minimally processed foods are more satiating and less hyperglycemic than ultra-processed foods: a preliminary study with 98 ready-to-eat foods. Food Funct. 2016;7(5):2338-46. doi: 10.1039/c6fo00107f.
18. Caraher M, Coveney J. Public health nutrition and food policy. Public Health Nutr. 2004;7(5):591-8. doi: 10.1079/phn2003575.
19. Lerma-Cabrera JM, Carvajal F, Lopez-Legarrea P. Food addiction as a new piece of the obesity framework. Nutr J. 2016;15:5. doi: 10.1186/s12937-016-0124-6.
20. Gearhardt AN, Corbin WR, Brownell KD. Preliminary validation of the Yale Food Addiction Scale. Appetite. 2009;52(2):430-6. doi: 10.1016/j.appet.2008.12.003.
21. Meule A, Müller A, Gearhardt AN, Blechert J. German version of the Yale Food Addiction Scale 2.0: prevalence and correlates of 'food addiction' in students and obese individuals. Appetite. 2017;115:54-61. doi: 10.1016/j.appet.2016.10.003.
22. Brunault P, Courtois R, Gearhardt AN, Gaillard P, Journiac

K, Cathelain S, et al. Validation of the French version of the DSM-5 Yale Food Addiction Scale in a nonclinical sample. Can J Psychiatry. 2017;62(3):199-210. doi: 10.1177/0706743716673320.
23. Aloi M, Rania M, Rodríguez Muñoz RC, Jiménez Murcia S, Fernández-Aranda F, De Fazio P, et al. Validation of the Italian version of the Yale Food Addiction Scale 2.0 (I-YFAS 2.0) in a sample of undergraduate students. Eat Weight Disord. 2017;22(3):527-33. doi: 10.1007/s40519-017-0421-x.
24. Sevinçer GM, Konuk N, Bozkurt S, Saraçlı Ö, Coşkun H. Psychometric properties of the Turkish version of the Yale Food Addiction Scale among bariatric surgery patients. Anadolu Psikiyatri Derg. 2015;16 Suppl 1:44-53. doi: 10.5455/apd.174345.
25. Granero R, Hilker I, Agüera Z, Jiménez-Murcia S, Sauchelli S, Islam MA, et al. Food addiction in a Spanish sample of eating disorders: DSM-5 diagnostic subtype differentiation and validation data. Eur Eat Disord Rev. 2014;22(6):389-96. doi: 10.1002/erv.2311.
26. Kim JH, Song JH, Kim R, Jang MY, Hong HJ, Kim HJ, et al. [Validity and reliability of a Korean version of Yale Food Addiction Scale for Children (YFAS-C)]. J Korean Acad Nurs. 2019;49(1):59-68. doi: 10.4040/jkan.2019.49.1.59.
27. Fawzi M, Fawzi M. Validation of an Arabic version of the Yale Food Addiction Scale 2.0. East Mediterr Health J. 2018;24(8):745-52. doi: 10.26719/2018.24.8.745.
28. Khine MT, Ota A, Gearhardt AN, Fujisawa A, Morita M, Minagawa A, et al. Validation of the Japanese version of the Yale Food Addiction Scale 2.0 (J-YFAS 2.0). Nutrients. 2019;11(3):687. doi: 10.3390/nu11030687.
29. Swarna Nantha Y, Abd Patah NA, Ponnusamy Pillai M. Preliminary validation of the Malay Yale Food Addiction Scale: factor structure and item analysis in an obese population. Clin Nutr ESPEN. 2016;16:42-7. doi: 10.1016/j.clnesp.2016.08.001.
30. Gearhardt AN, Corbin WR, Brownell KD. Development of the Yale Food Addiction Scale version 2.0. Psychol Addict Behav. 2016;30(1):113-21. doi: 10.1037/adb0000136.
31. Kline P. An Easy Guide to Factor Analysis. London: Routledge; 2014.
32. Arafat SM, Chowdhury HR, Qusar MM, Hafez MA. Cross cultural adaptation & psychometric validation of research instruments: a methodological review. J Behav Health. 2016;5(3):129-36. doi: 10.5455/jbh.20160615121755.
33. Gormally J, Black S, Daston S, Rardin D. The assessment of binge eating severity among obese persons. Addict Behav. 1982;7(1):47-55. doi: 10.1016/0306-4603(82)90024-7.
34. Mootabi F, Moloodi R, Dezhkam M, Omidvar N. Standardization of the binge eating scale among Iranian obese population. Iran J Psychiatry. 2009;4(4):143-6.
35. Thompson B. Ten commandments of structural equation modeling. In: US Dept of Education, Office of Special Education Programs (OSEP) Project Directors' Conference, 1998, Washington, DC, US. American Psychological Association; 2000.
36. Hoyle RH. Structural equation modeling: Concepts, issues, and applications: Sage; 1995.
37. Kuder GF, Richardson MW. The theory of the estimation of test reliability. Psychometrika. 1937;2(3):151-60. doi: 10.1007/bf02288391.
38. McDonald RP. Test Theory: A Unified Treatment. New York: Psychology Press; 2013.
39. Arbuckle JL. Amos (Version 7.0) [Computer Program]. Chicago: SPSS; 2006.
40. IBM Corp. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp; 2017.
41. Love J, Selker R, Marsman M, Jamil T, Dropmann D, Verhagen J, et al. JASP: graphical statistical software for common statistical designs. J Stat Softw. 2019;88(2):1-17. doi: 10.18637/jss.v088.i02.
42. Browne MW, Cudeck R. Single sample cross-validation indices for covariance structures. Multivariate Behav Res. 1989;24(4):445-55. doi: 10.1207/s15327906mbr2404_4.
43. Carmines EG. Analyzing models with unobserved variables. In: Bohrnstedt GW, Borgatta EF, eds. Social Measurement: Current Issues. SAGE Publications; 1981.
44. Hu Lt, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. Struct Equ Modeling. 1999;6(1):1-55. doi: 10.1080/10705519909540118.
45. Browne MW, Cudeck R. Alternative ways of assessing model fit. In: Bollen KA, Long JS, eds. Testing Structural Equation Models. Newbury Park, CA: SAGE Publications; 1993.p. 136-62.
46. MacCallum RC, Browne MW, Sugawara HM. Power analysis and determination of sample size for covariance structure modeling. Psychol Methods. 1996;1(2):130-49. doi: 10.1037/1082-989x.1.2.130.
47. Bentler PM. Comparative fit indexes in structural models. Psychol Bull. 1990;107(2):238-46. doi: 10.1037/0033-2909.107.2.238.
48. Garson D. PA 765 Statnote: An Online Textbook. http://www2.chass.ncsu.edu/garson/pa765/statnote.htm. Accessed February 28, 2004.
49. Shevlin M, Miles JNV. Effects of sample size, model specification and factor loadings on the GFI in confirmatory factor analysis. Pers Individ Dif. 1998;25(1):85-90. doi: 10.1016/s0191-8869(98)00055-5.
50. Innamorati M, Imperatori C, Manzoni GM, Lamis DA, Castelnuovo G, Tamburello A, et al. Psychometric properties of the Italian Yale Food Addiction Scale in overweight and obese patients. Eat Weight Disord. 2015;20(1):119-27. doi: 10.1007/s40519-014-0142-3.
51. Horsager C, Færk E, Lauritsen MB, Østergaard SD. Validation of the Yale Food Addiction Scale 2.0 and estimation of the population prevalence of food addiction. Clin Nutr. 2020;39(9):2917-28. doi: 10.1016/j.clnu.2019.12.030.
52. Schulte EM, Yokum S, Potenza MN, Gearhardt AN. Neural systems implicated in obesity as an addictive disorder: from biological to behavioral mechanisms. Prog Brain Res. 2016;223:329-46. doi: 10.1016/bs.pbr.2015.07.011.
53. Pedram P, Wadden D, Amini P, Gulliver W, Randell E, Cahill F, et al. Food addiction: its prevalence and significant association with obesity in the general population. PLoS One. 2013;8(9):e74832. doi: 10.1371/journal.pone.0074832.
54. Hauck C, Weiß A, Schulte EM, Meule A, Ellrott T. Prevalence of 'food addiction' as measured with the Yale Food Addiction Scale 2.0 in a representative German sample and its association with sex, age and weight categories. Obes Facts. 2017;10(1):12-24. doi: 10.1159/000456013.
55. Jiménez-Murcia S, Granero R, Wolz I, Baño M, Mestre-Bach G, Steward T, et al. Food addiction in gambling disorder: frequency and clinical outcomes. Front Psychol. 2017;8:473. doi: 10.3389/fpsyg.2017.00473.
56. Chao AM, White MA, Grilo CM, Sinha R. Examining the effects of cigarette smoking on food cravings and intake,

depressive symptoms, and stress. Eat Behav. 2017;24:61-5. doi: 10.1016/j.eatbeh.2016.12.009.
57. Navabi N, Asadi A, Nakhaee N. Impact of drug abuse on family quality of life. Addict Health. 2017;9(2):118-9.
58. Sherva R, Kranzler HR, Yu Y, Logue MW, Poling J, Arias AJ, et al. Variation in nicotinic acetylcholine receptor genes is associated with multiple substance dependence phenotypes. Neuropsychopharmacology. 2010;35(9):1921-31. doi: 10.1038/npp.2010.64.
59. Colantuoni C, Rada P, McCarthy J, Patten C, Avena NM, Chadeayne A, et al. Evidence that intermittent, excessive sugar intake causes endogenous opioid dependence. Obes Res. 2002;10(6):478-88. doi: 10.1038/oby.2002.66.
60. Vucetic Z, Kimmel J, Totoki K, Hollenbeck E, Reyes TM. Maternal high-fat diet alters methylation and gene expression of dopamine and opioid-related genes. Endocrinology. 2010;151(10):4756-64. doi: 10.1210/en.2010-0505.
61. Pelchat ML, Johnson A, Chan R, Valdez J, Ragland JD. Images of desire: food-craving activation during fMRI. Neuroimage. 2004;23(4):1486-93. doi: 10.1016/j.neuroimage.2004.08.023.
62. Sinha R, Li CS. Imaging stress- and cue-induced drug and alcohol craving: association with relapse and clinical implications. Drug Alcohol Rev. 2007;26(1):25-31. doi: 10.1080/09595230601036960.
63. Gearhardt AN, Yokum S, Orr PT, Stice E, Corbin WR, Brownell KD. Neural correlates of food addiction. Arch Gen Psychiatry. 2011;68(8):808-16. doi: 10.1001/archgenpsychiatry.2011.32.