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Validation of the French Version of the DSM-5 Yale Food Addiction Scale in a Nonclinical Sample

Validation de la version française de l'échelle de dépendance alimentaire de Yale (YFAS 2.0) du DSM-5 dans un échantilon non clinique

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Abstract

Objective: The Yale Food Addiction Scale (YFAS) is the only questionnaire that assesses food addiction (FA) based on substance dependence criteria in the Diagnostic and Statistical Manual of Mental Disorders (DSM), Fourth Edition, Text Revision. Following recent updating of addiction criteria, a new DSM-5 version (YFAS 2.0) has been developed. Our study tested the psychometric properties of the French YFAS 2.0 in a nonclinical population.

Method: We assessed 330 nonclinical participants for FA (French YFAS 2.0), eating behaviour, and eating disorder (Binge Eating Scale, Emotional Overeating Questionnaire, Three-Factor Eating Questionnaire-R18, Questionnaire on Eating and Weight Patterns-Revised, Eating Disorder Diagnostic Scale). We tested the scale's factor structure (confirmatory factor analysis based on 11 diagnostic criteria), internal consistency, and construct and incremental validity.

Results: Prevalence of FA was 8.2%. Our results supported a 1-factor structure similar to the US version. In both its diagnostic and symptom count versions, the YFAS 2.0 had good internal consistency (Kuder-Richardson alpha was 0.83) and was associated with body mass index (BMI), binge eating, uncontrolled and emotional eating, binge eating disorder, and cognitive restraint. FA predicted BMI above and beyond binge eating frequency. Females had a higher prevalence of FA than males but not more FA symptoms.

Conclusions: We validated a psychometrically sound French version of the YFAS 2.0 in a nonclinical population, in both its symptom count and diagnostic versions. Future studies should investigate psychometric properties of this questionnaire in clinical populations potentially at risk for FA (that is, patients with obesity, diabetes, hypertension, or other metabolic syndrome risk factors).

Abrégé

Objectif : L'échelle d'addiction à l'alimentation de Yale (YFAS) est le seul questionnaire qui évalue l'addiction à l'alimentation (AA) selon les critères de dépendance aux substances du Manuel diagnostique et statistique des troubles mentaux (DSM), 4e édition,

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texte révisé. Suite à la mise à jour récente des critères DSM-5 de trouble addictif, une nouvelle version (YFAS 2.0) a été mise au point. Notre étude a testé les propriétés psychométriques de la version française de la YFAS 2.0 dans une population non clinique.

Méthode : Nous avons évalué 330 participants (population non clinique) pour l'AA (YFAS 2.0 française), et des mesures de comportement alimentaire (versions françaises des échelles suivantes : Binge Eating Scale, Emotional Overeating Questionnaire, Three-Factor Eating Questionnaire-R18, Questionnaire on Eating and Weight Patterns-Revised, Eating Disorder Diagnostic Scale). Nous avons testé la structure factorielle de l'échelle (analyse factorielle confirmatoire basée sur les 11 critères diagnostiques DSM-5), la consistance interne, sa validité de construit et incrémentielle.

Résultats : La prévalence de l'AA était de 8,2%. Nos résultats corroboraient une structure unifactoriellle semblable à celle de la version américaine. Tant dans sa version diagnostique que dans celle du nombre de symptômes, la YFAS 2.0 avait une bonne consistance interne (l'alpha de Kuder-Richardson était de 0,83), et était associée à l'indice de masse corporelle (IMC), les mesures de comportement boulimique, l'alimentation incontrôlée et émotionnelle, l'hyperphagie boulimique, et la restriction cognitive. L'AA prédisait l'IMC de manière significativement plus importante que la fréquence des crises de boulimie. Les femmes avaient une prévalence de l'AA plus élevée que celle des hommes mais pas plus de symptômes d'AA.

Conclusions : Nous avons validé la version française psychométriquement fiable de la YFAS 2.0 dans une population non clinique, tant dans sa version diagnostique que dans celle du nombre de symptômes. Les futures études devraient se pencher sur les propriétés psychométriques de ce questionnaire dans des populations cliniques potentiellement à risque d'AA (c.-à-d., des patients souffrant d'obésité, de diabète, d'hypertension ou d'autres facteurs de risque de syndrome métabolique).

Keywords
food addiction, addictions, behavioral addictions, substance use disorders, Yale Food Addiction Scale 2.0, psychometric, factor analysis, eating disorders, binge eating, addictive disorders.

Drug addiction is a chronic relapsing disorder characterized by compulsion to seek and take the drug, a loss of control over drug-seeking and drug-taking behaviours, and the continued use of the drug despite its adverse consequences.[1] It has recently been suggested that addictions should also include compulsive engagement in some pleasurable activity, such as gambling, gaming, Internet use, sex, exercising, eating, or shopping, in addition to pharmacologic rewards.[2] Apart from gambling disorder, which has been included in a new behavioural addiction category of the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), more research is needed before considering the potential inclusion of these other activities as addictive disorders.[1]

Despite the fact that food is widely available in Western societies, that eating is an essential and frequent human activity, and that certain foods have powerful addictive and rewarding effects similar to drugs,[3,4] the hypothesis that some individuals are addicted to food or to their eating behaviour has only recently been proposed.[5] Gearhardt et al[6] recently proposed the concept of food addiction (FA) as a specific phenotype defined by applying the DSM-IV-TR diagnostic criteria for substance dependence to certain foods, particularly processed foods high in added sugar, fat, and salt. This led to the development of the first self-administered questionnaire assessing FA symptoms: the Yale Food Addiction Scale (YFAS; hereafter called "original YFAS").[7] Further studies demonstrated the excellent psychometric properties of the original YFAS, including a 1-factor structure, excellent internal consistency, and very good convergent validity with measures of binge eating.[7] This questionnaire has been cross-culturally validated, including Chinese,[8] French,[9] German,[10] Italian,[11] Spanish,[12] and Turkish[13] versions, allowing a growing body of research in this field.[14] FA was found to be more prevalent in single and obese individuals[15]; in those with higher levels of depression, higher impulsivity, higher prevalence of posttraumatic stress disorder, higher prevalence rate for diagnosis of attention-deficit hyperactivity disorder in childhood[16-19]; and in patients with alterations in brain circuitry similar to those found in drug addiction (elevated activation in reward circuitry in response to food cues and reduced activation of inhibitory regions in response to food intake).[20]

With the recent update of DSM-5 diagnostic criteria, an update of the original YFAS was needed to take into account 4 new criteria, namely, craving, use despite interpersonal or social consequences, failure in role obligations, and use in physically hazardous situations. An updated version could also help determine whether the DSM-5 criteria for addictive disorders could be applicable to food and whether FA could be included in the international diagnostic classifications as an addictive disorder. To this end, Gearhardt et al[21] designed the US version of the YFAS 2.0 and validated it in a non-clinical population: they used confirmatory factor analysis based on the 11 diagnostic criteria to compare a 1-factor model and a 2-factor model (7 DSM-IV-TR criteria plus craving compared with 3 DSM-IV-TR criteria of abuse recently added in the DSM-5). They finally retained a 1-factor structure based on fit indices (the 2-factor solution did not result in noticeably improved fit, and the 2 factors of the 2-factor model were highly correlated). This validation study demonstrated the excellent psychometric properties of the YFAS 2.0, with a 1-factor structure and high convergent validity with measures of disinhibited eating, obesity, and weight cycling. Regarding discriminant validity, the US

version of the YFAS 2.0 was not significantly correlated with dietary restraint, and approximately half the participants with an FA diagnosis did not meet criteria for an existing eating disorder. In addition, the YFAS 2.0 exhibited incremental validity by accounting for variance in elevated body mass index (BMI) above and beyond binge eating frequency. To our knowledge, there is currently no French version of the YFAS 2.0 and no studies investigating the prevalence of FA and its associated factors as assessed by the DSM-5 criteria.

This study aimed to measure the psychometric properties of a French version of the YFAS 2.0 in a nonclinical sample by establishing its factor structure (confirmatory factor analysis), its internal consistency, its construct validity with eating disorder diagnosis, binge eating symptoms, uncontrolled eating, emotional eating and emotional overeating (convergent validity) and with cognitive restraint (discriminant validity), and its incremental validity (does the YFAS 2.0 symptom count explain unique variance in BMI above and beyond binge eating frequency?). We hypothesized that the French YFAS 2.0 had a 1-factor structure, good internal consistency, high convergent validity with BMI, binge eating, and emotional eating, and no correlation with cognitive restraint.

Methods

Participants and Procedures

A total of 330 volunteers participated in our study between May 2014 and May 2015. They were recruited through a web-based questionnaire, created using Sphinx software (Sphinx Plus 2 version 5.1.0.4),[22] sent to students from the Department of Psychology and Medicine of Tours University ($n = 164$; 49.7% of the sample) and their families ($n = 166$; 50.3% of the sample). Students proposed the questionnaire to their family members who participated based on volunteering. We differentiated results from the students' and family members' answers. We ensured that only adults were included in the family sample. The YFAS translation procedure was the same as the one used in the validation of the French version of the original YFAS (see Brunault et al[9] for more details regarding the translation procedure): (1) translation, (2) blind-backward translation, (3) comparison between the 2 versions and modification if necessary, and finally (4) test of a pilot version in 10 controls and 10 patients and modification of the scale if necessary. The final French version of the YFAS 2.0 can be found in Table 1.

Measures

We used measures assessing the same constructs as Gearhardt et al[21] in their YFAS 2.0 validation study, collecting sociodemographic characteristics (i.e., age, sex, marital status), current BMI, and previous maximal BMI and using self-administered questionnaires assessing the same constructs (see below and Gearhardt et al[21] for more details).

Food Addiction (YFAS Version 2.0)

The YFAS 2.0 is a 35-item self-report scale designed by Gearhardt et al[21] to assess FA symptoms over the previous 12 months based on the 11 diagnostic criteria for substance-related and addictive disorders proposed in the DSM-5.[1] In this way, the YFAS 2.0 assesses 11 FA criteria (for a detailed description, see Supplementary Table S1), including the 7 previous food-related DSM-IV-TR criteria (consumption more than planned, persistent desire or unsuccessful efforts to cut down or control consumption of certain foods, great deal of time spent, important activities given up, use despite physical/psychological consequences, tolerance, withdrawal),[6] the 4 new criteria in the DSM-5 (i.e., craving, use despite interpersonal or social consequences, failure in role obligations, and use in physically hazardous situations), and significant distress in relation to food.

Each item is rated on an 8-point Likert-type scale ranging from 0 (*never*) to 7 (*every day*). Each item can be rated dichotomously (endorsed or not endorsed) depending on specific cutoffs that Gearhardt et al[21] defined for each item by examining the specificity for each response option based on receiver operator characteristic curves (see Gearhardt et al[21] for more details). Based on these thresholds, each of the 11 diagnostic criteria is met when 1 or more item representing that criterion is endorsed (see Supplementary Table S1 for the detailed scoring instructions for the YFAS 2.0).[21] The YFAS 2.0 provides 2 scoring options: a diagnostic version (FA is diagnosed when the participant reports 2 or more symptoms during the previous 12 months plus clinically significant impairment or distress) and a symptom count version (number of FA symptoms experienced in the previous 12 months, ranging from 0 to 11). FA is mild if there are 2 or 3 symptoms and clinically significant impairment/distress, moderate if there are 4 or 5 symptoms and significant impairment/distress, and severe if there are 6 or more symptoms and significant impairment/distress.[1,21]

Details of the psychometric properties of the English version of the YFAS 2.0 are described above in the introduction.

Binge Eating (Binge Eating Scale)

The Binge Eating Scale (BES) is a 16-item questionnaire designed to assess the severity of binge eating using behavioural, affective, and cognitive symptoms (cutoff ≥ 18).[23] The BES is a reliable tool for assessing binge eating disorder and has been validated in French.[24] In our sample, Cronbach's α was 0.89.

Eating Disorders (Questionnaire on Eating and Weight Patterns-R and the Eating Disorder Diagnostic Scale)

We screened for eating disorders based on DSM-5 criteria using the Questionnaire on Eating and Weight Patterns-R (QEWP-R)[25] (for binge eating disorder and bulimia nervosa) and the Eating Disorder Diagnostic Scale[26] (for anorexia nervosa).

Table 1. French version of the Yale Food Addiction Scale 2.0.

Consignes pour remplir le questionnaire:

Ce questionnaire porte sur vos habitudes alimentaires de **l'année passée**. Pour chaque question, merci d'entourer le chiffre (0, 1, 2, 3, 4, 5, 6 ou 7) qui correspond le mieux à vos habitudes alimentaires des 12 derniers mois. Les gens ont parfois du mal à contrôler la quantité de nourriture qu'ils peuvent manger, comme par exemple:

- Les aliments sucrés comme les glaces ou les crèmes glacées, le chocolat, les beignets, les biscuits, les gâteaux et les bonbons.
- Les féculents comme le pain, le pain de mie, les sandwichs, les pâtes et le riz.
- Les aliments salés comme les chips, les bretzels et les biscuits apéritifs.
- Les aliments gras comme le steak, les charcuteries, le bacon, les hamburgers, les cheeseburgers, les fromages, les pizzas et les frites.
- Les boissons sucrées comme le soda, la limonade et les boissons énergétiques.

Pour les questions suivantes, l'expression « CERTAINS ALIMENTS » sera utilisée. Dans ce cas, merci de penser à TOUT aliment ou boisson indiqué(e) dans la liste ci-dessus ou à TOUT AUTRE(S) aliment(s) qui vous a (ont) posé un problème au cours de **l'année passée**.

AU COURS DES 12 DERNIERS MOIS:	**Jamais**	**Moins d'une fois par mois**	**Une fois par mois**	**2 à 3 fois par mois**	**Une fois par semaine**	**2 à 3 fois par semaine**	**4 à 6 fois par semaine**	**Tous les jours**
1. Lorsque j'ai commencé à manger certains aliments, j'en ai mangé beaucoup plus que prévu.	0	1	2	3	4	5	6	7
2. Il m'est arrivé(e) de continuer à manger certains aliments même lorsque je n'avais plus faim.	0	1	2	3	4	5	6	7
3. J'ai mangé jusqu'à me sentir « mal » physiquement.	0	1	2	3	4	5	6	7
4. J'ai été très inquiet(e) à l'idée de diminuer ma consommation de certains types d'aliments, mais j'en continué à en manger.	0	1	2	3	4	5	6	7
5. J'ai passé beaucoup de temps à me sentir endormi(e) ou fatigué(e) après avoir trop mangé.	0	1	2	3	4	5	6	7
6. J'ai passé beaucoup de temps à manger certains aliments au cours de la journée.	0	1	2	3	4	5	6	7
7. Lorsque je n'avais pas certains aliments à ma disposition, j'ai fait des efforts pour en acheter. Par exemple, je suis allé(e) dans un magasin pour acheter ces aliments alors que j'avais d'autres aliments à la maison.	0	1	2	3	4	5	6	7
8. J'ai mangé certains aliments si souvent ou en si grande quantité que j'ai arrêté de faire d'autres choses importantes, comme par exemple travailler ou passer du temps avec ma famille ou mes amis.	0	1	2	3	4	5	6	7
9. J'ai eu des problèmes avec ma famille ou mes amis à cause de la quantité de nourriture que je mange.	0	1	2	3	4	5	6	7
10. J'ai évité certaines activités au travail, à l'école ou certaines activités sociales par peur de manger trop dans ces situations.	0	1	2	3	4	5	6	7
11. Lorsque j'ai diminué ou arrêté ma consommation de certains aliments, je me suis senti(e) irritable, stressé(e) ou triste.	0	1	2	3	4	5	6	7
12. Lorsque j'ai diminué ou arrêté ma consommation de certains aliments et que j'ai eu des symptômes physiques, j'ai mangé ces aliments pour me sentir mieux.	0	1	2	3	4	5	6	7
13. Lorsque j'ai diminué ou arrêté ma consommation de certains aliments et que je me suis senti(e) irritable, stressé(e) ou triste, j'ai mangé ces aliments pour me sentir mieux.	0	1	2	3	4	5	6	7

(continued)

Table 1. (continued)

AU COURS DES 12 DERNIERS MOIS:	Jamais	Moins d'une fois par mois	Une fois par mois	2 à 3 fois par mois	Une fois par semaine	2 à 3 fois par semaine	4 à 6 fois par semaine	Tous les jours
14. Lorsque j'ai diminué ou arrêté ma consommation de certains aliments, j'ai eu des symptômes physiques comme par exemple des maux de tête ou de la fatigue.	0	1	2	3	4	5	6	7
15. Lorsque j'ai diminué ou arrêté ma consommation de certains aliments, j'ai constaté que j'avais un besoin plus important ou une envie irrésistible de manger ces aliments.	0	1	2	3	4	5	6	7
16. Mon comportement vis-à-vis de la nourriture et de l'alimentation a été source de souffrance.	0	1	2	3	4	5	6	7
17. J'ai eu beaucoup de problèmes dans ma vie à cause de la nourriture et de l'alimentation, comme par exemple des problèmes pour gérer le quotidien, des problèmes au travail, à l'école, avec la famille ou encore des problèmes de santé.	0	1	2	3	4	5	6	7
18. Des fois, je me suis senti(e) si mal à cause de mon alimentation excessive que cela m'a empêché de faire des choses importantes, comme travailler ou passer du temps avec mes amis ou ma famille.	0	1	2	3	4	5	6	7
19. Mon alimentation excessive m'a empêché(e) de m'occuper correctement de ma famille ou de faire des tâches ménagères.	0	1	2	3	4	5	6	7
20. J'ai évité des opportunités professionnelles ou relationnelles parce que je ne pouvais pas manger certains aliments dans ces situations.	0	1	2	3	4	5	6	7
21. J'ai évité certaines activités sociales car dans ces situations, certaines personnes n'étaient pas d'accord avec la quantité de nourriture que je pouvais manger.	0	1	2	3	4	5	6	7
22. J'ai continué à manger le(s) même(s) type(s) d'aliment(s) ou la même quantité de nourriture bien que cela ait été responsable de problèmes psychologiques.	0	1	2	3	4	5	6	7
23. J'ai continué à manger le(s) même(s) type(s) d'aliment(s) ou la même quantité de nourriture bien que cela ait été responsable de problèmes physiques.	0	1	2	3	4	5	6	7
24. Le fait de manger la même quantité de nourriture qu'avant ne me donne plus le même plaisir qu'avant.	0	1	2	3	4	5	6	7
25. J'ai vraiment voulu diminuer ou arrêter ma consommation de certains aliments, mais je n'y suis pas arrivé.	0	1	2	3	4	5	6	7
26. J'ai eu besoin de manger de plus en plus pour avoir le même effet qu'avant, comme par exemple avoir moins de stress, avoir moins de tristesse ou avoir plus de plaisir.	0	1	2	3	4	5	6	7
27. Je n'ai pas réussi correctement au travail ou à l'école car je mangeais trop.	0	1	2	3	4	5	6	7

(continued)

Table 1. (continued)

AU COURS DES 12 DERNIERS MOIS:	Jamais	Moins d'une fois par mois	Une fois par mois	2 à 3 fois par mois	Une fois par semaine	2 à 3 fois par semaine	4 à 6 fois par semaine	Tous les jours
28. J'ai continué à manger certains aliments même si je savais que c'était dangereux pour ma santé physique. Par exemple, j'ai continué à manger des bonbons alors que je savais que j'avais du diabète, ou j'ai continué à manger des aliments gras alors que je savais que j'avais des problèmes cardiaques.	0	1	2	3	4	5	6	7
29. J'ai eu des envies si fortes pour certains aliments que je ne pouvais plus penser à autre chose.	0	1	2	3	4	5	6	7
30. J'ai eu des envies si fortes pour certains aliments que c'était comme si je devais absolument les manger tout de suite.	0	1	2	3	4	5	6	7
31. J'ai essayé de diminuer ou d'arrêter ma consommation de certains aliments, mais je n'ai pas réussi.	0	1	2	3	4	5	6	7
32. J'ai essayé mais n'ai pas réussi à diminuer ou à arrêter de manger certains aliments.	0	1	2	3	4	5	6	7
33. En mangeant, il m'est arrivé(e) d'être tellement inattentif (inattentive) que j'aurai pu être blessé(e) (par exemple en conduisant une voiture, en traversant la rue ou en utilisant une machine ou un instrument dangereux).	0	1	2	3	4	5	6	7
34. En pensant à la nourriture et à l'alimentation, il m'est arrivé(e) d'être tellement inattentif (inattentive) que j'aurai pu être blessé(e) (par exemple en conduisant une voiture, en traversant la rue ou en utilisant une machine ou un instrument dangereux).	0	1	2	3	4	5	6	7
35. Mes amis et ma famille ont été inquiets de la quantité de nourriture que je pouvais manger.	0	1	2	3	4	5	6	7

Item optionnel n°1. Merci d'entourer TOUS les aliments pour lesquels vous avez eu des problèmes (c'est-à-dire des difficultés à en contrôler la consommation).

Glaces/Crèmes glacées	Chocolat	Pommes	Beignets	Brocolis	Biscuits
Gâteaux	Bonbons	Pain	Pain de mie	Sandwichs	Laitues
Pâtes	Fraises	Riz	Chips	Bretzels	Biscuits apéritifs
Carottes	Steak	Charcuteries	Bananes	Bacon	Hamburgers
Cheeseburgers	Fromages	Pizzas	Frites	Sodas	Aucun de ces aliments

Item optionnel n°2. Merci d'indiquer ici s'il y a d'autre(s) aliment(s) pour lesquels vous avez eu des problèmes (c'est-à-dire des difficultés à en contrôler la consommation). Merci d'indiquer uniquement les aliments qui ne sont pas dans la liste ci-dessus.

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Items 1 and 2 are optional and are not present in the US version of the YFAS 2.0. These 2 items are not used in the determination of the food addiction diagnosis nor in the calculation of the number of food addiction symptoms endorsed, but we included them here because they were included in the original YFAS and they help to determine which types of foods are problematic.

Eating Behaviour Characteristics (Emotional Overeating Questionnaire, Revised 18-Item Version of the Three Factor Eating Questionnaire)

We assessed emotional overeating using the Emotional Overeating Questionnaire, which identifies the frequency of overeating in response to 6 emotions (anxiety, sadness, loneliness, tiredness, anger, and happiness) with high internal consistency ($\alpha = 0.85$).[27] In our sample, Cronbach's α was 0.81.

We used the revised 18-item version of the Three Factor Eating Questionnaire (TFEQ)[28,29] to assess

Table 2. Descriptive statistics of the overall sample and comparison of participants with and without food addiction.

	Overall Sample ($N = 330$)	Participants Without Food Addiction ($n = 303$)	Participants With Food Addiction ($n = 27$)	Statistical Test	*P*
Sociodemographic characteristics					
Age (years)	28.9 ± 11.3	28.8 ± 11.4	27.6 ± 11.0	$F = 0.25$	0.62
Gender (male)**	19.7% (65)	21.5% (65)**	0% (0) **	$\chi^2 = 7.21$	<0.01
Marital status (married or in a relationship)	35.8% (118)	36.3% (111)	29.6% (8)	$\chi^2 = 0.48$	0.49
Weight-related variables					
Weight (kg)*	65.7 ± 16.3	65.2 ± 15.7*	72.0 ± 21.5*	$F = 4.35$	<0.05
BMI (kg/m^2)**	23.3 ± 4.9	23.1 ± 4.5**	25.9 ± 7.7**	$F = 8.32$	<0.01
Previous maximal BMI (kg/m^2)***	24.8 ± 5.2	24.6 ± 4.7*	27.9 ± 8.8*	$F = 10.57$	<0.001
Food addiction prevalence and symptoms					
Prevalence of food addiction	8.2% (27)	—	—	—	—
Mild food addiction	3.3% (11)	—	—	—	—
Moderate food addiction	2.1% (7)	—	—	—	—
Severe food addiction	3.0% (9)	—	—	—	—
Number of food addiction symptoms***	1.1 ± 1.8	0.7 ± 1.4***	5.0 ± 3.5***	$F = 194.98$	<0.001
Food consumed in larger quantities or over a longer period than intended***	20% (66)	16.5% (50)***	59.3% (16)***	$\chi^2 = 28.33$	<0.001
Persistent desire or unsuccessful efforts to cut down or control consumption of certain foods***	12.1% (40)	8.9% (27)***	48.1% (13)***	$\chi^2 = 35.83$	<0.001
Considerable time spent to obtain, consume, or recover from effects of food***	12.4% (41)	10.2% (31)***	37.0% (10)***	$\chi^2 = 16.37$	<0.001
Giving up important social, occupational, or recreational activities because of food consumption***	7.6% (25)	4.0% (12)***	48.1% (13)***	$\chi^2 = 69.13$	<0.001
Continuing to eat certain foods despite physical or psychological problems***	7.9% (26)	4.3% (13)***	48.1% (13)***	$\chi^2 = 65.70$	<0.001
Tolerance***	6.4% (21)	3.0% (9)***	44.4% (12)***	$\chi^2 = 71.56$	<0.001
Withdrawal***	7.9% (26)	4.6% (14)***	44.4% (12)***	$\chi^2 = 54.17$	<0.001
Continued consumption despite social or interpersonal problems***	13.3% (44)	8.9% (27)***	63.0% (17)***	$\chi^2 = 62.68$	<0.001
Failure to fulfill major role obligation***	3% (10)	1.7% (5)***	18.5% (5)***	$\chi^2 = 24.00$	<0.001
Use in physically hazardous situations***	9.1% (30)	6.6% (20)***	37.0% (10)***	$\chi^2 = 27.79$	<0.001
Craving***	8.2% (27)	4.6% (14)***	48.1% (13)***	$\chi^2 = 62.52$	<0.001
Significant distress in relation to food***	9.7% (32)	1.7% (5)***	100% (27)***	$\chi^2 = 273.84$	<0.001

Descriptive data are presented as mean ± standard deviation or percentage (number). We compared participants with and without food addiction using parametric mean comparison tests (analysis of variance) and chi-square tests. BMI = body mass index.
*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$ indicate variables significantly associated with food addiction diagnosis.

uncontrolled eating (tendency to eat more than usual due to a loss of control over intake accompanied by subjective feelings of hunger; this subscale encompasses the previous ''disinhibition'' and ''hunger'' subscales of the 51-item TFEQ), emotional eating (inability to resist emotional cues), and cognitive restraint (conscious restriction of food intake to control body weight or to promote weight loss). The scores were calculated as described by de Lauzon et al[28]: the theoretical ranges for the items were 9 to 36 for uncontrolled eating, 3 to 12 for emotional eating, and 6 to 24 for cognitive restraint. In our sample, Cronbach's α was 0.89.

Statistical Analyses and Ethical Considerations

Analyses were conducted using AMOS (SPSS Inc., Chicago, IL)[30] for confirmatory factor analyses and using the *R* statistical package version 2.15.2[31] with the psych package[32] for the other statistics. Statistical analyses included descriptive statistics and examination of the psychometric properties of the scale (factor structure, item statistics, internal consistency, construct validity, and incremental validity).

To test the factor structure of the French YFAS 2.0, we used the same procedure as Gearhardt et al[21]: we conducted confirmatory factor analyses based on the 11 diagnostic criteria to compare a 1-factor model and a 2-factor model (7 DSM-IV-TR criteria plus craving compared with 3 former DSM-IV-TR criteria of abuse recently added in the DSM-5). To assess the internal consistency of the scale, we used Kuder-Richardson alpha (KR-20) and McDonald's omega. We used KMO statistics to assess the sampling adequacy.

We assessed the construct validity of both the diagnostic and the symptom count versions by examining the associations between FA (assessed using either the diagnostic or the symptom count version of the YFAS) and the following measures: sociodemographic characteristics, weight-related

Table 3. Prevalence of eating disorders and eating behaviour characteristics in the overall sample and comparison of participants with and without food addiction.

	Overall Sample ($N = 330$)	Participants Without Food Addiction ($n = 303$)	Participants With Food Addiction ($n = 27$)	Statistical Test	*P*
Eating disorders according to DSM-5 criteria (QEWP-R and EDDS)					
Anorexia nervosa	1.5% (5)	1.7% (5)	0% (0)	$\chi^2 = 0.45$	0.50
Bulimia nervosa	3.0% (10)	3.3% (10)	0% (0)	$\chi^2 = 0.92$	0.34
Binge eating disorder*	4.2% (14)	3.3% (10)*	14.8% (4)*	$\chi^2 = 5.51$	<0.05
Binge eating (mean BES score)***	8.5 ± 7.6	7.5 ± 6.7***	18.8 ± 9.0***	$F = 65.95$	<0.001
Eating behaviour characteristics (TFEQ)					
Cognitive restraint***	11.8 ± 4.0	11.3 ± 3.8***	16.4 ± 3.5***	$F = 45.36$	<0.001
Uncontrolled eating***	18.4 ± 5.2	18.0 ± 5.0***	22.8 ± 4.7***	$F = 23.00$	<0.001
Emotional eating***	6.4 ± 2.7	6.2 ± 2.7***	8.4 ± 2.5***	$F = 16.51$	<0.001
Emotional overeating (EOQ total score)**	2.8 ± 3.8	2.5 ± 3.0**	6.8 ± 7.9**	$F = 36.38$	<0.01
= Eating in response to . . .					
Anxiety***	0.8 ± 1.1	0.7 ± 1.0**	1.6 ± 1.7**	$F = 20.49$	<0.001
Sadness***	0.5 ± 0.9	0.4 ± 0.8*	1.2 ± 1.5*	$F = 21.00$	<0.001
Loneliness***	0.5 ± 0.9	0.4 ± 0.8*	1.3 ± 1.6*	$F = 21.74$	<0.001
Tiredness***	0.4 ± 1.0	0.4 ± 0.9	1.0 ± 1.7	$F = 10.92$	<0.001
Anger***	0.3 ± 0.7	0.2 ± 0.6*	1.0 ± 1.6*	$F = 28.84$	<0.001
Happiness**	0.4 ± 0.7	0.3 ± 0.6	0.7 ± 1.2	$F = 8.83$	<0.01

Descriptive data are presented as mean ± standard deviation or percentage (number). We compared participants with and without food addiction using parametric mean comparison tests (analysis of variance) and chi-square tests. QEWP-R = Revised Questionnaire on Eating and Weight Patterns; EDDS = Eating Disorder Diagnostic Scale; BES = Binge Eating Scale; TFEQ-R18 = revised 18-item version of the Three-Factor Eating Questionnaire; EOQ = Emotional Overeating Questionnaire.
*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$ indicate variables significantly associated with food addiction diagnosis.

variables, eating disorder diagnosis, binge eating, emotional eating and emotional overeating (convergent validity), and cognitive restraint (discriminant validity). We used chi-square tests, parametric mean comparison tests (analysis of variance), or Pearson's correlation tests, as appropriate.

We used hierarchical multiple regression to test incremental validity: does the YFAS 2.0 symptom count predict elevated BMI above and beyond binge eating frequency (item 3 of the QEWP-R)?

There were no missing data, as all of the questions required a response to proceed to the next page of the survey. Our study did not require institutional review board approval because it was not considered biomedical research under French law; however, it followed the tenets of the Declaration of Helsinki.

Results

Sample Characteristics

Table 2 presents the sociodemographic characteristics, weight-related variables, and prevalence of each FA symptom. Participants had a mean age of 28.9 years (SD 11.3, range = 18–76) and a mean current BMI of 23.3 kg/m^2 (SD 4.9). Supplementary Table S2 presents and compares the sociodemographic characteristics of students and family members). Prevalence of FA was 8.2%. The mean number of FA symptoms was 1.1 (SD 1.9), with no significant difference between men and women (0.7 SD 1.3 compared with 0.8 SD 1.4; $P = 0.65$). Ten percent were underweight (BMI <18.5 kg/m^2), 65.2% were normal weight (18.5 kg/m^2 ≤ BMI < 25 kg/m^2), 16.4% were overweight (25 kg/m^2 ≤ BMI < 30 kg/m^2), and 8.5% were obese (BMI ≥30 kg/m^2). Table 3 presents the prevalence of eating disorders and the eating behaviour characteristics of our population. Sixteen of the 27 participants with FA (59.3%) had significant binge eating.

Item Statistics, Factor Structure, and Internal Consistency

Table 4 summarizes the item statistics, including the mean, standard deviation, and item-total correlation for each item.

Results and fit indices of confirmatory factor analyses are presented in Table 5. The 1-factor model had adequate fit indices (confirmatory fit index [CFI] was 0.887, root mean square error of approximation [RMSEA] was 0.083) with all factor loadings greater than 0.32. In line with Gearhardt et al[21] and YFAS 2.0 validation study and consistent with the examination by Gillespie et al[33] of the factor structure of substance use disorder symptoms, we retained a 1-factor solution because the 2-factor model did not result in noticeably improved fit (CFI = 0.891, RMSEA = 0.082) and the 2 factors of this 2-factor model were highly correlated ($r = 0.69$, $P < 0.001$). The internal consistency of the YFAS

Table 4. Association between the Yale Food Addiction Scale 2.0 symptom score, sociodemographic characteristics, weight-related variables, and eating disorders and behaviours.

	Statistical Test	*P*
Sociodemographic characteristics		
Age (years)	$r = 0.02$	0.72
Gender (male)	$F = 1.74$	0.19
Marital status (married or in a relationship)	$F = 0.14$	0.70
Weight-related variables		
Weight (kg)***	$r = 0.24$	<0.001
BMI (kg/m^2)***	$r = 0.29$	<0.001
Previous maximal BMI (kg/m^2)***	$r = 0.27$	<0.001
Eating disorders according to DSM-5 criteria (QEWP-R and EDDS)		
Anorexia nervosa	$F = 2.46$	0.12
Bulimia nervosa	$F = 1.73$	0.19
Binge eating disorder**	$F = 6.72$	<0.01
Binge eating (mean BES score)***	$r = 0.60$	<0.001
Eating behaviour characteristics (TFEQ)		
Cognitive restraint***	$r = 0.26$	<0.001
Uncontrolled eating***	$r = 0.44$	<0.001
Emotional eating***	$r = 0.37$	<0.001
Emotional overeating (EOQ total score) = Eating in response to . . .	$r = 0.55$	<0.001
Anxiety***	$r = 0.45$	<0.001
Sadness***	$r = 0.46$	<0.001
Loneliness***	$r = 0.47$	<0.001
Tiredness***	$r = 0.36$	<0.001
Anger***	$r = 0.37$	<0.001
Happiness***	$r = 0.21$	<0.001

We compared participants with and without food addiction using parametric mean comparison tests (analysis of variance) and Pearson's correlation test. BMI = body mass index; QEWP-R = Questionnaire on Eating and Weight Patterns Revised; EDDS = Eating Disorder Diagnostic Scale; BES = Binge Eating Scale; TFEQ = Three-Factor Eating Questionnaire; EOQ = Emotional Overeating Questionnaire.
**$P < 0.01$; ***$P < 0.001$.

2.0 (11 diagnostic criteria plus significant distress) was good (KR-20 = 0.83, McDonald omega = 0.86) and higher than the one observed with the DSM-IV-TR diagnostic criteria of our sample (7 diagnostic criteria plus significant distress; KR-20 = 0.74). Sampling adequacy was very good (KMO = 0.86). Mean interitem correlation was 0.26 for the 7 DSM-IV-TR criteria and $r = 0.30$ for the 11 DSM-5 criteria.

Convergent Validity of the YFAS 2.0 (Diagnostic Version)

Participants with FA (compared with participants without FA) were more frequently female and had higher current weight, BMI, and higher previous maximal BMI (Table 2). They had a higher prevalence rate for DSM-5 binge eating disorder but not for bulimia nervosa or anorexia nervosa (Table 3). Participants with FA had higher scores for binge eating, uncontrolled eating, and emotional eating ($P < 0.001$). They also ate more frequently in response to negative and positive emotions (i.e., anxiety, sadness, loneliness, anger, tiredness, happiness; Table 3).

Convergent Validity of the YFAS 2.0 (Symptom Count Version)

Table 4 presents the factors associated with the YFAS symptom score: the YFAS symptom score was associated with higher current BMI and higher previous maximal BMI but not with marital status, age, or gender. The YFAS symptom score was associated with diagnosis of binge eating disorder, higher scores for binge eating, uncontrolled eating, emotional eating, and eating in response to negative or positive emotions such as anxiety, sadness, loneliness, anger, tiredness, or happiness. It was not associated with diagnosis of anorexia nervosa or bulimia nervosa.

Discriminant Validity of the YFAS 2.0 (Diagnostic and Symptom Count Versions)

FA diagnosis and symptom count were associated with higher cognitive restraint (Table 4).

Incremental Validity of the YFAS 2.0

In simple linear regression, binge eating frequency was a significant predictor of BMI ($t = 2.59$, $\beta = 0.14$, $P < 0.01$), accounting for 1.7% of the variance. In hierarchical multiple regression, when YFAS 2.0 symptom count was entered in the model, binge eating was no longer a significant predictor ($t = 0.61$, $\beta = 0.04$, $P = 0.55$), and YFAS 2.0 symptom count was a significant predictor ($t = 4.71$, $\beta = 0.27$, $P < 0.001$), accounting for an additional 6% of the variance in BMI ($F = 14.67$, $P < 0.001$).

Discussion

This study demonstrated that the French version of the YFAS 2.0 is a reliable tool to diagnose FA and FA symptoms based on the DSM-5 criteria for Substance-Related and Addictive Disorders. It has a one-factor structure, good internal consistency, and high convergent validity with measures of binge eating, emotional eating, BMI, and with diagnosis of DSM-5 binge eating disorder. We did not confirm the discriminant validity of the YFAS with cognitive restraint found in the US validation study. The YFAS symptom count predicted BMI above and beyond binge eating frequency. These results demonstrate that the addiction model is relevant and applicable to food consumption and that FA seems to be a unitary concept and construct, related to but different from traditional eating disorders.[21]

The 1-factor structure and good internal consistency of the French version of the YFAS 2.0 is in line with the results obtained with the DSM-5 version of the YFAS.[21] Interestingly, the addition of the 4 new criteria in the DSM-5 (including craving) did not modify the 1-factor structure

Table 5. Factor loadings for the 1- and 2-factor structures of the Yale Food Addiction Scale 2.0 (confirmatory factor analyses).

	One-Factor Structure[a]	Two-Factor Structure[b]	
	Factor 1 Loadings	Factor 1 Loadings	Factor 2 Loadings
Food consumed in larger quantities or over a longer period than intended	0.32***	0.32***	—
Persistent desire or unsuccessful efforts to cut down or control consumption of certain foods	0.70***	0.70***	—
Considerable time spent to obtain, consume, or recover from effects of food	0.40***	0.40***	—
Giving up important social, occupational, or recreational activities because of food consumption	0.53***	0.53***	—
Continuing to eat certain foods despite physical or psychological problems	0.51***	0.51***	—
Tolerance	0.57***	0.57***	—
Withdrawal	0.54***	0.53***	—
Continued use despite social or interpersonal problems	0.54***	—	0.51***
Failure to fulfill major role obligations	0.50***	—	0.46***
Eating certain foods in physically hazardous situations	0.65***	—	0.61***
Craving or a strong desire or urge to eat certain food	0.74***	0.73***	—

[a]This 1-factor model was significant with the corresponding fit indices: $\chi^2 = 143.01$, df (degrees of freedom) = 44; χ^2 (CMIN)/df = 3.25, $P = 0.001$; comparative fit index (CFI) = 0.887; incremental fit index (IFI) = 0.888; root mean square error of approximation (RMSEA) = 0.083 (0.068–0.0098); expected cross-validation index (ECVI) = 0.635.

[b]This 2-factor model (factor 1 = 7 DSM-IV-TR criteria plus craving; factor 2: 3 former DSM-IV-TR criteria of abuse recently added in the DSM-5) was significant with the corresponding fit indices: $\chi^2 = 138.23$, df = 43; χ^2 (CMIN)/df = 3.22; $P = 0.001$; CFI = 0.891; IFI = 0.893; RMSEA = 0.082 (0.067–0.0098); ECVI = 0.627. Factor 1 and factor 2 were significantly correlated ($r = 0.69$, $P < 0.001$).

***$P < 0.001$.

of this scale and even improved its internal consistency. The YFAS 2.0 also corrected a limitation of the original YFAS: the lack of reliability of items related to "persistent desire or unsuccessful efforts to cut down or control use."[34] In the French YFAS 2.0, this item was endorsed by 12.1% of the sample (compared with 90.1% in the original YFAS), indicating better assessment of this diagnostic criterion in the YFAS 2.0. Prevalence of FA was higher in the US sample than in the French sample (see Supplementary Table S3 for a comparison of FA prevalence and criteria in the original French YFAS, the French YFAS 2.0, and the US YFAS 2.0), probably because of cultural differences or differences in BMI (in our sample, 1 participant out of 4 was overweight or obese as compared with 1 out of 2 in the US sample[21]). The adequate factor loadings observed for all of the 12 dichotomous diagnostic criteria (11 diagnostic DSM criteria plus significance questions) suggest that the DSM-5 addiction criteria applied to food assess a unitary concept.

Although the DSM-5 thresholds have been lowered for addictive disorders (i.e., 2 criteria out of 11 are necessary for diagnosis in the DSM-5, compared with 3 out of 7 in the DSM-IV-TR), we found no significant increase in the prevalence rate for DSM-5 FA (Supplementary Table S3). The lower thresholds for the 11 addiction criteria might have been counterbalanced by the higher YFAS 2.0 thresholds for each item.

Interestingly, FA was associated with emotional eating, which is in line with the high comorbidity between FA, emotional dysregulation,[35] and mood and anxiety disorders.[5,36] Our results are in line with Bruch and Kaplan's psychosomatic theory, which postulates that food intake increases in response to an internal state of emotional arousal, such as anxiety or depression, and that this could partly explain weight gain.[37,38] Although FA was associated with higher BMI, it is still unclear whether FA could be a direct cause of weight gain and whether treatment for FA could improve weight. FA prevalence was higher among women than among men, but the mean number of FA symptoms did not differ between women and men. Because men have generally more difficulty than women at processing and expressing emotions,[39] use of the symptom count version (number of FA criteria met) may be more useful than the diagnostic version (diagnosis) for men.

We did not confirm the YFAS discriminant validity with cognitive restraint found in the US validation study,[21] probably because of cultural differences or differences in samples (by including young students, our participants may have had higher cognitive restraint and lower BMI).

This study has a number of limitations, including use of self-administered questionnaires (future studies should first design and validate a semistructured diagnostic instrument to test the sensitivity and specificity of the YFAS 2.0), use of self-report for height (often overestimated) and weight (often underestimated), no assessment of the test-retest reliability of the scale, and use of the YFAS 2.0 in a nonclinical population. Future research should test its psychometric properties in patients with eating disorders or with diseases potentially associated with FA (i.e., obesity, diabetes, hypertension, or other metabolic syndrome risk factors).

By validating the French version of the YFAS 2.0, this study provides an opportunity to study the food addiction phenotype and its associated factors in greater depth. Before including FA in the international classification of diseases—a subject that is still hotly debated—the similarities of this phenotype with other addictions in terms of disease course, phenomenology, comorbidity, neurobiological mechanisms, and response to treatment must be identified, as well as its

specificities.[40] If it is included, it must then be determined whether FA should be conceptualized as a substance-related disorder,[41] as a behavioural addiction,[42] or as a "mixed" substance-related and behavioural addiction. This could have important practical implications, such as choosing the most appropriate therapeutic strategy for a given patient (including psychotherapy and substitution or substance replacement therapy) and developing effective harm reduction programs or even public health policies. It also highlights the importance of investigating each patient's mental representations and values associated with food, which may explain how and why an individual chooses food rather than another substance or behaviour in a stressful situation.

Conclusions

This study demonstrated that the French version of the YFAS 2.0 is a reliable tool for assessing FA symptoms based on the DSM-5 criteria for substance-related and addictive disorders. We demonstrated that the YFAS 2.0 can be used either to diagnose FA or to assess the number of FA symptoms in a nonclinical sample. Future studies should test the validity of the YFAS 2.0 in other nonclinical and clinical samples. The assessment of a food addiction phenotype using this DSM-5–based questionnaire is an important preliminary step in identifying its risk factors and prior to discussing the pro and cons of considering FA as an addictive disorder. To contribute to this debate, future studies should investigate FA in patients who experience harm related to their FA, including obesity and other metabolic syndrome risk factors or metabolic complications (e.g., type 2 diabetes, hypertension, dyslipidemia, atherosclerosis, stroke, or coronary heart disease).

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Declaration of Conflicting Interests

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Supplemental Material

Supplemental material is available online at http://journals.sagepub.com/home/cpa.

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