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ORIGINAL ARTICLE

French validation of the addiction-like eating behavior scale and its clinical implication

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Abstract

Purpose The first conception of food addiction (FA) as substance addiction, measured by the Yale Food Addiction Scale (YFAS), is controversial. Some proposed that FA would be better conceptualized with a behavioral approach. In accordance with this conceptualization, Ruddock and colleagues published a new self-reported scale for food addiction, the Addiction-like Eating Behavior Scale (AEBS). Overall, preliminary validation of the scale demonstrated good psychometric properties with a community sample. The aim of the present study is twofold, to validate the French–Canadian version of the AEBS with a community sample and to examine how well the instrument fits into a clinical sample with overweight/obesity.

Methods A community sample ($N=466$) and a clinical sample with overweight/obesity seeking help for their eating difficulties ($N=126$) completed an online survey regarding FA, binge eating, dietary restraint, depression, and BMI. Factor analysis, internal consistency, and construct validity were assessed.

Results With the community sample, factorial structure, and psychometric properties of the AEBS were replicated. With the clinical sample, proper convergent validity was demonstrated with the YFAS 2.0 and binge eating, and proper divergent validity was demonstrated with dietary restraint. Among the clinical sample, AEBS explain similar variance of BMI and depression level when compared to YFAS 2.0.

Conclusion This study provided evidence that the French–Canadian version of the AEBS is a valid measure of food addiction, but it did not permit to establish advantages over YFAS 2.0 with a clinical sample. Clinical implications of the AEBS and FA characteristic are discussed.

Level of evidence Level V, cross-sectional, descriptive study.

Keywords Addiction-like eating · Eating behaviors · Eating disorders · Food addiction · Obesity · Validation

Introduction

High rates of individuals with overweight and obesity among most industrialized countries have forced scholar to concentrate on other explanation and potential interventional target than the "big two" factors (food environment and physical activity) to understand/treat this epidemic problem [1, 2]. Therefore, the last 2 decades have been marked by increased publications about food addiction (FA) [3], a typology for disorders related to weight and eating [4]. The first conception of FA relied upon substance-use disorder model while highly palatable food was considered as a potential addictive substance like alcohol and drugs [5]. Consistent with this idea, Gearhardt and colleagues [6] published the first measure of FA, the Yale Food Addiction Scale (YFAS), a self-reported questionnaire adapted from the Diagnostic Statistical Manual (DSM)-IV-TR [7] (and DSM-5 [8] in later version [9]) criteria for substance-use disorder. Since its publication, the YFAS has been the measure of choice and, even, the only one available for FA. The YFAS has helped to stimulate researches in the field of FA and majorly contributed to establish preliminary findings in this area [10–12].

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However, the FA construct measured by the YFAS raised a lot of discussions, especially regarding the comparison between food and alcohol/drugs as addictive substances [13–15]. For instance, contrary to alcohol and drugs, food is essential. Therefore, the idea that something as vital as food could be an addictive substance raised concerns. Moreover, while most findings highlighted the addictive potential of highly palatable and processed food (e.g., chocolate, cookies, and chips) on the reward circuit [5], the magnitude of the effect is smaller than with alcohol and drugs [16]. As a consequence, central criteria of substance-use disorder like tolerance and withdrawal still do not reach consensus across searchers when applied to food [13, 14]. Also, some criteria of substance-use disorder like "Use in physically hazardous situations" do not really apply to food consumption and are more specific to alcohol and drugs. While other arguments could be listed, the main idea is that FA show specific characteristics and may benefit from a conceptualization independent from already existing addiction disorder.

In response to theses limitations, some proposed that FA should be conceptualized as a behavioral addiction, the "eating addiction" [13]. Consistent with this idea, Ruddock and colleagues [17] published a new self-reported assessment for FA, the Addiction-like Eating Behavior Scale (AEBS), that does not rely upon substance-use disorder model (nor gambling addiction) and does not postulate that certain specifics foods are addictive. Instead, AEBS relies upon the dual-process theories of motivation that propose an interaction of two mechanisms to explain development of addictive behaviors: (1) an increased responsivity to reward-related cues couple with (2) a diminished ability to exert inhibitory control [18]. Consistent with literature that showed enhance craving, impulsivity, and immediate gratification in individuals with overweight/obesity, Ruddock and colleagues [17] focused on observable 'addiction-like eating' maladaptive behaviors, which place individuals at higher risk of overweight and obesity [17].

Based on a qualitative study, they identified six characteristics that were commonly associated with FA: (1) a tendency to eat for reward rather than physiological need, (2) persistent food cravings, (3) an inability to control oneself around food, (4) a preoccupation with food and eating, (5) increased weight or an unhealthy diet, and (6) a particular problem controlling one's intake of foods high in fat, salt and/or sugar. Initially with 62 items, the questionnaire was cut down to 15 items divided into a two-factor structure consistent with the dual-process theories of motivation related to FA. Factor one comprised nine items that refer to "appetitive drive" while factor two comprised six items that refer to "low dietary control". Using a community sample, the instrument demonstrated a two-factor structure as well as a high internal consistency. Additionally, using the same scales as those used in the validation of the YFAS, good convergent validity with binge eating, emotional eating, and disordered eating as well as good divergent validity with alcohol addiction and a measure of behavioral inhibition and activation were found. Finally, the AEBS successfully predicted whether respondents perceived themselves to be food addicts and succeeded to explain 1% more BMI variance while controlling for YFAS symptom count and binge eating severity score [17].

Overall, the AEBS is an alternative to assess FA that respond to most concerns regarding the YFAS. First, moving away from the DSM criteria for addictive disorders, the AEBS proposed an alternative way to assess FA that may be closer to eating behaviors and cognitions reported by people who identified themselves as food addicted. Second, it is not designed as a diagnostic tool for FA, instead, it assesses severity of addition-like eating behaviors. Third, the AEBS reflects a well-established dual-process model of addictive disorders and overeating (i.e., increased reward responsivity/diminished inhibitory control) that may provide relevant information in a clinical perspective. Finally, preliminary validation of the AEBS showed good psychometric properties that support its utilization [17]. Considering these previous statements, the purpose of the present study is twofold. The first aim is to validate the French–Canadian version of the AEBS with a community sample. Similar good psychometric properties (factor structure, internal consistency, and construct validity) than the original English version are expected. The second aim is to examine how well the instrument fits into a clinical sample with overweight/obesity. Good convergent and divergent validity were expected, and it was expected that the AEBS perform at least as well as the YFAS 2.0 to explain BMI and depression level.

Materials and methods

Participants

Two samples were recruited. Participants from Group 1 (community sample; $N = 466$) were students and employees from Laval University over 18 years old, with a mean age of 27.77 years (SD = 9.08). Of the participants, 90% were women, 95% described themselves as Caucasians and 82% were full-time or part-time students. Reported Body Mass Index (BMI) ranged between 14.40 and 45.70 kg/m^2 (M = 23.95; SD = 4.62). Participants from Group 2 (clinical sample, $N = 126$) were adult individuals (over 18 years old) seeking psychological help for problems related to eating or weight, with a mean age of 45.19 years (SD = 13.21). Of the participants, 94% were women, 97% described themselves as Caucasians, and 67% were full-time or part-time workers. Reported BMI ($N = 49$) ranged between 25.60 and 58.90 kg/m^2 (M = 37.22; SD = 7.01). For diagnosis, 1% met

DSM-5 criteria for bulimia nervosa (BN), 30% for binge eating disorder (BED), 8% were classified as otherwise specified feeding and eating disorder (OSFED; majorly because participants did not reach the frequency or duration criteria for BED), 39% as unspecified feeding and eating disorder, and 22% did not reach clinical level for an eating disorder.

Procedure

Participants from Group 1 were recruited at Laval University, through the campus email list including students and employees. To be eligible, participants had to be at least 18 years old. The recruitment email presented the procedure of the study, which was to complete an online survey via LimeSurey regarding eating behaviors and body image. Participants completed the survey on a voluntary basis. They provided electronic informed consent prior to the survey and, at the end of it, could provide their email to have a chance to win one of four 25$CAD gift certificate. Participants from Group 2 were recruited at Centre d'Expertise Poids, Image et Alimentation (CEPIA; Centre of Expertise on Weight, Image and Nutrition), a multidisciplinary clinic specialized in eating disorders and obesity management. Throughout the clinical evaluation process, participants had to complete questionnaires on LimeSurey and to participate in a diagnosis interview according to the DSM-5 criteria with a psychologist. With their consent, their data were included in a database used for the present study. To be included, participants had to be at least 18 years old and presenting overweight or obesity (BMI $\geq$ 25 kg/m^2). Data were all collected anonymously. The Laval University Research Ethics Committee approved the study.

Measures

Food addiction (behavioral approach)

The Addiction-like Eating Behavior Scale (AEBS [17]) is a 15-item self-reported questionnaire used to assess behaviors related to FA. Items are answered on a 5-point Likert Scale ranging from 1 (strongly disagree or never) to 5 (strongly agree or always). The AEBS is divided into two subscales, "appetite drive" includes nine items for a possible score ranging from 9 to 45 and "low dietary control" includes six items for a possible score ranging from 6 to 30. All items can be the sum for a global score ranging from 15 to 75. A higher score represents more frequent and severe addictive-like eating behaviors. The AEBS was translated using a forward–backward method: The scale was translated from English to French by a bilingual graduated student and then translated from French to English by another bilingual graduated student. Both translators and a research professional unaware of the prior steps of the translation process discussed the final item formulation until agreement.

Food addiction (substance approach)

The Yale Food Addiction Scale 2.0 (YFAS 2.0 [9]) is a 35-item self-reported questionnaire used to assess FA symptoms. The YFAS 2.0 covers FA criteria based on the DSM-5 eleven diagnostic criteria for substance-use disorders [8]. Items are answered on a 7-point Likert Scale ranging from 0 (never) to 7 (every day). To fulfill a criterion, participants must endorse at least one item related to the criterion. The YFAS 2.0 can be used in two different ways. First, it is possible to assess the presence/absence of the "FA diagnostic" if a participant has endorsed at least two criteria and has reported functional impairment or clinical distress. The second method is to assess the FA severity by summing up the endorsed criteria (0-11). In the present study, internal consistency was adequate with Kuder-Richardson of .86 for Group 1 and .82 for Group 2.

Binge eating

The Binge Eating Scale (BES [19]) is a 16-item self-reported questionnaire used to assess symptoms related to behavioral, cognitive, and emotional manifestations of binge eating episodes. For each item, the participant is asked to choose, among four statements, the one that best describes his or her situation. Each item is allocated weight, representing severity (varying between zero and three), and subsequently summed up, so that total scores vary from 0 to 46: a score of 17 or less indicates the presence of no or few binge eating episodes, a score of 18–26 indicates moderated binge eating severity or frequency, and a score of 27 or more indicates severe binge eating or high episodes frequency and suggests a binge eating disorder diagnosis. In the present study, internal consistency was adequate with Cronbach's alpha of .90 for Group 1 and .85 for Group 2.

Dietary restraint

The Three-Factor Eating Questionnaire (TFEQ [20]) is a 51-item self-reported questionnaire used to assess three behavioral aspects of eating: (1) dietary restraint; (2) disinhibition toward food; and (3) susceptibility to hunger. The first section of the TFEQ includes 36 dichotomous items (true or false), while the second section includes 15 items on a 4-point Likert Scale ranging from 1 to 4. A score for each subscale can be computed by adding each item according to a point system. In the present study, only the "dietary restraint" subscale was used. Internal consistency for the "dietary restraint" subscale was adequate with Cronbach's alpha of .87 for Group 1 and .82 for Group 2.

Other addictions

Three self-reported screening questionnaires for gambling, alcohol, and drug addiction were used with Group 1, but not Group 2. For gambling addiction, the second section of the Canadian Excessive Gambling Index (CEGI [21]) was used. This section comprises 12 items on a 4-point Likert Scale ranging from 0 (never) to 3 (always) that assess the frequency of behaviors related to gambling. For alcohol and drug addiction, different sections of the Screening-Assessment of Need for Help–Alcohol or Drugs (SANH–Alcohol/SANH–Drugs [22]) were used. Fifteen items were used to assess alcohol addiction severity [23] and four items were used to assess drug addiction severity [24] on a 4-point Likert Scale.

Self-perceived food addiction (SPFA)

In Group 1 only, participants were asked "Do you consider yourself food addict?" and had to answer by yes or no.

Body mass index (BMI)

Group 1 provided self-reported measures of height and weight. For Group 2, height and weight were measured with metric and weighting scales by a trained research assistant. BMI was calculated based on standard procedure (kg/m^2).

Depression level

The Beck Depression Inventory-II (BDI-II [25]) is a 21-item self-reported questionnaire used to assess depressive symptoms experienced in the last 2 weeks. Each symptom is rated on a 4-point Likert Scale from zero (no suffering) to three (intense suffering). The total score ranges from 0 to 63: a score from 0 to 13 represents normal mood-to-minimal depressive symptoms, a score from 14 to 19 represents mild-to-moderate depressive symptoms, a score from 20 to 28 represents moderate depressive symptoms, and a score from 29 to 63 represents severe depressive symptoms. The BDI-II was used, because it captures different manifestations (e.g., sadness, guilt, fatigue, and motivation) that can be related to distress. In the present study, internal consistency was adequate with Cronbach's alpha of .94 for Group 1 and .92 for Group 2.

Statistical analysis

IBM SPSS 23.0 and Mplus [26] statistical software programs were used. Prior to analyses, all variables' distributions were inspected, and it was determined that no transformation was needed. To respond to the first aim of the study, only Group 1 was used. First, a confirmatory factorial analysis (CFA) was performed to test the fit for data. Like Ruddock and colleagues [17], following inspection of the modification indices, model fit was improved by adding covariance pathways between error terms of items 8–10, 11–12, 6–13, 4–9, and 4–5. Group 1 sample size reach recommendations of 5 to 10 observations for each item included in a factor analysis [27]. To measure the fit of the data, the following indices were used: Normed χ^2 statistic (χ^2/df), Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR). A χ^2/df ratio of 3 or under and a value over 0.90 for the CFI indicates an acceptable fit, whereas values of 0.08 and under are acceptable for the RMSEA and SRMR indices [28, 29]. Second, Cronbach's alpha was used to assess the internal consistency of the scale; 0.70 was considered the acceptable lower bound [30]. Third, to assess the AEBS construct validity, a correlational matrix was made with the YFAS 2.0 and the BES, two measures expected to converge with the AEBS and its subscales, and with the TFEQ "dietary restraint" subscale and other addiction questionnaires, measures expected to diverge with the AEBS and its subscales. Finally, to explore further the construct validity, two logistic regressions were made using AEBS total score as predictor, one to predict SPFA and one to predict FA diagnosis according to YFAS 2.0. To respond to the second aim of the study, only Group 2 was used. First, internal consistency was evaluated again to ensure that the AEBS could be used with the clinical sample. Second, to see if construct validity results could be replicated with a clinical sample, correlational analysis was made using the same scales to evaluate convergent and divergent validity. Also, a logistic regression was made using AEBS total score to predict FA diagnosis according to YFAS 2.0. Finally, to explore the incremental validity, separated linear regressions were made using AEBS total score and YFAS 2.0 symptoms count to explain BMI and depression level.

Results

Descriptive statistics

Descriptive statistics for community and clinical samples with group comparisons are presented in Table 1. Globally, Group 2 was more severe on every measure, except TFEQ "dietary restraint" subscale. Additionally, in Group 1, SPFA was reported by 52% of participants, while only 11% meet FA diagnosis according to YFAS 2.0. In Group 2, SPFA was not assessed, but 71% meet FA diagnosis according to YFAS 2.0.

Factorial structure and internal consistency with community sample

The two-factor structure was confirmed and provided a good fit for data [normed χ^2 (χ^2/df) = 3.68, CFI = 0.914, RMSEA (90% CI) = 0.076 (0.067–0.085), SRMR = 0.056]. Following the addition of covariance pathways between error terms of items 8–10, 11–12, 6–13, 4–9, and 4–5, the fit was improved [normed χ^2 (χ^2/df) = 2.13, CFI = 0.966, RMSEA (90% CI) = 0.049 (0.039–0.059), SRMR = 0.046]. Factor loadings ranged from 0.50 to 0.87 and were all significant (Table 2). Cronbach's alpha revealed high internal consistency for the entire questionnaire (α = .91) and both subscales "appetite drive" (α = .90) and "low dietary control" (α = .83).

Construct validity with community sample

Globally, AEBS total score and both subscales showed proper convergent validity with YFAS 2.0 and BES and proper divergent validity with TFEQ "dietary restraint" and addiction questionnaires (Table 3). Additionally,

Construct validity with clinical sample

First, high internal consistency for the entire questionnaire (α = .88) and both subscales "appetite drive" (α = .83) and "low dietary control" (α = .86) were also obtained with the clinical sample. Second, similar correlation coefficients with YFAS 2.0, BES, and TFEQ "dietary restraint" were obtained

Table 1 Descriptive statistics and comparisons of Group 1 and 2

	Group 1		Group 2		
	M	*SD*	*M*	*SD*	*t* test
1. AEBS (/75)	36.35	10.25	50.39	9.40	$t(583) = 13.55$, $p < .001$
2. AEBS—appetite drive (/45)	21.29	7.02	30.97	5.60	$t(583) = 13.96$, $p < .001$
3. AEBS—low dietary control (/30)	15.06	4.58	19.41	5.07	$t(583) = 9.05$, $p < .001$
4. YFAS 2.0 (/11)	1.27	2.29	5.55	3.20	$t(589) = 16.96$, $p < .001$
5. BES (/46)	10.80	8.41	23.70	8.84	$t(590) = 15.10$, $p < .001$
6. BMI	23.95	4.62	37.22	7.01	$t(482) = 17.95$, $p < .001$
7. TFEQ—dietary restraint (/21)	8.51	5.01	8.20	4.47	$t(590) = -0.63$, $p = .53$
8. CEGI (/36)	0.22	1.38	–	–	
9. SANH—Alcohol (/45)	3.51	4.57	–	–	
10. SANH—Drugs (/12)	0.37	1.42	–	–	
11. BDI-II (/63)	11.14	10.82	15.81	11.89	$t(590) = 4.21$, $p < .001$

Table 2 Standardized factor loadings using Group 1

	Factor 1									Factor 2					
	1	2	3	4	5	7	9	14	15	6	8	10	11	12	13
CFA	0.79	0.76	0.81	0.72	0.87	0.71	0.64	0.70	0.50	0.57	0.74	0.66	0.60	0.71	0.77
CFA with covariables	0.79	0.77	0.82	0.69	0.86	0.71	0.62	0.71	0.50	0.52	0.73	0.63	0.55	0.69	0.75

Table 3 Pearson's correlations between study variables for Group 1

	1	2	3	4	5	6	7	8	9
1. AEBS	1	.93**	.82**	.57**	.75**	-.05	.09	.21**	.12*
2. AEBS—appetite drive		1	.54**	.59**	.80**	.05	.08	.22**	.10*
3. AEBS—low dietary control			1	.38**	.45**	-.20**	.07	.14*	.12*
4. YFAS 2.0				1	.68**	.21**	.19*	.15*	.19**
5. BES					1	.27**	.19*	.20**	.15*
6. TFEQ—dietary restraint						1	.08	.14*	.11*
7. CEGI							1	.10*	.34**
8. SANH—Alcohol								1	.22**
9. SANH—Drugs									1

*$p < 0.05$, **$p < 0.001$

Table 4 Prediction of SPFA and YFAS 2.0 FA with AEBS total score

	SPFA (Group 1)	YFAS 2.0 FA (Group 1)	YFAS 2.0 FA (Group 2)
1. Correct classification	337/466 = 72.3%	421/466 = 90.3%	92/119 = 77.3%
2. Incorrect classification	129/466 = 27.7%	45/466 = 9.7%	27/119 = 22.7%
3. Sensitivity	178/244 = 73%	8/53 = 15.1%[a]	81/86 = 94.2%[b]
4. Specificity	159/222 = 71.6%	413/458 = 90.2%[a]	11/33 = 33.3%[b]

[a]Done with a score of 61 on the AEBS total scale to maximize correct classification

[b]Done with a score of 41 on the AEBS total scale to maximize correct classification

Table 5 Pearson's correlations between study variables for Group 2

	1	2	3	4	5	6
1. AEBS	1	.89**	.87**	.69**	.67**	− .27*
2. AEBS—appetite drive		1	.55**	.62**	.67**	− .21*
3. AEBS—low dietary control			1	.60**	.51**	− .27*
4. YFAS 2.0				1	.64**	− .23*
5. BES					1	.05
6. TFEQ—dietary restraint						1

*$p < 0.05$, **$p < 0.001$

Table 6 Linear regression for BMI and depression-level variance explanation

	AEBS		YFAS 2.0	
	R^2	F	R^2	F
1. BMI	0.07	(1, 46) = 3.18	0.08	(1, 46) = 3.71
2. Depression level	0.08	(1, 117) = 10.18*	0.09	(1, 123) = 12.74**

*$p < 0.05$, **$p < 0.001$

with the clinical sample (Table 5). Third, AEBS score successfully predicted FA diagnosis according to YFAS 2.0 (B = 0.15, SE = 0.03, odds ratio = 1.16, $p < .001$) with 77.3% of correct classification. Further information about sensitivity and specificity are presented in Table 4. Finally, AEBS total score alone and YFAS 2.0 symptoms count alone failed to significantly predict BMI variance (Table 6). Still, both scales explained similar BMI variance (R^2 of 0.07 vs. 0.08). In return, both scales successfully predicted depression level according to BDI-II total score with similar explained variance (R^2 of 0.08 vs. 0.09).

Discussion

The first aim of the study was to validate the French–Canadian version of the AEBS with a community sample. As expected, similar good psychometric properties than the original version were obtained. The AEBS two-factor structure was replicated with good fit indices and good-to-excellent internal consistency was obtained with the total scale and both subscales. In Ruddock and colleague's preliminary validation [17], the item 15 "I feel unable to control my weight" was the only item with very small factor loading (0.28), but in the present study, even though item 15 had the smallest factor loading (0.50), it reached acceptable value. Still, the inclusion of this item is questionable. Conceptually, this item seems to represent another dimension of FA as it is the only item in the "appetite drive" subscale that do not target eating behaviors. Instead, this item refers to weight control, that can be associated with many other behaviors, like exercising and food choices. Recently, two integrative comprehensive models of FA did not incorporate weight controls as an essential characteristic [31, 32]. Instead, some even suggested that the absence of behaviors and cognition related to weight and shape concerns could be a key characteristic that differentiates FA from BED [33, 34]. Therefore, poor weight control may better represent a consequence than a characteristic of FA.

Regarding construct validity with the community sample, AEBS total scores as well as both subscales showed moderate-to-strong correlations with binge eating severity and the number of YFAS 2.0 FA symptoms, indicative of a proper convergent validity. AEBS total scores and both subscales showed small-to-no association with dietary restraint and alcohol, drugs, and gambling addiction severity measures, suggesting a proper divergent validity. Finally, the AEBS significantly predicted whether individuals perceived themselves as "food addicts" in a community sample and whether individuals are diagnosed with FA according to YFAS 2.0. For SPFA, both sensitivity, i.e., the capacity to detect people with SPFA, and specificity, i.e., the capacity to exclude people without SPFA, were adequate, suggesting that the AEBS

conception of FA is coherent with population vision. It could be argued that SPFA is a very subjective way to assess FA, but, to correctly conceptualize FA, it seems inevitable to explore people's perceptions [35]. Regarding YFAS 2.0 FA diagnosis, specificity was good, but sensitivity was very low, meaning that AEBS could easily identify people without YFAS 2.0 FA, but hardly identify people with YFAS 2.0 FA. No comparison could be made with Ruddock and colleagues' original validation [17], as sensitivity and specificity were not assessed.

The second aim was to examine how well the instrument fits into a clinical sample with overweight/obesity. As expected, proper convergent and divergent validity were demonstrated. AEBS total scores as well as both subscales showed moderate-to-strong correlations with binge eating severity and the number of FA symptoms and small significant negative correlations with dietary restraint. To date, three studies showed that dietary restraint (measured with TFEQ or Eating Disorder Examination) is opposed to FA (measured with YFAS) with non-significant correlation coefficients of .03 to .10 [9, 36, 37], but it is the first time a dietary restraint measure is used to explore AEBS divergent validity. The small significant negative correlations observed in this study with the AEBS and its subscales were also found with YFAS 2.0. However, this negative association with dietary restraint was not found when related to BES. Therefore, this may reflect an important distinction between FA and binge eating. Globally, our results replicate those obtained by Ruddock and colleagues in their original study [17] but for the first time, using the YFAS 2.0 as a convergent measure [9] and, by studying a clinical sample. Moreover, the AEBS significantly predicted whether individuals are diagnosed with FA according to YFAS 2.0, with good sensitivity, but specificity was very low which means that AEBS classified many people as having an FA diagnosis, while they had not according to YFAS 2.0. This prediction was done using a cut-off score of 41 to maximize correct classification. Therefore, a score of 41 or above could be interpreted as clinically relevant FA severity. Considering that the AEBS was never meant to be a diagnosis tool and was created as a severity measure, its good sensitivity with clinical population (i.e., a good capacity to detect people with FA) supports its utilization and suggests that it assess a construct closely related to YFAS 2.0 assessment. To explore further this idea, AEBS and YFAS 2.0 were compared on BMI and depression-level variance explanation. Both scales failed to significantly predict BMI, probably due to low statistical power. Even though no significant prediction was found, the 7% to 8% of BMI explained variance by each scale is coherent with previous studies reporting small effect, sometimes not significant, of BMI explained variance with self-reported measure of FA or other maladaptive/disordered eating behaviors [9, 17, 38]. This may be because too many factors can influence BMI or, as it has been suggested before, because the relation between BMI and maladaptive/disordered eating behaviors is non-linear [39–41]. Moreover, it may reflect that BMI is a measure to estimate body fat with some limitations [42]. Regarding depression level, both scales showed similar significant results, suggesting that depression related to FA can be captured by both scales equally when they are used as severity score.

Regarding the clinical implications, group comparisons showed that the clinical sample was more severe than the community sample as demonstrated by higher BES total score, YFAS 2.0 symptoms count, BDI-II score, and BMI. AEBS total score and both subscales were also significantly higher in the clinical sample, suggesting that AEBS successfully capture clinical severity. Dietary restraint was the only measure that did not differ between groups. Because dietary restraint is part of the eating disorder comprehensive model, it would be expected that dietary restraint will be higher in the clinical sample. However, the clinical sample was mixed with conditions related to dietary restraint like BN and BED and with conditions not related to dietary restraint like unspecified feeding and eating disorder and FA. Also, it must be acknowledged that our community sample was majorly represented by young adult women, a population that often report dieting even in the absence of eating disorder [43]. Therefore, no clear conclusion could be drawn, but still the low level of dietary restraint may be a key characteristic to better understand FA.

With both samples, AEBS and its subscales were highly correlated with YFAS 2.0 and BES. This overlap between FA and BED has already been documented in the previous studies, while at least 50% of individuals with overweight/obesity and BED also had FA and approximatively the same percentage of individuals with FA also met criteria for BED [4, 36]. While both these conditions represent a form of compulsive eating characterized by a lost-of-control over food, the mechanisms underpinning this compulsiveness are thought to be different [44, 45]. Even though the present study did not permit to establish a clear distinction between both conditions, the two-factor conceptualization of FA by the AEBS appears promising for this purpose. First, when looking at results from the present study, the moderated correlations (.54 and .55) between the "appetitive drive" and "low dietary control" subscales for Group 1 and 2, respectively, support the idea that they both represent two different facets of a unique underlying phenomenon. The first mechanism proposed by the AEBS to explain the development of addictive behaviors is the "appetitive drive", an increased responsivity to reward-related cues. This mechanism directly represents compulsive eating behaviors that the YFAS 2.0 and the BES already try to capture. As such, the correlation coefficients between the "appetite drive" subscale and the YFAS 2.0 and the BES are stronger than with the "low

dietary control" subscale, the second mechanism which represents a diminished ability to exert inhibitory control. Based on these correlational data, it is possible to propose that the drive to eat may be a similar characteristic between FA and BED, but the way inhibition and, by extension, restriction manifest may be a critical distinction. However, this assumption needs to be further test with more specific population (e.g., individuals with obesity and BED vs. individuals with obesity without BED). In fact, the heterogeneity of diagnosis in our sample made it difficult to affirm any conclusion yet.

The current study has limitations to consider. First, almost every BMI was calculated with self-report measure and some participants decided to not provide their height and weight. Therefore, for Group 2, the analysis including BMI were done with a small sample. Second, like Ruddock and colleague's community sample, both community and clinical samples of this study were mostly composed of women. It would be interesting to see if the psychometric properties of the AEBS diverge with a male sample. Nevertheless, this study still permitted a good comparison with preliminary validation of the AEBS and is coherent with the overrepresentation of women in eating disorder and obesity management services. Third, the heterogeneity of diagnosis in the clinical sample provides a good external validity, but makes it harder to draw clear conclusion regarding the added value of the AEBS. Comparison between more specific populations (e.g., individuals with obesity and BED vs. individuals with obesity without BED) could help to shed light on potential clinical differences between AEBS and YFAS. Finally, the cross-sectional design of this study does not make it possible to draw causal relation between FA and BMI or depression level. Therefore, regression analysis of both AEBS and YFAS 2.0 must be interpreted with caution.

Conclusion

The French–Canadian version of the AEBS, likewise the original version, showed good psychometric properties to assess addiction-like eating behaviors in community sample. With clinical sample, the AEBS showed a good construct validity and, proved to be at least as good to predict BMI and depression level than the YFAS 2.0, the only other assessment for FA. However, replication with larger and more specific clinical sample is needed. While this study provided evidence that AEBS is a valid measure of FA, it did not permit to establish advantages over YFAS 2.0. Therefore, future researches should focus on what differentiates the AEBS and the YFAS, the dual-process theories of motivation. That conception of AEBS permits to differentiate two facets of FA (i.e., increased reward responsivity and diminished inhibitory control) that may help establish clinical profiles and, therefore, refine clinical intervention and improve outcomes.

What is already known on this subject?

- The AEBS is a new assessment for food addiction, but it is only available in English and has only been validated with community sample.

What your study adds?

- This study demonstrated good psychometric properties of the AEBS' French–Canadian version with community and clinical samples, and showed similar clinical value than another assessment for food addiction.

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Compliance with Ethical Standards

Conflict of interest The authors have no conflicts of interest to report. Maxime Legendre received grants from the Fonds Québécois de la Recherche Santé and the Canadian Institutes of Health Research during this study. The authors confirm that the research presented in this article met the ethical guidelines, including adherence to the legal requirements, of Canada and received approval from the Laval University's Institutional Review Board.

Research involving human participants and/or animals This research involved human participants.

Informed consent Every participant provided informed consent.

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