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The Adult Eating Behaviour Questionnaire in a bariatric surgery-seeking sample: Factor structure, convergent validity, and associations with BMI

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Abstract

The aim of this study was to validate the Adult Eating Behaviour Questionnaire (AEBQ), a measure of food approach and avoidant traits, for use in bariatric surgery candidates. Participants were 337 bariatric surgery candidates in the Mid-Atlantic United States. Confirmatory factor analysis suggested that one item did not load onto its original factor. A 34-item, eight-factor model had better fit than a seven-factor model; dropping the Hunger factor, as previously suggested, did not improve fit. The factors had good internal consistency and showed convergent/divergent validity with an existing measure of food approach traits. The emotional overeating scale was positively correlated with BMI at programme entry, whereas the slow eating scale was negatively correlated with baseline weight. The AEBQ scales had the same pattern of intercorrelations and similar means to those of two previously published samples. The AEBQ is a valid measure of appetitive traits in bariatric candidates.

Keywords

adulthood; obesity; psychological testing; psychometrics

1 | INTRODUCTION

Obesity has reached epidemic levels across the globe. In the United States, the prevalence of adult obesity is increasing, reaching 39.8% in the 2015–2016 National Health and Nutrition Examination Survey (Hales, Carroll, Fryar, & Ogden, 2017). Bariatric surgery continues to be regarded as the most efficacious intervention to produce weight loss in persons with severe or extreme obesity (e.g., body mass index [BMI] ≥ 35 and 40, respectively; Welbourn et al., 2017), but 20–30% of patients fail to lose weight or regain weight following surgery. Adherence to dietary recommendations is the primary nonsurgical predictor of successful bariatric outcomes (e.g., Essayli, LaGrotte, Fink-Miller, & Rigby, 2018; Karmali et al., 2013). As part of a comprehensive treatment for bariatric patients, The American Society for Bariatric and Metabolic Surgery recommends that prospective surgery patients participate in a preoperative psychological assessment (Sogg, Lauretti, & West-Smith, 2016). The goal of this assessment is to identify behaviours that may serve as barriers for adherence to

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presurgical and/or postsurgical recommendations, potentially impeding weight loss or leading to complications.

To date, there is lack of consensus regarding the most appropriate measures of eating behaviour within a bariatric population (Barclay, Rushton, & Forwell, 2015). Commonly used measures include the Weight and Lifestyle Inventory (WALI; Wadden & Foster, 2006), Binge Eating Scale (Gormally, Black, Daston, & Rardin, 1982), Dutch Eating Behaviour Questionnaire (DEBQ; van Strien, Frijters, Bergers, & Defares, 1986), Questionnaire on Weight and Eating Patterns-Revised (Yanovski, 1993), Night Eating Questionnaire (Allison et al., 2008), Yale Food Addiction Scale (Meule, Heckel, & Kübler, 2012), and Three-Factor Eating Scale (TFEQ; Karlsson, Persson, Sjöström, & Sullivan, 2000). These tools assess a range of eating pathology, intending to point towards areas of clinical concern, such as binge eating disorder and night eating. Less is known about nonpathological appetitive traits associated with food selection and energy intake within bariatric samples. Appetitive traits are defined as genetically determined, early emerging response tendencies for food-related cues, both internal (e.g., physiological signals of energy needs and emotional states) and external (e.g., cues in the environment that signal the availability of food and the hedonic or sensory properties of food itself; French, Epstein, Jeffery, Blundell, & Wardle, 2012; Llewellyn & Fildes, 2017).

The Adult Eating Behaviour Questionnaire (AEBQ) is an age-upward extension of a widely used and well-validated measure of individual differences in food approach (enjoyment of eating, eating in response to food cues in the environment, and eating in response to negative affect) and avoidance (responsiveness to satiety, slow pace of eating, undereating in response to negative affect, and picky/“fussy” eating) in children (Hunot et al., 2016; Wardle, Guthrie, Sanderson, & Rapoport, 2001). The Child Eating Behaviour Questionnaire (CEBQ) scales are concurrently and prospectively associated with adiposity in children (e.g., Antoniou et al., 2016; Boswell, Byrne, & Davies, 2018; Koch & Pollatos, 2014; Llewellyn & Fildes, 2017). The AEBQ shares seven of the original CEBQ scales (excluding a scale measuring desire to drink and including a newly added scale measuring subjective hunger). In two validation samples, the AEBQ scales (with the exception of scales measuring hunger and picky/fussy eating) were correlated with BMI in the expected directions (Hunot et al., 2016; Mallan et al., 2017). The psychometric properties of the AEBQ have yet to be studied in adults with severe obesity.

There is a need to identify specific obesity-related eating behaviours that predict dietary nonadherence in either the presurgical or postsurgical period (Gelinas, Delparte, Wright, & Hart, 2015). The AEBQ, which assesses a range of traits related to increased food intake, decreased food intake, and dietary variety, using plain language and fewer items than other similar measures (e.g., DEBQ and TFEQ) used to assess fewer traits, will be a valuable tool for expanding this body of research. The aims of this study are to establish the factor structure of the AEBQ in a bariatric surgery-seeking adult sample with severe obesity, including evaluating seven- versus eight-factor model fit (see Section 2.2), and to explore the pattern of intercorrelations among the AEBQ scales and their relationships with gender and BMI. For the first time in a study of the AEBQ, we also used an existing measure of food-

approach traits in adults with obesity, Section H of the WALI, to explore the convergent and divergent validity of the approach and avoidance scales (Gelinas et al., 2015).

2 | METHODS

2.1 | Participants and procedures

Participants were 337 patients pursuing bariatric surgery at an academic medical centre in Central Pennsylvania that serves both urban and rural communities. Participants were 69.1% White, 10.4% African American, 9.2% Hispanic/Latinx, 5.6% multiracial, and 0.90% Asian; 1.5% selected a race/ethnicity of "other," and 3.3% did not report race/ethnicity. The mean age of participants was 43.04 (xSD = 12.22, range = 17–74); 266 identified as women (78.6%), 70 as men (21.1%), and one identified as a transman (0.3%). All participant-report data were collected at a single 2-hr visit at the beginning of the presurgical programme. During this session, participants complete the full WALI (Wadden & Foster, 2006), from which demographic data and Section H were used in this study, along with a separate packet of self-report measures including the AEBQ.

Weight and height were collected at the first nutritional counselling visit in the programme. Weight and height data were used to calculate BMI (a measure of adiposity expressed in kilograms per metre of height squared). The sample had a mean BMI of 48.27 (8.70). BMI ≥ 35 is considered severe obesity, whereas BMI ≥ 40 is considered extreme obesity; all participants had BMI ≥ 35 (with the exception of one participant with a BMI of 34.45), with 86.6% of participants falling in the extreme BMI range.

All research and consent procedures were approved by the Institutional Review Board of Pennsylvania State University and informed consent was obtained from all participants.

2.2 | Measures

2.2.1 | Adult Eating Behaviour Questionnaire—The AEBQ is a 35-item measure that assesses eight appetitive traits on a 1–5 Likert agree/disagree scale. The following eight scales include three to five items each; sample items for each scale are included in parentheses. Food responsiveness ("when I see or smell food that I like, it makes me want to eat"), Hunger ("If my meals are delayed I get light-headed"), Enjoyment of eating ("I love food"), Emotional overeating ("I eat more when I'm upset"), Emotional undereating ("I eat less when I'm upset"), Satiety responsiveness ("I often get full before my meal is finished"), Slow eating ("I am often last at finishing a meal"), and Food fussiness ("I often decide that I don't like a new food, before tasting it"). The eight-factor structure of the AEBQ was called into question in both previous validation studies, with both groups reporting slightly improved fit when dropping the Hunger items or allowing them to load on the Food responsiveness scale (Hunot et al., 2016; Mallan et al., 2017). A freely downloadable PDF copy of the original AEBQ is available from the developers at http://www.ucl.ac.uk/iehc/research/behavioural-science-health/resources/questionnaires/eating-behaviour-questionnaires (Hunot et al., 2016).

2.2.2 | Demographics and convergent validity—Participants reported their age, gender, and race/ethnicity on the demographic data collection section of the WALI. Data

from Section H of the WALI, an existing measure of food approach behaviours in persons with obesity that is widely used in the assessment of bariatric surgery candidates, were used for convergent validity (Gelinas et al., 2015;). Section H has three factors measuring eating in response to negative affect (Negative affect), eating in response to positive affect or in social situations (Social/positive), and eating in response to environmental food cues (External; Gelinas et al., 2015). In the current sample, the scales demonstrated internal consistency: Negative affect α = 0.88, Social/positive α = 0.75, External α = 0.85.

2.3 | Data analysis

Analyses were conducted using SPSS Version 24.0 (IBM Corporation, 2013) and RStudio version 1.1.423 (RStudio Team, 2016). Confirmatory factor analysis was computed using the R lavaan package (version 0.5–23; Rossel, 2012). Confirmatory factor analysis was fitted using maximum likelihood with a robust weighted least squares estimator (WLSMV), treating the 5-point Likert scale data as ordinal. Model fit specified correlated factors, a fixed scale of measurement, and set variance of each scale to 1. Fit was assessed using the following criteria: comparative fit index > 0.90, $\chi^2/df < 3$, and standardized root mean square residual ≤ 0.08 reflect acceptable fit and root mean square error of approximation exceeding 0.08 relatively poor fit (Hu & Bentler, 1999). Cronbach's α based on polychoric correlations were computed to assess internal consistency. Partial correlations controlling for gender were used in convergent validity analyses.

3 | RESULTS

3.1 | Factor structure and internal consistency

Two alternative models with seven and eigth factors were fit using all 35 items. Fit was adequate for both, with small differences in χ^2/df, comparative fit index, root mean square error of approximation, and standardized root mean square residual favouring eight factors. In both models, one item (Item 6, originally from the Hunger factor) had standardized loading <0.20. When this item was dropped and the seven- and eight-factor models refit, fit slightly improved for both, with fit indices still favouring the eight-factor model. Fit for a seven-factor model omitting the hunger items completely offered an even slighter improvement in fit indices over the 34-item, eight-factor model (Table 1). All eight factors had adequate internal consistency and high standardized loadings (Table 2). Scale means were close to the midpoint (e.g., 2.5 on a 1–5 scale) with the exception of Enjoyment of food, which had a mean of 4.01/5 (Table 2).

3.2 | Convergent validity

Point biserial correlations between the AEBQ scales and gender suggested that women reported slightly higher scores on Emotional overeating, Satiety responsiveness, Emotional undereating, and Slow eating (r's ranged from −0.14 to −0.20, p's < 0.05; female gender was coded as 0, male gender as 1; Table 4). Hunger, Food responsiveness, Enjoyment of food, and Food fussiness did not differ by gender. All convergent validity analyses, including scale intercorrelations, controlled for gender.

The AEBQ food approach scales were all positively correlated with the three Section H scales measuring food approach traits/behaviours (Table 3). The AEBQ food avoidance scales were not consistently associated with Section H. Food fussiness was not related to any Section H scale. Emotional undereating was negatively related to Negative affect, with a small effect size, and unrelated to the other scales. Slow eating was negatively correlated with Social/positive eating and Overeating/impaired appetite, but not related to Negative affect. Satiety responsiveness was negatively correlated with all three Section H scales, with the largest inverse relationship between Satiety responsiveness and Overeating/impaired appetite (Table 3).

All of the AEBQ food approach scales were positively intercorrelated (Table 4). Satiety responsiveness and Slow eating were both negatively correlated with Emotional overeating. Satiety responsiveness was also negatively correlated with Food responsiveness. Emotional undereating was moderately negatively correlated with Emotional overeating, had a small negative relationship with Hunger, and was not related to Food responsiveness or Enjoyment of eating. Food fussiness was positively correlated with Satiety responsiveness and negatively correlated with Enjoyment of food. Only Emotional overeating and Slow eating were correlated with BMI at programme entry with small positive and negative effects, respectively.

4 | DISCUSSION

The purpose of this study was to evaluate the factor structure, internal consistency, and convergent validity of the AEBQ in a sample of bariatric surgery candidates. The AEBQ has previously been validated in two samples of unselected adults from the United Kigndom and Australia. This is the first study of the psychometric properties of the AEBQ in a U.S. sample or a bariatric surgery-seeking sample with severe obesity.

Examinations of model fit indices and standardized item loadings supported either an eight-factor model that dropped one item originally on the Hunger scale, or a seven-factor model that omitted all original Hunger items. The original eight-factor model was chosen for convergent validity analyses for consistency with previous studies. All eight factors showed adequate internal consistency (alphas > 0.70). Scale means were similar to those found in two previous published, general samples (see Mallan et al., 2017).

Convergent/divergent validity of the AEBQ scales was assessed with three scales from Section H of the WALI, a measure of food approach traits in bariatric candidates (Gelinas et al., 2015). The food approach scales showed excellent convergent validity with Section H. The food avoidance scales showed both divergent and convergent validity with Section H: Satiety responsiveness was most strongly negatively related to Overeating/impaired appetite, and Emotional undereating was only associated with Negative affect, measures of the scales' respective opposing traits. Food fussiness was not correlated with any of the Section H scales, consistent with its pattern of relationships with the other AEBQ subscales and with Mallan et al.'s (2017) suggestion that Food fussiness is unique among food approach/avoidance traits, in that it measures food choice rather than caloric intake.

The subscales had a similar pattern of intercorrelations in this sample as in the two previous samples. The food approach subscales were moderately to strongly intercorrelated with each other and had smaller, but significant, negative correlations with Satiety responsiveness and Slow eating, which were moderately positively correlated with each other. As in the previous samples, Food fussiness was significantly negatively related to Enjoyment of food and positively related to Satiety responsiveness, but not correlated with the other scales. This pattern of relationships is also similar to those seen in children (e.g., Wardle et al., 2001). An unenthusiastic eating behaviour profile, characterized by high Food fussiness and Satiety responsiveness and low Enjoyment of food, has been identified and found to be associated with reduced fruit, vegetable, and protein intake in a latent profile analyses of the CEBQ scales in a general child sample (e.g., de Barse et al., 2015).

A positive association between Emotional undereating and Hunger has now been reported in three samples. Mallan and colleagues treated this as a challenge to the validity of the Hunger scale, especially given the negative correlation they observed with BMI. An alternative explanation is that the Hunger, Satiety responsiveness, and Emotional undereating scales might capture regulation of eating behaviour by physiological signals rather than hedonic systems. Individuals who are more aware of, and responsive to, hunger and satiety signals may be more likely to experience appetite suppression under stress because they are more responsive to the satiety-related sensations that are affected acutely by stress (e.g., Lutter & Nestler, 2009; Yau & Potenza, 2013).

Emotional overeating, Emotional undereating, Slow eating, and Satiety responsiveness were each related to female gender, with small effect sizes. This is the first study to directly report on gender differences in endorsement of these traits in adults, although Mallan et al. (2017) also controlled for gender in their analyses. Higher endorsement of the food avoidant traits related to caloric intake might reflect greater social desirability of dieting or restrained eating in women, particularly those seeking treatment for obesity. It may also be the case that women's greater endorsement of both overeating and undereating in response to negative affect is driven by gender differences in the self-reported frequency of experiencing negative affect (e.g., Costa, Terracciano, & McCrae, 2001). However, the observed effects were small and should be replicated in other clinical and general samples before hypotheses are generated regarding gender differences in adult appetitive traits.

Only two AEBQ scales, Emotional overeating and Slow eating, were associated with baseline BMI in treatment-seeking adults with obesity, with positive and negative correlations, respectively. Because this was a weight-loss treatment-seeking sample, with a high prevalence of current and previous weight loss dieting, it might be the case that eating in response to negative affect is associated with weight gain or impaired weight loss, whereas slow eating may be protective against weight gain or associated with greater success in previous weight loss efforts. However, because of the cross-sectional nature of this study, we were not able to directly test this hypothesis. Future studies should assess the sensitivity of the AEBQ to changes in these appetitive/avoidance traits in behavioural weight loss treatment, and whether these traits are associated with weight loss in prebaratric patients. In addition, there is a need for future research exploring the relationship of adult appetitive traits to bariatric dietary adherence.

The AEBQ has numerous advantages over existing measures of eating behaviour traits in bariatric populations. It measures normative, nonclinical traits and does not include items that appear pathological on their face. This might help to minimize defensive responding and provide an entryway for psychologists who evaluate bariatric candidates to discuss potentially maladaptive eating behaviours and develop individualized recommendations for diet and lifestyle modification during the presurgical period. The AEBQ minimizes participant/patient burden compared with similar existing measures; this relatively brief measure captures seven to eight appetitive traits with fewer items than most existing measures that assess two to three appetitive traits (e.g., DEBQ, TFEQ, and Section H); in addition, the AEBQ is the only validated measure of adult appetitive traits that also measures multiple food avoidant traits associated with poor dietary diversity (e.g., de Barse et al., 2015). The AEBQ will help to address the need for further research on relationships among adult appetitive traits and weight, health, and psychosocial outcomes in adults with obesity.

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TABLE 1

Diagonal weighted least squares fit indices for 35-, 34-, and 30-item models

Model	Items	Factors	$\chi^2(df)$	χ^2/df	CFI	RMSEA [95% CI]	SRMR
1	35	8 (FR and H)	1,293.2(532)	2.43	0.98	0.068 [0.06, 0.07]	0.07
2	35	7 (FRH)	1,409.4(539)	2.62	0.97	0.07 [0.068, 0.077]	0.075
3	34	8 (FR and H without Item 6)	1,161.2(499)	2.32	0.98	0.065 [0.06, 0.07]	0.07
4	34	7 (FRH without Item 6)	1,267.8(506)	2.51	0.98	0.07 [0.065, 0.074]	0.073
5	30	7 (FR only, no H)	889.6(384)	2.31	0.98	0.065 [0.06, 0.07]	0.068

Note. CFI, comparative fit index; RMSEA, root mean square error of approximation; SRMR, standardized root mean square.

TABLE 2

Standardized loadings for the 34-item factor solution

		Standardized loading	Scale alpha/alpha if item deleted	Scale mean
Hunger			0.73	2.79 ± 0.82
6*	I often notice my stomach rumbling	0.16	0.73	
9	If I miss a meal, I get irritable	0.63	0.60	
28	I often feel so hungry that I have to eat something right away	0.72	0.68	
32	I often feel hungry	0.77	0.68	
34	If my meals are delayed I get light-headed	0.45	0.69	
Food Responsiveness			0.82	2.98 ± 0.84
13	I often feel hungry when I am with someone who is eating	0.66	0.76	
17	Given the choice, I would eat most of the time	0.78	0.77	
22	I am always thinking about food	0.79	0.76	
33	When I see or smell food that I like, it makes me want to eat	0.74	0.78	
Emotional overeating			0.91	2.79 ± 1.04
5	I eat more when I'm annoyed	0.86	0.89	
8	I eat more when I'm worried	0.84	0.89	
10	I eat more when I'm upset	0.84	0.89	
16	I eat more when I'm anxious	0.77	0.90	
21	I eat more when I'm angry	0.82	0.90	
Enjoyment of food			0.85	4.02 ± 0.72
1	I love food	0.86	0.78	
3	I enjoy eating	0.93	0.69	
4	I look forward to mealtimes	0.78	0.88	
Satiety responsiveness			0.70	2.58 ± 0.74
11	I often leave food on my plate at the end of a meal	0.70	0.62	
23	I often get full before my meal is finished	0.62	0.61	
30	I cannot eat a meal if I have had a snack just before	0.53	0.72	
31	I get full easily	0.74	0.56	
Emotional undereating			0.88	2.64 ± 0.88
15	I eat less when I'm worried	0.74	0.87	

		Standardized loading	Scale alpha/alpha if item deleted	Scale mean
18	I eat less when I'm angry	0.77	0.85	
20	I eat less when I'm upset	0.79	0.85	
27	I eat less when I'm annoyed	0.80	0.84	
35	I eat less when I'm anxious	0.79	0.85	
Food fussiness			0.88	2.27 ± 0.84
2	I often decide that I don't like a food before tasting it	0.69	0.87	
7	I refuse new foods at first	0.66	0.87	
12	(R) I enjoy tasting new foods	0.90	0.84	
19	(R) I am interested in tasting new foods I haven't tasted before	0.89	0.84	
24	(R) I enjoy a wide variety of foods	0.80	0.85	
Slowness in eating			0.85	2.58 ± 0.91
14	(R) I often finish my meals quickly	0.71	0.83	
25	I am often last at finishing a meal	0.76	0.80	
26	I eat more and more slowly during the course of a meal	0.73	0.82	
29	I eat slowly	0.92		

* Loading and alpha-if-deleted for Item 6 is from the eight-factor model with 35 items.

TABLE 3

Weight and lifestyle inventory, Section H (Fabricatore et al., 2006)

	Negative affect	Positive/social	Overeating/impaired appetite
Food approach subscales			
Hunger	0.37**	0.22**	0.49**
Food responsiveness	0.51**	0.34**	0.59**
Emotional overeating	0.76**	0.16*	0.33**
Enjoyment of food	0.36**	0.21**	0.45**
Food avoidance subscales			
Satiety responsiveness	−0.13*	−0.14*	−0.39**
Emotional undereating	−0.18**	0.08	−0.02
Food fussiness	0.06	−0.004	−0.01
Slowness in eating	−0.09	−0.14*	−0.22**

Note. Partial correlations controlling for gender.

* $p < .05$.

** $p < .001$.

TABLE 4

AEBQ intercorrelations and relationships with gender and baseline BMI

	H	FR	EOE	EF	SR	EUE	FF	SE	Baseline BMI	Gender (female = 0, male = 1)
Food approach subscales										
Hunger	1	0.58**	36**	35**	−0.24**	0.13*	−0.05	−0.16*	−0.06	−0.04
Food responsiveness		1	0.43**	0.59**	−0.31**	0.02	−0.07	−0.09	−0.03	0.05
Emotional overeating			1	0.31**	−0.09	−0.31**	0.05	−0.10	0.14*	−0.12*
Enjoyment of food				1	−0.27**	−0.07	−0.14*	−0.14*	−0.05	0.09
Food avoidance subscales										
Satiety responsiveness					1	0.16*	0.12*	0.39**	0.05	−0.16**
Emotional undereating						1	0.02	0.14*	−0.11*	−0.18**
Food fussiness							1	−0.01	0.05	0.03
Slowness in eating								1	−0.08	−0.21**

Note. Correlations between AEBQ scales, baseline BMI $N = 337$. All analyses control for gender.

* $p < .05$.

** $p < .001$.