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ORIGINAL ARTICLE

Factor structure of a French version of the eating disorder examination-questionnaire among women with and without binge eating disorder symptoms

Isabelle Carrard · Marie My Lien Rebetez · Olivia Mobbs · Martial Van der Linden

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Abstract The Eating Disorder Examination-Questionnaire (EDE-Q) is a self-report questionnaire that is widely used to investigate the core features of eating disorders. The EDE-Q is derived from the Eating Disorder Examination, a semi-structured interview considered as the "gold standard" in the assessment of eating disorders. To verify the factor structure of both instruments, originally composed of four subscales, factor analyses have been conducted with various samples. Heterogeneous results were found. Because no study had investigated the factor structure of the EDE-Q in individuals with binge eating disorder, the goal of our study was to fill this gap. We started with a review of the studies on the EDE and EDE-Q factor structure to decide which models to compare. Among 21 studies that were identified, three models had been replicated several times. We compared these three models—a 22-item, 3-factor model, a brief 7-item, 3-factor model and a brief 8-item, 1-factor model—in two samples of participants, one with threshold and subthreshold criteria for binge eating disorder ($N = 116$) and one without eating disorders ($N = 161$). Confirmatory factor analysis revealed a good fit for the brief 7-item, 3-factor model for both populations, whereas other solutions were not acceptable. Cronbach's alpha coefficients of the three factors were acceptable to good, ranging between 0.714 and 0.953. The group with binge eating disorder symptoms had significantly higher scores for each factor. This brief 7-item instrument might be useful for screening or short interventions.

Keywords Binge eating disorder · Eating disorder examination questionnaire · Psychometrics · Factor analysis

I. Carrard
Department of Nutrition and Dietetics, School of Health Professions, University of Applied Sciences Western Switzerland (HES-SO), Geneva, Switzerland

I. Carrard (✉)
Filière Nutrition et diététique, Haute Ecole de Santé de Genève, Rue des Caroubiers 25, 1227 Carouge, Switzerland
e-mail: isabelle.carrard@hesge.ch

M. M. Lien Rebetez · O. Mobbs · M. Van der Linden
Cognitive Psychopathology and Neuropsychology Unit, University of Geneva, Geneva, Switzerland

Introduction

The Eating Disorder Examination-Questionnaire (EDE-Q) [1, 2] is a widely used measure of eating pathology. This questionnaire is the self-administered version of the eating disorder examination (EDE) [3, 4], which is a semi-structured investigator-based interview considered as the "gold standard" for evaluating the characteristic features of eating disorder psychopathology. Because it saves time and money compared to the interview, the self-report questionnaire is also very frequently used in research on eating disorders [1].

The current version, which is composed of 28 items, is the EDE-Q 6.0 [2]. Twenty-two items make up four subscales that specifically address the core features of eating disorders: restraint (RS, 5 items), eating concern (EC, 5 items), shape concern (SC, 8 items) and weight concern (WC, 5 items). One item belongs to both SC and WC subscales. These four subscales are similar for the interview and questionnaire. They were originally postulated on rational grounds [5]. The last six items assess the frequency of binge eating episodes and inappropriate compensatory behaviors.

In 2012, Berg et al. [6] published the first review of the psychometric properties of the EDE and EDE-Q. They emphasized the small number of studies that had examined the reliability and validity of the two instruments in spite of their wide use. In particular, they reported that only five studies had been done on the factor structure of the EDE (three studies [7–9]) and EDE-Q (two studies [10, 11]). Since Berg et al.'s review, the factor structure of both instruments, and particularly of the EDE-Q, has been the focus of attention, resulting in various models. Samples with and without eating disorders (ED) were analyzed. However, to our knowledge, no study has analyzed the factor structure of the EDE-Q in individuals with binge eating disorder (BED). The main goal of this study was to fill this gap. In order to define which models to examine, our first goal was to collect and review the articles that had analyzed the factor structure of the EDE and EDE-Q.

We carried out a MEDLINE search (retrieved on March 19, 2014) with the keywords "eating disorder examination" and "factor analysis". We selected articles written in English. Articles using versions of the EDE/EDE-Q adapted to other languages or to children were included. With this MEDLINE search, we obtained 22 articles. Eighteen addressed the factor structure of the EDE and EDE-Q, while four concerned other questionnaires and were removed. While studying the 18 articles, we found three additional papers on the subject and included them. In the end, we obtained 21 articles, which are summarized in Table 1.

Table 1 shows that a large number of heterogeneous solutions were found. To summarize: the original 4-factor structure that theoretically supported the construction of the instrument could not be satisfactorily replicated, except in one study [12]. Three studies reported different four-factor structures [13–15]. Three-factor solutions, with one factor grouping WC and SC and two factors resembling EC and RS, were found often [10, 16–20]. Barnes et al.'s [16] and Giovazolias et al.'s [19] solutions exactly confirmed Peterson et al.'s [10] model, but in Hilbert et al.'s [20], Darcy et al.'s [17] and White et al.'s [18] models, items were gathered differently in each of the three factors. Two-factor solutions grouping SC, WC and EC in one factor and RS items in another were reported by three studies [9, 17, 21]. In several cases, some items did not load clearly on any factor or cross-loaded on two factors, and were removed [8, 9, 11, 17], or not removed [15, 18, 20], from the final structure. Two more drastic proposals, in terms of item removal, could be replicated with some success: first, Wade et al.'s brief 8-item, 1-factor (items from WC and SC) model provided a good fit to samples of children [22–24] and of adults [7, 25] with or without ED. Second, Grilo et al.'s [8] brief 7-item, 3-factor (items from RS, SC and WC) model was obtained at first with exploratory factor analysis and confirmed with confirmatory factor analysis (CFA) in patients with BED, using the EDE. It was then replicated with overweight or obese participants [26] and with bariatric surgery candidates [27].

It emerges from this review that there has been no consensus as yet on the EDE's and EDE-Q's factor structure. However, replication attempts across studies have produced refinements in the suggested solutions and three models that were tested several times—Peterson's, Wade's, and Grilo's—were replicated.

Table 1 also highlights the lack of any study on the factor structure of the EDE-Q in patients with BED. To fill this gap, we chose to compare the three models that have been replicated with some success in the literature:

- Peterson et al.'s [10] 3-factor model (Factor 1: all of the SC and WC items except one (11 items); Factor 2: all of the EC items with 1 SC/WC item and 1 RS item (7 items); Factor 3: all RS items except one (4 items); includes all 22 items;
- Wade et al.'s [22] brief 8-item, 1-factor model (8 SC and WC items);
- Grilo et al.'s [8] brief 7-item, 3-factor model (Factor 1: "dietary restraint" (3 RS items), Factor 2: "shape/weight overvaluation" (1 SC and 1 WC item); Factor 3: "body dissatisfaction" (1 SC and 1 WC item).

The goodness of fit of these three models was also evaluated in a population of women without ED, to check a possible translation of the solution found in the sample with BED to a control sample. Then we examined the reliability of the factors that had been provided by the CFA and compared the factor means of both samples.

Methods

Participants and procedure

Data came from two studies on ED conducted between 2007 and 2011, at the University of Geneva and the University Hospitals of Geneva (Switzerland, French-speaking part of the country). Both study protocols were approved by the ethics committee of the University Hospitals of Geneva and all participants signed an informed consent form prior to participating in the studies.

One hundred and sixteen women meeting threshold or subthreshold criteria for BED were recruited from the community ($N = 74$) and from the University Hospital obesity department ($N = 42$) to participate in a study assessing the efficacy of an Internet self-help treatment program. They completed the EDE-Q before entering the treatment program. Participants had to be aged between 18 and 70 years and to suffer from BED symptoms

Table 1 Review of studies published in English that explore the factor structure of the eating disorder examination (EDE) and eating disorder examination-questionnaire (EDE-Q)

Authors, year	EDE EDE-Q	Participants, *N*	Methods	Results
Mannucci et al. [9]	EDE	With obesity, without BED, $N = 115$ (92 F)	EFA; Italian adaptation	2-factor model with 19 items
Peterson et al. [10]	EDE-Q	With threshold or subthreshold criteria for BN, $N = 203$ (F)	EFA; replication of the original structure	Original 4-factor structure not replicated Post hoc analyses: 3-factor model
Hrabosky et al. [11]	EDE-Q	With obesity, BS candidates, $N = 337$ (281 F)	EFA on a first subsample; CFA on the second subsample	4-factor model with 12 items
Wade et al. [22]	EDE	Two cohorts of twins, $N = 349$ and $N = 350$ (F)	EFA on each cohort separately; adaptation for children	Solution not stable between cohorts, except for Factor 1 consisting of 8 WC and SC items
Villarroel et al. [12]	EDE-Q	Undergraduate students, $N = 708$ (F)	CFA assessing the original 4-factor structure; Spanish adaptation	Original 4-factor structure replicated
Becker et al. [15]	EDE-Q	Non-clinical sample of Fijian adolescents, $N = 523$ (F)	EFA; replication of the original structure; Fijian adaptation	Original 4-factor structure not replicated
Byrne et al. [7]	EDE	ED referrals, $N = 158$ (F); community, $N = 317$ (F); overweight, $N = 170$ (F)	CFA comparing original 4-factor model/Peterson's 3-factor model/Mannucci's 2-factor model/Wade's brief 8-item, 1-factor model/1-factor model on each sample separately	Wade's brief 8-item, 1-factor model acceptable only in the ED sample
Grilo et al. [8]	EDE	With threshold BED criteria, $N = 688$ (557 F)	EFA on a first subsample; CFA on the second subsample	3-factor model with 7 items
Allen et al. [25]	EDE-Q	ED patients, $N = 228$ (F); Without ED, $N = 211$ (F)	CFA comparing original 4-factor model/3-factor model/2-factor model/1-factor model/Wade's brief 8-item 1-factor model on each sample separately	Wade's brief 8-item, 1-factor model acceptable in both the ED and community samples
Hilbert et al. [20]	EDE-Q	Community/Germany, $N = 2{,}520$ (1,354 F)	EFA; German adaptation	3-factor model
Grilo et al. [26]	EDE	Overweight Latina/os, $N = 156$ (141 F)	CFA comparing original 4-factor model/Grilo's brief 3-factor model Spanish adaptation	Grilo's brief 7-item, 3-factor model
Aardoom et al. [14]	EDE-Q	ED patients (AN, BN, BED, EDNOS), $N = 935$ (F)	EFA; Dutch adaptation	4-factor model (that did not replicate the original structure)
Barnes et al. [16]	EDE-Q	Students, $N = 403$ (91.8 % F); ED, $N = 166$ (95.8 % F)	CFA comparing original 4-factor model/Peterson's 3-factor model/1-factor model on the whole sample	Peterson's 3-factor model No differences between samples
Grilo et al. [27]	EDE-Q	With obesity BS candidates, $N = 174$ (131 F)	CFA comparing original 4-factor model/Hrabosky's 8-item model/Grilo's 7-item, 3-factor model	Grilo's brief 7-item, 3-factor model
Giovazolias et al. [19]	EDE-Q	Undergraduate students, $N = 500$ (F)	CFA comparing 1-factor model/Original 4-factor model/Hilbert's[a] 3-factor model (17 items)/Peterson's 3-factor model Greek adaptation	Peterson's 3-factor model
Darcy et al. [17]	EDE-Q	Competitive athletes, $N = 976$ (544 F); Comparison group, $N = 658$ (429 F)	CFA assessing the original 4-factor model on each sample separately; EFA	CFA: Original 4-factor structure not confirmed. EFA: 3-factor model for competitive athletes and female comparison group; 2-factor model for male comparison group
Hilbert et al. [24]	EDE	Children/adolescents with ED, overweight, or chronic illness, $N = 352$ (226 F)	CFA comparing original 4-factor model/3-factor model/1-factor model/Wade's brief 8-item, 1-factor model Adaptation for children, in German	No model convincing Wade's brief 8-item, 1-factor model superior to the other models

Table 1 continued

Authors, year	EDE EDE-Q	Participants, *N*	Methods	Results
Friborg et al. [13]	EDE-Q	Community, $N = 1{,}076$ (F)	EFA on a first subsample; CFA comparing 5 models on the second subsample: 1-factor model/original 4-factor model/EFA 3–4 factor models/Nested 4-factor model Norwegian adaptation	4-factor model (that did not replicate the original structure) with a nested general factor
Jongenelis et al. [23]	EDE	Children from primary schools, $N = 247$ (141 F); Children with obesity and ED, $N = 288$ (163 F)	CFA assessing Wade's brief 8-item, 1-factor model on each sample separately Adaption for children	Wade's brief 8-item, 1-factor model with covariance pathway between two SC and WC items
White et al. [18]	EDE-Q	Adolescents, $N = 917$ (522 F)	CFA assessing the original 4-factor model on a first subsample; EFA on the second subsample	CFA: Original 4-factor model inadmissible EFA: 3-factor model
Penelo et al. [21]	EDE-Q	Students aged from 11 to 18, $N = 2{,}928$ (1,544 F)	CFA comparing original 4-factor model/3-factor model/2-factor model/1-factor model/Spanish adaptation	2-factor model

AN Anorexia Nervosa, *BED* Binge Eating Disorder, *BN* Bulimia Nervosa, *BS* Bariatric Surgery, *CFA* confirmatory factor analysis, *ED* eating disorders, *EDNOS* eating disorder not otherwise specified, *EFA* exploratory factor analysis, *F* female, *SC* shape concern subscale, *WC* weight concern subscale

[a] Hilbert's model: Hilbert et al. [28] examined the German version of the EDE-Q in a mixed sample of clinical, subclinical, and nonclinical individuals, using EFA. They retained a 17-item, 3-factor solution. Article in German and therefore not included in the review

(subthreshold criterion: at least one objective binge episode per month for 6 months, see studies for a detailed description of the recruitment process and the inclusion criteria [29, 30]). Eating disorders were evaluated with the eating disorders in obesity (EDO) questionnaire [31] used as a clinical interview. The EDO contains ten items transcribing the DSM-IV criteria for BED, and including a clarification of the definition of binge eating. Exclusion criteria were severe psychiatric comorbidity, severe medical condition, or bariatric surgery. The mean age of this sample was 38.5 (SD = 11.4) and the mean BMI 31.4 (SD = 6.4). Among the participants, 55.2 % ($N = 64$) met the full BED diagnosis and 59.5 % ($N = 69$) had a BMI equal to or higher than 30 kg/m^2.

One hundred and sixty-one women without ED were recruited from the community through advertisements in newspapers or at the university and asked to participate in a study on cognitive biases toward food or body shape. Participants had to be aged between 18 and 55, French-speaking and have normal or corrected vision. They were excluded if they suffered from ED—assessed with the structured clinical interview (SCID-I) [32]—or had a history of neurological disease, substance abuse or psychosis. The mean age of this sample was 28.1 (SD = 8.1) and the mean BMI 21.0 (SD = 2.3).

Questionnaires

Eating disorder examination-questionnaire 6.0 [2]

As described above, the EDE-Q 6.0 is composed of 28 items, 22 of which make up the four subscales that form the original factor structure plus six assessing the frequency of binge eating episodes and inappropriate compensatory behaviors [2]. The whole assessment refers to the previous 28 days. The 22 items that constitute the four subscales are rated with a Likert-type scale from 0 (no days) to 6 (every day); the mean of the four subscale scores constitutes a global score.

After obtaining Prof. C.G. Fairburn's authorization to work on a French version of the EDE-Q, the questionnaire was translated from English into French by our group and then back-translated from French into English by a professional translator. Then, our group and the professional translator compared the two English versions to check for discrepancies, until agreement was reached.

Statistical analyses

All analyses included the 22 EDE-Q items composing the subscales. The two samples—with BED symptoms and without ED—were analyzed separately.

CFA were conducted with MPlus (version 5.0). Model fits were evaluated with the root mean square error of approximation (RMSEA) [33] and the standardized root mean square residual (SRMR) [34], two indices that are claimed to be less sensitive to small misspecifications of the factor structure [35]. We also report the comparative fit index (CFI) [36], a commonly used fit index. A good fit is indicated by an RMSEA and an SRMR below 0.05. An RMSEA between 0.05 and 0.08 and an SRMR between 0.05 and 0.10 indicate an acceptable fit [37]. A CFI above 0.90 corresponds to an acceptable fit [38]. The Chi square statistic tests that the model does not fit significantly worse than a model in which the variables correlate freely. *p*-values greater than 0.05 indicate a good fit. Before comparing factor means for the two groups, we checked the invariance of the model between groups (comparison of factor variances between groups). To do this, the factor loadings were held equal and constant for both groups (to test the invariance of the factor loadings) and the goodness of fit was evaluated.

Cronbach's alpha coefficients were calculated for each factor resulting from the CFA to evaluate internal consistency. Coefficients should be at least 0.70 to be considered as acceptable, but 0.80 is recommended as a more appropriate value [39].

Results

The goodness of fit of the three models tested with CFA is presented in Table 2. CFA revealed that Grilo's brief 7-item, 3-factor model provided an adequate fit to the data in both samples, with all fit statistics corresponding to the standards. All indices were good except the RMSEA in the no ED sample, which was acceptable. In contrast, Peterson's 22-item, 3-factor model and Wade's brief 8-item, 1-factor model had a poor fit to the data, with fit indices that were unacceptable in both samples.

Factor loadings for Grilo's brief 7-item, 3-factor model are presented in Table 3. The names of the three factors are presented in Table 3 as interpreted by Grilo et al. [8]: dietary restraint, shape/weight overvaluation and body dissatisfaction.

Cronbach's alpha coefficients were all acceptable to good: 0.840 and 0.830 for dietary restraint, 0.901 and 0.953 for shape/weight overvaluation, and 0.714 and 0.860 for body dissatisfaction, for the BED symptoms and the no ED group, respectively.

When the invariance of the factor structure was tested by holding the factor loadings constant and equal for both groups, the fit statistics appeared not to be statistically different ($\chi^2 = 42.9$, $df = 30$, $p > 0.05$), revealing an equal fit of the model in both samples.

Table 2 Fit indices for Peterson's 3-factor model, Grilo's brief 7-item, 3-factor model and Wade's brief 8-item, 1-factor model of the EDE-Q in samples with BED symptoms ($N = 116$) and no ED ($N = 161$)

	χ^2 (df)	RMSEA	SRMR	CFI
Peterson's 3-factor model				
BED symptoms	498.558 (df = 206)**	0.111	0.106	0.664
No ED	747.827 (df = 206)**	0.128	0.083	0.751
Grilo's brief 3-factor model				
BED symptoms	7.470 (df = 11)	0.000	0.032	1.000
No ED	16.700 (df = 11)	0.057	0.029	0.990
Wade's brief 1-factor model				
BED symptoms	133.872 (df = 20)**	0.641	0.222	0.134
No ED	213.562 (df = 20)**	0.802	0.245	0.059

RMSEA root mean square error of approximation, *SRMR* standardized root mean square residual, *CFI* comparative fit index

**$p < 0.05$

Table 3 Factor loadings for samples with BED symptoms ($N = 116$) and without ED ($N = 161$) in Grilo's brief 7-item, 3-factor model

	Factor 1: dietary restraint		Factor 2: shape/weight overvaluation		Factor 3: body dissatisfaction	
EDE-Q items	BED s.	No ED	BED s.	No ED	BED s.	No ED
1. Restraint over eating	0.721	0.820				
3. Food avoidance	0.860	0.764				
4. Dietary rules	0.814	0.776				
22. Importance of weight			0.871	0.996		
23. Importance of shape			0.941	0.915		
25. Dissatisfaction with weight					0.410	0.859
26. Dissatisfaction with shape					1.428	0.880

BED s Binge eating disorder symptoms, *ED* eating disorder, *EDE-Q* eating disorder examination-questionnaire

Numbers in front of the items are the item numbers in the EDE-Q

Factor means of both groups were calculated and compared (Table 4), showing significant differences for all factors. The sample with BED symptoms obtained higher (i.e., more severe) scores.

Discussion

To test the factor structure of the EDE-Q in individuals with BED symptoms, we started with a review of articles

Table 4 Comparison of the factor means of groups with BED symptoms and without ED in Grilo's brief 7-item, 3-factor model

	BED symptoms $N = 116$		No ED $N = 161$		Group comparison	
	Mean	SD	Mean	SD	t (df)	p
Dietary restraint	2.8	1.9	0.9	1.3	9.6 (275)	<0.001
Shape/weight overvaluation	4.3	1.8	0.9	1.3	18.5 (275)	<0.001
Body dissatisfaction	5.4	1.0	1.7	1.6	22.6 (275)	<0.001

BED binge eating disorder, *ED* eating disorders

written in English that examined the factor structure of the EDE and the EDE-Q. This review showed considerable heterogeneity in the solutions found. However, three models were reproduced successfully in different samples, with and without ED: a first model (Peterson's) that included all 22 items of the instrument distributed among three factors [10]; a second model (Wade's) including eight items grouped in one factor [22]; and a third model (Grilo's) including seven items distributed among three factors [8]. We used CFA to compare these three structures in two samples, one of which met the threshold or subthreshold criteria for BED and one without ED.

Among the three models tested, only one provided a good fit to the data, in both samples: Grilo's brief 7-item, 3-factor solution. These results are in line with the results of Grilo et al. [8], who found that this model provided a good fit to the data of BED patients tested with the EDE.

It should be noted that several studies of the EDE's and EDE-Q's factor structure have tried to reproduce structures found with one instrument on the basis of data collected with the other instrument (e.g., factor structures found with the EDE tested on EDE-Q data, and vice versa). This stems from the original hypothesis that the EDE and the EDE-Q have the same factor structure. But when the EDE and EDE-Q have been compared, differences have been found among their subscale scores. For example, Wilfley et al. [40] showed that individuals with BED exhibited higher scores on EDE-Q than on EDE subscales and that the correlations between them were sometimes modest. They suggested that this lack of concordance might be partially due to the complexity of several items. Fairburn and Beglin [1] reported that when concepts were unambiguous and easily defined, an individual's responses were more likely to be consistent across the two measures. Conversely, when concepts were complex, the individual's responses were more likely to diverge because the items in the EDE were explained more carefully by the investigator and this modified the participant's perception of the question. In this context, the seven items identified by Grilo et al. [8] with the EDE might be the least equivocal. This might contribute to explaining why we were able to find a similar factor solution with the EDE-Q.

In the present study, Grilo's brief 7-item, 3-factor model was tested for the first time with a control sample without ED. It provided a good fit to the sample of participants without ED and the structure of the solution was invariant between the two samples. On the other hand, the goodness of fit of Peterson's 3-factor model and Wade's brief 8-item 1-factor model was not acceptable, although these models had shown an acceptable fit with adult control samples in some previous studies [16, 19, 25], but not all [7].

Factor reliability was acceptable to good in both samples and, as expected, factor means were higher for the group with BED symptoms than for the group without ED, indicating that the BED symptoms group was more severely impaired on the three dimensions, namely dietary restraint, shape/weight overvaluation and body dissatisfaction.

Grilo's brief 7-item version has several advantages over the two other solutions to which it was compared: first, in comparison with Peterson's 22-item model, a brief version is easy to include in a research context, where batteries of questionnaires can be overloaded. Then, unlike Peterson's and Wade's models, Grilo's model includes a distinction between body dissatisfaction and shape/weight overvaluation. As discussed by Grilo et al. [8], shape/weight overvaluation reflects the specific tendency to evaluate oneself according to one's shape or weight, whereas body dissatisfaction is widespread among the population. Indeed, shape/weight overvaluation has proven to be a clinical sign of severity associated with greater ED pathology and depressive levels in populations with BED and bulimia nervosa (BN) [41]. Even at a threshold that can be qualified as "moderate", it has been reported to predict poorer psychosocial functioning in BED participants [42]. Shape/weight overvaluation has also been found to be a sign that differentiates BED from other psychiatric disorders [42]. Finally, unlike Wade's model, Grilo's model has the advantage of taking account of dietary restraint, which is a core dimension in Fairburn et al.'s [43] transdiagnostic model of eating disorder pathologies. Overall, the three factors proposed in this 7-item model are meaningful for research across all ED pathologies.

This brief 7-item version of the EDE-Q might be a useful instrument for screening or for short interventions. Before judging its usefulness, this new scale made up of the seven items retained in the factor analysis should be tested with new samples, and with samples of patients suffering from BN or anorexia nervosa (AN), which were the targets of the EDE when it was first developed. If the factor structure of this brief 7-item instrument proves to be valid,

its use could spread, ensuring that studies based on good psychometric properties can be compared.

Several limitations have to be considered regarding this study. Both samples were composed of women only, limiting the generalization of the results to men. Patients with threshold and subthreshold criteria for BED were recruited since studies have tended to show more similarities between these two groups than between individuals with subthreshold BED symptoms and controls [44, 45]. A further study could compare the factor structure of the EDE-Q between participants who meet the threshold and subthreshold criteria for BED. As well, the control group recruited at the university was made up primarily of students, so it cannot be considered as representative of the general population. Finally, the use of samples of convenience is a weakness. In fact, the psychometric properties of a scale should be assessed with data specifically collected for this purpose [6].

In summary, we replicated with a French adaptation of the EDE-Q a solution that emerged with the EDE in Grilo et al.'s studies: a brief 7-item, 3-factor model provided a good fit to a sample of participants with BED symptoms. Moreover, this model proved to be valid for a population without ED. If replicated with a new sample and with samples with BN or AN, this brief 7-item version of the EDE-Q might prove to be a valuable instrument with good psychometric properties for research in ED.

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Conflict of interest None.

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