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Factor structure and psychometric properties of the TFEQ in morbid obese patients, candidates to bariatric surgery

Diana Taboada[1], Mercedes Navío[1], Rosa Jurado[1], Vanesa Fernández[1], Carmen Bayón[2], Mª José Álvarez[1], Isabel Morales[1], Guillermo Ponce[1], Gabriel Rubio[1], José Carlos Mingote[1], Felipe Cruz[1] and Miguel Ángel Jiménez[1]

[1] Hospital Universitario 12 de Octubre and [2] Hospital Universitario La Paz

Abstract

Background: To analyze the factor structure and psychometric properties of the TFEQ in a morbid obese Spanish sample of bariatric surgery candidates. **Method:** Multi-trait/ multi-item analyses and alpha coefficients were conducted to test the convergent /discriminant validity and the internal consistency reliability. Principal components analyses (varimax) were used to explore the factor structure. Sub-group factor analyses by gender, age and body mass index (BMI) were conducted to identify unstable items. **Results:** The internal structure of the original TFEQ factors was unsatisfactory, especially the Disinhibition Scale. Most Disinhibition and Hunger items were grouped on one factor labeled "Dysregulation Eating". Cognitive Restraint was split into two factors. The first one, related to the behavioral component of Restraint, labeled "Restrained Behaviour" and the second one related to weight and eating concerns called "Predisposition to Restraint". **Conclusions:** The original factor structure of the TFEQ was not replicated. A revised 23-item instrument, representing the three new derived factors is offered as a valid screening instrument for severely obese patients.

Keywords: TFEQ, Eating Inventory, Morbid obesity, Factor structure.

Resumen

Estructura factorial y propiedades psicométricas del TFEQ en pacientes con obesidad mórbida candidatos a cirugía bariátrica. **Antecedentes:** analizar la estructura factorial y las propiedades psicométricas del TFEQ en una muestra española de obesos mórbidos candidatos a cirugía bariátrica. **Método:** se realizó un análisis multi-rasgo/multi-ítem y de coeficientes alpha para probar la validez convergente/discriminante y la consistencia interna. Se utilizó un análisis de componentes principales (varimax) para estudiar la estructura factorial. Se llevó a cabo también un análisis de factores de subgrupos por género, edad e IMC para identificar aquellos ítems inestables. **Resultados:** la estructura interna original de los 3 factores TFEQ fue insatisfactoria, especialmente en la escala de Desinhibición. La mayoría de los ítems de Desinhibición y Hambre se agruparon en un mismo factor denominado "Desregulación en la ingesta". La Restricción Cognitiva se dividió en dos factores. El primero, relacionado con el componente de Restricción, se denominó "Restricción Activa" y el segundo, relacionado con el peso y las preocupaciones de la ingesta, se llamó "Predisposición a la Restricción". **Conclusiones:** la estructura factorial original del TFEQ no se replica. En este artículo se presenta un instrumento revisado de 23 ítems, que representa los tres nuevos factores derivados, como instrumento de cribado válido para pacientes obesos graves.

Palabras clave: TFEQ, Inventario de Alimentación, obesidad mórbida, estructura factorial.

Obesity is a metabolic disorder that has reached epidemic proportions in developed countries throughout the last century (WHO, 2000, 2003).

One of the most frequently used questionnaires for the measurement of behavioral and cognitive components of food intake in obesity is the Three Factor Eating Questionnaire (TFEQ; Stunkard & Messick, 1985), also known as the Eating Inventory (EI; Stunkard & Messick, 1988). The TFEQ is based on Herman and Mack's Restraint Theory (Herman et al., 1975) and on the boundary model of food regulation (Herman & Polivy, 1984). It was created to improve some of the psychometric issues found in the predictive and construct validity of the Restraint Scale and to promote the study of restraint in obesity (Ruderman, 1986). It was developed, via factorial analysis, from responses to the Restraint Scale (Herman & Polivy, 1980), the Latent Obesity Questionnaire (Pudel, Metzdorff, & Oetting, 1975) and some new items based on clinical practice. Three factors were extracted, "Cognitive Restraint of Eating", "Disinhibition of Eating Control" and "Susceptibility to Hunger". The internal consistency indexes were .93, .91 and .85, respectively.

Some studies have tried to confirm the factorial structure of the TFEQ. Ganley (1988) found, in a mixed sample of women, a four-factor design, with the factors Restraint, Hunger and the original Disinhibition factor divided into Weight Lability and Emotional Eating, in relation to the loss of control over eating when associated with negative emotional states . Hyland, Irvine, Thaker, Dann, and Dennis (1989) found a three-factor organization

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Corresponding author: Diana Taboada Denia
Servicio de Psiquiatría
Hospital Universitario 12 de Octubre
28045 Madrid (Spain)
e-mail: taboada.diana@gmail.com

(Disinhibition and Hunger joined in a single factor, Restraint, and Emotional Eating) in a similar sample. These factorial solutions were analyzed by a confirmatory factor analysis conducted by Mazzeo, Aggen, Anderson, Tozzi, and Bulik (2003) in a population sample of female twins, finding a poor fit of the factor structure in their sample.

In 2000, Karlsson, Persson, Sjostrom, and Sullivan carried out the "Swedish Obese Subjects (SOS)" study (N= 4.377), in which obese subjects undergoing treatment were assessed. The resulting scale had a three-factor structure: Cognitive Restriction, Uncontrolled Eating—which includes most of the Disinhibition and Hunger items— and Emotional Eating. In their reduced version of the TFEQ (TFEQ R-18), they proposed to change the scoring method, switching from dichotomous responses to a 4-point Likert scale. Some studies using the TFEQ R-18 have shown good internal consistency in the general population (Angle et al., 2009; de Lauzon et al., 2004). Tholin, Rasmussen, Tynelius, and Karlsson (2005) added 3 items in order to avoid floor and ceiling effects in the Emotional Eating factor in a twin male sample. They found a strong genetic influence in the three factors that could not be confirmed for females (Mazzeo et al., 2003; Neale, Mazzeo, & Bulik, 2003).

In Spain, the only adaptation of the original TFEQ was carried out on a non-clinical sample of university female students (Sánchez-Carracedo, Raich, Figueras, Torrás, & Mora, 1999). Nevertheless, no validation has been made to date with a clinical obese Spanish sample, despite that questionnaire has proven particularly useful among this population (Gade, Rosenvinge, Hjelmesaeth, & Friborg, 2014). The TFEQ is a sensitive tool to describe changes in the dysfunctional eating behavior of obese patients undergoing surgery (Laurenius et al., 2012), to choose between different bariatric techniques (Apovian et al., 2013), to adapt interventions to reduce weight based on eating behavior (Bryant, Caudwell, Hopkins, King, & Blundell, 2012), to test the effectiveness of psychotherapeutic interventions focused on dysfunctional eating (Gade, Hjelmesaeth, Rosenvinge, & Friborg, 2014) and for web-based weight loss programs (Svensson et al., 2014).

Thus, the objective of the present research was to study the factorial structure and psychometric properties of the original TFEQ among a Spanish sample of morbidly obese patients (defined as those with a BMI of 40 or more and those with a BMI≥ 35 with other medical comorbidities), candidates for bariatric surgery (BS). Following Karlsson's work, the reduction of items was aimed, as a secondary objective, in order to yield more efficient scales.

Methods

Participants

The sample was composed of 222 outpatients (66 men and 156 women) with morbid obesity (BMI mean: 45.16; SD: 7.26. Range: 30-80) that had already initiated the previous assessment process for BS according to the criteria defined in the World Guide to Obesity (WHO,2000). From a total sample of 230 patients, 3.5% (8 candidates) refused to participate in the study.

Mean age for participants was 41.84 years (SD: 11.11; Range: 18-75), mean years of education was 10.97 (SD: 3.31; Range: 2-22), one third of the sample only had primary education (35.1%). Patients were part of a Public Financial study where clinical and neuropsychological features of morbidly obese patients with and without binge eating disorder were obtained. The TFEQ, together with two other self-applied questionnaires, were administered to patients as part of the psychiatric evaluation protocol. The sample was recruited from two National Public Health Hospitals in Madrid: The "Hospital Universitario 12 de Octubre" (78% of the total sample), and the "Hospital Universitario de la Paz" (22% of the sample). The study was approved by the Research Ethics Committee and all patients completed an informed consent before the assessment.

Instruments

The Three-Factor Eating Questionnaire (Stunkard & Messick, 1985) is a 51-item self-applied questionnaire divided in two parts: the first part is composed of 36 items with two-option answers (true-false) and the second part is composed of 15 items with 4-choice answers. The 0-1 responses are added to yield a total score. Higher scores reflected greater levels of Cognitive Restraint (21 items), Disinhibition (16 items) and Hunger (14 items).

Procedure

Direct translation and adaptation from the original questionnaire was conducted by a senior Psychiatrist (PhD) and a Psychologist (MSc, proficiency English level) specialized in eating disorders and obesity. It was subsequently compared with the adaptation carried out by Sánchez-Carracedo in order to discuss and solve the differences found between the two versions. Due to the particular cultural levels in the present study's recruitment area, some items were adapted in order to facilitate their comprehension, favoring the use of colloquial expressions commonly used to describe eating behaviors in daily life (Table 1).

Data analyses

A multi-trait/multi-item analysis was conducted to study the psychometric properties of the original scales of the TFEQ (Ware, 1983). The item-scale correlation matrices were calculated, comparing each item across the three scales. The items' convergent validity (Criterion 1) was appropriate when every item considerably correlated with the scale it represented ($r \geq 0.40$, corrected overlap) (Howard & Forehand, 1962).

Discriminant validity of items (criterion 2) was considered appropriate when the items highly correlated with the scale they represented in comparison with the other two scales. The significant difference between the item/scale correlations was determined using the standard matrix error of correlations ($1/\sqrt{n}$). The significant criterion used was 2 standard errors. Alpha coefficients (KR- 20) were also calculated to estimate the internal consistency of the scales' scores (reliability) (Kuder & Richardson, 1937).

A principal components factor analysis was conducted to study the TFEQ's factor structure (Gorsuch, 1983). Orthogonal (varimax) and oblique (promax) rotations were explored. A sediment tree was used to determine the number of factors. Items with a minimum loading of 0.40 were selected for each factor. Every extracted factor was renamed after a content analysis. With the purpose of studying the unidimensionality and homogeneity of the original scales of the TFEQ, factor analyses of every original scale were performed separately.

Table 1
Original TFEQ and Spanish adaptation

Part I (True or False)		Parte I (Verdadero o Falso)
1. When I smell a sizzling steak or see a juicy piece of meat, I find it very difficult to keep from eating, even if I have just finished a meal.		1.Cuando me llega el olor de la carne en la sartén, o veo un buen filete jugoso me resulta difícil retenerme y no comérmelo, incluso habiendo terminado de comer
2. I usually eat too much at social occasions like parties and picnics.		2. Suelo comer demasiado en reuniones sociales, como fiestas y picnics
3. I am usually so hungry that I eat more than three times a day.	***DE-13***	*3. Suelo tener tanta hambre que como más de tres veces al día*
4. When I have eaten my quota of calories, I am usually good about not eating any more.		4. Cuando he tomado mi cuota de calorías, entonces dejo de comer.
5. Dieting is so hard for me because I just get too hungry.	**DE**	5. Me resulta muy difícil seguir una dieta porque me muero de hambre.
6. I deliberately take small helpings as a means of controlling my weight.	**RB-6**	6. Me sirvo deliberadamente poco como medida para controlar el peso
7. Sometimes things just taste so good that I keep on eating even when I am no longer hungry.	**DE**	7. A veces las cosas saben tan bien que no puedo remediar seguir comiendo aún sin tener hambre
8. Since I am often hungry, I sometimes wish that while I am eating, an expert would tell me that I have had enough or that I can have something more to eat.	**DE-13**	8. Puesto que tengo hambre a menudo, a veces desearía que, cuando como, un experto me dijera que ya comí suficiente o que todavía puedo comer algo más
9. When I feel anxious, I find myself eating.	**DE-13**	9. Cuando me siento ansioso/a, me encuentro a mi mismo/a comiendo .
10. Life is too short to worry about dieting.	**PR-4**	10. La vida es demasiado corta para preocuparse de seguir una dieta (inv)
11. Since my weight goes up and down, I have gone on reducing diets more than once.		11. Me he puesto a dieta más de una vez porque mi peso sube y baja.
12. I often feel so hungry that I just have to eat something.	**DE**	12. A menudo tengo tanta hambre que tengo que comer algo.
13. When I am with someone who is overeating, I usually overeat too.	**DE**	13. Cuando estoy con alguien que come demasiado, normalmente yo también lo hago.
14. I have a pretty good idea of the number of calories in common food.		14. Sé bastante bien la cantidad de calorías que tienen los más comunes.
15. Sometimes when I start eating, I just can't seem to stop.	**DE-13**	15. A veces, cuando empiezo a comer, parece como si no pudiera parar.
16. It is not difficult for me to leave something on my plate.		16. No es difícil para mí dejarme algo en el plato.
17. At certain times of the day, I get hungry because I have gotten used to eating then.		17. Hay algunos momentos del día en los que tengo hambre porque me he acostumbrado a comer a esa hora.
18. While on a diet, if I eat food that is not allowed, I consciously eat less for a period of time to make up for it.		18. Cuando sigo una dieta, si como algo que me está prohibido, como conscientemente menos, durante un cierto periodo de tiempo, para compensarlo.
19. Being with someone who is eating often makes me hungry enough to eat also.	**DE-13**	19. Estar con alguien que está comiendo, a menudo, me pone lo bastante hambriento para comer yo también.
20. When I feel blue, I often overeat.	**DE-13**	20. Cuando me siento triste, a menudo como demasiado.
21. I enjoy eating too much to spoil it by counting calories or watching my weight.	**RB**	21. Me gusta demasiado comer como para estropearlo contando calorias o controlando el peso (Inv)
22. When I see a real delicacy, I often get so hungry that I have to eat right away.	**DE**	22. Cuando veo una verdadera exquisitez, a menudo me entra tanta hambre que tengo que comer de inmediato.
23. I often stop eating when I am not really full as a conscious means of limiting the amount that I eat.	**RB-6**	23. A menudo dejo de comer cuando todavía no estoy lleno como una medida consciente de limitar la cantidad de comida que tomo.
24. I get so hungry that my stomach often seems like a bottomless pit.	**DE-13**	24. Tengo tanta hambre que mi estómago, a menudo, parece un pozo sin fondo.
25. My weight has hardly changed at all in the last ten years.	**PR**	25. Mi peso casi no ha cambiado en los últimos diez años (inv).
26. I am always hungry so it is hard for me to stop eating before I finish the food on my plate.	**DE-13**	26. Siempre tengo hambre, así que me es difícil dejar de comer hasta que no he terminado todo lo que tengo en el plato.
27. When I feel lonely, I console myself by eating.	**DE-13**	27. Cuando me siento solo me consuelo comiendo.
28. I consciously hold back at meals in order not to gain weight.	**RB-6**	28. Me controlo conscientemente en las comidas para no ganar peso.
29. I sometimes get very hungry late in the evening or at night.	**DE**	29. A veces me entra mucha hambre a últimas horas de la tarde o por la noche.
30. I eat anything I want, any time I want.	**RB-6**	30. Como lo que quiero, todas las veces que lo deseo. (inv)
31. Without even thinking about it, I take a long time to eat.		31. Incluso sin darme cuenta me paso mucho tiempo comiendo. (inv)
32. I count calories as a conscious means of controlling my weight.		32. Cuento las calorías como un modo consciente de controlar mi peso
33. I do not eat some foods because they make me fat.	**RB**	33. Algunos alimentos no los tomo porque engordan.
34. I am always hungry enough to eat at any time.	**DE-13**	34. Siempre tengo suficiente hambre para comer a cualquier hora.
35. I pay a great deal of attention to changes in my figure.	**RB**	35. Presto mucha atención a los cambios que se producen en mi figura.
36. While on a diet, if I eat a food that is not allowed, I often then splurge and eat other high calorie foods.	**DE-13**	36. Cuando sigo un régimen, si tomo algo que me está prohibido, a menudo me suelto y tomo más alimentos altamente calóricos.

Table 1 (continuated)
Original TFEQ and Spanish adaptation

Part II	Parte II
Please answer the following questions by circling the number above the response that is appropriate to you.	*Por favor, responde a las siguientes preguntas marcando el número correspondiente a la respuesta que describe tu comportamiento.*
37. How often are you dieting in a conscious effort to control your weight? **1. Rarely; 2. Sometimes; 3. Usually; 4. Always** **RB-6**	37. ¿Con qué frecuencia está a dieta en un esfuerzo consciente por controlar su peso? 1. Raramente; 2. A veces; 3. Normalmente; 4. Siempre
38. Would a weight fluctuation of 5 lbs affect the way you live your life? **1. Not at all; 2. Slightly; 3. Moderately; 4. Very much**	38. ¿Le afectaría a su forma de vida un cambio de peso de 2 kg? 1. Nada; 2. Ligeramente; 3. Moderadamente; 4. Mucho
39. How often do you feel hungry? **1. Only at mealtimes; 2. Sometimes between meals; 3. Often between meals; 4. Almost always** **DE-13**	39. ¿Con qué frecuencia tiene hambre? 1. En las comidas; 2. A veces entre horas; 3. Frecuentemente entre horas; 4. Casi siempre
40. Do your feelings of guilt about overeating help you to control your food intake? **1. Never; 2. Rarely; 3. Often; 4. Always** **RB-6**	40. ¿Su sentimiento de culpa por comer demasiado le ayuda a controlar lo que come? 1. Nunca; 2. Raramente; 3. A menudo; 4. Siempre
41. How difficult would it be for you to stop eating halfway through dinner and not eat for the next four hours? **1. Easy; 2. Slightly difficult; 3. Moderately difficult; 4. Very difficult** **DE**	41. ¿Le sería difícil interrumpir su comida a la mitad y no comer durante las 4 horas siguientes? 1. Fácil; 2. Un poco difícil; 3. Moderadamente difícil; 4. Muy difícil
42. How conscious are you of what you are eating? **1. Not at all; 2. Slightly; 3. Moderately; 4. Extremely** **PR-4**	42. ¿Es usted consciente de lo que come? 1. Nada; 2. Un poco; 3. Bastante; 4. Mucho
43. How frequently do you avoid 'stocking up' on tempting foods? **1. Almost never; 2. Seldom; 3. Usually; 4. Almost always**	43. ¿Con qué frecuencia evita comprar comidas tentadoras? 1. Casi nunca; 2. A veces; 3. Normalmente; 4. Casi siempre
44. How likely are you to shop for low calorie foods? **1. Unlikely; 2. Slightly unlikely; 3. Moderately likely; 4. Very likely**	44. ¿Suele comprar alimentos bajos en calorías? 1. No; 2. Alguna vez; 3. Normalmente; 4. Siempre
45. Do you eat sensibly in front of others and splurge alone? **1. Never; 2. Rarely; 3. Often; 4. Always**	45. ¿Come sensatamente delante de los demás y se atiborra solo? 1. Nunca; 2. Raramente; 3. A menudo; 4. Siempre
46. How likely are you to consciously eat slowly in order to cut down on how much you eat? **1. Unlikely; 2. Slightly unlikely; 3. Moderately likely; 4. Very likely** **PR-4**	46. ¿Le sería posible comer despacio conscientemente para comer menos? 1. Imposible; 2. Poco posible; 3. Posible; 4. Muy posible
47. How frequently do you skip dessert because you are no longer hungry? **1. Almost never; 2. Seldom; 3. At least once a week; 4. Almost every day**	47. ¿Con qué frecuencia no toma postre porque ya no tiene más hambre? 1. Casi nunca; 2. A veces; 3. Al menos una vez por semana; 4. Casi cada día
48. How likely are you to consciously eat less than you want? **1. Unlikely; 2. Slightly unlikely; 3. Moderately likely; 4. Very likely** **PR-4**	48. ¿Estaría dispuesto a comer conscientemente menos de lo que desea? 1. Imposible; 2. Poco posible; 3. Posible; 4. Muy posible
49. Do you go on eating binges though you are not hungry? **1. Never; 2. Rarely; 3. Sometimes; 4. At least once a week** **DE-13**	49. ¿Continúa comiendo lo que encuentra aunque no tenga hambre? 1. Nunca; 2. Raramente; 3. A veces; 4. Al menos una vez por semana
50. On a scale of 0 to 5, where 0 means no restraint in eating (eating whatever you want, whenever you want it) and 5 means total restraint (constantly limiting food intake and never 'giving in'), what number would you give yourself? **0. Eat whatever you want, whenever you want it** **1. Usually eat whatever you want, whenever you want it** **2. Often eat whatever you want, whenever you want it** **3. Often limit food intake, but often 'give in'** **4. Usually limit food intake, rarely 'give in'** **5. Constantly limiting food intake, never 'giving in'** **RB**	50. En una escala del 0 al 5, donde 0 significa "ninguna restricción para comer" (comer lo que uno quiere y cuando quiere), y 5 significa "restricción total" (limitarse constantemente la comida y no ceder nunca). ¿Qué puntuación se daría a sí mismo? 0. Como lo que quiero, cuando quiero 1. Normalmente como lo que quiero, cuando quiero 2. A menudo como lo que quiero, cuando quiero 3. A menudo limito lo que como, pero cedo frecuentemente 4. A menudo limito lo que como y cedo rara vez 5. Constantemente limito lo que como, no cediendo nunca
51. To what extent does this statement describe your eating behavior? 'I start dieting in the morning, but because of any number of things that happen during the day, by evening I have given up and eat what I want, promising myself to start dieting again tomorrow.' **1. Not like me; 2. Little like me; 3. Pretty good description of me; 4. Describes me perfectly**	51. ¿Hasta qué punto describe su hábito alimentario lo siguiente?: "Empiezo a seguir un régimen por la mañana pero, a causa de numerosas circunstancias que suceden durante el día, al final de la tarde ya lo he dejado y como lo que me apetece prometiéndome a mí mismo que volveré a empezar el régimen al día siguiente" 1. Nada; 2. Un poco; 3. Bastante; 4. Perfectamente

To analyze the stability and generality of the new factor structure, analyses of subgroups by age, sex and BMI were conducted (items with loadings <0.40 were excluded). The psychometric properties of new scales were studied with a multi-trait/multi-item analysis.

Finally, to examine the prognostic value of the newly revised scales, correlations (Pearson) of new scales with BMI in the moment of assessment and the percentage of weight lost 20 months after surgery were performed. Results of those scales were considered among two subgroups of patients, depending on

the presence or absence of binge eating disorder at the moment of evaluation, using a one-way ANOVA.

Results

Multitrait/multi-item scaling analyses

In Table 2, the Multitrait/multi-item scaling analyses are presented. The reliability coefficients (KR-20) for every scale were over the 0.70 standard, but under the 0.90 limit recommended for individual evaluation. The item-scale correlation analysis showed a weak internal consistency of items, especially in the Cognitive Restraint and Disinhibition scales. Seven of the 21 items of Restraint, 9 out of 16 from the Disinhibition and 7 of the 14 items of the Hunger factor exceeded the minimum desired level (r ≥0.40, corrected overlap) of convergent validity of items. The discriminant validity analyses showed clear difficulties in the assignment of the designated items to the Disinhibition and the Hunger factors. Many items were related to both scales, mainly the ones corresponding to the Disinhibition factor. Items assigned to Cognitive Restraint demonstrated a strong discriminative capacity. Correlations between those items and the other two scales were low (r<0.32) and only one item could not overcome discriminate validity criteria. In sum, 7 out of 21 items from the Cognitive Restraint, 5 out of 16 from the Disinhibition and 5 out of 14 items from the Hunger scales fulfilled discriminant and convergent validity criteria in this study's sample.

Factor structure of the TFEQ

Following the scree test indications, a 3- factor solution was inforced. Item loadings of 0.40 or higher are represented in Table 3. The solution explained a 32% of the total variance. It was not possible to differentiate between the concepts of Disinhibition and Hunger, as was observed in the scalar multi-trait analysis above. The first factor contained 8 items from the Disinhibition and 12 from the Hunger scales with moderate loadings (ranging from 0.42 to 0.64). Item number 15 showed the highest loading (0.64). This factor included a wide range of items related to an extreme appetite, a failure of control over eating and the items about emotional eating with loadings around 0.60. Renaming this factor as "Dysregulated Eating" was considered so as to include diverse aspects such as appetite or lack of control over eating associated to any type of trigger. Patients who scored in this scale described an elevated intensity of the hunger sensation and a frequent loss of control over food intake in any daily situation.

The second factor comprised 10 items from the Cognitive Restraint scale. Item number 28 yielded the highest loading (0.68). In this factor, items related to active behaviors of restraint were observed, and was consequently labeled as "Restrained Behavior". Patients scoring in this scale stated that they usually employed behavioral strategies for the self-control of their daily food intake.

The third factor included 4 items from the Restraint scale and 1 from Disinhibition (item number 25), related to motivation and concern over intake and weight, and therefore was designated as "Predisposition to Restraint". Patients scoring in this scale showed an elevated disposition to perform restraint behaviors and showed evidences of being concerned about food intake and body weight.

Unidimensionality of the original TFEQ scales

The analysis of each original scale led to the confirmation of the division into two factors of the Cognitive Restraint scale (according to the scree test) where, in the first factor, items related to restraint behaviors were grouped, and in the second factor, items associated with "Predisposition to Restraint" were found. The analysis of the 12 items of Hunger showed factor loadings of 0.40 and higher. Only one factor was identified. The Disinhibition scale revealed the possibility of two factors, although when forcing the two-factor solution, the saturations in both scales were above 0.40 on 33% of the items, leaving 2 items from the original scale out of the solution. Correlations of factorial scores (after oblique rotation) showed a moderate association (r= 0.33).

Table 2
Summary of the results of multitrait/multi-item scaling tests of the TFEQ and Reliability estimates

	Multitrait/multi-item scaling tests				Reliability	
	Ítem-scale convergent validity		Ítem-scale discriminant validity		Scaling fulfilment	
	Range of r	Criterion 1	Range of r	Criterion 2		
Scales[a]	Item-scale correlations[b]	Number of item-scale correlations ≥0.40[c]	Correlations with other scales[d]	Number of items significantly higher[e]	Number of items that meet both criteria 1 and 2[f]	KR-20
Sample (n= 222)						
Cognitive restraint	0.03 - 0.59	7/21	0.00 - 0.31	20/21	7/21	0.75
Disinhibition	0.03 - 0.51	9/16	0.01 - 0.53	8/16	5/16	0.70
Hunger	0.12 - 0.56	7/14	0.01 - 0.49	8/14	5/14	0.79

[a] Cognitive restraint (21 items), Disinhibition (16 items) and Hunger (14 items).
[b] Pearson correlations between items and scales (corrected for overlap).
[c] Item-scale correlations that meet the standard for convergent validity (r ≥0.40)/ Number of correlations.
[d] Range of correlations between items and competing scales.
[e] Correlations significantly higher between items and original scale in comparison with all other scales (by 2 standard errors or more / total number of correlations.) The standard error of the correlation matrix was 0.067.
[f] Items in each scale that met criteria for both convergent (Criterion 1) and discriminant (Criterion 2) validity

Table 3
Factor structure (three-factor solution) of the TFEQ, Reliability estimates, Means, Standard Deviations (SD) and Ranges of each factor

Factor loadings≥ 0.40 (orthogonal rotation)					
Factor 1 "Dysregulated eating"[a]		**Factor 2 "Restraint behaviour"**		**Factor 3 "Predisposition to restraint"**	
Item [b]		**Item**		**Item**	
DI15	0.64	CR28	0.68	DI25	0.59
HU3	0.63	CR6	0.63	CR10	0.58
HU24	0.62	CR23	0.63	CR46	0.53
DI9	0.61	CR40	0.61	CR48	0.52
HU26	0.61	CR30	0.53	CR42	0.49
DI27	0.60	CR37	0.52		
HU34	0.60	CR33	0.46		
HU20	0.59	CR50	0.46		
DI49	0.59	CR21	0.43		
DI19	0.55	CR35	0.42		
HU39	0.54				
DI13	0.53				
DI7	0.52				
DI36	0.50				
HU22	0.50				
HU8	0.46				
HU29	0.45				
HU12	0.44				
HU5	0.44				
H41	0.42				
KR-20	0.88	**KR-20**	0.78	**KR-20**	0.64
Mean (SD)	**Range**	**Mean (SD)**	**Range**	**Mean (SD)**	**Range**
9.85 (5.54)	0-20	4.09 (2.78)	0-10	3.52 (1.45)	0-5

[a] Eigenvalues were 7.89 for Factor 1; 4.67 for Factor 2; and 3.5 for Factor 3.
[b] Letters and item numbers refer to the original placement in StunKard and Messick (9): Cognitive Restraint (CR), Disinhibition (DI) and Hunger (HU)

Multitrait/ multi-item analyses of the revised scales

Factors derived from the factor analysis, "Dysregulated Eating" (DE), "Restrained Behavior" (RB) and "Predisposition to Restraint" (PR) were examined and organized into different subgroups. The factor structure was studied for the men and women subgroups, in patients under 45 years of age and in patients of 45 or older, and in subjects with a BMI<45 vs a BMI ≥45. The only items contributing with over a 0.40 for one factor in every subgroup were included. The items that compose the final scales are listed in Table 1. A total of 23 items: 13 assigned to "Dysregulated Eating" (DE-13), 6 items to "Restrained Behavior" (RB-6) and 4 items to "Predisposition to Restraint" (PR-4). The estimated internal consistency (KR-20) was appropriate for the revised scales: DE-13 (0.85) and RB-6 (0.73) and PR-4 (0.60), which showed the poorest adjustment.

As can be observed in Table 4, the new scales fulfilled the discriminant validity criteria suggested, except for the item *"I eat anything I want, any time I want"* (inverse punctuation) from the RB-6 scale, whose correlation with the PR-4 scale did not reach two standard errors as significant difference (0.12<0.13 of established minimum value of difference between correlations). The same case is found in item number *10 "Life is too short to worry about dieting"* (inverse punctuation) (0.11<0.13).

Convergent validity criteria (corrected overlap) presented moderated levels of correlation. In the DE-13 scale, all the items yielded correlations above 0.40, excluding item 8 *"Since I am often hungry, I sometimes wish that while I am eating, an expert would tell me that I have had enough or that I can have something more to eat"* which presented a correlation of 0.37, close to the recommended standard. Furthermore, at a clinical level, it was considered appropriate to maintain this item due to its conceptual characteristics. It was certainly related to the maladjustment of the satiety signal response and the need of an external measure as a way to control overeating, which is characteristic in a high percentage of morbidly obese patients. In the RB-6, only item 37 *"How often are you dieting in a conscious effort to control your*

Table 4
Summary of results of multitrait/multi-item scaling tests for revised and reduced scales and Reliability estimates

	Multitrait/multi-item scaling tests					**Reliability**
	Ítem-scale convergent validity		**Ítem-scale discriminant validity**		**Scaling fulfilment**	
	Range of r	**Criterion 1**	**Range of r**	**Criterion 2**		
Revised scales [a]	**Item-scale correlations[b]**	**Number of item-scale correlations ≥0.40[c]**	**Correlations with other scales[d]**	**Number of items significantly higher[e]**	**Number of items that meet both criteria 1 and 2[f]**	**KR-20**
Sample (n= 222)						
Dysregulated eating	0.37-0.58	12/13	0.00-0.31	13/13	12/13	0.85
Restraint behaviour	0.36-0.53	5/6	0.00-0.29	5/6	5/6	0.73
Predispostion to restraint	0.32-0.44	1/4	0.01-0.20	3/4	1/4	0.60

[a] Dysregulaedt eating (14 items), Restraint behaviour (6 items) and Predisposition to Restraint (4 items).
[b] Pearson correlations between items and scales (corrected for overlap).
[c] Item-scale correlations that meet the standard for convergent validity (r ≥0.40)/ Number of correlations.
[d] Range of correlations between items and competing scales.
[e] Correlations significantly higher between items and original scale in comparison with allother scales (by 2standard errors or more/ total number of correlations.) The standart error of the correlation matrix= 0.067
[f] Items in each scale that meet criteria for both convergent (Criterion 1) y discriminant (Criterion 2) validity

weight?", with a correlation of 0.36, did not reach the proposed condition. Its inclusion was considered as it represented a nuclear characteristic of the scale. The PR-4 scale presented a level of correlations of 0.32-0.44 between its items. Item 46: *"How likely are you to consciously eat slowly in order to cut down on how much you eat?"* was the only item presenting a correlation higher than 0.40, and item 10 (r= 0.32) was the only item correlating under 0.38.

RB-6 scale (r= 0.87) and moderately correlated with PR-4 (r= 0.48).

Preliminary results of the predicted values of revised scales in a subgroup of the sample (n= 22) allowed to point out that scores in the revised PR-4 scale showed a small positive association with BMI (r= 0.17; p= 0.012) and the revised RB-6 scale was positively associated with the percentage of weight lost (mean= 37.74; SD= 10.44) about 18 months (Mean:18.27; DT: 5.05) after BS (r= 0.54; p= 0.009).

Table 5
Intercorrelations between the original TFEQ scale scores, derived factor scores (three factors) and revised-reduced scale scores (n= 222)

	Pearson correlations (r)								
	TFEQ original scales			Derived factors			Derived factors		
	CR-21	DI-16	HU-14	Factor 1	Factor 2	Factor 3	DE-13	RB-6	PR-4
TFEQ original scales									
Cognitive restraint (CR-21)									
Disinhibition (DI-16)	-0.120 0.074								
Hunger (HU-14)	-0.187(**) 0.005	0.716(**) 0.000							
Derived factors									
Factor 1 (Dysregulation eating)	-0.193(**) 0.004	0.867(**) 0.000	0.939(**) 0.000						
Factor 2 (Restraint behaviour)	0.924(**) 0.000	-0.157(*) 0.020	-0.189(**) 0.005	-0.212(**) 0.001					
Factor 3 (Predisposition to Restraint)	0.420(**) 0.000	0.065 0.338	-0.124 0.065	0.047 0.487	0.357(**) 0.000				
Revised-scales									
Dysregulated eating (DE-13)	-0.164(*) 0.014	0.838(**) 0.000	0.910(**) 0.000	**0.972(**)** 0.000	-0.186(**) 0.005	-0.051 0.446			
Restraint behaviour (RB- 6)	0.872(**) 0.000	-0.111 0.098	-0.119 0.077	-0.140(*) 0.037	**0.939(**)** 0.000	0.254(**) 0.000	-0.106 0.115		
Predisposition to Restraint (PR-4)	0.478(**) 0.000	-0.010 0.876	-0.165(*) 0.014	-0.115 0.089	0.315(**) 0.000	**0.957(**)** 0.000	-0.097 0.149	0.292(**) 0.000	

** Statistical significant correlation at 0.01 (bilateral).
* Statistical significant correlation at 0.05 (bilateral)

Correlations between the original scales, derived factors and revised scales

In Table 5, the degrees of association between the original scales of the TFEQ are presented, with the scores for the derived factors and the revised scales. Strong associations between revised scales and their corresponding factors were obtained: DE-13 vs Factor 1/DE (r= 0.97), RB-6 vs. Factor 2 /RB (r= 0.94), and PR-4 vs Factor 3/PR (r= 0.96). Factor 1 and Factor 2 showed a light inverse correlation (r= -0.21). A positive association between Factor 2 and Factor 3 was observed (r= 0.36), while Factor 1 and Factor 3 were not related (r= 0.05). The DE-13 scale presented high correlations with the original scales of Disinhibition (r= 0.84) and Hunger (r= 0.91), and a weak inverse correlation with Cognitive Restraint (r= -0.16). At the same time, the original scale of Cognitive Restraint strongly correlated with the revised

Table 6
Means, Standard Deviations (SD) and 95% Confidence Index (CI(95%) of the revised scales in an obese group suffering from Binge Eating (BE-Group) and those without Binge Eating (N BE-Group). Difference between groups (one way ANOVA)

	BE-Group (n= 89)		N BE-Group (n= 132)			
Revised scales[a]	Mean (SD)	CI (95%)	Mean (SD)	CI (95%)	F(1,219)	P-value
DE-13	9,20 (3,15)	8,54 - 9,87	5,33 (3,08)	4,80 - 5,86	82,29	0,000
RB-6	2,15 (1,71)	1,78 - 2,51	2,56 (1,94)	2,23 - 2,89	2,66	0,104
PR-4	3,09 (0,92)	2,89 - 3,28	2,61 (1,36)	2,37 - 2,84	8,60	0,004

[a] DE-13 (Dysregulated eating); RB-6 (Restraint behaviour); PR-4 (Predisposition to Restraint)

Moreover, the performance of the scales was analyzed according to the presence or absence of binge eating. The revised DR-13 and PR-4 scales yielded a significantly different effect for both groups. Results are shown in Table 6.

Discussion

The factor structure of the original TFEQ was not replicated among this study's sample of patients with morbid obesity. This research obtained the following factors: "Dysregulated Eating", "Restraint Behavior" and "Predisposition to Restraint". Moreover, the removal of items that did not sufficiently represent those factors in the different subgroups of the sample, yielded 3 reduced scales (DE-13, RB-6 and PR-4) that maintained appropriate psychometric properties.

The factor explaining most of the variability of the data, containing almost the complete sum of items from the original factors of Hunger and Disinhibition, was the factor labeled "Dysregulation Eating" (DE). The failure to replicate both factors was already stated by Karlsson et al. (2000), who referred that these factors were sustained in the hypothesis of the internal-external model of obesity: obese patients would be more sensible to environmental temptations (items representing disinhibition) and less sensible to internal signs of hunger and satiety (items representing hunger). The studies aimed at confirming such hypothesis have shed inconsistent results, related mainly to the difficulties in distinguishing between internal and external eating stimuli. The psychometric analysis in this research verified the strong association between the items from the Hunger and Disinhibition scales, supporting the idea of a lack of differentiation between internal and external triggers.

In the DE factor, the items referring to emotional eating were included, contrary to previous studies that supported the presence of a differentiated factor for it (Angle et al., 2009; Ganley, 1988; Karlsson et al., 2000; Tholin et al., 2005). The differences can be explained by the disparity of size and characteristics from the studied samples. In this study, the sample was fairly homogenous (severe to extreme obesity, resistance to traditional treatments of weight reduction, elevated percentage of patients with binge eating) compared to previous studies that included different ranges of weight (normal weight, overweight and obesity), non-clinical samples, and obese patients under weight reduction treatment, etc.

Chronicity and severity of obesity were considered as determinant factors in the absence of item differentiation related to emotional eating. Following the psychosomatic theory of obesity, emotional eating is at the base of the development of obesity (Kaplan & Kaplan, 1957). The continuous association between physiological activation and comfort-searching through food intake, observed in some dysphoric states, could result in a cognitive reattribution of those signs of activation into perceived hunger signs, leading to a cognitive overlap between the physiologic hunger sensation and the state of emotional dysphoria.

In this study's sample, the original Restraint factor was clearly divided in two factors. The first factor was related to behaviors of active restraint (RB) and the second factor was associated with cognitive aspects of restraint (worry about eating and motivation for restraint) (PR). Previous research has found similar results in this tendency (Fairburn & Beglin, 1994; White, Masheb, & Grilo, 2009). One of such studies, the White et al. (2009) study, found a two-factor solution (Regimented Restraint and Lifestyle Restraint). However, Bond, McDowell and Wilkinson (2001) obtained three factors from the original Restraint scale (Strategic Dieting Behavior, Attitude to Self-Regulation, Avoidance of Fattening Foods); and Westenhoefer (1991) found a division: Rigid Control and Flexible Control, associated respectively with higher or lower scores in Disinhibition.

In this study's model, the presence of strategies of control over eating behaviors (RB) was associated with a lower intensity of lack of control over eating (DE). Therefore, in patients with morbid obesity, the employment of behavioral resources for the control of food intake would reduce the probability of overeating episodes, as was reported in studies of obese patients in treatment (Foster et al., 1998).

Contrasting with prior researches that could not find any relation between the basal TFEQ scores and weight reduction (Bocchieri-Ricciardi et al., 2006; Burgmer et al., 2005), the preliminary results of patients' follow-up after surgery indicated a clear association between basal punctuations in the RB-6 and the percentage of weight lost in a medium term post-surgery. This confirmed that the acquisition and the implementation of control over eating habits before surgery were translated into better objective achievements after the procedure. Those findings were especially relevant to development of behavior-cognitive treatments before surgery. They could contribute to decrease the intensity of the symptoms of lack of control over eating after the procedure, since it is the principal predictive factor of the long term response to surgery (Kalarchian et al., 2002; White, Kalarchian, Masheb, Marcus, & Grilo, 2010).

Nevertheless, the cognitive component of Restraint (PR), that is, the worries related with eating or the focused attention to restraint, was associated with a higher BMI and with the presence of binge eating. In this study's sample, being evaluated as candidates for BS could act as a positive bias, increasing the probability of answering positively in this scale, because patients with higher levels of BMI (and presumably greater presence of comorbidities) BS could be their last chance of treatment. The association of the PR-4 with binge eating was consistent with the alteration of cognitive patterns in patients with BED,which implied a great concern over eating and weight, but a persistent incapability to manage or control their eating over time (Hsu et al., 2002; Kalarchian, Wilson, Brolin, & Bradley, 1998).

The factor structure derived from the sample showed appropriate statistical values of validity and reliability. To our knowledge, this was the first study that has analyzed the performance of TFEQ on a Spanish clinical population with severe obesity. The purpose of reducing the number of items included in the scales allowed the identification of the items that represented the relevant information in men and women, in different ranges of ages and in different levels of severe obesity.

The adaptations carried out previously, with Spanish and Mexican women, showed different factor structures (2-factorsolutions) (López-Aguilar et al., 2011; Sánchez-Carracedo, Raich, Figueras, Torras, & Mora, 1999). Comparing these results with the ones obtained in the present study, it is difficult to substantiate differences among sex distribution, mean age or educational level in the different samples. The next goal should be to increase the sample number with normal-weight participants for comparison with general population.

The principal issue of the study was the lack of equity in the sex distribution and the limited number of patients' follow-up in two years, thus it would be convenient to replicate the results obtained in greater samples. Moreover, the sample showed very homogeneous clinical features, which means that the scales derived from the

analysis could result in a useful and easy-to-manage instrument in BS and endocrinology offices, where the evaluation process for surgery normally / generally starts, allowing for a better detection of successful candidates for BS and providing specific adaptations to treatments performed before procedures.

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