ORIGINAL

Three-Factor Eating Questionnaire-R18 (TFEQ-R18) Spanish Version: Factor Structure Analysis Among Normal Weight and Overweight Adults[1]

Cuestionario de Tres Factores de la Alimentación R18 (TFEQ-R18) Versión en Español: Análisis de la Estructura Factorial en los Adultos de Peso Normal y con Sobrepeso

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Abstract

The objective of this study was to examine the construct validity of the Three Factor Eating Questionnaire (TFEQ) Revised-18, an instrument designed to measure: Uncontrolled Eating, Emotional Eating and Cognitive Restraint, in a sample of Mexican adults of different weights. 342 man and women, with age range 19-79 years old (M=40), were recruited. TFEQ was emailed to the participants who earlier had their weight and height measured. Exploratory and confirmatory factor analysis was applied to examine TFEQ structure. The original three factor structure was corroborated, with nine items loading high on Uncontrolled Eating factor, three on Emotional Eating and four out of the original six on Cognitive Restraint. Two items were excluded due to low item-total correlations. Higher levels of Cognitive Restraint were associated with higher BMI ($r=.13$, $p < .05$), we found no connection between Uncontrolled Eating or Emotional Eating and body weight. Our findings suggest that the abbreviated TFEQ (16 items), is a psychometrically valid measure, and can be used to evaluate the tendencies of Cognitive Restraint, Uncontrolled Eating and Emotional Eating in the population of Mexican adults with different body weights.

Keywords: TFEQ-R18, Eating Behavior, Factor Structure, Mexican Population

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Resumen

El objetivo de este estudio fue examinar la validez de constructo del Cuestionario de Tres Factores de Alimentación (TFEQ) revisado-18, un instrumento diseñado para medir: Ingesta Incontrolada (II), Ingesta Emocional (IE), y Restricción Cognitiva (RC), en mexicanos adultos de diferentes pesos. Participaron 342 hombres y mujeres, con un rango de edad 19-79 años (M 40). A los participantes se les midió peso y estatura y posteriormente se les envió TFEQ por correo electrónico. La estructura del TFEQ se examinó con el análisis factorial exploratorio y confirmatorio. Se corroboró la estructura original de tres factores, con nueve reactivos que cargaron alto en II, tres en IE y cuatro de los seis originales en RC. Se excluyeron dos ítems debido a las bajas correlaciones reactivo–puntaje total. Los niveles más altos de RC se asociaron con un IMC más alto (r .13, p <.05), no se encontraron relaciones entre II o IE y el peso corporal. Nuestros hallazgos sugieren que el TFEQ abreviado (16 ítems) es una medida psicométricamente válida y puede usarse para evaluar las tendencias de II, IE, y RC en la población de adultos mexicanos con diferentes pesos.

Palabras Clave: TFEQ-18, Comportamiento Alimentario, Estructura Factorial, Población Mexicana

Better knowledge of the psychology of eating, its cognitive, emotional and behavioral aspects call for more attention given the increasing prevalence of obesity worldwide, and particularly in the under-investigated populations where obesity rates are peaking. In Mexico 75% of adults is either overweight or obese (Secretaría de Salud, 2018), yet the interaction between eating behavior and health has not been extensively investigated. There is a need for valid instruments applicable to a Latin population for evaluating eating behavior.

The Three-Factor Eating Questionnaire (TFEQ) is one of the recognized, and extensively used instruments in the study of eating behavior, yet it has not been validated –its shorter version- in Mexican population. The TFEQ was originally developed by Stunkard and Messick (1985) to measure cognitive restraint in relation to food intake in obese population, with items pool derived from Herman and Polivy's Revised Restraint Scale, Pudel's Latent Obesity Questionnaire and items written based on clinical experience (Stunkard & Messick, 1985). It was created to improve some of the psychometric issues found in the predictive and construct validity of the Restraint Scale proposed earlier by Herman and Mack (1975). The original TFEQ consisted of 51 items related to cognitive restraint, disinhibition of eating control, and susceptibility to hunger. Since then, several studies have raised doubt regarding the structure stability and scalability of the instrument. Karlsson, Persson, Sjostrom, & Sullivan (2000) to test scaling properties and construct validity of the TFEQ applied it in a sample of 4377 Swedish, middle-aged, obese men and women. The original factor structure of the TFEQ was not replicated, resulting in a revised version of the questionnaire, with the number of items reduced to 18, representing three modified sub-scales: Uncontrolled Eating, Emotional Eating, and Cognitive Restraint. Uncontrolled Eating dimension comprised 9 items from the original disinhibition of eating control and susceptibility to hunger sub-scales. Emotional Eating emerged as a factor corresponding to three items from disinhibition subscale. Optimized Cognitive Restraint scale included 6 items related to a self-imposed cognitive limitation (Karlsson et al., 2000).

The concept of cognitive control was introduced in a study by Herman and Mack (1975), pointing out to the restrained eaters' disinhibition effect, i.e., the overeating after a perceived diet violation. Most restrained eaters do not succeed in maintaining uninterrupted restriction of food intake, so restraint is interrupted with episodes of disinhibited eating resulting in overeating (Heatherton, Herman, Polivy, King, & McGree, 1988). Restrained eaters in comparison to unrestrained eaters are thought to use self-control

processes to try to consciously suppress their food intake and this way to manage their weight, what can lead to dysregulation of internal perceptions of satiety and hunger based on physiological signals (Sweerts, Apfeldorfer, Romo, & Kureta-Vanoli, 2016). Disinhibition or Uncontrolled Eating refers to this tendency of overeating while feeling out of control. It can be triggered by for example stress (Greeno & Wing 1994), ego threats, (Heatherton, Herman, & Polivy 1991), or distraction (Mann & Ward, 2000). Emotional Eating represents the tendency to eat in response to negative emotions (Moskovich, Hunger, & Mann, 2012).

As Karlsson et al. (2000) indicated the TFEQ represented an advance in measuring the eating behavior allowing to advance understanding of eating patterns in obese population, yet further studies beyond obese populations were needed. Since then, the TFEQ-R18 structure was successfully replicated in samples of different weight categories and in different cultures. e.g., in a sample of 529 French men and women (de Lauzane et al., 2004); in a sample of Spanish students ranging from underweight to obese (Jáuregui-Lobera, García-Cruz, Carbonero-Carreño, Magallares, & Ruiz-Prieto, 2014), or in 2997 Finnish females, aged 17 to 20 years, majority of normal weight but including also underweight and obese (Anglé et al., 2009). Same structure was confirmed in Poland in the group of 200 normal weight and 37 obese adults (Brytek-Matera, Rogoza, & Czepczor-Bernat, 2017). It was also tested in Chile (Pérez-Fuentes, Molero Jurado, Gázquez Linares, & Oropesa Ruiz, 2018) with a sample of adults, (n=983) replicating three-dimensional structure.

The objective of the present study was to evaluate the factor structure and reliability of TFEQ- R18 in a Mexican sample of adults representing different weight categories. We also examined associations between the TFEQ-R18 and both Body Mass Index (BMI) and Waist to Height Ratio WHtR). Both BMI and WHtR have been proven good predictors of cardio metabolic risk, with the cut-off points: BMI≥25 for overweight and ≥30 for obesity, and .5cm for Waist to Height Ratio.

Method

Participants

Subjects were recruited among the participants of a larger obesity study at the *Universidad Nacional Autónoma de México* (UNAM), that aims at examining multiple factors contributing to obesity. For the present study participants included 342 workers and students form that university, of average age 40 +/-14 years (range 19-79). Table 1 includes demographic and anthropometric characteristics of the participants.

Table 1
Demographic and anthropometric characteristics of the participants, n= 342

Variable	Mean/ Percentage	SD
Age	40.4	13.8
Women	*68%*	
Single	*58%*	
Higher education	*72%*	
Overweight & obese	*57%*	
Weight kg	68.3	13.2
Height cm	161.6	9.1
Waist Circumference cm (WC)	85.9	11.5
BMI kg/m^2	26.08	4.10
WC/Height cm (WHtR)	0.53	0.07

Instruments

TFEQ-18 Measure. The 18 item TFEQ is a widely used self-assessment questionnaire to evaluate eating behavior. It comprises three sub-scales: Uncontrolled Eating (9 items), Emotional Eating (3 items), Cognitive Restraint (6 items). Uncontrolled Eating refers to loss of control over eating, higher scores indicate less control. Emotional Eating indicates overeating under the influence of negative emotions, higher scores are indicative of consuming more under the influence of emotions. Cognitive Restraint, refers to controlling food intake to manage body weight, higher scores indicate more control (Karlsson et al., 2000). The

Cognitive Restraint sub-scale was reversed for reliability and factor analysis. 17 items are measured on a 1 to 4 response scale, (responses to items 1 through 13 go from 1 definitely false till 4 definitely true) and the last item on an eight-point numerical rating scale. This last item was later recoded to 4 item scale. The English version was translated into Spanish. Item 1 with a reference to meat "When I smell a sizzling steak or a juicy piece of meat, I find it very difficult to keep from eating, even if I have just finished a meal.", was replaced with a more general expression "When I smell delicious food, I find it very difficult to keep from eating, even if I have just finished a meal." (Anglé et al., 2009). It was considered that this wording was more inclusive, not alienating those who do not eat meat.

Anthropometric measurements. Height was measured with a stadiometer to the nearest half centimeter, weight with OMRON HBF-514C scale to the nearest 0.1 kg without shoes and any outerwear, and waist circumference (WC) with SECA 201 ergonomic circumference measuring tape to the nearest centimeter. Waist to Height Ratio (WHtR) and BMI were calculated. To classify participants into BMI categories World Health Organization's norms were applied <18.5 for underweight, <25 for normal weight, <30 for overweight, and ≥30 for obese. Those with BMI <18.5 were excluded. Those with obesity and overweight were grouped together (n=193, 57% of the total sample) to assure groups comparability vs. those with normal weight (n=147, 53%). For WHtR a boundary value of .5 was applied, reported in recent studies as a sensible threshold, more sensitive than BMI as an early warning of obesity-related health risks for men, women, children and across different ethnic groups (Ashwell, Gunn, & Gibson, 2012; Browning, Hsieh, & Ashwell, 2010).

Procedure

During pre-scheduled appointment participants of the larger obesity study at UNAM had their anthropometric measures taken. Written consent was obtained from every participant and data discussed here is anonymized. Within couple months from the appointment TFEQ-R18 was sent to the same participants via email.

Statistical Analysis

The sample was randomly split in half to perform exploratory factor analysis on one half, and confirmatory factor analysis on the other data set. Data included frequency distribution, skew and kurtosis, differences between quartile 1 and 3. Cronbach's alpha coefficients were computed to estimate the internal-consistency reliability of the scale scores, including coefficients for subscales and total score, item-to-scale correlations for scales and total score, and alpha if item deleted. Sample adequacy for factor analysis was assessed with the Kaiser-Meyer-Olkin (KMO) index and with Bartlett's sphericity tests.

Exploratory factor analysis (EFA) was performed to test factor structure, loads of the TFEQ and percentage of the variance explained. Two extraction methods were explored: principal components with orthogonal, Varimax rotation and maximum likelihood with Quartimax rotation. A cut-off point of >.40 was used for the factor loadings.

Confirmatory factor analysis (CFA) was used to test the fit of the three-factor model to the data, with the final model required to have: CMIN/DF <3, Comparative Fit Index (CFI) >.95; Goodness of Fit Index (GIF) >.90, errors: Root Mean Square of Approximation (RMSEA) <.06, and Standardized Root Mean Square Residual (SRMR) <.08, indicative of good fit (Hu & Bentler, 1999).

Relationships between the TFEQ factors and: BMI and WHTR were examined via correlations and t-test. Data was analyzed with SPSS 25 and AMOS 23 for exploratory and confirmatory analysis respectively.

Results

Data suitability for factor analysis

Analysis of item frequency distribution indicated that item 14 "How often do you feel hungry?" had 62%

of responses accumulated in the answer "sometimes between meals". As no other issues were identified with this item, and taking into consideration the closeness of 62% to the cut-off point of 60% the item was maintained in further analysis.

None of the items obtained values of skew or kurtosis greater than |1.3| suggesting normal distribution of the data. Items 2 and 15 did not discriminate between extreme groups of quartiles 1 and 3. KMO index of sample adequacy was .838 (.841 after removing items 2 and 15), falling within the acceptance range of >.80 and Bartlett's sphericity tests resulted in $\chi 2(153) = 854.659$, $p < .001$ (after removing items 2 and 15 $\chi 2(120) = 778.577$, $p < .001$), meeting the criteria of p<.05, indicative of sample adequacy for the factor analysis (Hair, Black, Babin, & Anderson, 2014).

Internal Consistency

Revision of item-total correlation showed weak correlations for item 2 "I deliberately take small helpings as a means of controlling my weight." (-.054) and item 15 "How frequently do you avoid 'stocking up' on tempting foods?" (-.041), both from the Cognitive Restraint sub-scale. Inverting the items did not increase item-total correlation. Other item-total correlations ranged from .27 to .59 Elimination of the two items improved total scale's internal-consistency reliability from .77 to .82. The sub-scale coefficients ranged from .59 for Cognitive Restraint to .84 for Uncontrolled Eating. See Table 2. Although values greater than .70 are commonly considered as indicative of acceptable reliability based on Cronbach's alpha, Schmitt (1996) has proposed that there is no general level (as .70) where alpha becomes acceptable, but rather that instruments even with lower value of alpha can still be useful in certain circumstances. Number of items from Cognitive Restraint were reduced from six to four, future incorporation of additional items or translation-optimized items could improve the sub-scale reliability.

Factor Structure of the TFEQ-R18

According to the principal component analysis with a Varimax rotation, the original three factor structure was replicated, with the following number of items per sub-scale: Uncontrolled Eating with 9 original items, Emotional Eating with 3 original items, and Cognitive Restraint with 4 items, out of original 6. Item communalities ranged from .32 to .66. Communalities of 11 out of the 16 items were >.45. The three-factor solution accounted for 50% of the total variance. A rotated component matrix indicated that each of the 16 items loaded positively to one of the three factors. Items with factor loadings >.40 are presented in Table 2. Using Maximum likelihood extraction with Quartimax rotation produced similar factor structure and high item loadings.

Inter-correlations of sub-scales

Emotional Eating was positively associated with Uncontrolled Eating ($r = .45$, p<.001), higher Emotional Eating scores were connected with higher disinhibition. An inverse association was observed between Uncontrolled Eating and Cognitive Restraint scores ($r = -.26$, p<.001), higher dietary restraint scores were connected with less tendencies to exhibit uncontrolled eating. Correlation between Emotional Eating and Cognitive Restraint was not significant ($r = -.13$, p=.08).

Confirmatory Factor Analysis

Confirmatory factor analysis evaluated the model fit with three sub-scales, with 18 items and 16 items. A better model fit was obtained removing items 2 and 15. See Table 3. In addition, following the indications from the modification indices for the model fit optimization, we associated the errors of items related to hunger on the Uncontrolled Eating scale. The factor structure of the TFEQ-R16 is depicted in Figure 1.

Table 2
TFEQ sub-scales and factorial weights for items, consistency indices and communalities

Item		Uncontrolled Eating	Factor Emotional Eating	Cognitive Restraint	Communality
9	I am always hungry so it is hard for me to stop eating before I finish the food on my plate	0.80			0.66
8	I get so hungry that my stomach often seems like a bottomless pit.	0.79			0.66
13	I am always hungry enough to eat at any time.	0.73			0.54
4	Sometimes when I start eating, I just can't seem to stop.	0.69			0.58
7	When I see a real delicacy, I often get so hungry that I have to eat right away.	0.68			0.49
17	Do you go on eating binges though you are not hungry?	0.56			0.35
14	How often do you feel hungry?	0.54			0.31
1	When I smell a delicious food, I find it very difficult to keep from eating, even if I have just finished a meal	0.46			0.34
5	Being with someone who is eating often makes me hungry enough to eat also	0.46			0.34
6	When I feel blue, I often overeat.		0.79		0.65
10	When I feel lonely, I console myself by eating.		0.77		0.64
3	When I feel anxious, I find myself eating.		0.76		0.60
12	I do not eat some foods because they make me fat.			0.77	0.59
11	I consciously hold back at meals in order not to gain weight.			0.71	0.53
18	On a scale of 1 to 8, where 1 means no restraint in eating and 8 means total restraint, what number would you give yourself?			0.66	0.46
16	How likely are you to consciously eat less than you want?			0.46	0.32
Variance explained		30%	11%	9%	
Cronbach's Alpha		*0.84*	*0.73*	*0.59*	

Further analysis was conducted with 16 items: keeping the original structure of Emotional Eating and Uncontrolled Eating, and with 4 items of Cognitive Restraint.

Associations between TFEQ-R18 scores and BMI

Means and standard deviations per scale are presented in Table 4. Mean scores on the three domain scores reported by gender (male, female) showed that mean domain scores were comparable for Uncontrolled Eating and meaningfully different for male and female samples for Emotional Eating and Cognitive

Table 3
Fit indices for two measurement models examined via CFA, n=171

	Model TFEQ-R18	Model TFEQ-R16 w/o items 2&15	Model TFEQ-R16 errors on hunger correlated
Chi-square	254 a*	180b*	139 c*
CMIN/df	1.93	1.78	1.42
CFI	0.88	0.92	0.96
GFI	0.85	0.87	0.91
RMSEA	0.07	0.07	0.05
SRMR	0.09	0.06	0.06

Note: Benchmarks are cited from Hu & Bentler (1999); CFI= Comparative Fit Index, GFI= Goodness of Fit Index, RMSEA= Root Mean Square of Approximation, SRMR= Standardized Root Mean Square Residual, a df =132, b df = 101, c df = 98, *p<.001.

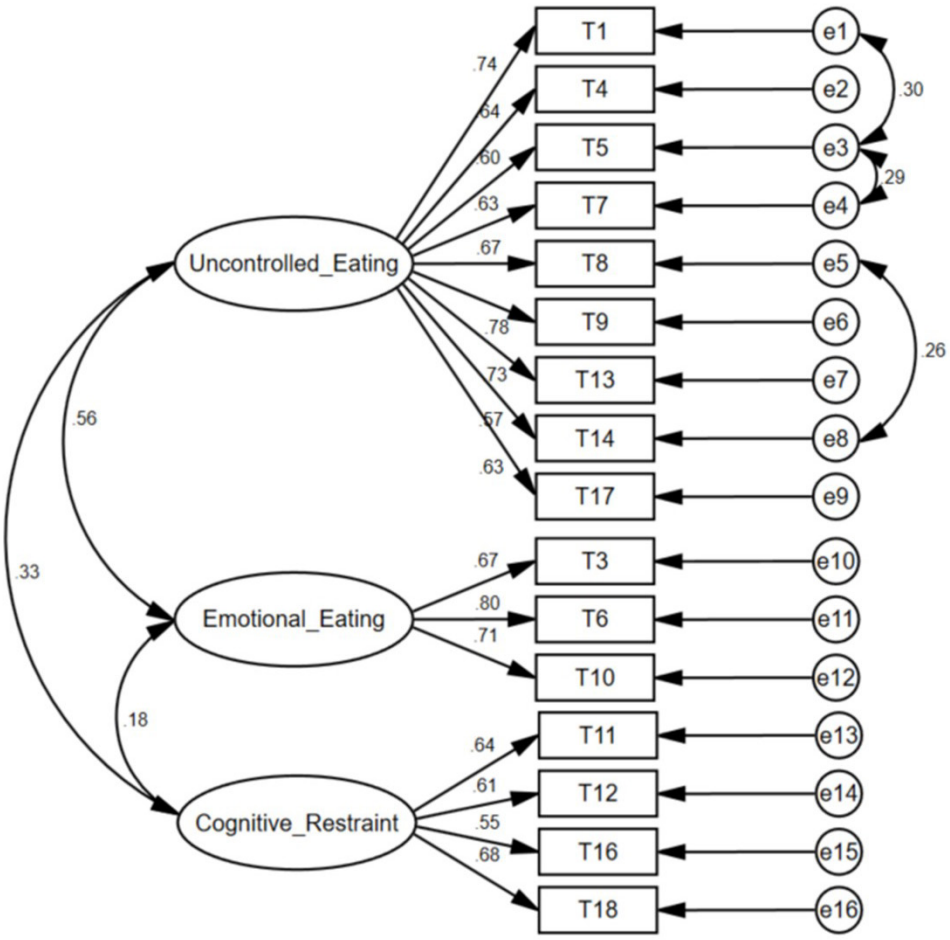

Figure 1. The three-factor model with standardized factor loadings in Mexican adults.

Restraint, with females having more tendency to exercise emotional eating and cognitive control than men.

Pair-wise comparisons of sub-scale scores between the two BMI categories (normal weight vs BMI≥25) reached statistical significance only for Cognitive Restraint (t=-2.287, df=339, p=.023), indicating that the overweight group (obese included) tends to exercise more cognitive control over the quantities they eat. When additionally split by gender the significant difference between overweight (obese included) and non-overweight was maintained only in the female group. Meaning overweight women use more cognitive control vs. normal weight women (t=-2.558 df=229 p=.011). Interestingly there was a significant difference in Emotional Eating between normal BMI and overweight (obese included) men (t=2.350 df=101 p=.021), indicating more consumption under distress in case of the overweight men, yet still below female levels of overeating when facing negative emotions.

When examining BMI as a continuous variable, BMI and TFEQ Cognitive Restraint scores were correlated among the entire sample: the higher the BMI, the higher the Cognitive Restraint score ($r = .13$, $p < .05$). BMI correlations with Uncontrolled Eating, and Emotional Eating scores were close to zero and not statistically significant. When split by BMI at 25, and by gender, the correlation between BMI and Cognitive Restraint stayed significant only for women with normal weight (r .28, p=.004), indicating that while overweight women (obese included) have overall higher Cognitive Restraint scores, within the group of normal BMI Cognitive Restraint scores grow with

BMI. For normal weight men, negative correlations of BMI with both Emotional Eating (EE) and Uncontrolled Eating (UE) scores were encountered (EE: r = -.52 p=.001, UE: r = -.53 p>.001). See Table 5.

Although pair-wise comparisons of sub-scale scores between the two BMI categories indicated no meaningful difference with regard to Uncontrolled Eating (slightly lower scores among those with normal weight), there was a significant association with BMI within the group of normal weight: the lower the BMI the higher the Uncontrolled Eating scores. When split by gender this was true only for men.

Associations between TFEQ-R18 scores and waist to height ration (WHtR)

Dividing the sample based on waist/height .5 cut-off point, showed significant differences between the means for Cognitive Restraint scores, indicating that those with larger waist circumferences, specifically larger WHtR, exercise more cognitive control over the quantities they eat (t=-2.399 df=341 p=.017). No significant difference was found for the other two sub-scales. Overall tendencies were similar as with regard to association between BMI and the TFEQ sub-scale scores.

Discussion

In the present study, factor structure of the Three Factor Eating Questionnaire Revised-18 was examined in a population-based sample of 340 Mexican adults, with body weight varying from normal to obese. Originally, this version of the questionnaire was obtained by Karlsson and colleagues (2000), based on the revision of the earlier 51-item instrument in a sample of 4377 middle-aged, Swedish obese. The three-factor structure obtained by Karlsson et al. (2000) was replicated in the sample of Mexican adults: nine items loaded high on Uncontrolled Eating (UE), three items loaded high on Emotional Eating (EE), and four out of the original six items loaded high on the factor Cognitive Restraint (CR). The items 2 and 15 were excluded from the Cognitive Restraint scale due to low item-total correlations. A study with the French general population also found low item-total correlations for the item 15 (de Lauzon et al., 2004). Also,

Table 4
Means and standard deviations per TFEQ sub-scales, split by gender, BMI & WHtR, n=342

		Uncontrolled Eating		Emotional Eating		Cognitive Restraint	
	N	M	SD	M	SD	M	SD
	342	1.88	0.55	1.92	0.74	2.47	0.65
Women	232	1.86	0.57	**2.03**[a]	0.75	**2.61**[b]	0.65
Men	110	1.93	0.52	**1.71**[a]	0.68	**2.36**[b]	0.64
BMI ≥ 25	195	1.90	0.57	1.92	0.76	**2.60**[c]	0.62
BMI normal	147	1.86	0.53	1.92	0.73	**2.44**[c]	0.68
Women BMI ≥ 25	125	1.86	0.58	1.99	0.76	**2.71**[d]	0.64
Women BMI normal	108	1.88	0.56	2.07	0.74	**2.50**[d]	0.64
Men BMI ≥ 25	70	1.96	0.55	**1.81**[e]	0.74	2.42	0.55
Men BMI normal	39	1.83	0.44	**1.52**[e]	0.52	2.29	0.76
WHtR ≥.5cm	234	1.89	0.57	1.93	0.77	**2.59**[f]	0.65
WHtR <.5cm	108	1.88	0.53	1.91	0.68	**2.41**[f]	0.65

Note: Pair numbers marked with bold (a, b, c, d, e, f) indicate significant difference at p<.05.

Table 5
Correlations between TFEQ sub-scales and: BMI and WHtR, n=342

	Total sample	Split by BMI		Split by Gender		Split by BMI & Gender			
						Women		Men	
		BMI < 25	BMI ≥ 25	Women	Men	BMI < 25	BMI ≥ 25	BMI < 25	BMI ≥ 25
TFEQ sub-scales correlations with BMI									
Uncontrolled Eating	-.03	**-.18***	-.02	.00	-.10	-.07	.03	**-.53****	-.12
Emotional Eating	.03	-.14	.11	.03	.08	-.01	.15	**-.52****	.03
Cognitive Restraint	**.13***	**.20***	-.02	**.13***	.17	**.28****	-.09	.07	.11
TFEQ sub-scales correlations with WHtR									
Uncontrolled Eating	-.06	-.12	-.09	-.03	-.16	-.02	-.04	**-.45****	-.21
Emotional Eating	.02	-.06	.08	.04	.04	.05	.12	**-.40***	-.01
Cognitive Restraint	**.13***	.13	.02	**.15***	.13	.13	.03	.17	-.03

Note: **p < .01, *p < .05.

a study with a Greek population (Kavazidou et al., 2012) encountered issues regarding the item 15, that loaded apart from the other items of the Cognitive Restraint factor. It is up to the future research to investigate whether cultural differences or the item interpretation based on the specific language translation, contribute to the item weakness.

Overall, we conclude that construct validity of the TFEQ was good. Our results corroborate earlier findings suggesting that the TFEQ is a valid measure of eating behavior among population of varying weight: from normal weight to obese. The three-factor solution has been corroborated also in French adults' sample, with multitrait/multiitem scaling analyses showing satisfactory internal consistency (de Lauzon et al., 2004), the coefficients ranged from .83 for Uncontrolled Eating to .87 for Emotional Eating. The three factor solution was also confirmed via CFA in Chile sample of healthcare professionals, obtaining good internal consistency, with the following Cronbach's alpha coefficients: .88 UE, .90 EE and .85 for CR. Slightly lower value for alpha for Cognitive Restraint, compared to other sub-scales, was also found in the Swedish obese subjects' study were:.76 CR,.83 UE, .85 EE (Karlsson et al, 2000); or in the study with young Finnish females: .75 CR, 0.85 UE, and 0.87 for EE (Anglé et al., 2009). In this study CR had the lowest Cronbach's alpha among three sub-scales, which might be also related to the elimination of two items. Additional studies may help to optimize the CR sub-scale.

The relationships between the sub-scales were similar to those obtained by Karlsson and colleagues (2000), i.e. higher Emotional Eating scores were connected with higher disinhibition while higher dietary restraint scores were connected with less tendencies to exhibit Uncontrolled Eating. We also found that higher Emotional Eating scores were associated with lower cognitive control, the relationship that was not found in the earlier mentioned study. The difference between our study and Karlsson's et al. (2000), may be attributed to the sample characteristics. Our sample included adults of various weights, while the other study focused only on obese.

TFEQ and Body Weight

The second objective of our study was to analyze TFEQ-R18 scores relationship with BMI and waist to height ratio (WHtR). We found that of the three factors of the TFEQ, Cognitive Restraint was connected with BMI in Mexican adults. Higher scores of Cognitive Restraint were associated with a higher BMI and WHtR. The overweight and obese women had significantly higher levels of Cognitive Restraint compared to the normal weight females, yet within the group of normal weight women there was a

stronger positive association between BMI and Cognitive Restraint scores. These findings are in line with the restraint theory of obesity and some earlier studies, for example, Anglé et al. (2009) and Beiseigel & Nickols-Richardson (2004), yet it needs to be noted that both mentioned studies found this relationship in female populations.

Is it cognitive control that predicts body weight or is it body weight that influences certain patters of cognition and behavior in relation to eating? The question has been raised by Anglé et al. (2009), and the two-year-follow-up study realized by de Lauzon-Guillain, Basdevant, Romon, Karlsson, Borys, & Charles, (2006) showed that a high initial BMI was associated with a larger increase in CR after two years, while initial CR did not predict change in BMI variable, suggesting that the latter might be true. The question with regard to the effectiveness of Cognitive Restraint as a dieting strategy is still pending more clear answer. Some studies point out that the restraint domain could be divided into two forms, flexible and rigid, and that the rigid form (characterized by an 'all-or-nothing' approach to eating) seemed to be associated more with overeating (Meule, Westenhöfer, & Kübler, 2011).

Of the three factors of TFEQ-R18, we found no connection between Uncontrolled Eating or Emotional Eating and body weight, when BMI was analyzed as a continuous variable. In the total sample, Uncontrolled Eating had no connection with BMI, yet when split based on BMI =25, in the normal weight group there was an inverse correlation between BMI and Uncontrolled Eating. Regarding the Emotional Eating, for instance Anglé et al. (2009) found Emotional Eating being connected with body weight in women, higher scores of Emotional Eating were associated with the higher BMI. Lack of a meaningful correlation between the two in our sample can be driven by the inclusion of men. Women overall had higher levels of EE, compared to men in our study.

Some limitations need to be mentioned. The sample included mostly those with higher education (72%), and consisted predominantly of women (68%). There are several studies of TFEQ with female samples only, yet there is little information on how TFEQ scores may differ depending on the education level. Overall, the data we gathered using the TFEQ behaved in the analyses in a similar manner when compared to earlier analyses of the questionnaire, indicating that the instrument was valid, yet low internal consistency for Cognitive Restraint sub-scale needs to be addressed in further studies.

Conclusions

The construct validity of the abbreviated version (16 items) of TFEQ was good in the sample of Mexican adults with a varying range of body weights, after eliminating two items from the Cognitive Restraint scale. Our findings suggest that the abbreviated TFEQ, is a psychometrically valid measure, and can be used to evaluate the tendencies of cognitive restraint, uncontrolled eating and emotional eating in this population. Additionally, as shown in earlier studies higher levels of cognitive restraint were associated with higher BMI, which raises the question on the usefulness of dietary techniques based on rigid cognitive control.

Conflict of interests

None.

Referencias

Anglé, S., Engblom, J., Eriksson, T., Kautiainen, S., Saha, M-T., Lindfors, P., Lehtinen, M., & Rimpelä, A. (2009). Three-Factor Eating Questionnaire-R18 as a measure of cognitive restraint, uncontrolled eating and emotional eating in a sample of young Finnish females. *International Journal of Behavioral Nutrition and Physical Activity, 6*(1), 41. doi:10.1186/1479-5868-6-41

Ashwell, M., Gunn, P., & Gibson, S. (2012). Waist-to-height ratio is a better screening tool than waist circumference and BMI for adult cardiometabolic risk factors: systematic review and meta-analysis. *Obesity Reviews, 13*(3), 275-286. doi:10.1111/j.1467-789X.2011.00952.x

Beiseigel, J. M. & Nickols-Richardson, S. M. (2004). Cognitive eating restraint scores are associated with body fatness but not with other measures of dieting in women. *Appetite, 43*(1), 47–53. doi:10.1016/j.appet.2004.02.002

Browning, L. M., Hsieh, S. D., & Ashwell, M. (2010). A systematic review of waist-to-height ratio as a screening tool for the prediction of cardiovascular disease and diabetes: 0.5 could be a suitable global boundary value. *Nutrition Research Reviews, 23*(2), 247-269. doi:10.1017/S0954422410000144

Brytek-Matera, A., Rogoza, R., & Czepczor-Bernat, K. (2017). The Three-Factor Eating Questionnaire-R18 Polish version: factor structure analysis among normal weight and obese adult women. *Archives of Psychiatry and Psychotherapy*, *3*, 81–90. doi:10.12740/APP/76342

de Lauzon, B., Romon, M., Deschamps, V., Lafay, L., Borys, J-M., Karlsson, J., Ducimetière, P., Charles, M. A., & the Fleurbaix Laventie Ville Sante (FLVS) Study Group. (2004). The Three-Factor Eating Questionnaire-R18 is able to distinguish among different eating patterns in a general population. *Journal of Nutrition, 134*(9), 2372-2380.

de Lauzon-Guillain, B., Basdevant, A., Romon, M., Karlsson, J., Borys, J.-M., & Charles, M. A. (2006). Is restrained eating a risk factor for weight gain in a general population? *The American Journal of Clinical Nutrition, 83*(1), 132–138. doi:10.1093/ajcn/83.1.132

Greeno, C. G. & Wing, R. R. (1994). Stress-induced eating. *Psychological Bulletin, 115*(3), 444–464. doi:10.1037/0033-2909.115.3.444

Hair, J. F., Black, W. C., Babin, B.J., & Anderson, R. E. (2014). *Multivariate data analysis.* 7th Ed. Essex: Pearson Education.

Heatherton, T. F., Herman, C. P., Polivy, J., King, G. A., & McGree, S. T. (1988). The (mis)measurement of restraint: an analysis of conceptual and psychometric issues. *Journal of Abnormal Psychology*, *97*(1), 19–28.

Heatherton, T. F., Herman, C. P., & Polivy, J. (1991). Effects of physical threat and ego threat on eating behavior. *Journal of Personality and Social Psychology, 60*(1), 138–143. doi:10.1037/0022-3514.60.1.138

Herman, C. P. & Mack, D. (1975). Restrained and unrestrained eating. *Journal of Personality, 43*(4), 647–660. doi:10.1111/j.1467-6494.1975.tb00727.x

Hu, L. T. & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*(1), 1–55. doi:10.1080/10705519909540118

Jáuregui-Lobera, I., García-Cruz, P., Carbonero-Carreño, R., Magallares, A., & Ruiz-Prieto, I. (2014). Psychometric properties of Spanish version of the Three-Factor Eating Questionnaire-R18 (TFEQ-Sp) and its relationship with some eating- and body image-related variables. *Nutrients*, *6*(12), 5619–5635. doi:10.3390/nu6125619

Karlsson, J., Persson, L. O., Sjostrom, L., & Sullivan, M. (2000). Psychometric properties and factor structure of the Three-Factor Eating Questionnaire (TFEQ) in obese men and women. Results from the Swedish Obese Subjects (SOS) study. *International Journal of Obesity and Related Metabolic Disorders, 24*, 1715–1725.

Kavazidou, E., Proios, M., Liolios, I., Doganis, G., Petrou, K., Tsatsoulis, A., & Tsiligiroglou-Fachantidou, A. (2012). Structure validity of the Three-Factor Eating Questionnaire-R18 in Greek population. *Journal of Human Sport & Exercise, 7*(1), 218-226. doi:10.4100/jhse.2012.71.01

Mann, T. & Ward, A. (2000). Don't mind if I do: disinhibited eating under cognitive load. *Journal of Personality and Social Psychology, 78*(4), 753–763.

Meule, A., Westenhöfer, J., & Kübler, A. (2011). Food cravings mediate the relationship between rigid, but not flexible control of eating behavior and dieting success. *Appetite*, *57*(3), 582-584. doi:10.1016/j.appet.2011.07.013.

Moskovich, A., Hunger, J., & Mann, T. (2012). *The psychology of obesity. In J. Cawley (Ed.), The Oxford handbook of the social science of obesity* (pp. 87-104). Oxford University Press. doi: 10.1093/oxfordhb/9780199736362.013.0006

Pérez-Fuentes, M., Molero Jurado, M., Gázquez Linares, J. J., & Oropesa Ruiz, N. F. (2018). Psychometric properties of the Three-Factor Eating Questionnaire in healthcare personnel. *Nutrición Hospitalaria, 36*(2), 434-440. doi: 10.20960/nh.2189

Schmitt, N. (1996). Uses and abuses of coefficient alpha. *Psychological Assessment, 8*(4), 350–353. doi:10.1037/1040-3590.8.4.350

Sweerts, J. S., Apfeldorfer, G., Romo, L., & Kureta-Vanoli, K. (2016). Treat or enhance cognitive restraint in individuals suffering from overweight or obesity? Systematic review of the literature. *SOJ Psychology, 3*(1), 1-8.

Secretaría de Salud. Instituto Nacional de Estadística y Geografía, & Instituto Nacional de Salud Pública. (2019). *Encuesta nacional de salud y nutrición 2018. Presentación de resultados*. https://ensanut.insp.mx/encuestas/ensanut2018/doctos/informes/ensanut_2018_presentacion_resultados.pdf

Stunkard, A. J. & Messick, S. (1985). The Three-Factor Eating Questionnaire to measure dietary restraint, disinhibition and hunger. *Journal of Psychosomatic Research, 29*(1), 71–83.