The Three-Factor Eating Questionnaire-R18 Is Able to Distinguish among Different Eating Patterns in a General Population[1]

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ABSTRACT A revised version of the Three-Factor Eating Questionnaire (TFEQ) was developed in an obese population, but its applicability to the general population was not assessed. We aimed to define the relationship between eating behavior and reported food intake. This was a cross-sectional study of 529 middle-aged adults and 358 teenagers and young adults recruited on a geographical basis. The TFEQ-R18 measures 3 aspects of eating behavior: cognitive restraint (CR), uncontrolled eating (UE), and emotional eating. Reported food intake was calculated from a food frequency questionnaire. Girls who scored higher on restrained eating had a lower energy intake than the other girls (9164 kJ vs. 13,163 kJ, $P < 0.001$). In adult men, energy intake increased with UE (9663 kJ vs. 11,029 kJ in the lower and higher UE tertiles, respectively, $P < 0.05$). When specific food groups were analyzed, higher CR was positively associated in adults with healthy food groups like green vegetables [OR = 1.92 (0.68–2.44)] and negatively associated with French fries [OR = 0.35 (0.22–0.57)] and sugar [OR = 0.38 (0.23–0.61)]. Energy-dense foods, such as fat, were positively associated with UE [OR = 2.28 (1.46–3.57) for dietary fat]. Finally, emotional eaters had a higher snacking food intake. In teenagers and young adults, most associations were seen with CR. Converse to observations in adults, teenagers and young adults who exhibited a high cognitive restraint reported consumption of fewer energy-dense foods rather than more "healthy foods." The TFEQ-R18 was therefore able to distinguish among different eating patterns in our sample of a French general population. J. Nutr. 134: 2372–2380, 2004.

KEY WORDS: • *eating behavior* • *food intake* • *adult* • *teenager* • *epidemiology*

To understand interactions between eating and health and to develop nutritional prevention programs in the context of the global obesity epidemic, better knowledge of the different eating behaviors and their prevalence in the general population would be helpful. Dietary restraint, which seems to be widespread in modern societies, is indeed suggested to play a causal role in the development of eating disorders and obesity (1,2). Other types of eating behaviors have been identified, such as the loss of control over intake and the tendency to overeat in the presence of emotional distress (3), but little is known about their prevalence in the general population.

Several questionnaires, the Restraint Scale (RS)[3] (4), the Dutch Eating Behavior Questionnaire (DEBQ) (5), and the Three-Factor Eating Questionnaire (TFEQ) (6), have been used in the study of eating behavior. In healthy populations, components of eating behavior assessed by these questionnaires are related to energy and macronutrients intake or to specific food intake (sweet and fattening foods) (7–10). However, these questionnaires include many items (10 to 51 items) that limit their use in epidemiological studies of multifactorial disease, where a number of other questionnaires are required. Karlsson et al. (11) developed a reduced version of the Stunkard and Messick TFEQ, the Three-Factor Eating Questionnaire Revised 18-item version (TFEQ-R18), which comprises 3 different scales corresponding to cognitive restraint, emotional eating, and uncontrolled eating. Consisting of 18 items, the TFEQ-R18 is easier to use in epidemiological studies where subjects complete many questionnaires. The TFEQ-R18 scales were derived in obese subjects; however, identical factors were obtained by Hyland et al. in a student sample (12), indicating that the instrument is valid also in nonobese individuals. In fact, Hyland et al. (12) performed a psychometric analysis of the TFEQ and they compared their results to those obtained using the DEBQ structure. That psychometric anal-

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[3] Abbreviations used: CR, cognitive restraint; DEBQ, Dutch Eating Behavior Questionnaire; EE, emotional eating; FLVS, Fleurbaix-Laventie Ville Santé; RS, restraint scale; TFEQ, Three-Factor Eating Questionnaire; TFEQ-R18, Three-Factor Eating Questionnaire-Revised 18 items; UE, uncontrolled eating.

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ysis identified 3 factors similar to those used in the TFEQ-R18. We conducted the current study to determine whether these factors are associated with different eating patterns in a general population by studying the relationship among the 3 TFEQ-R18 scales and reported food intake, as measured by a food frequency questionnaire. Associations are described in terms of energy and macronutrient intakes and also in terms of food items. Analyses were performed separately in adults and in teenagers and young adults.

SUBJECTS AND METHODS

Study design. Subjects were participants in the Fleurbaix-Laventie Ville Santé II (FLVS II) study. The purpose of the study was to investigate transversal and longitudinal relations between weight and fat mass and genetic, metabolic, and environmental factors in children and adults. This community-based cohort was constituted in 1999 on a voluntary basis by 1175 subjects, aged >8 y, from families living in the cities of Fleurbaix and Laventie and surroundings. All families had previously participated in the Fleurbaix-Laventie Ville Santé I study (13). One main difference between the families who participated and those who did not was that the cities of residence were more likely in participating families to be Fleurbaix and Laventie than the smaller cities, probably because they were easier to reach. The other main difference was in the frequency of overweight children, which was lower in participating families (8% vs. 13% of overweight children, respectively, $P = 0.01$). Other criteria such as parents' overweight, age, and gender did not differ between the 2 groups. The study protocol of FLVS II was previously approved by the Ethic Committee of Lille in July 1998 and the data files were declared to the National Committee for the Respect of Freedom and Rights in Computerized Data.

For the purpose of this study, only adolescents (≥14 y) and adults were considered. Among the 393 families invited to participate in the FLVS II study, 294 (75%) agreed to participate. Of the 887 subjects older than 14 y who participated in the study, 14 individuals were excluded due to missing sociodemographic or anthropometric data, and 19 individuals did not complete the food frequency questionnaire. Thus, a total of 31 subjects (3.5%) were excluded from the analysis. They were similar to the subjects remaining in the analysis with regard to gender (47.7 and 48.4% of men among respondents and nonrespondents, respectively, $P = 0.94$), age (mean = 33.0 and 28.3 y, $P = 0.11$), and body mass index (23.5 and 22.9 $kg \cdot m^{-2}$, $P = 0.56$).

Subjects were divided into 2 groups, the adult group, which comprised all the parents, and the teenagers and young adults group (the offspring). The sample for analysis was thus composed of 236 (45.4%) men and 284 (54.6%) women in the adult group (aged 30 to 67 y), and 171 (51.2%) boys and 163 (48.8%) girls in the teenagers and young adults group (aged 14 to 27 y).

Three-Factor Eating Questionnaire. Eating behavior was described using a French translation of TFEQ-R18 (11). The instrument is a shortened and revised version of the original 51-item TFEQ (6). The translation of the French version was accomplished using common procedures for cross-cultural adaptation, including back translation by a native English speaker. The questionnaire refers to current dietary practice and measures 3 different aspects of eating behavior: restrained eating (conscious restriction of food intake in order to control body weight or to promote weight loss), uncontrolled eating (tendency to eat more than usual due to a loss of control over intake accompanied by subjective feelings of hunger), and emotional eating (inability to resist emotional cues). The TFEQ-R18 consists of 18 items on a 4-point response scale (definitely true/mostly true/mostly false/definitely false). Responses to each of the 18 items are given a score between 1 and 4 and item scores are summated into scale scores for cognitive restraint, uncontrolled eating, and emotional eating (see the Appendix) (6,11). The raw scale scores are transformed to a 0–100 scale [((raw score − lowest possible raw score)/possible raw score range) × 100] and the commonly used "half-scale" method is utilized to compensate for missing data on some items. Higher scores in the respective scales are indicative of greater cognitive restraint, uncontrolled, or emotional eating. The mean number of missing values per subject was 0.06 (min–max: 0–2).

Psychometric analysis procedure. The TFEQ-R18 was constructed in a Swedish obese population and was used here in a French general population. Therefore, the internal validity of this tool in our sample had to be confirmed. We therefore performed a multitrait/multi-item analysis in both adult and teenager and young adult samples to test scaling assumptions underlying the construction and scoring of the TFEQ-R18. The aim of the analysis was to check that items were strongly correlated to their assigned scales (convergent validity) and more correlated to their assigned scale than to the other 2 (discriminant validity). A matrix of item-scale correlations was computed and the correlations for each item were compared across scales. Item convergent validity (Criterion 1) was indicated when each item correlated substantially with the scale that it was assumed to represent ($r \geq 0.40$, corrected for overlap, i.e., the correlation was assessed between an item and a modified scale corresponding to its assigned scale excluding the studied item). Item-discriminant validity (Criterion 2) was supported when items correlated significantly higher with their assigned scale than with all other scales. A difference between 2 item-scale correlations was assumed to be significant when it was higher than 2 standard errors of the correlation matrix ($1/\sqrt{n}$). The scaling fulfillment was evaluated by the proportion of items in a scale that met both convergent and discriminant validity. The internal-consistency reliability of scale scores was estimated by Cronbach's α coefficients.

Food Frequency Questionnaire (FFQ). The dietary questionnaire used in the study was specifically developed for the FLVS subjects. It is a semiquantitative self-administered FFQ that relates to intake during the previous 12 mo and inquires about 124 different foods. The foods were chosen among those that contributed most to energy and macronutrients intake in the 3-d food records completed by the same population during the FLVS I study (14). From the same data, gender-specific standard portions were estimated as the mean consumption for each food and beverage. From the reported frequencies of foods and drinks and gender-specific portions, it was possible to estimate an average daily intake of foods, drinks, energy, and major nutrients. Estimations of the daily energy and macronutrients intakes were computed from a food composition database derived from the French food composition tables, "Répertoire général des aliments" (15), and the McCance and Widdowson food composition tables (16). In order to study differences in types of foods consumed by each group of subjects, intakes of foods and drinks were aggregated into 25 different food groups. The groups were offal (e.g., liver or guts), processed pork meat products (e.g., ham or sausages), eggs, meat, cooked dishes (e.g., pizza or lasagna), fish, cheese, yogurt, dairy desserts, sugar and confectionery, dietary fat, milk, bread, cereals and pasta, potatoes, French fries, cakes/pastries/biscuits, oleaginous fruits (e.g., peanuts), fruit, green vegetables, dry vegetables, fat-reduced foods, sweet beverages, alcoholic beverages, and water.

We assessed the reproducibility and validity of the FFQ. Ninety-four participants completed four 24-h dietary recalls over a 1-y period and a repeat administration of the FFQ. For energy, the attenuation-corrected Pearson correlation was 0.73 ($P < 0.0001$). For protein, fat, and carbohydrate intake, it was 0.47, 0.66, and 0.74, respectively ($P < 0.0001$ for all correlations). For foods, the same correlations were, for example, 0.76 for milk ($P < 0.0001$), 0.58 for fats ($P = 0.0004$), 0.38 for fruit ($P = 0.0012$), and 0.78 for green vegetables ($P < 0.0001$).

Statistical analysis. To test for associations, TFEQ-R18 and dietary variables were transformed into qualitative variables. For the TFEQ-R18 data, the respondents were grouped into gender- and group- (adults or teenagers and young adults)-specific tertiles, according to their relative position on each scale. With the same method, respondents to the FFQ were divided into "low" and "high" eater groups for each food group, according to the median intake of their gender and age subgroup.

Energy and macronutrient contributions to energy intake were used as continuous variables (energy intake was log-transformed).

Separate analyses were conducted in the adult group and in the teenager and young adult group. In the descriptive analysis, we used χ^2 (for qualitative variables) and Kruskall-Wallis tests (for continu-

ous variables). Multivariate analyses were performed by logistic regressions for qualitative data and analyses of variance-covariance for quantitative data, controlling for gender and age as continuous variables within each age group. When a significant interaction between a TFEQ-R18 factor and gender was detected, analyses were also conducted separately for men and for women. The Generalized Estimating Equations (SAS proc genmod) were used to take into account the familial correlation between individuals (17). A significance level of $P < 0.05$ was required for an explanatory variable to remain in the models.

The Statistical Analysis Systems statistical software package version 8.2 (SAS Institute) was used for the analyses.

RESULTS

Multitrait/multi-item scaling analysis. Item convergent validity and item discriminant validity were analyzed in each age group. Results of multitrait/multi-item scaling analysis in both samples were similar (**Table 1**). In both groups, 5 of 6 cognitive restraint items, 9 for 9 uncontrolled eating items, and 3 of 3 emotional eating items exceeded the minimum desired level ($r \geq 0.40$, corrected for overlap) for items convergent validity. Item-scale correlations (corrected for overlap) showed, therefore, a very good item internal consistency. Correlations between items assigned to cognitive restraint and the other 2 scales were low ($r < 0.35$) and therefore all cognitive restraint items succeeded in the discriminant validity test. Only 1 uncontrolled eating item failed in the discriminant validity test; this was in the adult group. In summary, 5 of 6 cognitive restraint items in each age group, 8 of 9 uncontrolled eating items in adults, and 9 of 9 uncontrolled eating items in teenagers and young adults, and 3 of 3 emotional eating items in each age group met the criteria for both convergent and discriminant validity. Internal-consistency reliability coefficients (Cronbach's α) for each of the 3 scales were above the 0.70 standard and below the 0.90 limit recommended for individual assessment. These coefficients were similar to those found in the Swedish Obese Subjects study (11).

Eating behavior. TFEQ-R18 scores were significantly different between genders in both groups (**Table 2**). Higher scores for cognitive restraint (CR) and emotional eating (EE) were found in females. The uncontrolled eating (UE) score was higher in boys than in girls, but there was no significant difference between genders in the adult group. Moreover, CR and EE were correlated in adults ($r = 0.35$, $P < 0.0001$) and in teenagers and young adults ($r = 0.27$, $P < 0.0001$). UE and EE were also correlated in adults ($r = 0.61$, $P < 0.0001$) and in teenagers and young adults ($r = 0.40$, $P < 0.0001$). CR and UE were correlated in the adult group ($r = 0.20$, $P < 0.0001$) but not among teenagers and young adults ($r = -0.04$, $P = 0.47$).

Dietary data (Table 2). Estimated energy intake was significantly higher in males than in females in both groups. Protein contribution to energy intake was significantly lower in males than in females in both groups. Fat contribution to energy intake was higher in boys than in girls. Reported intakes in energy-dense foods, like processed pork meat products, potatoes, or French fries, were greater in men than in women. On the contrary, women reported higher fruit consumption. Several differences between genders were identified only in adults or in adolescents. Indeed, boys reported eating more cheese, dairy desserts, sugar, and sweet beverages than girls, and adult women reported a higher intake of healthy food groups such as fish, green vegetables, and fat-reduced foods.

Relationships between eating behavior and food intake. The association among the 3 TFEQ-R18 scores and reported food intake was quite different in the 2 age groups.

In adults (**Table 3**), CR score was positively associated in both sexes with healthy food groups like fat-reduced food or green vegetables and negatively associated with French fries and sugar and confectionery. Uncontrolled eating was positively associated with energy-dense foods like fat or potatoes and, only in men, with fruit. Finally, subjects with a high emotional eating score had a higher consumption of snacking foods such as oleaginous fruits and cakes/pastries/biscuits.

High intake of yogurt was significantly related to a high cognitive restraint and a high uncontrolled eating, and alco-

TABLE 1

Summary of multitrait/multi-item testing of TFEQ-R18 in the adult and the teenager and young adult group

	Multitrait/multi-item scaling tests					
	Item-scale convergent validity		Item-discriminant validity			
	Assigned scale[1]	Criterion 1[2]	Other scales[3]	Criterion 2[4]	Scaling fulfillment[5]	Reliability[6]
Cognitive restraint						
Adults	0.34–0.72	5/6	0.05–0.33	11(12)/12	5/6	0.84
Teenagers	0.28–0.70	5/6	0.01–0.24	12(12)/12	5/6	0.80
Uncontrolled eating						
Adults	0.40–0.63	9/9	0.00–0.54	16(17)/18	8/9	0.83
Teenagers	0.40–0.58	9/9	0.00–0.37	17(18)/18	9/9	0.80
Emotional eating						
Adults	0.69–0.82	3/3	0.26–0.59	6(6)/6	3/3	0.87
Teenagers	0.58–0.64	3/3	0.16–0.42	6(6)/6	3/3	0.78

1 Range of Pearson correlations between items and their hypothesized scale (corrected for overlap).
2 Proportion of item-scale correlations which meet minimum standard for convergent validity ($r \geq 0.40$).
3 Range of Pearson correlations between items and other scales.
4 Proportion of correlations that were significantly higher (or higher but not significantly) between items and their hypothesized scale in comparison with the two other scales.
5 Proportion of items that meet criteria for item-scale convergent (criterion 1) and discriminant (criterion 2) validity.
6 Cronbach's α.

TABLE 2

Dietary intake and TFEQ-R18 scores of male and female adults and teenagers and young adults

	Middle-age adults		Teenagers and young adults	
	Male (n = 236)	Female (n = 284)	Male (n = 171)	Female (n = 163)
Age, *y*	44 ± 5	42 ± 5***	17 ± 3	17 ± 2
Body mass index, $kg \cdot m^{-2}$	26 ± 4	25 ± 5	21 ± 4	21 ± 3
TFEQ-R18 scores				
Cognitive restraint score	22 ± 18	39 ± 21***	18 ± 16	34 ± 20***
Uncontrolled eating score	26 ± 18	27 ± 19	39 ± 19	35 ± 19*
Emotional eating score	22 ± 25	43 ± 31***	26 ± 23	46 ± 29***
Food group consumption, *g/d*				
Offal	5 ± 10	4 ± 5***	5 ± 7	4 ± 7**
Pork meat products	45 ± 36	30 ± 22***	45 ± 39	30 ± 29***
Eggs	25 ± 20	24 ± 19	30 ± 26	23 ± 31***
Meat	152 ± 87	132 ± 76**	131 ± 79	106 ± 76***
Cooked dishes	105 ± 72	84 ± 56**	156 ± 107	110 ± 79***
Fish	26 ± 22	31 ± 28*	28 ± 28	27 ± 28
Cheese	37 ± 37	35 ± 41	31 ± 31	25 ± 37*
Yogurt	82 ± 70	92 ± 80	96 ± 85	105 ± 81
Dairy desserts	32 ± 39	30 ± 43	59 ± 61	42 ± 47***
Sugar and confectionery	47 ± 30	47 ± 32	72 ± 51	51 ± 38***
Dietary fat	25 ± 22	25 ± 21	27 ± 23	22 ± 18
Bread	131 ± 67	116 ± 62*	135 ± 71	121 ± 72
Cereals and pasta	143 ± 108	122 ± 84*	165 ± 96	135 ± 90**
Potatoes	130 ± 98	106 ± 83**	122 ± 92	90 ± 77***
French fries	74 ± 71	47 ± 50***	96 ± 73	57 ± 71***
Cakes/pastries/biscuits	40 ± 40	40 ± 49	65 ± 65	41 ± 35***
Oleaginous fruits	7 ± 9	6 ± 8*	8 ± 11	6 ± 9***
Fruits	116 ± 110	149 ± 127***	96 ± 109	122 ± 142*
Green vegetables	257 ± 213	313 ± 243***	153 ± 155	178 ± 158
Dry vegetables	6 ± 8	5 ± 6	8 ± 13	5 ± 6
Fat-reduced foods	37 ± 50	74 ± 79***	49 ± 67	48 ± 64
Beverage consumption group, *mL/d*				
Sweet beverages	243 ± 343	215 ± 454	628 ± 584	404 ± 479***
Water	635 ± 306	689 ± 260	579 ± 317	678 ± 281**
Alcoholic beverages	476 ± 498	137 ± 207***	114 ± 329	18 ± 32*
Milk	197 ± 201	198 ± 199	423 ± 279	303 ± 246***
Energy and macronutrients				
Energy,[2] *kJ/d*	11,970 ± 3823	10,308 ± 3446***	14,713 ± 5380	10,949 ± 4124***
Carbohydrate, *% energy*	44 ± 7	45 ± 7	48 ± 6	49 ± 7
Total fat, *% energy*	37 ± 6	38 ± 6	37 ± 5	36 ± 6*
Protein, *% energy*	16 ± 3	17 ± 3**	15 ± 2	16 ± 3**

[1] Values are means ± SEM. Asterisks indicate a difference from males of the same group: * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.
[2] Excluding alcohol.

holic beverages were negatively related to both cognitive restraint and emotional eating scores.

In adults, for the food groups which were associated with 2 TFEQ-R18 scores, a multivariate logistic regression was performed to assess whether these associations were independent or explained by the correlations between the 2 TFEQ-R18 scores. The odds ratio for yogurt intake decreased from 1.75 for cognitive restraint ($P = 0.047$) and 1.87 for uncontrolled eating ($P = 0.026$) to 1.53 ($P = 0.21$) and 1.68 ($P = 0.10$), respectively, when both scores were included in the model. Alcoholic beverage intake remained independently and negatively associated with both cognitive restraint ($P = 0.015$) and emotional eating ($P = 0.027$) scores. For cognitive restraint, the association with alcoholic beverages was not linear but only due to a high tertile of cognitive restraint, compared to the 2 lower levels of cognitive restraint.

In teenagers and young adults, there were fewer associations between reported intake of specific food groups and TFEQ-R18 scores (**Table 4**). Most relationships were found with the cognitive restraint score. The food groups associated with cognitive restraint were different from those found in adults: the consumption of energy-dense foods like sugar, French fries, or processed pork meat products was negatively associated with CR in teenagers and young adults. Only alcoholic beverages intake was positively related to uncontrolled eating; fruit and yogurt among men were negatively and positively related to emotional eating, respectively.

Relationships between eating behavior and energy intake. Girls with a high cognitive restraint score (**Table 5**) reported a lower energy intake than those with a low cognitive restraint score ($P = 0.001$). Among women, the difference for CR was not significant ($P = 0.28$), but reported energy intake was greater in the higher than in the lower tertile of uncontrolled eating ($P = 0.019$). In men, the emotional eating score was linked to energy intake, with a higher energy intake in the higher emotional eating tertile ($P = 0.007$).

Relationships between eating behavior and macronutrient intake. Females with a high cognitive restraint score had a higher proportion of energy intake derived from protein (Table 5) in comparison with females who had a low cognitive restraint score ($P = 0.001$ in women, and in girls). In the adult group, the proportion of energy derived from fat was greater for

TABLE 3

Associations between eating behavior and food group intake among middle-age adults[1,2]

	Cognitive restraint	Uncontrolled eating	Emotional eating
Offal	1.25 [0.76–2.06]	1.53 [0.93–2.52]	1.25 [0.78–2.01]
Pork meat products			
Men	0.86 [0.46–1.63]	2.56 [1.32–4.97]*	1.53 [0.88–2.68]
Women	0.81 [0.44–1.50]	2.01 [1.09–3.71]*	1.79 [0.98–3.26]
Eggs	0.88 [0.56–1.38]	1.40 [0.90–2.18]	1.31 [0.87–1.98]
Meat	0.71 [0.45–1.11]	0.94 [0.60–1.48]	0.92 [0.60–1.41]
Cooked dishes	1.27 [0.80–2.00]	1.60 [1.02–2.50]*	1.17 [0.78–1.76]
Fish	1.75 [1.10–2.77]*	1.16 [0.72–1.87]	1.05 [0.69–1.58]
Cheese			
Men	2.02 [1.06–3.84]*	0.87 [0.45–1.65]	1.35 [0.61–2.98]
Women	1.10 [0.59–2.04]	2.36 [1.28–4.35]*	1.06 [0.59–1.91]
Yogurt	1.75 [1.12–2.73]*	1.87 [1.19–2.95]*	1.62 [1.07–2.45]*
Dairy desserts	0.92 [0.59–1.46]	1.33 [0.84–2.11]	1.20 [0.78–1.83]
Sugar and confectionery	0.38 [0.23–0.61]*	1.41 [0.88–2.27]	1.33 [0.88–2.03]
Dietary fat	0.78 [0.50–1.23]	2.28 [1.46–3.57]*	1.20 [0.80–1.80]
Bread	0.83 [0.53–1.30]	1.05 [0.67–1.65]	1.24 [0.81–1.89]
Cereals and pasta	1.02 [0.65–1.62]	1.38 [0.88–2.16]	1.56 [1.05–2.33]*
Potatoes	0.61 [0.39–0.96]*	1.81 [1.12–2.92]*	1.32 [0.89–1.96]
French fries	0.35 [0.22–0.57]*	1.28 [0.79–2.06]	1.03 [0.67–1.57]
Cakes/pastries/biscuits	0.86 [0.54–1.36]	1.56 [0.99–2.46]	1.97 [1.29–3.00]*
Oleaginous fruits	0.87 [0.54–1.40]	1.44 [0.90–2.31]	2.28 [1.48–3.52]*
Fruits			
Men	1.29 [0.68–2.44]	2.26 [1.17–4.35]*	1.45 [0.83–2.53]
Women	1.70 [0.90–3.22]	0.93 [0.51–1.70]	2.06 [1.13–3.75]*
Green vegetables	1.92 [1.21–3.07]*	1.68 [1.05–2.68]*	1.30 [0.85–2.00]
Dry vegetables	1.05 [0.66–1.67]	1.08 [0.66–1.76]	1.09 [0.72–1.65]
Fat-reduced foods			
Men	3.15 [1.62–6.12]*	1.43 [0.75–2.73]	1.63 [0.93–2.86]
Women	8.00 [3.94–16.23]*	1.56 [0.85–2.84]	1.50 [0.83–2.71]
Sweet beverages	0.78 [0.50–1.23]	1.54 [0.97–2.45]	1.66 [1.09–2.55]*
Alcoholic beverages			
Men	0.50 [0.26–0.95]*	0.58 [0.30–1.10]	0.66 [0.38–1.16]
Women	0.54 [0.29–1.02]	0.72 [0.40–1.01]	0.45 [0.25–0.81]*
Milk	1.82 [1.16–2.85]*	0.84 [0.54–1.30]	1.38 [0.91–2.10]
Water	1.60 [0.99–2.59]	1.22 [0.76–1.96]	1.09 [0.70–1.69]

[1] Values are age-adjusted OR [95% CI] for a higher reported intake of a selected food group according to the higher tertile of the TFEQ-R18 score (vs. lower tertile). The OR were also adjusted for gender unless there was a significant interaction term. * Significant, $P < 0.05$.

[2] The OR associated with the middle vs. lower tertile, which were in general intermediate, are not shown to improve the clarity of the table.

subjects with a high than a low uncontrolled eating score ($P = 0.009$). In the teenagers and young adults group, contribution of fat to energy intake was lower among subjects with a high cognitive restraint score ($P = 0.042$).

For any score, results did not differ before and after adjustment for the other 2 TFEQ-R18 factors.

DISCUSSION

The TFEQ-R18 was developed in a Swedish population of subjects with severe obesity. It was administered in our study to a general population living in Northern France. The multitrait/multi-item scaling analysis showed a satisfactory internal consistency of the TFEQ-R18 in our general population in both the adult and the teenager and young adult groups. Only 1 minor discrepancy was detected in the cognitive restraint scale: the item-scale correlation for item 15 was lower than expected, while all other items on this scale were highly correlated. The TFEQ-R18 would therefore be valid, not only in an obese population, but also in the general population. This is in line with a previous study suggesting that the factor structure of the TFEQ-R18 was valid in normal-weight subjects. Indeed, the 3 TFEQ-R18 scales were identical to factors obtained from the TFEQ by Hyland et al. (12) in a student sample.

In our population, the TFEQ-R18 was able to distinguish among different eating patterns as assessed by reported food intake. In addition, it highlights specific differences between genders and between "teenagers and young adults" and adults. The comparison between genders showed higher cognitive restraint and emotional eating scores in women. These results were consistent with several studies that include both sexes (7,18–20). It is, however, notable that most of the studies about eating behavior were conducted only among women (1,10,21–25). The higher cognitive restraint scores in women might be related to a greater propensity for dieting (26–28). Our study also showed that associations between reported food intake and TFEQ-R18 scores were similar in both genders, except for a few relations. The influence of eating behavior on specific choices appears therefore to be mostly independent of gender (8).

In adults, the 3 different eating behaviors identified by the TFEQ-R18 were associated with different patterns of reported food intake. High restrainers reported preferentially "healthy" food, such as fish, vegetables, and fat-reduced food. Emotional eating was associated with snack foods, such as cakes, biscuits, and oleaginous fruits, and uncontrolled eaters reported eating more fatty and salty foods. Sunday et al. (29) reported that restrained eaters displayed different attitudes toward com-

TABLE 4

Associations between eating behavior and food group intake among teenagers and young adults[1,2]

	Cognitive restraint	Uncontrolled eating	Emotional eating
Offal	1.87 [1.00–3.48]	0.80 [0.45–1.44]	0.76 [0.42–1.35]
Pork meat products			
Men	0.75 [0.33–1.68]	1.05 [0.47–2.33]	0.53 [0.23–1.25]
Women	0.52 [0.22–1.19]	0.56 [0.72–3.37]	0.87 [0.39–1.93]
Eggs			
Men	0.85 [0.38–1.90]	1.27 [0.59–2.76]	0.70 [0.32–1.57]
Women	0.56 [0.26–1.22]	1.83 [0.85–3.93]	0.82 [0.37–1.80]
Meat	0.83 [0.47–1.47]	1.15 [0.68–1.93]	1.03 [0.59–1.81]
Cooked dishes	0.47 [0.25–0.88]*	1.53 [0.88–2.65]	1.20 [0.68–2.12]
Fish	0.92 [0.49–1.72]	0.67 [0.39–1.15]	0.78 [0.45–1.35]
Cheese	0.60 [0.34–1.06]	1.40 [0.82–2.38]	1.12 [0.64–1.96]
Yogurt			
Men	1.44 [0.63–3.26]	1.55 [0.70–3.41]	1.80 [0.80–4.05]
Women	1.35 [0.61–3.01]	1.07 [0.49–2.32]	0.75 [0.34–1.63]
Dairy desserts			
Men	1.61 [0.66–3.91]	0.91 [0.42–1.98]	1.09 [0.50–2.36]
Women	0.41 [0.16–1.03]	2.07 [0.95–4.52]	1.93 [0.90–4.16]
Sugar and confectionery	0.25 [0.13–0.46]*	1.50 [0.89–2.54]	0.97 [0.57–1.67]
Dietary fat	0.37 [0.21–0.65]*	1.42 [0.82–2.47]	1.19 [0.67–2.11]
Bread	0.57 [0.31–1.05]	1.20 [0.73–1.99]	1.22 [0.69–2.14]
Cereals and pasta	0.62 [0.34–1.14]	1.24 [0.72–2.12]	1.04 [0.60–1.79]
Potatoes	0.59 [0.32–1.10]	1.60 [0.93–2.76]	0.91 [0.53–1.59]
French fries	0.52 [0.30–0.92]*	1.91 [1.10–3.34]*	1.11 [0.64–1.94]
Cakes/pastries/biscuits	0.48 [0.27–0.88]*	1.90 [1.08–3.34]*	1.62 [0.92–2.86]
Oleaginous fruits	1.18 [0.63–2.20]	1.04 [0.58–1.86]	1.28 [0.75–2.20]
Fruits	1.09 [0.59–2.01]	1.09 [0.52–1.89]	0.48 [0.27–0.84]*
Green vegetables	1.89 [1.02–3.50]*	1.20 [0.69–2.06]	0.71 [0.41–1.25]
Dry vegetables	0.83 [0.47–1.47]	1.10 [0.63–1.93]	1.40 [0.79–2.05]
Fat-reduced foods	1.72 [0.96–3.11]	0.93 [0.55–1.58]	1.38 [0.82–2.33]
Sweet beverages	0.46 [0.25–0.84]*	0.92 [0.55–1.56]	0.94 [0.55–1.60]
Alcoholic beverages	1.49 [0.78–2.84]	1.38 [0.77–2.48]	0.86 [0.48–1.56]
Milk			
Men	0.43 [0.18–1.04]	0.93 [0.43–1.98]	1.11 [0.53–2.35]
Women	0.69 [0.30–1.58]	0.72 [0.35–1.51]	0.72 [0.33–1.59]
Water	0.71 [0.39–1.32]	0.88 [0.49–1.57]	0.52 [0.29–0.94]*

[1] Values are age-adjusted OR [95% CI] for a higher reported intake of a selected food group according to the higher tertile of the TFEQ-R18 score (vs. lower tertile). The OR were also adjusted for gender unless there was a significant interaction term. * Significant, $P < 0.05$.

[2] The OR associated with the middle vs. lower tertile, which were in general intermediate, are not shown to improve the clarity of the table.

monly encountered foods from unrestrained eaters, with a preference for low-fat foodstuffs. While several researchers have suggested a specific avoidance of fat in restrained eaters (10,19,30), the trend to avoid animal products and instead to select "healthy" foods, such as fruit and vegetables, was less consistent (7,8,30). As reported by others (7–9,20,23), high female restrainers were also found to have a lower energy intake, a lower contribution of fat to energy intake, and a higher part of energy derived from protein. Concerning emotional and uncontrolled eating, our findings were consistent with a previous paper (10), which suggested that uncontrolled and emotional eating affected positively the preference for "sweet" and "fattening" foods. In our study, a high uncontrolled eating score was associated with a high energy intake. This is in line with previous observations that the disinhibition and hunger scales of Stunkard and Messick TFEQ were positively associated with energy intake (20,23,31). Indeed, items of the TFEQ-R18 uncontrolled and emotional eating scales were derived from the TFEQ disinhibition and hunger scales.

Reported food intake was differently affected by the 3 TFEQ-R18 factors among the teenager and young adult and the adult groups. Especially, cognitive restraint was predominately associated with a higher consumption of healthy foods (fat-reduced foods, green vegetables, fish, yogurt) among the adult group, whereas it was associated with a lower consumption of fat and sweet foods (French fries, sugar and confectionery, processed pork meat products, fat, sweet beverages) among the teenagers and young adults group. UE and EE scores were less able to differentiate specific food attitudes in teenagers and young adults compared with adults. This may be due to a specificity of these eating behaviors in teenagers and young adults or to our measurement tools, which may be less understood by teenagers and young adults. Indeed, the TFEQ-R18 questionnaire was developed among middle-age subjects. TFEQ-R18 items would thus refer to specific behavior, which could be more confusing for teenagers and young adults. Teenagers and young adults may also be less able to assess their own eating behavior. Children's eating behaviors were examined in several other studies, especially for the impact of parents' eating behavior on children's eating patterns (32,33). However, in studies that reported the relationships between eating behavior and reported food intake, teenagers were not examined as a distinct group. Indeed, they were often included either in the adult group (10,26,28,34) or in the child group (9,35). Differences between middle-age adults and teenagers or young adults regarding eating behavior and food intake were not underlined. In the teenagers and young adults group, higher uncontrolled eaters reported a higher alcoholic beverage intake than medium uncontrolled eaters [OR = 1.38

TABLE 5

Associations between energy intake and relative macronutrient intakes and TFEQ-R18 scores in adults and teenagers and young adults

	Energy[2]		Protein		Carbohydrate	Fat
	Male	Female	Male	Female	All	All
	kJ/d		*% Energy*			
			Middle-age adults			
Cognitive restraint						
Low	12,029 ± 394	10,513 ± 349	16.1 ± 0.3	17.1 ± 0.4	44.6 ± 0.5	36.6 ± 0.5
Medium	12,029 ± 400	10,541 ± 351	16.5 ± 0.3	16.6 ± 0.3	44.3 ± 0.5	37.9 ± 0.4
High	11,864 ± 477	9678 ± 313	16.7 ± 0.3	18.6 ± 0.4	44.5 ± 0.5	36.8 ± 0.5
P[3]				<0.001		
Uncontrolled eating						
Low	11,158 ± 388	9663 ± 363	16.9 ± 0.4	17.8 ± 0.4	44.4 ± 0.6	36.0 ± 0.5
Medium	12,140 ± 492	10,067 ± 320	16.3 ± 0.3	17.0 ± 0.3	44.9 ± 0.5	37.0 ± 0.4
High	12,437 ± 362	11,029 ± 357	16.2 ± 0.3	17.2 ± 0.3	44.0 ± 0.5	38.2 ± 0.5
P		<0.05				<0.01
Emotional eating						
Low	11,272 ± 359	9929 ± 407	16.9 ± 0.3	17.4 ± 0.4	43.6 ± 0.6	37.0 ± 0.5
Medium	11,377 ± 654	10,438 ± 383	15.6 ± 0.5	17.2 ± 0.4	45.5 ± 0.7	36.6 ± 0.6
High	12,741 ± 376	10,437 ± 292	16.3 ± 0.3	17.3 ± 0.3	44.6 ± 0.4	37.6 ± 0.4
P	<0.05					
			Teenagers and young adults			
Cognitive restraint						
Low	15,400 ± 1086	13,163 ± 678	15.2 ± 0.5	14.6 ± 0.4	47.4 ± 0.6	37.7 ± 0.6
Medium	15,389 ± 653	11,041 ± 489	14.4 ± 0.3	15.5 ± 0.4	49.2 ± 0.5	36.0 ± 0.4
High	13,602 ± 615	9164 ± 513	15.2 ± 0.3	16.7 ± 0.4	48.2 ± 0.7	36.1 ± 0.6
P		<0.001		<0.001		<0.05
Uncontrolled eating						
Low	14,185 ± 891	10,091 ± 767	15.2 ± 0.3	16.0 ± 0.4	48.7 ± 0.7	35.9 ± 0.6
Medium	14,637 ± 693	11,291 ± 557	14.8 ± 0.3	15.5 ± 0.4	49.0 ± 0.6	36.0 ± 0.5
High	15,204 ± 607	11,337 ± 457	14.7 ± 0.3	15.5 ± 0.4	47.6 ± 0.6	37.3 ± 0.5
P						
Emotional eating						
Low	15,182 ± 1107	10,933 ± 771	15.2 ± 0.4	16.1 ± 0.4	48.1 ± 0.7	36.3 ± 0.6
Medium	14,488 ± 740	11,149 ± 531	14.6 ± 0.3	15.3 ± 0.4	48.2 ± 0.7	36.9 ± 0.6
High	14,604 ± 560	10,782 ± 440	14.9 ± 0.3	15.6 ± 0.4	48.7 ± 0.5	36.1 ± 0.5
P						

[1] Values are age-adjusted means ± SEM (n = 236 for adult males, 284 for adult females, 171 for teenage and young adult males, and 163 for teenage and young adult females. The mean was also adjusted for gender unless there was a significant interaction term.
[2] Excluding alcohol.
[3] P value for comparisons among the TFEQ-R18 tertiles.

(0.77–2.48), OR = 0.68 (0.37–1.25), respectively, for the higher vs. lower UE tertile and for the medium vs. lower UE tertile; $P = 0.04$]. Thus, uncontrolled eating, which expresses inability to limit food intake and an extreme sensitivity to external stimuli, may detect behaviors, which could lead to excessive alcoholic beverage intake. On the other hand, an excessive alcohol intake can disregulate food intake and may therefore lead to an excessive food intake.

The FFQ measures a reported food intake. It would therefore be greatly important to identify underreporters. Unfortunately, current methods for assessing underreporting were not usable with a food intake measured from a FFQ. Consequently, it would be impossible to directly evaluate underreporting in our study. However, a previous study (36) defined specificity of underreporters' eating patterns in our adult sample. In that study, 2 kinds of food groups were affected by underreporting. First, like cognitive restrainers, underreporters had a lower reported intake of potatoes, French fries, and sugar and confectionery, and they were characterized by a higher intake of vegetables and a larger part of protein to energy intake. Second, contrary to uncontrolled eaters, they eat less dietary fat and processed pork meat products, and consequently their contribution of fat to energy intake was lower. Few relations were found between underreporters' and emotional eaters' food patterns. Asbeck et al. (37) previously underlined the associations between eating behavior (restraint and disinhibition) and underreporting. Cognitive restraint could be a tool to help us to identify subjects who are likely to underreport their intake in a food frequency questionnaire (in which underreporting cannot be directly evaluated). However, further research would be needed to understand the impact of eating behaviors on underreporting to improve food intake assessment. Understanding the association between eating behavior and reported food intake may prove helpful in the analyses of the relations between health and diet.

The associations between reported food intake and eating behavior were adjusted here for age and gender. Because health awareness and access to healthy foods were partially linked to socioeconomic level, it would be of great interest in further analyses to evaluate the impact of these confounders on eating behavior and reported food intake. Unfortunately, income assessment was not possible with our

data. However, adjustment for education level did not change our results.

Several studies about eating behavior were previously conducted in a general population in Quebec (20) and in France (9). The consistency of our results on food intake with those studies, especially concerning restraint or disinhibition/UE, although different eating questionnaires were used, is in favor of the suitability of the TFEQ-R18 use in the general population.

In conclusion, the TFEQ-R18 appeared to be an easy self-administered questionnaire, able to distinguish among varied eating behaviors in a general population, especially in adults. In teenagers and young adults, cognitive restraint was the most identifiable behavior.

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APPENDIX

The Three-Factor Eating Questionnaire—Revised 18-Item

1. When I smell a sizzling steak or juicy piece of meat, I find it very difficult to keep from eating, even if I have just finished a meal.
   Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)
2. I deliberately take small helpings as a means of controlling my weight.
   Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)
3. When I feel anxious, I find myself eating.
   Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)
4. Sometimes when I start eating, I just can't seem to stop.
   Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)
5. Being with someone who is eating often makes me hungry enough to eat also.
   Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)
6. When I feel blue, I often overeat.
   Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)
7. When I see a real delicacy, I often get so hungry that I have to eat right away.
   Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)
8. I get so hungry that my stomach often seems like a bottomless pit.
   Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)
9. I am always hungry so it is hard for me to stop eating before I finish the food on my plate.
   Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)
10. When I feel lonely, I console myself by eating.
    Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)
11. I consciously hold back at meals in order not to weight gain.
    Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)
12. I do not eat some foods because they make me fat.
    Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)
13. I am always hungry enough to eat at any time.
    Definitely true (4)/ mostly true (3)/ mostly false (2)/ definitely false (1)
14. How often do you feel hungry?
    Only at meal times (1)/ sometimes between meals (2)/ often between meals (3)/ almost always (4)
15. How frequently do you avoid "stocking up" on tempting foods?
    Almost never (1)/ seldom (2)/ usually (3)/ almost always (4)
16. How likely are you to consciously eat less than you want?
    Unlikely (1)/ slightly likely (2)/ moderately likely (3)/ very likely (4)
17. Do you go on eating binges though you are not hungry?
    Never (1)/ rarely (2)/ sometimes (3)/ at least once a week (4)
18. On a scale of 1 to 8, where 1 means no restraint in eating (eating whatever you want, whenever you want it) and 8 means total restraint (constantly limiting food intake and never "giving in"), what number would you give yourself?
    The 1–2 scores were coded 1; 3–4 scores were coded 2; 5–6 scores were coded 3; 7–8 scores were coded 4.

The cognitive restraint scale was composed of items 2, 11, 12, 15, 16, and 18. The uncontrolled eating scale was composed of items 1, 4, 5, 7, 8, 9, 13, 14, and 17. The emotional eating scale was composed of items 3, 6, and 10.