

VALIDATION OF THE ROMANIAN VERSION OF A SELF-ADMINISTERED FOOD FREQUENCY QUESTIONNAIRE

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Abstract

Background and aims: The present study aimed to assess the relative validity of the Romanian version of a food frequency questionnaire (FFQ) in evaluating habitual dietary intake. **Material and methods:** We used an FFQ that comprised questions on 90 beverage and food items from Nurses Health Questionnaire. The linguistic interchangeability between translation and original questions of the FFQ was assessed in 50 bilingual adults. Also, the FFQ was validated against the 24-h recall diary in 85 participants from ORO study enrolled in Cluj County. **Results:** The Spearman correlation coefficients between the Romanian and English versions of the FFQ ranged between 0.614 and 1.000, with the majority having values >0.900 ($p < 0.05$ for all). Caloric and nutrient intake estimated from FFQ was significantly correlated with that derived from 24-h dietary recall (correlation coefficients 0.243 to 0.339; p -values < 0.05). $>70\%$ of the participants were classified in the same or adjacent quartiles of energy and nutrient consumption showing a good agreement between FFQ and 24-h dietary recall. Tested FFQ questionnaire had a good internal consistency with Cronbach's alpha coefficients of 0.931 and 0.949, respectively. **Conclusion:** Tested FFQ had an acceptable relative validity and can be used to estimate caloric and macronutrient intake.

key words: food frequency questionnaire, Romanian version, dietary intake

Background and aims

Mid-term and long-term evaluation of dietary intake are a key part of nutritional epidemiological studies for assessing dietary habits of given populations or identification of dietary risk factors for non-communicable

chronic diseases. Practical methods for assessing dietary intake are limited. The most commonly used methods are detailed, validated food frequency questionnaires (FFQ), 24-hour dietary recalls and prospective food diaries. 24-h dietary recalls usually require trained interviewers and prospective food diaries require food weighting

and may be subject to limited adherence from the studied population and may also be associated with changes in usual diet during the followed time. FFQ are the most frequently used tools to assess dietary behavior in large populations. They may be self-administered, thus limiting the need of trained interviewers, their processing is relatively inexpensive, and they are intended to estimate mid-term and long-term individual habitual dietary intake [1].

Before being used in nutrition researches, all newly developed or adapted FFQ must be validated in the target population as they are prone to errors due to cultural variations in food consumption across different populations [2]. The validation is usually performed against other methods that assess dietary intake – i.e. 24-h dietary recalls, food diaries or biomarkers for nutrient intake [2-6].

For Romania, we are aware of only one FFQ adapted for and validated in Romanian population [7]. The translated version of the EPIC-Norfolk questionnaire [5] comprising 130 food and drink items was previously validated in 125 persons [7]. However, this validated Romanian version of the EPIC-Norfolk questionnaire was intended to be administered by a trained interviewer and is relatively long, thus limiting its use in large epidemiological studies due to budgetary constraints.

Here we aimed to assess the relative validity of the Romanian version of a shorter FFQ in evaluating the individual habitual dietary intake. This proposed FFQ is self-administered and could be more easily used in epidemiological studies to assess the dietary habits in Romanian population. The validation was part of the Obesity in Romania Study - Study of the prevalence of obesity and related risk factors in Romanian general population (ORO study). This was an observational, cross-sectional study conducted in 2014 in 8 centers across Romania

with the main objective to assess the prevalence of overweight and obesity and the lifestyle habits in the Romanian population [8,9].

Material and methods

Study design and participants

FFQ was self-administered with the help of investigators, who provided instructions on how to be filled in. It comprised questions from Nurses Health Questionnaire [10], covered the previous 12 months and assessed the frequency of consumption of 90 individual food and beverage items: bread, pasta, cereals, fish, meat, eggs, milk and dairy products, snacks, sweets, fruits, legumes, vegetables, fried food, fast-food and type of fat used for cooking. For each item, portion sizes were provided, and participants were asked to choose among nine frequency response options, ranging from “never” to “6 or more times per day”. For 83 of the 90 food items possible score values ranged between 1 and 9 (with 1 for never or less than once/month and 9 for over 6 times/day). For the frequency of fried food and fast-food consumption potential scores ranged between 1 and 4. Type of fat used (butter/margarine/olive oil/ lard/vegetable oil) were scored as “not used” and “used” [8]. FFQ was conceptually translated in the Romanian language and adapted.

The validation of the FFQ was performed in 2014 as a 2-step study.

Linguistic interchangeability and internal consistency

In the first step, we enrolled 50 participants from Cluj County, with the aim of determining the linguistic interchangeability between translation and original questions of the FFQ and internal consistency of the Romanian version of the FFQ. The questionnaire was administered both in English and Romanian to bilingual participants and the correlations between

individual item scores in the 2 languages was determined.

FFQ validation against the 24-h dietary recall

In the second part of the study, the FFQ was validated against the 24-h dietary recall in a subset of 85 participants from ORO study enrolled in Cluj County. For this part the test method was considered the FFQ and the reference method the 24-h dietary recall. Of the 90 food and beverage items included in the FFQ, were excluded from validation the 5 items that assessed the type of fat used for cooking due to their scoring methodology. For the 24-h dietary recall an interview was conducted for each participant and detailed information was obtained on food and beverages consumed in the previous 24 h as type of meal (breakfast, lunch, dinner, snacks), amount in grams or milliliters and type of food.

For this second step the information from FFQ was used to estimate the average intake for previous 12 months by multiplying the frequency with the provided portion sizes. Daily intake of each food item was calculated by dividing the average intake for the previous 12 months with 365 days. This daily intake of individual food items was further multiplied with kcal and nutrient amount (g) to obtain the caloric intake and g of macronutrients consumed/day from an individual food item. Total caloric intake/g of macronutrients per day was computed by summing the caloric intake/g of macronutrients from all individual food items.

Also, total caloric intake/day, caloric intake/day from macronutrients and g of macronutrients were also calculated from 24-h dietary recall, which was used as the reference method.

All FFQs and 24-h dietary recalls were checked for completeness. For calculation of energy and nutrients intake were used the food

tables published by the Romanian Society of Nutrition [11].

Additional data collected

The following data were collected per patient: demographic, anthropometric data, socio-economic status, personal and familial medical history, data on gender, age and place of living (urban/rural area). Each person's education and employment status were collected and used as measures of socio-economic status. Information on medical history and smoking status were also collected. Weight and height were measured by the investigators. The BMI was calculated with the formula $\text{weight (kg)/[height (m)]}^2$.

Ethics

The study was conducted in accordance with the ethical principles stated in the Declaration of Helsinki, 1964 with all subsequent revisions and amendments, as well as Good Clinical Practice (GCP) requirements (ICH E6) and the applicable regulations in Romania. The study was approved by the National Bioethics Committee of Medicine and Medical Devices. Prior to any protocol procedures and treatment, the investigator and the participants, signed and personally date the consent form as confirmation of consent.

Statistical analysis

The linguistic interchangeability between translation and the original questions, were assessed by calculating Spearman correlation coefficients between individual item scores in the 2 languages. A Spearman's correlation level of 0.5 was considered acceptable for this part of the study. The internal consistency was tested by Cronbach's alpha intraclass correlation coefficients.

In the second part, validity was assessed by comparing estimates of total caloric intake

(kcal/day), kcal/day from carbohydrates, lipids and proteins and grams/day of macronutrients from FFQ with those calculated from 24-h dietary recall. Also, as part of validity evaluation in this step we assessed the correlations between above mentioned parameters by Spearman's correlation coefficient. To assess the relative agreement between the 2 methods was performed the cross-classification of the proportion of participants who were classified by the two methods in same, adjacent, and extreme quartile.

The categorical variables are presented as percent, continuous variables with normal distribution as mean \pm standard deviation and continuous variables with abnormal distribution as median (1st quartile; 3rd quartile). Due to deviations from normal distribution, nonparametric tests were used to compare total caloric intake (kcal/day), kcal/day from carbohydrates, lipids and proteins and grams/day of macronutrients estimated from FFQ with those calculated from 24-h dietary recall. For all statistical tests used, the significance level chosen was 0.05, and the two tailed p value was computed. Statistical analysis was performed using IBM SPSS Statistics for Windows, Version 22.0 (Armonk, NY: IBM Corp).

Results

Linguistic interchangeability and internal consistency

For the first part of the validation we enrolled 50 bilingual participants (English and Romanian; 62.0% women), with the mean age 25.1 \pm 3.6 years (ranging between 22.0 and 37.0 years) and mean BMI 22.5 \pm 4.4 kg/m² (ranging between 16.6 and 36.6 kg/m²).

The Spearman correlation coefficients between the answers provided to Romanian and English versions of the questions from the Nurses Health Questionnaire ranged between

0.614 and 1.000, with the majority having values >0.900. All were statistically significant showing a good reproducibility between the translation in Romanian and the original questions in English.

For the reliability analysis, Cronbach's alpha coefficient for the Romanian version of the FFQ questionnaire was 0.931 showing a good internal consistency.

FFQ validation against the 24-h dietary recall

In the second part of the study, in order to validate the FFQ against a 24-h dietary recall, we enrolled 85 participants. The characteristics of the participants are presented in [Table 1](#). The majority were women (76.5%), from urban area (76.5%), the mean age was 37.3 years and the mean BMI 24.4 kg/m².

Table 1. The characteristics of the participants completing both food frequency questionnaire and a 24-h dietary recall.

Variable	Value
Women, n (%)	52 (61.2%)
Age, years (mean \pm SD)	37.3 \pm 14.3
Urban area, n (%)	65 (76.5%)
Education, n (%)	
Middle school	3 (3.5%)
High school	16 (18.8 %)
Vocational school	13 (15.3 %)
University	53 (62.4 %)
Professional situation, n (%)	
Full time program	51 (60.0%)
Part time program	5 (5.9 %)
Unemployed	1 (1.2%)
Retired	6 (7.1 %)
Student	16 (18.8 %)
Householder	4 (4.7 %)
Other	2 (2.35 %)
Associated diseases, n (%)	
Diabetes mellitus	4 (4.7 %)
Hypertension	16 (18.8 %)
Smoking, n (%)	19 (22.4 %)
BMI, kg/m ² (mean \pm SD)	24.4 \pm 4.4
Waist circumference, cm (mean \pm SD)	84.2 \pm 17.8

n (%) - number (percentage) in a given category; BMI – body mass index; SD – standard deviation

The comparative quantitative evaluation of food intake, regarding caloric consumption and

grams of macronutrients between FFQ and 24-h dietary recall is presented in [Table 2](#). The estimated total caloric intake, caloric intake from lipids and proteins as well as grams of proteins and lipids per day from FFQ were similar to those calculated from 24-h dietary recall. Intake of carbohydrates and caloric intake from carbohydrates estimated from FFQ was statistically significantly lower compared to the one calculated from 24-h dietary recall. Total number of kcal/day and number of kcal/day consumed from macronutrients derived from

FFQ were significantly correlated with those derived from 24-h dietary recall (correlation coefficients ranging between 0.243 and 0.339; p-values <0.05). Also, the daily intake of grams of macronutrients derived from FFQ were significantly correlated with those derived from 24-h dietary recall (correlation coefficients 0.312 for lipids, 0.279 for carbohydrates and 0.250 for proteins). For the reliability analysis, Cronbach's alpha coefficient for the Romanian version of the FFQ questionnaire in this sample was 0.949.

Table 2. Quantitative evaluation and correlation coefficients for caloric and nutrient intake from food frequency questionnaire and 24-h dietary recall.

Variable	Estimation based on FFQ	Estimation based on 24-h dietary recall	p-value for difference	Coefficient of correlation	p-value for correlation coefficients
Caloric intake, kcal	1227 (917;2339)	1412 (1117;2157)	0.818	0.339	0.001
L, g	48.3 (30.2;77.5)	56.0 (37.0;76.0)	0.852	0.312	0.004
CH, g	168.2 (122.4;321.4)	177.0 (123.0;255.0)	0.006	0.279	0.010
P, g	61.5 (40.0; 94.5)	78.0 (51.0;106.5)	0.708	0.250	0.021
Kcals from L/day	440 (275;705)	504 (333; 684)	0.777	0.312	0.004
Kcals from CHs/day	723 (526;1382)	708 (492;1020)	0.006	0.279	0.010
Kcals from P/day	264 (176;407)	312 (204;426)	0.818	0.243	0.025

L – lipids; CH – carbohydrates; P – proteins; FFQ – food frequency questionnaire; kcal – kilocalories; g – grams

Table 3. Cross-classification of caloric and nutrient intake for food frequency questionnaire versus 24-h dietary recall.

Variable	Same quartile N (%)	Adjacent quartile N (%)	One quartile apart N (%)	Opposite quartile N (%)
Caloric intake, kcal	23 (27.1)	38 (44.7)	20 (23.5)	4 (4.7)
L, g	29 (34.1)	31 (36.5)	19 (22.4)	6 (7.1)
CH, g	21 (24.7)	40 (47.1)	19 (22.4)	5 (5.9)
P, g	24 (28.2)	37 (43.5)	19 (22.4)	5 (5.9)
Kcals from L/day	29 (34.1)	31 (36.5)	19 (22.4)	6 (7.1)
Kcals from CHs/day	21 (24.7)	40 (47.1)	19 (22.4)	5 (5.9)
Kcals from P/day	24 (28.2)	38 (44.7)	18 (21.2)	5 (5.9)

L – lipids; CH – carbohydrates; P – proteins; FFQ – food frequency questionnaire; kcal – kilocalories; g – grams

The cross-classification of daily caloric and nutrient intakes measured by FFQ and 24-h dietary recall is displayed in [Table 3](#). For all nutrients the proportion of participants classified in the exact same quartile ranged between 24.7% (carbohydrates) and 34.1% (lipids). The disagreement between the two methods (classification of the same participant in extreme

quartile) varied from 4.7% (total energy intake) and 7.1% (lipids).

Discussions

In this manuscript we present the validity and reliability of a translated version of a FFQ in Romanian population used in the ORO study. We showed that this FFQ had an acceptable relative validity in relation to the reference

method. Also, we observed a good agreement between the 2 methods with regards to quartile categorization.

When FFQ was validated against the 24-h dietary recall correlation coefficients varied between 0.243 and 0.339 for energy and macronutrients intake. These values of the coefficients define a moderate correlation [12,13], showing that the validated FFQ is a suitable tool to assess dietary intake in Romanian population. Also, these correlation coefficients are similar to the ones previously reported in studies of FFQ validation in other populations and in which were used 1-day or 3-days dietary recalls [1]. For example, in the validation of the FFQ used in the Polish group of the Prospective Urban and Rural Epidemiological (PURE) study in which were enrolled 146 adults, and in which were used 24-h dietary recalls, the correlation coefficients for caloric and macronutrients intake ranged between 0.14 and 0.56 depending on place of residence of enrolled participants [1]. In another study in which were enrolled 29 persons and was used a 3-day dietary record the correlation coefficients between FFQ and dietary recall for caloric intake and macronutrients ranged between 0.14 and 0.29 [14]. Validation studies which used 7-days dietary records reported better correlation coefficients as compared to ours [15,16]. Although correlation coefficients are methods accepted for assessing new methods against reference methods, they are not a measure of agreement. For assessing the agreement, we analyzed the ranking of the FFQ and 24-h dietary recall and we confirmed the relative validity of the tested FFQ, with a high percentage of participants being ranked in the same or adjacent quartile of energy and nutrients intake.

We observed that the FFQ underestimates daily intake of carbohydrates. For the total daily energy intake and intake of proteins and lipids,

although the estimated values were lower with FFQ than the ones derived from 24-h dietary recall, the differences were not statistically significant. These observations of under- or overestimations of energy and nutrient intake with FFQ questionnaires was expected and was previously reported in other validation studies of FFQ [1,15,16]. These observed differences between FFQ and 24-h dietary recall may be due to recall bias, as the FFQ refers to the previous months, and, also, to perception of portion sizes consumed. However, in our study more than 70% of the participants were classified in the same or adjacent quartiles of energy and nutrient consumption showing a good agreement between FFQ and the reference method. This agreement shows that the validated FFQ represents a useful method to assess the diet and the associations between diet and diet-related diseases in Romanian population.

This validation study has several limitations that we must acknowledge. The biomarkers are considered the gold standard for dietary intake [17]. However, dietary recalls are widely used due to budgetary constraints, despite self-reported bias that may be associated with their use, [18,19]. It has been also shown that increasing the number of days for dietary recalls improves the accuracy of this type of record with regards to true dietary intake. In our study we used only 1 day for dietary recall, and we chose this approach due to a foreseen limited interest of the population to participate in a longer duration study.

Conclusion

In conclusion, we showed that the tested 90-item FFQ had an acceptable relative validity and can be used to estimate caloric and macronutrient intakes and to investigate the associations between diet and disease in Romanian population.

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REFERENCES

- 1. Dehghan M, Ilow R, Zatonska K et al.** Development, reproducibility and validity of the food frequency questionnaire in the Poland arm of the Prospective Urban and Rural Epidemiological (PURE) study. *J Hum Nutr Diet* 25(3): 225-232, 2012.
- 2. Cade J, Thompson R, Burley V, Warm D.** Development, validation and utilisation of food-frequency questionnaires – a review. *Public Health Nutr* 5(4): 567-587, 2002.
- 3. Bingham S, Luben R, Welch A et al.** Associations between dietary methods and biomarkers, and between fruits and vegetables and risk of ischaemic heart disease, in the EPIC Norfolk Cohort Study. *Int J Epidemiol* 37(5): 978-987, 2008.
- 4. Hu FB, Rimm E, Smith-Warner SA et al.** Reproducibility and validity of dietary patterns assessed with a food-frequency questionnaire. *Am J Clin Nutr* 69(2): 243-249, 1999.
- 5. Kroke A, Klipstein-Grobusch K, Voss S et al.** Validation of a self-administered food-frequency questionnaire administered in the European Prospective Investigation into Cancer and Nutrition (EPIC) Study: comparison of energy, protein, and macronutrient intakes estimated with the doubly labeled water, urinary nitrogen, and repeated 24-h dietary recall methods. *Am J Clin Nutr* 70(4): 439-447, 1999.
- 6. Subar AF, Kipnis V, Troiano RP et al.** Using intake biomarkers to evaluate the extent of dietary misreporting in a large sample of adults: the OPEN study. *Am J Epidemiol* 158(1): 1-13, 2003.
- 7. Gherasim A, Arhire LI, Nita O, et al.** Can the EPIC food frequency questionnaire be applied to the population in Romania? *Rev Med Chir Soc Med Nat Iasi* 119: 856-863, 2015.
- 8. Roman G, Bala C, Creteanu G et al.** Obesity and Health-Related Lifestyle Factors in the General Population in Romania: a Cross Sectional Study. *Acta Endo (Buc)* 11(1): 64-72, 2015.
- 9. Roman G, Bala C, Craciun A, Craciun C, Rusu A.** Eating Patterns, Physical Activity and Their Association with Demographic Factors in the Population Included in the Obesity Study in Romania (ORO Study). *Acta Endo (Buc)* 12: 47-51, 2016.
- 10. Nurses Health Questionnaire.** [online] Available at: http://www.channing.harvard.edu/nhs/?page_id=52 [Accessed 8th Dec 2014].
- 11. Societatea de Nutritie din Romania.** Ghid pentru alimentatia sanatoasa. [online] Available at: <http://old.ms.ro/?pag=185> [Accessed 6th Jan 2018].
- 12. Block G, Wakimoto P, Jensen C, Mandel S, Green RR.** Validation of a food frequency questionnaire for Hispanics. *Prev Chronic Dis* 3: A77, 2006.
- 13. McNaughton SA, Hughes MC, Marks GC.** Validation of a FFQ to estimate the intake of PUFA using plasma phospholipid fatty acids and weighed foods records. *Br J Nutr* 97(3): 561-568, 2007.
- 14. Sauvageot N, Alkerwi A, Adelin A, Guillaume M.** Validation of the Food Frequency Questionnaire Used to Assess the Association between Dietary Habits and Cardiovascular Risk Factors in the NESCAV Study. *J Nutr Food Sci* 3: 208, 2013.
- 15. Brunner E, Stallone D, Juneja M, Bingham S, Marmot M.** Dietary assessment in Whitehall II: comparison of 7 d diet diary and food-frequency questionnaire and validity against biomarkers. *Br J Nutr* 86(3): 405-414, 2001.
- 16. Chen Y, Ahsan H, Parvez F, Howe GR.** Validity of a food-frequency questionnaire for a large prospective cohort study in Bangladesh. *Br J Nutr* 92(5): 851-859, 2004.
- 17. Day N, McKeown N, Wong M, Welch A, Bingham S.** Epidemiological assessment of diet: a comparison of a 7-day diary with a food frequency questionnaire using urinary markers of nitrogen, potassium and sodium. *Int J Epidemiol* 30(2): 309-317, 2001.
- 18. Araujo MC, Yokoo EM, Pereira RA.** Validation and calibration of a semiquantitative food frequency questionnaire designed for adolescents. *J Am Diet Assoc* 110: 1170-1177, 2010.
- 19. Haftenberger M, Heuer T, Heidemann C, Kube F, Krems C, Mensink GB.** Relative validation of a food frequency questionnaire for national health and nutrition monitoring. *Nutr J* 9: 36, 2010.