

DEVELOPING A RELATIVELY VALIDATED AND REPRODUCIBLE FOOD FREQUENCY QUESTIONNAIRE IN BAGHDAD, IRAQ

Mohammed Tareq Mutar ^{1*}, Mustafa Majid¹, Mazin Judy Ibrahim², Ali Saad ¹, Mohammed Saleh¹, Ali Abdulmortafea ¹, Maryam Akram¹, Mohammed Asaad Al-ani¹

¹ Medical student ,College of medicine, University of Baghdad, Iraq

² Assistant professor, internal medicine and oncology, College of medicine, University of Baghdad, Iraq

**Corresponding author: mohammed.tareq1600c@comed.uobaghdad.edu.iq*

ABSTRACT

Nutritional assessment is essential in the evaluation of individuals' health status. this study seeks to develop and validate a food frequency questionnaire (FFQ) that can be used as a nutritional assessment tool in epidemiological studies. a stratified random sampling enrolled sixty-five participants from Baghdad university college of medicine. participants were asked to fill a four days food upon which the questionnaire was developed. the participants were asked to fill the questionnaire based on their food intake in the last year. the data was entered using a food application, and the data source for the food nutritional values was obtained from different food composition tables. the serving size was assessed based on the Canadian nutritional society guidelines. the validation and reliability of the questionnaire were evaluated by comparing food intake of the records and the questionnaires using paired mean difference and Pearson correlation coefficient. the energy was adjusted using the nutrient density method. the mean difference between the records and questionnaire was 151.3 kcal, 7.61, 10.45, 10.24 gram for energy, fat, carbohydrate, and protein, respectively. the correlation coefficient between the record and the questionnaire was 0.829, 0.583, 0.323, and 0.547 for energy, fat, carbohydrate, and protein, respectively. in conclusion, this is the first valid food frequency questionnaire that was shown to be valid and reliable in providing a nutritional assessment of dietary intake in Iraq. it requires more efforts to be considered as a national tool for dietary assessment.

Keywords: Food frequency questionnaire, Dietary records, Nutrition, assessment, Iraq

Introduction

The nutritional care process is a method that are used by dieticians to critically think and make decision regarding nutritional problem and provide safe and effective quality care (Barasi, 2013), nutritional assessment represents an important step in the nutritional care (Ferrie S, 2020).

Various methods can be used for the nutritional assessment: 24-hour dietary record, multiple-day food record, weighed diet record, diet history, and Food frequency questionnaire FFQ (Barasi, 2013).

Using FFQ over the other dietary methods provides some advantages as they are relatively simple in construction and easy to be filled by the subject with less required time and resources (Serban CL et al., 2021) .Food frequency questionnaires are a helpful method in nutritional assessment, getting information about deficiencies or excess of nutrients because they are relatively easy and more economical to administer (Pierce et al., 2007), and may capture foods that only be eaten seasonally (Rayman TK et al., 2014). One limitation of FFQ is that it does not measure absolute food intake; instead, it is a tool for assessing relative intake (Dehghan et al., 2013). An achieved benefit of FFQ was done by Hu, et al, who identified two major dietary patterns using factor analysis of 131 items FFQ, which then was used for assessing the relative risk of coronary heart disease in relation to diets. (Hu et al., 2000).

Multiple-day food records (like four days records) have the advantage of not being dependent on memory since food is being recorded after the meal immediately and can provide detailed intake data. Considering that multiple day records are more representative(McLean RM, 2018), in this study, four days records were taken. However, time, cost, participants' motivation, and their ability to understand and follow the instruction (literacy) among them limit their usage (Dehghan et al., 2013).

There is no single gold method for developing FFQ or assessing its validity; however, Comparing food frequency questionnaire nutrients value to the records of the same cases is observed in multiple studies(Rezazadeh A, 2020) which is an appropriate method to establish a validated questionnaire.

Malnutrition is a problem in Iraq especially in area with high level of violence (Serdan, 2009), (Acharya et al., 2020), about 19% of Iraqi children are underweight (Ghazi et al, 2013). Since there is no available food frequency questionnaires in Iraq and studies rely on non-validated questionnaire for assessments (Alabbody, 2018), it seems necessary to develop and validate one to be used in Iraqi studies.

This study seeks to develop and validate a food frequency questionnaire that should be used to assess nutritional health and malnutrition in Iraq that will help in the early detection of malnourishment in desired populations.

Methods

This study represents a validation study focusing on content, construct, and criterion validities using a cross sectional design. It was held in 2018 from February till May. sixty-five participants were enrolled in the study (the sample size was chosen according to the number of students in the college grade where the study was held and according to the randomization methods). those participants were selected randomly from the college of medicine university of Baghdad using stratified sampling. those participants were young and free from chronic illness, and none of them were pregnant or lactating. informed consent was taken from the participants, and their identity was kept secret. participants were asked to fill a four days dietary record and a food frequency questionnaire. A programmer developed a food app, and the source of data in the study was food composition tables of the United States (US department of agriculture, 2019), Bahrain (musaiger, 2011) and some other researches are done in the region (bawadi et al., 2009).

Four Days Food Record

All participants were asked to fill a food record in a written or electronic form for four days, three of which included workdays, the other one is a holiday day. these forms are composed of tables, and participants were asked to fill those tables during their day at each meal they consumed. those meals were classified into breakfast, lunch, dinner, and snacks to assess the main meals and the snacks between and after the main meals. those participants were asked to weigh their food if possible, and if they couldn't, they were provided with a guide to assess the serving size. food record was taken during February prior to the development of the food frequency questionnaire and the food commonly consumed provided some assistance in the development of the FFQ. the participants completed the four days record within one month.

Food Frequency Questionnaire (FFQ)

The questionnaire is self-structured (105)-itemed, semi-quantitative paper form which was given to the participants and it was self-administrable. the questionnaires were collected after 2-4 weeks of administrations. the questionnaire was designed after reviewing the literature and food records collected previously from the participants. the questionnaire was designed to find the consumption of food during the last year. participants were asked to mention, on average, the frequency of consumption and the portion size of each food item they consumed during the previous year.

The frequency of consumption in the questionnaire was a range consisting of 6 items (once a year, once a month, 1-2 times per week, 3-4 times per week, daily or never). a serving size guide was administered with the questionnaires to help in estimating portion size in each meal. This guide was constructed based on portion size estimated by dietitians of Canada society (dietitians of Canada, 2018).

the mean intake of each item per day during last year was calculated using frequency portion size and number of portions: $[\text{frequency} \times \text{number of portions} \times \text{portion size}] / 365$. for example, a person eats meat once daily for the previous year and of one portion size (365 days a year is the frequency, once a day is the number of portions (1), and one portion size (1)), that is, $(365 \times 1 \times 1) \div 365$ and equal a mean of 1 gram.

Validity and Reliability

Validity was obtained by comparing the nutrients intake estimated by the FFQ with that of 4 days weighted record as the 4-day record represents a better, more reliable method of dietary assessment. Reliability was assessed by comparing the results of two FFQ collected one week apart. it was tested for 20 participants by distributing the questionnaire for the second time after one week of the first-time nutrients, and the correlation data will be shown in the results section.

Statistical analysis

The data was analyzed using SPSS v.24.(IBM corp. 2016) the macronutrients and food groups were shown to follow normal distribution using shapiro wilk, kolmogorov simonov, and histogram. descriptive statistics in term of mean, median, and interquartile range was used while the Pearson correlation coefficient, mean difference, percentage difference was used to establish relative validity and reproducibility of the questionnaire. Cronbach alpha was also used to establish reliability which had a value of 0.699251.

The mean percentage was calculated as the mean of all individual differences between the FFQ and 4-days records ($[\text{mean (FFQ - 4-days records)}] / [\text{mean (4-days records)}]$).

Implausible energy intake was checked to avoid the bias from wrongly reported intake in the FFQ, the total energy intake distribution was studied. a cut-off value was determined as the 75th percentile plus 1.5 the interquartile range and the 25th percentile minus 1.5 the interquartile range. this caused the exclusion of three food frequency questionnaire which reported energy intake (8563, 6327, and 5837). (steinemann et al., 2017).

The nutrients were energy-adjusted with nutrients density method to account for measurements error since is preferable to physical activity and body weight as indicated by some studies (rhee et al., 2014), (hu et al., 2000). for visualization, bland–altman diagrams were drawn for energy, fats, carbohydrates, and proteins. all statistical analysis was two-sided with a confidence level 95%.

Ethical approval

The study was done with ethical considerations and approval had been taken from college of medicine university of Baghdad.

Results

The mean age of the participants was 21.6 years, with a standard deviation of 8.7. 57% of them were female. The participants' mean weight was 74 Kilograms with a standard deviation of 18.2 and their mean height was 166 centimetres with standard deviation of 15.2. 93% of participants were students. Table one and table two represent statistical numbers (Means, Medians, Mean differences, Pearson correlation coefficients with and without energy adjustment and quartiles details) that were used in the validation and in the reliability of the questionnaire. Table three shows the percentage of each macronutrient and energy from each food group.

Table 1: Energy and macronutrient validation and reliability statistics values between the questionnaire and the 4 days record.

Items	4 days records Mean	Median	IQR ¹	FFQ ² mean	Median	IQR	Mean difference of FFQ and 4DRs (%)	Pearson Correlation of 4 DRs and FFQ	Energy Adjusted	Mean difference of FFQ 1 & FFQ 2	Pearson Correlation FFQ1 & FFQ2	Energy adjusted	Item in the same or adjacent quartile between FFQ & 4DRs (out of 65)
Energy	2192.28	2246.25	857.732	2343.598	2286	778.75	151.310 (0.069)	0.82923	Not appropriate	23.38294	0.834472	Not appropriate	61
Fats	73.19116	69	34.81	80.80462	76	35	7.613460 (0.1041)	0.583170	0.734944	-11.9339	0.997734	0.95410	59
Carbs	298.7795	284	105.4375	309.2298	304	98	10.45032 (0.0349)	0.323360	0.706583	10.24174	0.770808	0.908238	61
Protein	84.61235	85	38.75	94.85937	94	29	10.24702	0.54795	0.715974	3.878959	0.869007	0.90139	60

Table 3: The percentages of energy and macronutrients in each food group included in the questionnaire

	Meat percent age	Dairy percent age	Vegetables percent age	Starch percent age	Drinks percent age	Fruits percent age	Soup percent age	Sweets percent age
Protein	0.29657	0.131517	0.141196	0.26473	0.022146	0.099501	0.011234	0.033106
Fats	0.007806	0.045091	0.163078	0.331478	0.028806	0.299857	0.015812	0.107861
Carbs	0.267214	0.141752	0.109146	0.256272	0.031088	0.053183	0.022281	0.118349
Energy	0.045558	0.095426	0.163537	0.293826	0.050563	0.22716	0.018871	0.104702

*Energy unit is calorie (Kcal), while other macronutrients were calculated in grams

Figure one to figure four represent the dot charts which show the distribution of mean protein, carbohydrate, fats and energy intake of the questionnaires with the mean difference between records and the questionnaire.

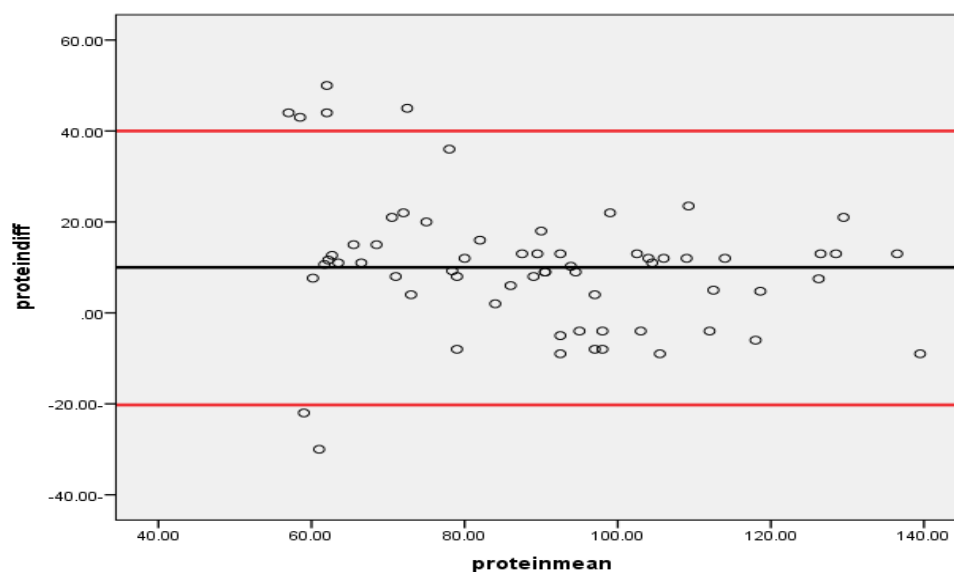


Fig 1: The distribution of mean protein intake of the questionnaires with the mean difference between records and the questionnaire.

*Proteindiff: Protein difference between records and questionnaires.

*Black line represents the mean of the difference between the records and the questionnaire.

*Red lines represent standard deviations from the mean difference.

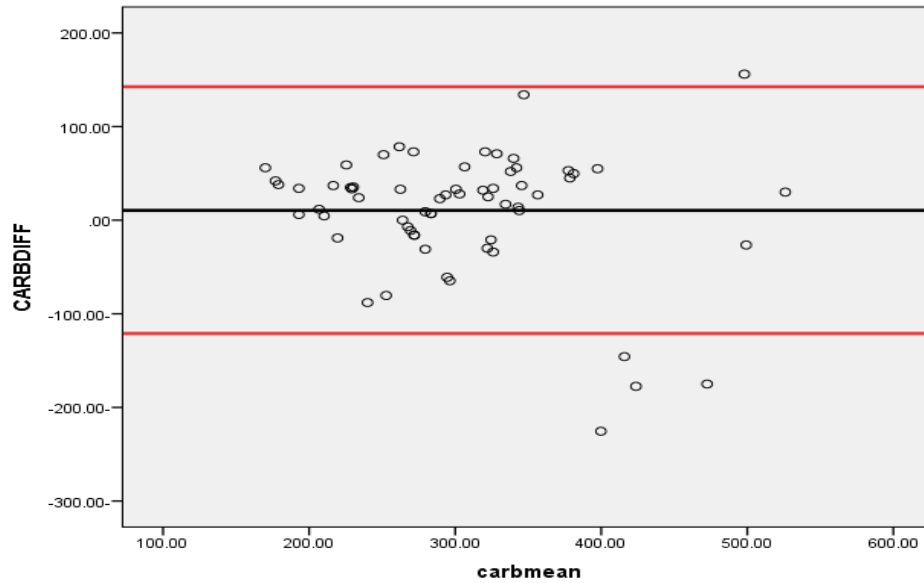


Fig 2: The distribution of mean carbohydrate intake of the questionnaires with the mean difference between records and the questionnaire.

*Carbdiff: carbohydrate difference between records and questionnaires.

*Black line represents the mean of the difference between the records and the questionnaire.

*Red lines represent standard deviations from the mean difference.

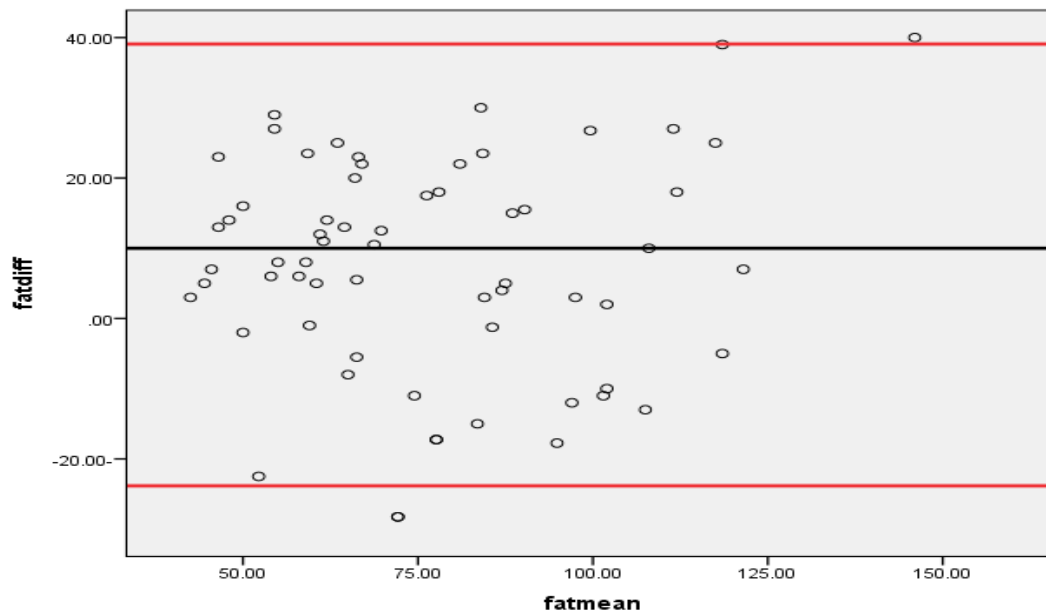


Fig 3: The distribution of mean fat intake of the questionnaires with the mean difference between records and the questionnaire.

*fatdiff: fat difference between records and questionnaires.

*Black line represents the mean of the difference between the records and the questionnaire.

*Red lines represent standard deviations from the mean difference.

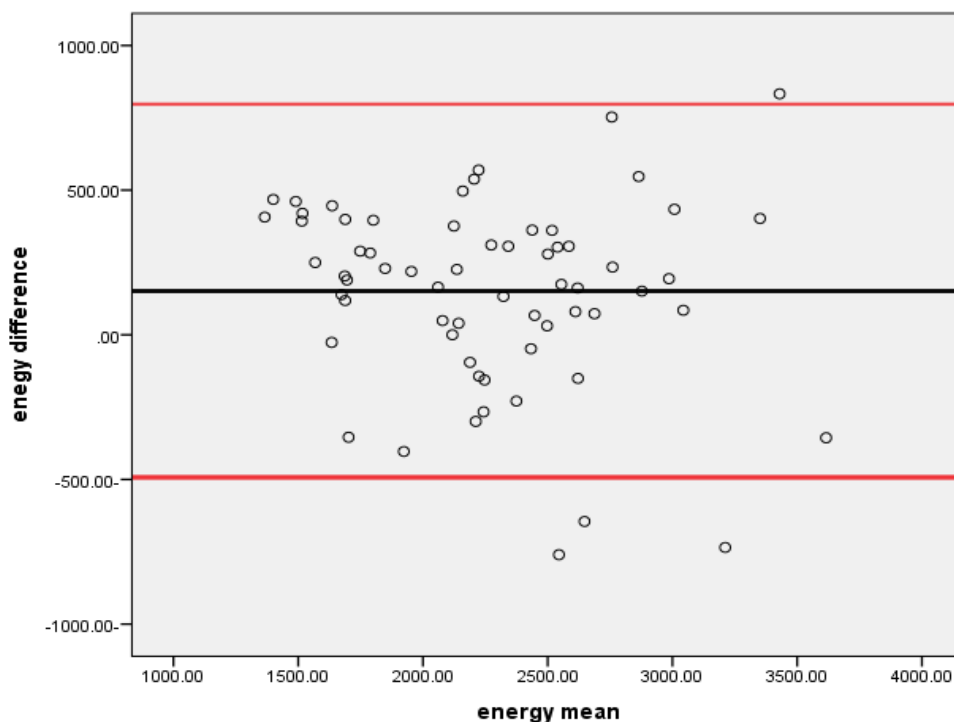


Fig 4: The distribution of energy intake of the questionnaires with the mean difference between records and the questionnaire.

*energydiff: energy difference between records and questionnaires.

*Black line represents the mean of the difference between the records and the questionnaire.

*Red lines represent standard deviations from the mean difference.

The energy, carbohydrate and protein showed statistically insignificant difference between the questionnaires and records. Meanwhile, fat intake showed significant difference between the two parts.

Discussion

This is the first trial to develop a food frequency questionnaire (FFQ) in Iraq. The Eastern Mediterranean region, including Iraq, suffers many nutritional problems like obesity and malnutrition (Nasreddine et al., 2018), and this issue requires detection and monitoring. FFQ is one of the best methods for that.

FFQ is often used in epidemiological studies for long-term evaluation of food consumption in adults, children, and adolescents (Lovell et al., 2017). These tools are highly beneficial because they may be a self-administered format. They represent dietary intake over long periods of time. They can be used for many participants, and they can compare nutritional intake among different populations. In this study, FFQ is developed and tested for relative validity and reproducibility with 4-days dietary records, a quantitative questionnaire was used to evaluate food consumption (Saravia et al., 2018). One of the most frequent limitations of the questionnaire is its length (Kolodziejczyk et al., 2012). as lengthy questionnaire might have an effect on the number of participants, and this is thought to be the cause of small sample size for this study which was 65 participants.

Compared with the energy and nutrients intake estimated by the 4-days dietary records, the questionnaire overestimated them, and this finding was also described by Steinemann et al and Dehghan et al (Steinemann et al., 2017) (Dehghan et al., 2013).

In this study, the highest mean difference percentage was 12.11% which suggests a good agreement is achieved for most items (Kowalkowska et al, 2013). The correlation coefficient was also used to assess the validity and agreement between methods as suggested by studies that a good correlation is considered if the correlation coefficient is more than 0.5, fair if they are between 0.39 and 0.49, and poor if they are less than 0.30 and in this study, most of the coefficients were more than 0.5 (Mukaka, 2012) (Fatihah et al., 2015).

The correlation coefficient in this study showed variation when compared among food groups between 4-days dietary record and questionnaire, this may be attributed to differences in the food items, and the portion sizes estimation errors, and between-person variances in consumption. (Goode JP et al., 2021) Nutritional assessment in this study involved only macronutrients; since micronutrients nutritional researches have measurements error and inter- and intra-individual variability (Webster-Gandy et al., 2020), there are many methods for estimating micronutrients, but not one of them is ideal.(Øverby et al., 2009).

Limitations

The length of questionnaire and difficulty with remembering frequencies were the main causes for such sample size, this limitation should be addressed and evaluated in the future to evaluate the generalizability of the questionnaire among general population. Most of the sample in this study were young in their 20s which may reflect nutritional intake among young Iraqis.

Conclusions

this self-administered FFQ showed validity for protein, calories, fats and carbohydrate intake. more effort is required to establish more powerful validity for this questionnaire to be used in nutritional assessment.

Conflicts of Interest

The author declares no conflicts of interest.

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