



Research Article

Development of an Innovative Tool for Assessment of Dietary Intake in the Fasting Month of Ramadan- A Ramadan-Specific Food Frequency Questionnaire

Rahmat Gul^{1*}, Imran Khan¹, Iftikhar Alam², Zia Uddin¹ and Zafar Iqbal³

¹Department of Human Nutrition, The University of Agriculture, Peshawar, Khyber Pakhtunkhwa (KPK), Pakistan;

²Program Human Nutrition and Dietetics, Department of Agriculture, Bacha Khan University Charsadda, Charsadda, Khyber Pakhtunkhwa (KPK), Pakistan; ³Department of Agricultural Chemistry and Biochemistry, The University of Agriculture, Peshawar, Khyber Pakhtunkhwa (KPK), Pakistan.

Abstract | Dietary habits, both in terms of amount of food and variety of food, during the month of Ramadan are different from those during non-Ramadan period of the year. Therefore, general Food Frequency Questionnaire are not capable to report on dietary intake in Ramadan. To define the design of a Food Frequency Questionnaire to be used for the assessment of food intake during the fasting month of Ramadan. A cross-sectional study was conducted in 2018. Data on food intake was collected using a 24-hour dietary recall during the fasting month of Ramadan in 2018 from a sample of 109 (majority men; 60.5%). Based on these data, using the frequency of report and on the contribution to the intake of energy and nutrients in the 24-HDR, 80 distinct food items were identified that are commonly used during Ramadan. Respective reference servings of these food items were selected to comprise the Food Frequency Questionnaire food list. The most reported portion sizes in the 24-HDR were used for Reference defining portions. The Food Frequency Questionnaire has a final list of 80 food items, which were categorized as cereal or equivalents (n = 18), vegetables (n = 10), pulses (n = 8), meat/organ meat or alternatives (n = 6), fruits (n = 12), beverages (n = 12), miscellaneous (n = 14), and functional foods (n = 7). The Food Frequency Questionnaire list comprised 80 food items organized by food groups with eight categories of frequency of consumption. In conclusion, the Food Frequency Questionnaire included the most relevant food items in Ramadan fasting month. Ramadan specific Food Frequency Questionnaire has great utility for dietary intake in the fasting month of Ramadan.

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***Correspondence** | Rahmat Gul, Department of Human Nutrition, The University of Agriculture, Peshawar, Khyber Pakhtunkhwa (KPK), Pakistan; **Email:** rguladil@gmail.com

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1. Introduction

In the Islamic calendar, Ramadan is the ninth month of the year, of 29 or 30 days; based on the observation of the crescent moon. According to Islamic practice, Ramadan is the month in which fasting is practiced, in commemoration of the first

revelation of the Quran to the prophet Muhammad. During fasting from dawn to dusk, Muslims abstain from consuming food and drink and engaging in sexual activity. Food and drink are served daily before sunrise and after sunset in meals called suhur (the pre-dawn meal) and iftar (the break-fasting meal), respectively (Alam *et al.*, 2019).

Ramadan fasting brings about numerous changes in food intake (Ali *et al.*, 2021; Alam *et al.*, 2019). Reporting accurate food intake during the month of Ramadan is challenging but highly relevant area of research to elucidate relationships between diet and metabolic diseases including, for example, diabetes, body weight and composition, and hypertension that is one of the high research priority areas in the current epidemiological studies on fasting (Correia *et al.*, 2021). The development of specific instruments for accurate dietary assessment during Ramadan associated with other indicators of nutritional status can help monitoring dietary trends and shaping public health policies (Shalaei *et al.*, 2013).

Food Frequency Questionnaire (FFQ) is the most widely applied method for the assessment of food intake in epidemiological studies (Mouratidou *et al.*, 2019). A typical FFQ consists of a list of food items that are most commonly consumed or included in the food habits of a given population at a given time. The FFQ is used to record the usual intake frequency of listed foods in a pre-established period as well as specifications of average portions consumed (Willet, 2012). FFQ is easy-to-use, low-cost objective instrument and the most practical and useful method for the assessment of food intake (Willet, 2012; Mouratidou *et al.*, 2019).

Despite all its usefulness, FFQ method also has certain limitations including, for example, its reliance on the respondents' recall of past habits, less accuracy to quantify food intake by using standardized measures, lesser ability to report on detailed food intake due to a pre-established food listing (Farshchi *et al.*, 2017; Willet, 2012). Factors such as age, education, and ethnic origin may affect the validity of data collected by FFQ (Kristal *et al.*, 1997). In addition, FFQ developed for general use may not be able to be used for assessment of food intake during specific occasions, for example, social festivals and religious occasions like the month of Ramadan fasting. Food habits during Ramadan enormously change and FFQ designed for non-Ramadan days proved to be of limited utility in catching the true picture of dietary intake during this month.

Most of these limitations can be minimized if occasion-specific FFQ are designed, which are less prone to misinterpretation and can provide more accurate, valid information (Whitton *et al.*, 2017).

Some cultural-specific FFQ have been previously developed for Asians (Sevak *et al.*, 2004) and Pakistani immigrants (Kassam-Khamis *et al.*, 1999). There have a number of other studies that mostly addressed development of culture-sensitive FFQ (Zaragoza-Martí *et al.*, 2018; Villano *et al.*, 2013; MacIntyre *et al.*, 2001). However, there has been no Ramadan-specific FFQ developed so far. Given the importance and need of appropriate food intake assessment, the main purpose of the current study was to develop an FFQ based on a probability sample for use in studies on food intake in adults during the fasting month of Ramadan. There is a need of an innovative tool in the form of an FFQ that may appropriately capture dietary habits of population and that may give a true picture of dietary intake. This study represents a major advance in nutritional epidemiology as it is unprecedented the development of a unique FFQ specifically for Ramadan fasting.

2. Materials and Methods

2.1 Study design and setting

The current study was undertaken in 2018. The study used a cross-sectional design. The sample used for the current study is part of our ongoing series of studies (2016-2021) on Ramadan fasting (Alam *et al.*, 2019).

2.2 Study population

The development of the FFQ was based on prior administration of 24-hour dietary recalls (24-HDR) on 109 adults living in the semi-urban area of KPK, a sample randomly selected from a probability sample in a population-based study (Alam *et al.*, 2019).

2.3 Sample size and sample selection

Sample size: According to Willet (2012), a sample of 100 or above respondents is considered sufficient to develop instruments to provide acceptable results in FFQ validity studies. Therefore, for the present study, a sample of 100 subjects was considered enough.

Inclusion and exclusion criteria: The full inclusion and exclusion criteria have been reported previously (Alam *et al.*, 2019), but briefly, bedridden and disabled individuals, pregnant and breastfeeding women, patients with chronic-non-infectious diseases requiring dietary changes were not eligible to participate in the study. Patients suffering from diseases were excluded mainly because they were not fasting at the time of when this study was undertaken.

All respondents selected agreed to participate with no refusals recorded.

Sample selection procedure: We have used twenty-four-hour dietary recalls (24-HDR) in our previous study (Alam et al., 2019). The sample for the present study was mainly derived from our previous work. Briefly, District Mardan and Malakand were selected from two lists of districts classified according to household head income by the Nutrition, Education Awareness and Training (NEAT), a government registered non-for-profit organization. Streets of the selected districts were mapped and households were drawn. Only one individual per household aged between 21-70 years was selected to avoid information interdependence among respondents. NEAT provided us with the list of their members, residing in these districts fulfilling the inclusion criteria. From these list, we randomly selected subjects using lottery method.

2.4 Data collection

Data was collected through household interviews carried out in April-May, 2018. Information about food intake were collected using 24-HDR and a standard questionnaire was used to record self-reported socioeconomic information. Anthropometric on weight and height data were collected by trained dietitians. Dietary data was collected using 24-HDR. Care was taken to evenly select weekdays and weekend in order to get dietary data representative of the whole week. Common household utensils and glassware were used for the report of portion sizes. This was facilitated by arranging all interviews in the households with either males or females depending upon the availability of feasibility of the respondent. In case of processed foods, their trademarks, product type, and packaging capacity were recorded for more accurate assessment of portions consumed.

During the interview sessions, respondents were encouraged to report all food items and beverages consumed in the last 24 hours, and their amounts and portion sizes in household measures. Accuracy of responses from elderly subjects were ascertained from someone at household. This was specifically done as old individuals usually have memory problem and can not accurately recall what they have eaten during the previous day (Alam et al., 2019).

To improve accuracy of data collected the following

measures were taken:

- Based on a pre-defined list of foods and dishes, available in the study manual, interviewers checked for missing items not usually reported in similar studies (Willet, 2012);
- All ingredients of dishes, as well as amounts consumed, were specified;
- Time and place where foods were consumed were recorded;
- All items were carefully reviewed to ensure that no food was missing.

2.5 Socioeconomic status determination

Socioeconomic status (SES) of respondents was assessed. Participants were divided on the basis of their monthly income into four socioeconomic classes, High class (H), high middle class (HM), and low middle class (LM) and below poverty line group (BPL). The stratification was based on the criteria provided by the World Bank (Bank, 2013). We wanted to collect data from a mixed sample of all those belonging to different socio-economic status in order to have a representative sample.

2.6 Development of the FFQ

A list of 276 food items was constructed using data from 24-HDR. For the FFQ, those items most commonly reported in the sample studied at a frequency of 15% or more, either as a single item or part of any preparation and recipe, or even together with other foods of similar nutritional composition, were selected (Ferreira et al., 2010). The food list also included specific food items that, despite below the established frequency cutoff, can possibly help identify dietary patterns or trends, e.g., seasonal or processed food, Ramadan specific foods, and regional dishes (Alam et al., 2019). Also, some foods were grouped by their nutritional similarity.

We also estimated the energy contribution of each food item and 13 other nutrients (carbohydrate, protein, total fat, saturated and unsaturated fat, cholesterol, fiber, iron, calcium, folate, thiamin, vitamin C and vitamin B6). This was done using Block et al. (1985) method, which calculates the ratio between the amount of a nutrient in each food item and total nutrient in all food items, multiplied by 100. There were also prepared lists of foods that contributed with 90% of intake of energy and major nutrients in the diet of the sample studied.

Food intake frequency options were defined based on those used in FFQs developed for use in adults and adolescents. Reference portion sizes were defined based on the most common food portions reported in the 24-HDR. Conventional portioning was used for some foods, for example, a samosa or pakora (one unit). The nutritional composition of each food item was assessed using information from our previous works.

2.7 Ethical considerations

All respondents were informed about the study purposes and signed an informed consent, which was in Urdu language. The study was submitted to and approved by Research Ethics Committee of Department of Human Nutrition, Agriculture University Peshawar, Pakistan (HN-HREC/2017-022). No invasive procedures were performed in the current study.

2.8 Statistical analysis

Data were presented in means (standard deviation) and percentage, whatever appropriate. All the data were fed into excel sheets and then transported to SPSS software for further analysis

3. Results and Discussion

The sample included 60.5 % (n= 66) men. Overall mean age was 34.5 (± 9.1) years; significantly higher number (46.2%) completed the high school education (10 years) and 20.2% completed elementary school education (12 years) or never attended school (Table 1). Majority of the sample (85%) were of normal body weight (BMI 18.5 -24.9) and most of the subjects belonged to middle income group (64.2%; n= 70).

The food items reported at a frequency of at least 15% in the sample studied are listed in Table 2. Rice, meat, beans, soft drinks, sugar, bread, samosa, pakora, jalibee, sherbet, soft drinks, fruit chat, tea with milk, and pickles were consumed by over 75% of the sample. The intake of foods rich in protein, especially beef (62.5%), beans (58.2%), chicken (44.5%), and milk (44.3%) was remarkable. Lettuce (55.0%), ladyfinger (54.0%), brinjal (52.0%) and tomato (51.0%) were the most common vegetables consumed. Food items less (5-10%) commonly reported were: eggs, cookies, canned food, milk powder, sweetened yoghurt, organ meat, candied fruits and caramelized milk.

Table 1: Socioeconomic and demographic characteristics of adults (N = 109).

Age (years)	n	%
20–39	41	37.6
30–39	32	29.4
≥ 40	36	33.0
Gender		0.0
Male	56	51.4
Female	53	48.6
Schooling		
Did not attend school/	0	0.0
Primary	31	28.4
Middle	31	28.4
Matric	26	23.9
College education	12	11.0
Graduate education	9	8.3
Socioeconomic classification*		
H	24	22.0
HM	30	27.5
LM	33	30.3
BPL	22	20.2

*Participants were divided on the basis of their monthly income into four socioeconomic classes, High class (H), high middle class (HM), and low middle class (LM) and below poverty line group (BPL). The stratification was based on the criteria provided by the World Bank.

Table 2: Frequency of food items mostly consumed in the study population assessed by 24-hour dietary recalls.

Food items	n	%
Rice	100	91.7
Sherbat	100	91.7
Beef	87	79.8
Pakora	81	74.3
fresh salad	79	72.5
Chicken	78	71.6
Yogurt chitnee	76	69.7
Jalibee	72	66.1
Functional foods/Ramadan Specific	72	66.1
lasi	69	63.3
qehwa	68	62.4
Soft drinks	67	61.5
Tea with milk	67	61.5
pickles	67	61.5
sugar	66	60.6
samosa	62	56.9
organ meat	62	56.9
wheat Bread	59	54.1
honey	57	52.3
Lettuce	47	43.1
Tomato	46	42.2
Beans	42	38.5
Whole milk	36	33.0

Table 3: A summary of elements of the FFQ.

Attributes	Cereals	Vegetables	Pulses	Meat*	Fruits	Beverages #	Others!	Functional Foods+
Total food items/mixed dishes	34	36	28	6	18	19	13	29
≥15% Energy Contribution	29	12	11	5	14	12	7	5
Grouping of food items	18	10	8	5	11	10	5	5
Inclusion of other foods	0	0	0	1	1	2	2	2
Final food items	18	10	8	6	12	12	7	7

*this group also contained meat alternatives/ground meat/ organ meat; # Beverages: this group also contained sherab made from sugar/gur (brown local sugar), lemonades, lemon-pani, lassi, ! Miscellaneous: mostly dishes, nuts; +Functional Foods: various herbal/ medicinal plants/seed/husk etc were included in this group. .

In this study 212 different food items were recorded from the 24-HDR. A consolidated list of food items was developed. From this list, Dietitians from NEAT grouped similar food items. This resulted in a total of 178 food items. Subsequently, conceptually similar food items were grouped together using our previous work as a guide (Ullah *et al.*, 2006). This yielded a final list of 71 food items (Table 3). An additional 9 food items were included to cover Ramadan specific dietary habits and the final 80 food items were categorized as cereal or equivalents (n=18), vegetables (n=10), pulses (n=8), meat/organ meat or alternatives (n=6), fruits (n=12), beverages (n=12), miscellaneous (n=14), and functional foods (n=7). The FFQ list comprised 80 food items organized by food groups with eight categories of frequency of consumption, e.g.: More than 2 times a day 5–6 times a week, 2–4 times a week; once a week; 1–3 times a month; and never etc.

The FFQ developed offers up three choices of servings consumed for 80 food items. For all other items, we considered only their dietary frequency as they were food condiments or foods and dishes with nutritional composition similar to other items in the list. Table 3 describes reference portions sizes (in grams and common household measures) of the food items most commonly reported in the sample.

Dietary habits in Ramadan fasting tend to enormously change as compared to those in non-Ramadan days. This has been constantly reported by previous studies (e.g. Alam *et al.*, 2019; Ali *et al.*, 2021). Some foods are eliminated, while many new foods are included in daily food intake during Ramadan. Therefore, we hypothesized that general FFQ developed for assessment of dietary intake is not capable to catch a real picture of dietary habits in Ramadan fasting. Therefore, we developed an FFQ that may be used for dietary intake assessment in the month of Ramadan

fasting. To the best of our knowledge, this is the ever first study to develop Ramadan-specific FFQ.

In the present study, the FFQ food list was elaborated from information obtained in 24-HDR recalls, given the lack of studies on the most consumed foods among adults. Meat, rice, and bread (plain bread, Chapatti, paratha) were the main sources of energy. Traditional Pakistani foods such as bread, rice and meat have been also reported previously to be the staple diet of Pakistani population (Ullah *et al.*, 2006; Taus-Bolstad, 2003), which can be generally seen as a positive finding, since trends have shown that these foods have declined in importance. On the other hand, unhealthy eating habits were evidenced such as high intake of simple carbohydrates and soft drinks and low fruit and vegetable intake, which suggest risk behaviors (Lobstein and Davies, 2009).

We adopted a systematic way while developing the Ramadan-specific FFQ. The methods used in this study to construct the food list for the FFQ are considered the most suitable as they allow to obtaining a list that is not limited, enabling the development of an instrument with greater ability to assess actual food intake (Sauvageot *et al.*, 2013). The advantages of 24-HDR include its short administration, low cost, high acceptance and being easily understandable by respondents (Thompson and Byers, 1994). A comparison between the list obtained from food frequency reports and that obtained from the percentage contribution of food to energy and nutrients showed that the former included all food items of greatest relevance to the diet in the sample studied.

The food list of the proposed FFQ was supplemented with food items considered of interest to describe food intake in the sample studied. For example, we included seasonal items (fruits, leafy vegetables, and

legumes), processed foods that may cause health effects (chocolate powder, cookies, canned meats and vegetables and other canned foods, yogurt, mayonnaise, carbonated beverages, etc.) and regional foods and dishes (gur sherbet, fish, meat and rice, some functional foods etc.). These additions have made the list more comprehensive and minimized the possibility of missing important foods usually consumed by the target population. The food list of the FFQ was reviewed by nutritionists of public and private health services and they verified that the main foods of the diet of the local population were included in the instrument.

The number of food items included in the FFQ is consistent with what suggested by [Fisberg et al. \(2008\)](#), whereby small food lists (<50 items) may underestimate food intake, and very large lists (>100 items) may drain respondents and thus overestimate food intake. Some authors also maintain that very large lists do not expand the validity of the FFQ when compared to smaller lists. Moreover, very large questionnaires tend to have higher rates of non-response, increasing study costs and duration ([Thompson and Byers, 1994](#); [Burley and Cade, 2000](#)). We chose closed questions to report frequency of consumption. The consensus is that closed questions are more appropriate because they reduce coding time and transcription errors as well as missing questionnaires due to incomplete or incomprehensible answers ([Cade et al., 2002](#)). In this study, we defined 8 categories of frequency of consumption that are easy to comprehend and organized in a continuous decreasing order as proposed by [Willet \(2012\)](#). It should be noted that all items had the same frequency options. Frequency options in FFQs should range between 5-10; questionnaires with <5 categories may have substantial amount of missing information, while those with surplus categories may be unclear. Most importantly, FFQ must be able to discriminate foods that are most frequently consumed and those that are rarely consumed ([Willet, 2012](#)).

In the FFQ, standardized portion sizes were included in order to describe the food intake amount. The use of standardized portions in FFQ is still controversial. Some authors claim that this information does not significantly improve the instrument's validity, arguing that in determining the instrument's validity the quantification of portion size may be less relevant than frequency of consumption ([Willet, 2012](#); [Molag](#)

[et al., 2007](#)). Despite these controversies, a review study found that 42% of the questionnaires reviewed provided information on portion size, 22% did not have this information and the remaining 36% asked respondents to describe the portion size regularly consumed ([Cade et al., 2002](#)).

Some questionnaires developed in Pakistan use median or mean portion size as reference (e.g. [Iqbal et al., 2014](#)). Given that reference portion sizes in FFQs should be adequate to the study population to avoid underestimating or overestimating, we found it appropriate to include in the FFQ the most frequently reported portions in the 24-hour dietary calls or traditional portion sizes for foods like bread and eggs (units).

There are some strengths and limitations of the current study. The major strength is that there has been no such study to develop Ramadan-specific FFQ. As far as we know, this is the ever first study in this connection. Secondly, we included substantial a higher number of respondents (109) of both gender and from various age and socio-demographic groups to collect data on food intake. One limitation of the present study is that only one 24-HDR was administered to construct the FFQ food list. A single administration may not be enough to capture information on usual dietary habits ([Ferreira et al., 2010](#)). We tried to minimize this limitation through two approaches: Representation of all days of the week to capture different dietary intake and the inclusion in the FFQ of food items rarely reported. For better discrimination of food intake, it is important that the food list in the FFQ includes not only food items that are consumed by a fairly substantial proportion of the sample studied but also those whose consumption varies among individuals ([Willet, 2012](#); [Iqbal et al., 2014](#)). Also, the lack of a full Pakistani food composition database is a limiting factor for conducting studies on food intake. Software programs available in Pakistan are mostly based on collected international tables. Databases developed in other countries have a limited application in Pakistan because the chemical composition of foods can vary significantly and food cooking and/or preparation are not always consistent with local dietary habits. Furthermore, many typical foods consumed by our population are not included in these tables ([Soomro et al., 2016](#)). Another limitation of the present study may be the seasonal variability of foods. Seasons have significant effects on the food choices of population.

This study was completed in 2018 Ramadan, which fell in the hottest months of the year. Ramadan fasting falling in winter is likely to be variable in terms of food intake. Therefore, one should be cautious while interpreting the results of this study due to its limitation of reporting food habits in summer. Finally, the FFQ developed in this study needs to be validated before using for actual data collection.

Finally, FFQs in general, typically collect information on the frequency of consumption but not necessarily on the quantity consumed. When FFQs do include questions about quantity consumed it is typically based on standard portion sizes, rather than direct weight or use of household utensils. Therefore, FFQs are not as accurate as other quantitative dietary assessment methods (e.g. 24-hour Dietary Recall). Additional measurement error is introduced when food lists are not specific to the studied population, when questionnaires use inconsistent or imprecise portion sizes, or when the food lists are not granular enough to make an accurate match to a food composition table for deriving nutrient content of the diet. Because food lists are developed with a specific population in mind, it can be difficult to accurately compare results across populations (cultures or countries) with different dietary patterns

Given the importance of diet in the etiology of various chronic non-communicable diseases and conditions, there has been growing interest in the development of more appropriate reliable instruments for the assessment of food intake. The strategy for FFQ development described in this study can provide input for the development of similar dietary assessment instruments in other scenarios (other than Ramadan fasting, e.g. Christmas, festivities etc.) and population groups other than Muslims, for example.

Conclusions and Recommendations

The FFQ included the most relevant food items in Ramadan fasting month in Pakistan. Ramadan specific FFQ has great utility for dietary intake in the fasting month of Ramadan in clinical settings as well as field settings for doctors, nurses, dietitians, and researchers etc.

The development of the FFQ took into account dietary habits and practices during the fasting month of Ramadan in a population sample of Pashtun

ethnicity. After appropriate verification of its validity and reliability, this questionnaire may be a valuable tool in studies investigating foods and their level of consumption during the fasting month of Ramadan that may be determinants (protective/risk factors) of nutritional status and overall health in the adult population. This is a critical step to improve quality of information collected on food intake in this population. Future studies should derive FFQ from multiple 24-HDR instead of a single recall. This will increase the likelihood of including most food items that are part of the dietary practice during Ramadan fasting.

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Novelty Statement

This is the first FFQ developed that is Ramadan-specific and the work is expected to be of wider appreciation by researchers in the field of metabolism and fasting.

Author's Contribution

Imran Khan is the supervisor and planned the work. Rahmat Gul carried out fieldwork and collected the data. Iftikhar Alam, Zia Uddin and Zafar Iqbal analyzed the data and prepared the results and wrote the manuscript with the Help of Imran Khan and Rahmat Gul.

Conflict of interest

The authors have declared no conflict of interest.

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