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DEVELOPMENT OF A RAW FOOD BASED QUANTITATIVE FOOD FREQUENCY QUESTIONNAIRE FOR ITS REPRODUCIBILITY AND VALIDITY IN URBAN INDIVIDUALS OF HYDERABAD, INDIA

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ABSTRACT

Wide variations between urban and rural diets exist in India because of regional difference and varied food consumption patterns. Food frequency questionnaire (FFQ) is the frequently used tool to assess long term, habitual food intake pattern in large epidemiological studies related to chronic diseases such as type 2 diabetes mellitus in which diet is one of the major etiological factors. In this pilot study, we attempted to develop and assess the reproducibility and validity of a 127 item, raw food based quantitative food frequency questionnaire (RFQnFFQ) based on commonly consumed foods and local food habits. RFQnFFQ was administered twice, at baseline (Phase I-P1) and after 6 months (Phase II- P2) on free-living individuals (n=36, P1 and n=33, P2) in urban setup. The RFQnFFQ was validated by comparing it with mean of 3 non-consecutive days 24 hour recall (24hR) which was the reference (at P1and P2). The 24hR included two week days and one weekend day preferably done within a week. The median intake of major foods and nutrients by the subjects estimated from the RFQnFFQs and 24hR at P1and P2 were not by and large significantly different. Spearman's rank correlation coefficient (ρ) for comparison between mean 24hR at P1 and P2 and RFQnFFQ at P2 were found to be significant for protein, calcium, phosphorus, thiamine, niacin and iron and also for the foods; cereals and millets, pulses, flesh foods, milk and milk products, fats and sugars. The ρ values for nutrients and foods to assess the reproducibility of the RFQnFFQs at P1 and P2 were found to be highly significant. The results showed that the formulated RFQnFFQ had acceptable validity and good reproducibility.

Key Words: Habitual food intake pattern, chronic lifestyle diseases, dietary assessment tool, raw food based quantitative food frequency questionnaire (RFQnFFQ), reproducibility, validity

INTRODUCTION

Dietary intake ranks the most important risk determinants of chronic diseases (Willet and Lenart, 1998) as the quantity and quality of foods play a key role in the development of many chronic diseases including diabetes mellitus. 24 hour dietary recall (24hR), Food frequency questionnaire (FFQ) and Food diary are the most commonly used dietary assessment methods for epidemiological studies. Among these, 24hR and Food diary are targeted for shorter duration. 24hR will probe the dietary intake of the subject's immediate previous day. Food diary is a recorded list of food items consumed by the subject for a certain short period of time, usually, one week. The FFQ allows the estimation of the individual's habitual food intake pattern over a defined period of time. The FFQ is the most widely used and preferred dietary assessment tool in larger nutritional epidemiology studies, particularly for chronic lifestyle diseases including type 2 diabetes (T2DM) and cardiovascular diseases. The 24hR should be done multiple times across many time points so as to capture long-term food and nutrient intake and the Food diary is for a short period of time; whereas the FFQ could be used for long term dietary history. Quantitative food frequency questionnaires (QnFFQs) consist of a list of foods along with its weights or volumes and its consumption frequency over a defined period of time. The information collected by an FFQ is reliable once it is properly validated. FFQs could be validated against multiple 24hR so as to measure its reproducibility and validity (Willet and Lenart, 1998, Pietinen et al., 1988, Willet et al., 1985, Wynn-Dumartheray et al., 2006, Marques –Vidal et al., 2011, Dwarkanath et al., 2014; Kroke et al., 1999, Ishihara et al., 2009).

Distinct cultural and linguistic differences exist in India. Thus it is essential to develop and validate an appropriate FFQ suitable for the study purpose and setting. An urban population was taken into consideration as T2DM is frequently reported in urban area than the rural population (Kutty et al., 1999; Gupta and Misra, 2007). Many studies using validated FFQs had been done in the Europe and USA. However, studies in India using a raw food based QnFFQ (RFQnFFQ) which collects both quantified portion sizes as well as the frequency of consumption of foods was fewer (Hebert et al., 1998; 1999). In developing countries, urban diet surveys involving multiple weighted 24hR method is time and resource intensive and it only provides the current intakes. For chronic conditions it is required to be done at many time points over a designated duration to quantify the usual intakes and dietary patterns of subjects. It is therefore necessary to develop a simpler, time and cost effective quantitative methods for assessing dietary intakes in larger population groups in emerging economic countries including India (FAO/WHO,1992; Hatloy et al.,1998; Dop et al.,1994; Ferguson et al.,1993, Ferguson et al., 1994; Kigutha, 1997; Coulibaly et al., 2008).

The number of food items listed in the FFQ plays an important role in the estimation of nutrient intake. An FFQ with only a few foods leads to underestimation of nutrient intake; whereas an elaborate food list may lead to overestimation of nutrient intake. A well formulated FFQ should contain adequate number of foods which should yield a near to accurate picture of nutrient intake of the subjects. The list of food items in the FFQ should be framed as per the food preferences of the target population (Cassidy, 1994). Compared to the rural population, the availability and variety of foods is more in an urban setting. The consumption of processed foods is also high by urban population.

A recipe based semi-quantitative FFQ was developed by Sudha et al., 2006 for assessing the dietary intake of urban adults in Southern India. For the recipe based QnFFQ the standardisation of the recipes should be done prior to the diet survey and that itself is an elaborate process. It is specific to the population in which the study has to be undertaken. RFQnFFQ is preferred over the recipe based QnFFQ as the recipes are likely to change from household to household and as per seasonal availability of food items. Whereas the weights of raw food ingredients could be collected directly using the weighing scale at the time of administration of the RFQnFFQ. The framed RFQnFFQ was based on raw food ingredients and hence it could be used in other regions of the country.

Therefore, this study was carried out with an objective to develop and validate an interviewer administered RFQnFFQ which could be a reliable tool to quantify long term dietary intakes of urban population in Hyderabad.

METHOD

STUDY DESIGN AND SUBJECTS

This pilot study was undertaken in two phases; phase I (P1) and phase II (P2) spanning at a gap of 6 months. While P1 was conducted in July-August 2010, P2 was conducted in March-April 2011. The study was conducted in the respective households of the subjects involved in the study. The study protocols were approved by the Institutional ethics committee of National Institute of Nutrition (NIN) and informed consent was obtained from the study. The subjects (n= 36) were randomly selected from one of the areas in the northern zone of Greater Hyderabad Municipal Corporation. The study involved a general population. This pilot study was done since there were no related data available and hence we decided to assess the efficiency and comprehensibility of the formulated RFQnFFQ (Teijlingen and Hundley, 2001). Only those who were above 18 years of age were considered for the subjects. There were three dropouts during P2, and thus P2 constituted a total number of 33 subjects.

STANDARD CUPS AND SPOONS

Twelve cups of varying volumes (C1=1500 mL to C12=25 mL) were standardised along with two spoons. These were used as visual tools for conducting the diet surveys. The volumes of the standard cups and spoons are shown in Figure 1.

Figure 1: Standard cups and spoons used in the study
Volumes of standard cups in descending order: 1=1500 mL, 2= 1100 mL, 3=900 mL, 4=700 mL, 5=470 mL, 6=360 mL, 7=200 mL, 8=155 mL, 9=115 mL, 10=95 mL, 11=70 mL, 12= 25 mL
Large spoon = 15 mL, Small spoon = 5 mL

DETERMINATION OF EDIBLE PORTION SIZE OF FOODS

Actual edible portion of foods is important to estimate the intake of foods as accurately as possible (Bamji et al., 2009). Knowledge about the edible portion of raw foods is required for nutrient calculation also. Standardisation was done for the selected 77 commonly consumed raw food items for their edible portion sizes which could be substituted while quantifying the RFQnFFQ. The edible portion sizes for the remaining food items listed in the formulated RFQnFFQ were adopted from pre existing NNMB database.

DEVELOPMENT OF RFQNFFQ

RFQnFFQs are more accurate compared to qualitative FFQs as there are precise quantities of foods involved. The formulated RFQnFFQ was a 127 item schedule with appropriate columns for marking the quantity or portion size along with its frequency of consumption. This RFQnFFQ is a modified version of the Harward FFQ developed by Willet et al., (1985) which is redesigned to cater the requirements of this study. The formulated RFQnFFQ inquires about the habitual intake of the subjects during the past one year period. There were frequencies in 9 categories (daily, twice a week, thrice a week, four times a week, once a week, once in a fortnight, once in a month, seasonally, occasionally). The 127 commonly consumed food items were selected after an initial market survey in Hyderabad city. The selected food items were listed under 15 sub-groups. They were cereals and millets, pulses, leafy vegetables, other vegetables, roots, nuts, condiments, fruits, fish, other flesh foods, fats and oils and sugars.

ADMINISTRATION OF DIET SURVEYS

The diet surveys were conducted on non-festival days: excluding festival days, function days and fasting days, to avoid the effect of fasting and feasting as well as under/over estimation of foods and nutrients. Diet surveys were done by a trained interviewer at P1 and P2 in the respective household of the subjects. The person who is directly concerned with the cooking in the respective households was interviewed. In India, it is customary that the lady of the house is involved in the process of cooking, to serve food to each and every member of the concerned family. For 24hR the interviewee was encouraged to recall the just previous day's food intake for self and for others in the household. 24hR was conducted for 3 nonconsecutive days at P1 and P2. It was seen that one of the 24hR included a weekend day so as to study the change of menu in weekends. 24hR was followed by administration of an RFQnFFQ completed within seven days after the completion of the third 24hR. A portable digital diet balance (Seca Culina -852) ® with an accuracy of 1g was used to weigh the major raw food ingredients like rice, wheat flour and pulses by direct weighment method at the time of survey. The duration of each interview varied from 20 minutes to 30 minutes. Information on age, gender, education, religion, community, type of family, occupation, physiological status, activity status and annual income were also collected along the dietary survey. Standardised edible portion size values were imparted for fruits and vegetables corresponding to their size. The 24hR were carried out for three non-consecutive days of a particular week; of which one was a weekend day; to capture the day to day variations.

DATA ENTRY

The filled up 24hR sheets and the RFQnFFQ were coded for each entry. Standard values for edible portion sizes were imputed wherever necessary and the data was entered in MS-EXCEL for statistical analyses. Weights of commonly consumed foods were assessed using the standardised set of cups and spoons. Edible portion sizes of 77 raw food items which were standardised prior to the pilot study were appropriately substituted. For ready-to-eat (RTE) food items, standard portion size values were obtained from the labeling of the packet and also from the data available from the National Nutrition Monitoring Bureau (NNMB). Standardized reference values for edible portion sizes of commonly consumed raw foods were thus available and it was imputed in the RFQnFFQ at the time of data entry. For RTE a separate data base was formulated along with codes based on the nutrition labeling of the pre-packed food items and also from the standardized recipes as reported earlier (Pasricha, 2004). The data obtained was processed to get information based on food groups as well as nutrients. Drop out subjects at P2 was removed from the study. The frequency categories were assigned as daily (1), twice a week (2/7), thrice a week (3/7), 4 times a week (4/7), once a week (1/7), once in a fortnight (1/15), once in a month(1/30), seasonally (1/120) and occasionally (1/180). Food intake from the 24hR was calculated directly from the schedules. Food and nutrient intake from the RFQnFFQ was calculated based on individual consumption unit (CU). This was developed by NIN for different sex, age, physiological and activity groups on the basis of the energy requirements (coefficient) of a reference man (aged 18-29 years, healthy, weighing 60 kg and engaged in sedentary activity) as one CU.

Food intake in g/mL *(from FFQ)* = [Total Quantity of Food (g/mL) / Total CU] * Individual CU * Frequency of consumption

STATISTICAL ANALYSIS

Based on the food intake per day; energy and nutrient intakes of the subjects were calculated using the Indian food composition database (Gopalan et al., 2009). The formulated RFQnFFQ was statistically cross checked with the 24hR which is considered as gold standard for testing the reliability of the RFQnFFQ. Median intakes for various foods and nutrients were calculated along with the intra quartile ranges (IQR) in 24hR and RFQnFFQ. Validity and reproducibility between 24hR and RFQnFFQ were evaluated using Spearman's rank correlation coefficient method. The reproducibility of the RFQnFFQ was checked by comparing the RFQnFFQs at P1 and P2 by Spearman's correlation. The validity of the RFQnFFQ was checked by comparing it with the mean of the three day 24hR for both phases of the study. The level of significance was considered at 0.05. The statistical analysis was performed by Statistical Package for Social Sciences (SPSS) Version 19.0, IBM Corporation, Somers, New York, USA.

RESULTS

SOCIODEMOGRAPHIC PROFILE

The sociodemographic profile of the study subjects is shown in Table 1. The mean age of subjects was found to be 38 years. Majority of the subjects (57.6 %) were males. All the subjects are related to sedentary lifestyle pattern. All the subjects belonged to the nuclear type of family. It was observed that the literacy level was high in the subjects and at least one person in the household was employed. The houses were *pucca* with sanitary latrine and accessibility to safe drinking water and reflecting similar socioeconomic background. In all the households except one, it was found that the housewife was involved in the process of cooking and serving the food. The dropout rate of the subjects for this study was was found to be 8.3%.

Table 1: Socio-demographic details of the study subjects (n=33)

Age (Years)#	
Men	36±14.0
Women	41±11.4
Combined	38±13.0
Type of Family	
Nuclear Family	33(100)
Religion	
Hindu	21(64)
Christian	9(27)
Muslim	3(9)
Gender	
Male	19(58)
Female	14(42)

Values are Mean ± SD
* * Values are n (%)

INTAKES OF FOODS AND NUTRIENTS BY THE SUBJECTS

Though the median intakes estimated from the RFQnFFQ and 24hR at P1and P2 for most of the food groups were slightly higher for the RFQnFFQ at P1 and P2 than the 24hR but were not by and large significantly different. This was in accordance with various reported studies (Bowen et al., 2012; Rodríguez et al., 2002; Zhuang et al., 2012; Segovia-Siapco et al., 2007). Rice was the most commonly consumed cereal followed by wheat. Red gram dal was found to be most common source of protein among the protein rich foods consumed by the subjects. It was also observed that the consumption of non-vegetarian foods by the subjects was more in the weekend days. The daily intake of foods and nutrients as assessed by the 24hR and the RFQnFFQ is shown in Table 2 as median along with IQR values.

Nutrient density of the subjects' food intake was calculated from the RFQnFFQ for the nutrients by comparing it with the RDA for an adult sedentary man expressed for 1000 kcal, in order to check the adequacy of nutrient intakes from the RFQnFFQ. For macronutrients such as energy, protein and micronutrients such as thiamin, riboflavin, niacin and iron; the nutrient density estimated did not differ much from the levels suggested based on RDA (data not shown). Majority of subjects were found to be energy and protein adequate, with no significant gender differentials. Gender specific difference in consumption of foods and nutrients of subjects at P1 and P2 was also analyzed. It was observed that a slight differences existed in the consumption pattern, quantity and quality of foods consumed between males and females which were not statistically significant (data not shown).

Table 2: Median intake of foods and nutrients by the study subjects estimated by RFQnFFQ and 24hR at P1 and P2 Values expressed as Median (IQR)

	P1 (N=36)		P2 (N=33)	
	24hR†	RFQnFFQ	24hR†	RFQnFFQ
Energy (k cal)	1888 (1759, 2084)	2083 (1740, 2426)	1800 (1575, 2035)	2007 (1709, 2284)
Protein (g)	60 (53, 66)	67 (57,77)	53 (46, 60)	67 (57,76)
Fat (g)	48 (42, 62)	54 (44, 64)	48 (41, 60)	51 (41, 58)
Calcium (mg)	817.6 (602.8, 1027.0)	913.5 (727.4, 1101.0)	808.5 (660.8, 917.1)	829.2 (697.8, 1048.3)
Phosphorus (mg)	1119.7(1012.0, 1448.2)	1366.8 (1141.9, 1592.0)	1104.5 (1015.6, 1293.4)	1413.2 (1153.4, 1701.5)
Vitamin A (µg) *#	324.5 (205.8, 501.3)	770.7 (664.0, 878.0)	336.3 (241.7, 531.3)	753.5 (662.3, 875.7)
Thiamine (µg)	0.9 (0.7, 1.0)	1.1 (0.9, 1.1)	0.9 (0.8, 1.2)	1.1 (1.0, 1.3)
Riboflavin (mg)	0.8 (0.7,1.0)	0.8 (0.6, 1.0)	0.7 (0.7, 0.8)	0.9 (0.7, 1.0)
Niacin (mg)	10.6 (8.6, 12.3)	11.9 (9.9, 14.0)	10.1(8.2, 13.5)	12.9 (10.8, 14.8)
Vitamin C (mg)	31.2 (61.6, 108.3)	117.1 (97.1,137.0)	52.4 (37.4, 104.6)	95.3 (82.7, 108.9)
Iron (mg)	10.9 (9.3,13.1)	14.4 (12.0, 16.0)	12.3 (9.1, 14.3)	14.8 (12.0, 17.5)
Folic Acid (Free) (µg) *#	45.5 (34.2, 57.4)	77.7 (70.4, 86.0)	46.3 (39.4,54.2)	77.9 (65.9,86.8)
Cereals & Millets (g)	231 (200, 270)	263 (189, 336)	240 (201, 266)	259 (218, 298)
Pulses (g)	31 (25, 44)	48 (31, 63)	36 (14, 56)	50 (38, 62)
Leafy vegetables (g) *#	8 (4, 26)	48 (37, 57)	22 (6,37)	45 (37, 49)
Other Vegetables (g) #	61 (31,111)	109 (86, 129)	37 (21, 56)	88 (78, 109)
Roots (g) *	43 (30, 54)	99 (67,132)	80 (55, 111)	83 (62, 107)
Nuts (g)	12 (8, 33)	19 (8, 31)	12 (3, 25)	20 (12, 32)
Condiments (g)	14 (12, 19)	15 (11, 21)	14 (11, 23)	17 (13, 23)
Fruits (g)	34 (12,129)	106 (86,123)	38 (8, 66)	74 (55, 95)
Flesh Foods (g) #	26 (17, 69)	49 (35, 58)	5 (3, 12)	49 (38, 60)
Milk & Milk products (mL / g)	183 (123, 332)	285 (185, 326)	195 (129, 291)	279 (177, 326)
Visible Fats (g)	21 (13, 38)	27 (19, 35)	20 (14, 23)	24 (21, 31)
Sugars (g)	8 (3,18)	9 (2, 17)	10 (0, 26)	8 (0, 14)

† - mean of three 24hR
* - Significant difference (P<0.05) between RFQnFFQ and 24hR at P1 # - Significant difference (P<0.05) between RFQnFFQ and 24hR at P2

VALIDITY OF THE RFQNFFQ

Validity of the RFQnFFQ was done to test the extent of accuracy of the nutritional assessment made by it in comparison with the 24hR (Zhang and Ho, 2009). The validity of the RFQnFFQ was assessed by calculating the Spearman's correlation coefficient (ρ) (unadjusted) between mean 24hR at the two time periods i.e., at P1 and P2 with RFQnFFQ at P2. Table 3 shows the correlation coefficients between the RFQnFFQ at P2 and mean 24hR at P1 and P2. The ρ values for comparison between mean 24hR at P1 and P2 and RFQnFFQ at P2 were found to be significant for protein, calcium, phosphorus, thiamine, niacin and iron and also for the foods; cereals and millets, pulses, flesh foods, milk and milk products, fats and sugars.

Table 3: Validity of the RFQnFFQ

Nutrients	**r**
Energy (kcal)	0.216
Protein (g)	0.492**
Fat (g)	0.218
Calcium	0.352*
Phosphorus	0.394*
Vitamin A (µg)	0.302
Thiamine (mg)	0.501**
Riboflavin (mg)	0.150
Niacin (mg)	0.359*
Vitamin C (mg)	0.269
Iron (mg)	0.537**
Folic Acid (free) (µg)	0.287
Food Groups	
Cereals & Millets (g)	0.350*
Pulses (g)	0.619**
Leafy vegetables (g)	-0.110
Other Vegetables (g)	0.165
Roots (g)	0.256
Nuts (g)	-0.169
Fruits (g)	-0.099
Flesh Foods (g)	0.417*
Milk & Milk products (g/mL)	0.457**
Fats	0.454**
Sugars	0.443**

(r **-** Spearman's rank correlation between RFQnFFQ at P2 and mean of 24hR at P1 and P2)
* - r value significant at the 0.05 level (2-tailed); ** - r value significant at the 0.01 level (2-tailed)

THE REPRODUCIBILITY OF THE RFQNFFQ

Reproducibility of the RFQnFFQ is the extent to which it produces similar results on two time points (Lee-Han et al., 1989). Reproducibility of FFQs show the similarity of information obtained from the two FFQs. Good reproducibility of an FFQ ensures a reliable tool and thereby better capture of dietary information. The reproducibility was verified by comparing the RFQnFFQs (unadjusted) at two time points: P1 and P2. Spearman's correlation coefficient (ρ) was used to check the reproducibility of the two RFQnFFQs. Reproducibility of the formulated RFQnFFQ was checked for the food groups as well as nutrients. The RFQnFFQ which had been tested for reproducibility showed good correlation for almost of all the food groups and nutrients. The reproducibility of the RFQnFFQ is presented in Table 4 as ρ values. The ρ values of food groups ranged from 0.167 (nuts) to 0.928 (cereals and millets). The ρ values of nutrients ranged from 0.565 (vitamin A) to 0.960 (protein). The ρ values of all the nutrients were above 0.4. The ρ values for nutrients and foods to assess the reproducibility of the RFQnFFQs at P1 and P2 were found to be highly significant.

Table 4 - Reproducibility of the RFQnFFQ

Nutrient	**r**
Energy (kcal)	0.896
Protein (g)	0.960
Fat (g)	0.882
Calcium(mg)	0.902
Phosphorus (mg)	0.901
Vitamin A (µg)	0.565
Thiamine (mg)	0.920
Riboflavin (mg)	0.831
Niacin (mg)	0.931
Vitamin C (mg)	0.904
Iron (mg)	0.872
Folic Acid (µg)	0.902
Folic Acid (free) (µg)	0.894
Food Groups	
Cereals & Millets (g)	0.928
Pulses (g)	0.894
Leafy vegetables (g)NS	0.229
Other Vegetables (g)	0.826
Roots (g)	0.488
Nuts (g)NS	0.167
Fruits (g)	0.707
Fish (g)	0.880
Other Flesh Foods (g)	0.920
Milk & Milk products (g/mL)	0.989
Fats	0.502
Sugars	0.650

r - Spearman's rank correlation between RFQnFFQ at P1 and RFQnFFQ at P2
NS- not significant
All values are significant at P<0.01, except for Leafy vegetables and Nuts

DISCUSSION

This pilot study evaluated the validity and reproducibility of an RFQnFFQ developed to estimate the habitual dietary intake of urban adults in Hyderabad, India. This was done with an aim to develop a reliable method of assessing food consumption pattern and may be used to determine the nutritional risk factors associated with T2DM and its complications and also other chronic diet related disorders. NNMB is the national agency in India which carries regular diet surveys all over India. They use 24hR method for obtaining data. We thought of developing and using an RFQnFFQ that is reliable and can capture information on dietary practices for a long term, usually, one year.

In this study, we observed that the median intake of foods and nutrients by the subjects estimated from the RFQnFFQ and 24hR at P1 and P2 are comparable for most of the foods and nutrients (Streppel et al., 2013; Dehghan et al., 2012). Also, it was observed that there is significant correlation (ρ) between the RFQnFFQ at P2 and mean 24hR values at P1 and P2 for protein, and micronutrients (calcium, phosphorus, thiamine, niacin, and iron). There is also a significant correlation (ρ) between the RFQnFFQ and 24hR values for the food groups (cereals and millets, pulses, flesh foods, milk and milk products, fats, and sugars).

However, some of the nutrients and food groups showed weak correlations. For green leafy vegetables, fruits, fish the correlation was found to be negative. Day to day variation in food intake, particularly, green leafy vegetables, nuts, and fruits were observed. The tendency for overestimation of foods and nutrients in the RFQnFFQ than the 24hR might be because of the seasonal variations of food intakes. There is also a chance that certain foods were not consumed in the previous 24hR of the day of the survey. Reporting bias of the subjects may also be a factor behind these variations. In India most of the fruits and vegetables are easily available and affordable during the particular season. The price of the foods also plays an important role in consumption of certain foods. The chance of over estimation for RFQnFFQ may be high because of the elaborate food list and also due to non-allowance for leftovers in it. The over estimation of the dietary data could also be attributed by lower sample size. It has been observed that the consumption of foods, mainly non-vegetarian foods vary even in a week, particularly weekend days (Torheim et al., 2001). It was found that the consumption of non-vegetarian foods was high in weekend days. These variations might be attributed because of the reporting bias of the subjects, seasonal difference in the availability of various food items and thereby the day to day purchase and consumption of food items, particularly fruits, green leafy vegetables and other vegetables by the subjects involved in this study.

The Spearman's correlation coefficient for testing the reproducibility of the RFQnFFQ between the P1 and P2 was found to be good. The reproducibility of the formulated RFQnFFQ also represents good response and better comprehensibility of the RFQnFFQ by the participants.

CONCLUSIONS

From the study, it is concluded that the RFQnFFQ has good reproducibility with acceptable validity. The 127 item RFQnFFQ is a valid tool in estimating the dietary intake of urban individuals. Based on the reproducibility and validation results of the RFQnFFQ, the formulated RFQnFFQ may be used for eliciting information on dietary data of chronic diseases. The pretested and validated 127-item RFQnFFQ could act as a premier initiative tool for further studies in the similar line with large sample size. Since this RFQnFFQ is based on raw food items it could also be used in other parts of India.

LIMITATIONS OF THE STUDY

The sample size for this pilot study was less to study on gender specific differences and it would be interesting to consider more number of subjects (>18 years) for the actual validation study extended to one year and spread across 3 seasons to study the effect of seasonal variations on food and nutrient intakes. Inclusion of certain biomarkers would have been an added support to this study. Because of the limited sample size of this pilot study, the Bland-Altman Plot could not be used for assessing the absolute agreement between the RFQnFFQ and 24hRs. There is also a chance for improvement of results if the subjects were selected specifically for a single gender. This limitation could be rectified by considering more subjects from different genders in the actual validation study for studying seasonal differences of food and nutrient intakes.

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