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Validation of a Food Frequency Interview Schedule to Assess the Dietary Intake of the Population in Hyderabad City - A Cross-Sectional Study

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ABSTRACT

Introduction: The food frequency questionnaire (FFQ) is the preferred method to evaluate long-term usual dietary intake in population-based epidemiological studies because it is simple, easy to administer and requires minimal effort from the subjects. Therefore, we validated a food frequency interview schedule (FFIS) to estimate the dietary intakes of the urban population of Hyderabad city. **Methods:** A cross-sectional study was conducted among five socio-economic sections of Hyderabad. Areas for the survey were selected by cluster random sampling and households in each area were selected by simple random sampling. The FFIS was developed and validated against a 6-day 24-hour dietary recall (HDR) method. The instruments were administered to the participants six months apart to check for reproducibility. Statistical analyses for validation and reproducibility included correlation, regression analyses and paired *t*-test. **Results***:* Means of intakes of foods measured by 24-HDR were significantly lower than those measured by FFIS for some foods at alpha levels of 0.05. Pearson's correlation (*r*) for the intakes by the two methods ranged from 0.12 to 0.85. Regression coefficients were significant for 12 food groups. Correlation coefficients for the two FFISs were between 0.31 (spices) and 0.81 (carbonated beverages) and showed good reproducibility. Intakes of conventional foods like cereals, pulses, vegetables etc. by FFIS correlated better with 24-HDR than the processed foods such as breakfast cereals and bakery items. **Conclusion:** The data suggests that the FFIS is a well-validated, reproducible tool for assessment of long term dietary habits of a specific population. However, its use for populations of other regions requires specific modifications.

Key words: Dietary assessment, food frequency interview, standardised recipes

INTRODUCTION

Regular dietary assessments are essential for evaluation of food intakes and assessing their associations with related health consequences. Commonly used methods in dietary surveys are 24-hour dietary recalls (24-HDR), food records and food frequency questionnaires (FFQs). Food records and 24-HDR are used as reference methods but their

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administration becomes cumbersome in studies with a large sample size. Therefore, in large scale epidemiological studies, FFQs may provide a reasonable estimation of habitual dietary intakes over a long term despite the limitation of being structured and having poor validity against the reference standards (Willet, 1990; Willet, Sampson & Stampfer, 1985). The food items included in the FFQs need to be selected carefully to yield a list of foods which reflect the habitual consumption patterns and choices of the study population. FFQs provide information on the usual diet of the respondents and ease the burden on them (Howrath, 1993). However, the FFQs should be appropriately used only with the population for which it was developed and subsequently validated with a list of predetermined food items (Tucker *et al.,* 1998).

In India, the National Nutrition Monitoring Bureau (NNMB, 2000) conducts regular dietary surveys in rural and urban areas of five socio-economic levels in ten state units. These socio-economic levels are the high, middle and low income groups, industrial labourers and slum dwellers. The method used for dietary assessment includes a weighed method where all the raw ingredients are weighed (providing information on consumption at household level) and a 24-HDR (providing food consumption information at individual level (NNMB, 1991). This method provides an accurate estimate of all the *conventional foods* (as defined by NNMB) which are eaten at regular frequencies (daily or 2 - 3 times a week). However, there is a lack of reported information about the consumption of various processed foods among the urban population despite their increased consumption levels. Besides, the 24-HDR used by NNMB (includes usually 2 or 3 days per week) may not be very useful to assess the long term intakes of seasonal and processed foods like fruits, vegetables, bakery items, carbonated beverages which are usually consumed but not in regular frequencies like daily or weekly. The sporadic yet substantial intakes of such foods may not be covered by the routine 24-HDR in India.

The FFQ approach may be particularly appropriate for the Indian population because of the relatively large inter-relative to intra-person (mainly day-to-day) variability (Chadha, 1995). Several studies about validation of specific interviewer-administered FFQs have been reported from rural regions of India (Bharathi *et al.,* 2008; Hebert *et al.,* 1998; 1999; Vaz *et al.,* 2009). There is a dearth of reports of development of FFQs for urban adult populations of India. Interviewer-administered schedules have been mostly used as the instrument for dietary surveys (for ease of responses by subjects) in India, unlike in western countries where self-administered questionnaires are used. Therefore, a test instrument termed as Food Frequency Interview Schedule (FFIS) was validated to assess the usual consumptions of various conventional and processed foods among the five urban socio-economic levels of Hyderabad.

METHODS

Development of FFIS

The FFIS included two broad categories of *conventional* and *processed* foods. For the present study, *conventional foods* were considered as those which were cooked at home in regular frequencies (daily or one to two times a week, like cereals, pulses, vegetables etc.) and their quantities. These foods underwent only primary processing like milling, washing and cutting. The foods which were processed at secondary and tertiary levels (mainly either ready to cook or ready to eat) were categorised as processed foods.

The initial FFIS was constructed including conventional and processed foods. Conventional foods were selected from a pre-existing national food composition database, Nutritive Value of Indian Foods (NVIF, 1993). These foods were classified as cereals, pulses, green leafy vegetables, roots and tubers, other vegetables, oils, and sugar and jaggery (unrefined sugar). The category of *processed foods* at first included 94 commonly consumed items which were obtained by conducting a pilot survey. The pilot survey was done in 30 households and 50 retail shops to obtain an initial list of commonly consumed processed foods by interviewing the subjects. The category of processed foods was sub-divided into breakfast cereals (ready to cook), ready to eat (RTE), bakery foods, carbonated beverages (CB), health drinks (HD) and syrups and concentrates.

The FFIS was pre-tested again in 30 households to select the most commonly consumed conventional and processed foods. The food groups which showed rare consumption (once or 2 times a year or never) like packaged water and syrups and concentrates were removed from the original FFIS. The foods that were rarely consumed (once or 2 times a year or never) in each food group were also removed as an increase in the number of items increases over-reporting. The final FFIS consisted of a total of 142 food items categorised into conventional foods and processed foods. The conventional foods category consisted of cereals and millets, pulses, leafy vegetables, roots and tubers, other vegetables, fruits, milk, animal foods, fats and oils, spices and condiments, and sugars and jiggery. The processed foods category consisted of breakfast cereals, ready to eat items, bakery items, carbonated beverages and health drinks.

Portion sizes of foods in FFIS

Commonly prepared recipes of each food item in the FFIS were collected from 30 households during the pilot survey. Portion sizes of the recipes were determined in the laboratory. Representative recipes were collected from households belonging to all the socio-economic levels as variations in the concentrations of ingredients were observed in different socio-economic levels in earlier studies (Hebert *et al.,* 1999). Portion sizes of all types of preparations were determined in three standardised cup volumes (50, 100 and 250mL) each at three levels of dilution (thin, medium and thick). Weights of single units of items like *chapatis (thick and thin), pooris, idli, dosas* (thick and thin), *vadas* (small and big) were calculated using the total amounts of raw ingredients divided by number of items obtained. Edible portion sizes of raw foods (like fruits and salads) were recorded as weights in grams of whole fruits and pieces. Amounts of liquids (milk and juices) were obtained in standard cup sizes. Portion sizes for processed foods were obtained from the labeling information (like breads, biscuits, chocolates, *namkeens* and other packed snacks). For local unbranded food items, average per piece weights were obtained from 10 outlets. Other portion sizes used were teaspoons (5g) and tablespoons (15g).

Study design and subjects

A cross-sectional dietary survey was done on five socio-economic levels of Hyderabad as done in many of the NNMB surveys (NNMB, 2000). These were the high income group, middle income group, low income group, industrial labourers and slum dwellers. The localities for each socio-economic level were selected by cluster randomisation based on the classification provided by Greater Hyderabad Municipal Corporation (GHMC). The income and household infrastructure of the families were also obtained to strengthen the classification. A total of 35 households were selected referring to the sample size in an earlier study (Hebert *et al.*, 1999) and providing sufficient margin for dropouts. Members from seven households from each of the socio-economic level were selected by systematic random sampling. Households settled in Hyderabad for more than 5 years and having at least two adults (one male and one female above 18 years of age) were selected. If the respective subjects were not present at home at the time of survey, the adjacent household having an appropriate number of subjects was selected. The diet survey interview was carried out in the houses and each subject was visited 6 times a year for the 24-HDR (three times each in summer and winter). Subjects were also administered the FFIS two times a year, six months apart. The study was reviewed by the Institutional Scientific Advisory Committee (SAC). Written consent was obtained from all the participants after informing them about the aim and expected outcome of the study. Telephonic confirmation was also obtained from the subjects on the day of the survey before the visit. The study was conducted from April 2009 to February 2010.

Administration of FFIS

The FFIS was administered by interview method by a trained nutritionist. It was developed in the English language but was explained by the nutritionist in either English, Hindi (national language) or *Telugu* (regional language) according to the preference of the subjects. The duration of administration ranged from 20 to 45 minutes per subject. The recall period was kept as 1 month. Frequencies of intakes were once per day (1x1), twice per day (2x1), 3 times per day (3x1), once per week (1/7), 2 times per week (2/7), 3 times per week (3/7), once per month (1/30), 2 times per month (2/30), 3 times per month (3/30), 2 times per year (2/365) and once yearly (1/365). Provision was made to fit the responses (as recipes and frequencies) which were not earlier included in the FFIS. Foods consumed two times a year and once a year were termed as rarely consumed. The subjects were also asked to mention the numbers of servings (in terms of standard cups and measures) consumed each time the food was consumed.

The interview schedules were administered in two seasons, that is, summer (FFISs) and winter (FFISw) to cover the seasonal variations of fruits and vegetables. To calculate the amounts of foods consumed with seasonal variability (fruits and vegetables), the number of months of availability was obtained by the respondents and the vendors. For example, every season (once a year), mangoes were available for four months, watermelon for three months and custard apple for three months. The respondents were asked about the frequency of consumption during the season and the amount per consumption. The total amount per year was calculated and converted as average intakes per day.

The intake of all the foods was recorded as amounts consumed/day/ person. Averages of two FFIS were taken for foods which were found to be consumed in both the FFIS and single values were taken for seasonal foods showing single entries. This was calculated by multiplying the frequency of intake by serving size by total number of servings by amount of food per serving, that is,

Amount consumed (g/ per day)
= frequency of intake (per week or month or year) x total number of servings x raw amount per serving (serving size)

Administration of reference method

The weighed method along with 24-HDR (as used in NNMB surveys) was used as reference methods of the diet survey. Feasting and fasting days were excluded to avoid under- or over-estimation. Interviews were conducted on three days and the interviews conducted on Mondays reported the consumption of non-vegetarian foods that were usually consumed on Sundays. Each subject was administered the FFIS over a 3-day 24-HDR/week reporting the foods consumed on the previous day. The intakes were represented as averages of 3-day 24-HDR. Standardised cup volumes (C1, 1520mL- C12, 30mL) were used for weighing cooked foods and liquids. The raw ingredients for all the recipes made at home were measured (weighed method) by a calibrated grocer's balance, the teaspoon (5g) and the tablespoon (15g). The average raw amounts consumed/day/person were calculated by using the conversion factor for the food items (NNMB, 1991; 2000).

Statistical analyses

Descriptive statistics (means and standard deviations(SD)) of consumption for each of the food items were obtained for both the test s (FFISs and FFISw) and the reference (6-day 24-HDR) methods. For validation, paired difference *t*- test was used to determine significant differences between means (amounts of intakes and energy) of the reference and test methods at *á* level of 0.05. Spearman's rank (non-parametric) correlation coefficient, Pearson's (parametric) correlation coefficient (*r*), standardised regression coefficient (b) and coefficient of determination (R^2) were calculated for all the foods (amounts consumed and energy intake), to assess the linear relationship between the test and reference methods. Misclassification error was assessed by dividing mean intakes by the FFIS and 24-HDR into quintiles. Then the percentage of agreement between the two methods (classification in the same quintile) was estimated to support the rank order correlation. The differences between the reference and test methods plotted against the means of total energy consumed were obtained by both the methods as Bland and Altman plots as correlation and regression studies may not always be able to suggest the agreement between the reference and test methods (Bland & Altman, 1986; 2007).

Pearson's intra-class correlation (ICC) coefficients were calculated to assess the intra-individual variations by the two FFIS to check for the reproducibility of the FFIS. The energy intakes were calculated using the values provided in NVIF (1993) for the conventional foods and from information provided in labeling for the packed processed foods. The statistical analysis was done using the Statistical Package for Social Sciences (SPSS) version 19.0, IBM Corporation, Somers, New York, US.

RESULTS

Members of 27 households completed both the FFIS and the 6-day 24-HDR. We included the data from 25 households (a total of 112 adults, 54 females and 58 males) to obtain 5 households from each socio-economic level excluding the two households which had the lowest number of family members (two in number), one each from slum dwellers and middle income group.

Validation of FFIS

A skewed distribution of food intakes was obtained due to wide variations in the responses and dietary habits. Therefore, the data was log transformed to meet the assumptions of normal distribution. Consumption for most food groups was higher when measured by FFIS as compared to 24-HDR. However, consumptions of fruits, and breakfast cereals was higher when measured by 24-HDR. The values measured by FFIS were up to 20% higher than 24-HDR. Differences of values obtained from an average of the two FFIS (FFISs and FFISw) and 24-HDR are shown in Table 1. The FFIS measurements of total energy intake were also significantly higher for eight food groups than the intakes by reference method (Table 2). The estimates of intakes were adjusted according to energy by residual methods to improve the correlations between the methods (Boeing *et al.,* 1997). The mean Spearman rank correlation coefficients for intakes of food groups were 0.51 for 24-HDR vs FFISs and 0.50 for 24-HDR vs FFISw. The mean Pearson's correlation coefficients were 0.54 for 24-HDR vs FFISs and 0.40 for 24-HDR vs FFISw (Table 3). Both the correlations showed similar trends for intakes of food groups. The Pearson's coefficients of correlation for energy consumption from individual food groups are shown in Table 4. Many food groups showed moderate to

Table 1. Mean intake of food groups (g/d) by six 24-hour dietary recalls and two food frequency interview schedules

Food groups	*24-HDR Mean (SD)*	*FFISs Mean (SD)*	*Difference from reference (% mean difference)*	*FFISw Mean (SD)*	*Difference from reference (%mean difference)*
Cereals and millets	236.1 (97.3)	284.9 (116.9)	48.8 (20)	242.5 (105.4)	6.4 (2.7)
Pulses	36.6 (24.4)	43.6 (37.3)	6.9 (18)	38.0 (23.6)	5.3 (14.5)
Green leafy vegetables	65.0 (43.2)	80.4** (40.8)	15.4 (23.7)	73.9 (40.2)	8.9 (13.6)
Roots and tubers	106.8 (62.1)	90.3 (40.9)	- 16.4 (15.4)	85.4 (35.7)	- 21.4 (20)
Other vegetables	188.8 (110.1)	216.1*** (123.2)	27.3 (14.5)	204.6** (92.1)	15.8 (8.3)
Milk	189.9 (135.7)	209.7 (121.6)	19.8 (10.4)	202.4 (109.0)	12.5 (6.5)
Fruits	131.5 (100.7)	92.2*** (77.9)	- 39.2 (29.8)	96.2**(59.6)	- 35.3 (26.8)
Oils and fats	32.1 (15.1)	35.1 (12.3)	2.9 (9.2)	29.1 (14.8)	- 3.0 (9.4)
Animal foods	61.8 (46.7)	45.9 (35.6)	- 15.9 (25.6)	47.2 (35.2)	- 14.5 (23.5)
Sugars	26.0 (12.6)	27.6 (14.2)	1.5 (5.8)	27.9 (9.5)	1.9 (6.9)
Spices	23.7 (14.2)	26.6*(15.9)	2.9 (12.2)	25.6* (15.2)	1.9 (7.2)
Breakfast cereals	17.6 (7.5)	15.1*** (5.5)	- 2.4 (13.5)	16.5 (6.7)	- 1.0 (5.7)
Ready-to-eat items	26.8 (12.3)	29.5 ** (10.6)	2.7 (9.9)	27.3* (13.1)	0.5 (1.8)
Carbonated beverages	31.4 (31.0)	32.5 (44.6)	1.0 (3.2)	32.2 (23.8)	0.7 (2.2)
Health drinks	6.0 (4.4)	10.5*** (8.3)	4.5 (74.5)	9.4***(3.9)	3.3 (55.6)

24-HDR -Twent-four Hour DietaryRecall; FFISs - Food Frequency Interview Schedule (summer); FFISw - Food Frequency Interview Schedule (winter); SD - standard deviation

***p<0.05, ** p <0.01, *** p <0.001 α level, by paired t-test statistics for Ho: mean from food frequency = mean from reference.

Values are expressed as mean (standard deviation)

Table 2. Differences in energy intakes (Kcal/d) by 24-HDR and FFIS (mean of FFISs and FFISw)

Food groups	*24-HDR*	*FFIS mean*	*Mean difference*	*%mean difference*	*P value*
Cereals and millets	1876	2145	-269	-14.34	0.01**
Pulses	120	138	-18	-15.00	0.000***
Green leafy vegetables	22	25	-3	-13.64	0.75
Roots and tubers	58	65	-7	-12.07	0.01**
Other vegetables	24	26	-2	-8.33	0.32
Fruits	106	90	16	15.09	0.21
Milk	181	194	-13	-7.18	0.000***
Animal foods	59	71.7	-12.7	-21.53	0.05*
Sugar	86	91	-5	-5.81	0.02*
Spices	28	34	-6	-21.43	0.01**
Oils and fats	262	289	-27	-10.31	0.25
Breakfast cereals	15	19	-4	-26.67	0.14
Ready-to-eat foods	58	69	-11	-18.97	0.31
Bakery Items	241	256	-15	-6.22	0.34
Carbonated beverages	66	79	-13	-19.70	0.73
Health drinks	46	59	-13	-28.26	0.000***

24-HDR - Twenty-Four hour Dietary Recall; FFIS- Food Frequency Interview Schedule

*** Mean energy consumption values significantly different at p<***0.001, p<** 0.01 level and * p<0.05 α level by paired t-test statistics for Ho: mean energy intake from food frequency = mean from reference.

good correlations of above 0.5 (Cade *et al.,* 2002) for both amounts of food and energy consumptions.

Bland and Altman plots were drawn to check the limits of agreements for mean intake of the food groups and energy consumption values obtained by reference method (24-HDR) and FFIS.

Reproducibility of FFIS

Reproducibility and intra-individual variation of the two FFIS, administered six months apart, was tested by Pearson's Intra-class correlation (ICC) of the mean amounts of food groups consumption (Table 5). There was a modest correlation for the number of items consumed in the two FFIS ($r = 0.5$, $p<0.05$), showing that subjects who showed varied food intakes in the first administration also showed a similar practice during the second administration of the FFQ as also shown by Vaz *et al.* (2009).

DISCUSSION

The paper describes the validation of an FFIS for the urban adult population of Hyderabad. Earlier studies in India demonstrated the development of FFQs for the rural population of western and southern regions (Hebert *et al.,* 1999; Sudha *et al.,* 2006). The FFIS developed in the present study quantified the intakes of processed foods along with the conventional foods consumed by an urban population. FFIS correlated better with the reference method for conventional foods than processed foods. The measurements for mean values of consumptions for most of the food groups were higher for both the FFIS than 24-HDR as shown by many earlier studies (Liu *et al.,* 2013; Iqbal *et al.,* 2009; Shahril *et al.,* 2008; Paandey *et al.,* 2005). However, the mean intakes of fruits and some of the processed foods like breakfast cereals were higher for 24-HDR as also shown by

Table 3. Correlation for food groups' intakes (g/d) between food frequency interview schedules and the average of the six 24-hour recalls

Food groups	*Spearman's Correlation Coefficients*				*Pearson's Correlation Coefficients*			
	24-HDR vs FFISw	*P value*	*24-HDR vs FFISs*	*P value*	*24-HDR vs FFISs*	*P value*	*24-HDR vs FFISw*	*P value*
Cereals	0.56	0.043*	0.44	0.008**	0.53	0.05*	0.07	0.015*
Pulses	0.44	0.462	0.45	0.002**	0.43	0.217	0.42	0.241
Green leafy vegetables	0.35	0.002**	0.53	0.002**	0.39	1.060	0.54	0.002**
Roots and tubers	0.44	0.054*	0.42	0.05*	0.59	0.000***	0.19	0.293
Other vegetables	0.67	0.000***	0.81	0.000***	0.72	0.000***	0.64	0.000***
Fruits	0.63	0.000***	0.51	0.004**	0.59	0.000***	0.51	0.003**
Milk	0.46	0.054*	0.48	0.033*	0.42	0.244	0.04	0.838
Animal foods	0.44	0.014*	0.45	0.011*	0.73	0.000***	0.65	0.000***
Fats and oils	0.63	0.163	0.54	0.011*	0.61	0.264	0.15	0.423
Sugars	0.53	114	0.89	0.024*	0.56	0.380	0.18	0.332
Spices	0.80	0.000***	0.47	0.008**	0.69	0.000***	0.55	0.001***
Breakfast cereals	0.78	0.000***	0.56	0.001***	0.77	0.000***	0.56	0.001***
Ready-to-eat items	0.75	0.000***	0.69	0***	0.76	0.000***	0.65	0.000***
Bakery items	0.22	0.032*	0.28	0.02*	0.22	0.02*	0.23	0.012*
Carbonated beverages	0.41	0.020*	0.42	0.02*	0.52	0.002**	0.59	0.000***
Health drinks	0.14	0.457	0.14	0.477	0.15	0.423	0.19	0.284

24-HDR - Twenty-four Hour Dietary Recall; FFISs - Food Frequency Interview Schedule (summer); FFISw - Food Frequency Interview Schedule (winter); correlation coefficients significant at *** $p < 0.001$, ** $p < 0.01$and * $p < 0.05$ of α levels for spearman rank correlations and Pearson's correlation coefficients.

Table 4. Correlation and regression analyses for total energy consumption (kcal/d) between food frequency interview schedules and the average of the six 24-HDRs

Foods	*24-hr DR vs FFISs (r)*	*b*	*R^2*	*P value*	*24hr DR vs FFISw (r)*	*b*	*R^2*	*p value*
Cereals and millets	0.60	0.437	0.36	0.003	0.62	0.582	0.38	0.000
Pulses	0.51	0.452	0.26	0.000	0.57	0.671	0.32	0.001
Green leafy vegetables	0.41	0.410	0.17	0.022	0.63	0.772	0.40	0.00
Roots and tubers	0.55	0.466	0.29	0.001	0.49	0.612	0.25	0.00
Other vegetables	0.79	0.529	0.63	0.000	0.85	0.532	0.72	0.00
Fruits	0.66	0.703	0.43	0.000	0.46	0.467	0.21	0.009
Milk	0.64	0.571	0.41	0.002	0.59	0.561	0.36	0.001
Animal foods	0.59	0.674	0.36	0.000	0.51	0.360	0.26	0.004
Sugar	0.34	0.326	0.42	0.032	0.41	0.625	0.16	0.004
Spices	0.74	1.033	0.55	0.000	0.48	0.461	0.23	0.006
Oils and fats	0.69	0.913	0.48	0.000	0.59	0.729	0.34	0.000
Breakfast cereals	0.71	0.718	0.50	0.000	0.50	0.335	0.25	0.004
Ready-to-eat items	0.67	0.858	0.45	0.000	0.55	0.602	0.31	0.001
Bakery items	0.16	0.387	0.13	0.343	0.25	0.254	0.06	0.324
Carbonated beverages	0.42	0.517	0.17	0.020	0.48	0.492	0.23	0.007
Health drinks	0.17	0.252	0.02	0.376	0.19	0.276	0.04	0.304

24-HDR - Twenty-four hour Dietary Recall; FFISs - Food Frequency Interview Schedule (summer); FFISw - Food Frequency Interview Schedule (winter); r - coefficient of correlation; b-coefficient of regression; R^2-coefficient of determination; *p* -value is the significance of the Pearson's correlation coefficient (r) for energy intakes by the two methods

Table 5. Intra-class correlation between the two Food Frequency Interview Schedules (summer and winter)

Food groups	*FFISs vs FFISw*	*95% CI*	*P value*
Cereals	0.75	0.32-0.91	0.034*
Pulses	0.81	0.59-0.99	0.054*
Green leafy vegetables	0.52	0.28-0.75	0.008**
Roots and tubers	0.44	0.22-0.73	0.03*
Other vegetables	0.67	0.49-0.81	0.000***
Fruits	0.78	0.60-0.89	0.001**
Milk	0.56	0.33-0.76	0.002**
Animal foods	0.69	0.44-0.84	0.000***
Fats and oils	0.41	0.23-0.71	0.043*
Sugars	0.81	0.65-0.99	0.000***
Spices	0.84	0.71-92	0.000***
Breakfast cereals	0.69	0.44-0.89	0.000***
Ready-to-eat (RTE)	0.78	0.59-0.89	0.000***
Bakery items	0.32	0.13-0.54	0.045*
Carbonated beverages	0.55	0.18-0.77	0.004**
Health drinks	0.37	0.14-0.68	0.062

FFISs - Food Frequency Interview Schedule (summer)
FFISw- Food Frequency Interview Schedule (winter)
Intra-class correlation coefficient significant at *** $p<0.001$, ** $p< 0.01$ and * $p<0.05$ of α level.

other studies (Erkola *et al.,* 2001; Wong *et al.,* 2012). The reason for high values of correlations for some foods like rice, wheat flour, and vegetables like tomatoes and onions may be their regular consumption as major constituents of the diet, irrespective of the socio-economic status. However, green leafy vegetables, milk, animal foods and secondary and tertiary processed foods were not consumed daily. A high day-to-day variation in the consumption of these food items was also observed in 24-HDR. Economic differences among the SES and gender based differences in intra-household consumption were observed for processed foods (pastries, puffs, biscuits, chips, and bread), carbonated beverages, health drinks, fish and milk as also shown in earlier studies (Sudha *et al.*, 2006; Vaz *et al.*, 2009).

Some foods were consumed regularly as major components of a diet unlike in western countries leading to lesser bias in recall due to cognitive and memory related problems. However, the day-to-day variations within the subjects could have caused lower correlations.

Higher correlation coefficients were observed in studies conducted among knowledgeable professionals who were motivated volunteers (Turconi *et al.*, 2010; Dehghan *et al.*, 2012; Rodriguez *et al.,* 2002). However, subjects in our study were from low to high income groups with an average of 12 years of formal education. Difficulties in accurately specifying the portion sizes by the respondents also led to high intra-individual variation.

Flegal *et al.* (1998) and Flegal and Larkin (1990) observed that errors in frequency estimation are the most important sources of error in ranking individuals by levels of intakes estimated from an FFQ. Therefore, we reduced the items under every food group in the FFIS. Variations in the responses have been shown to be directly proportional to the number of options in the FFQ (Vaz *et al.,* 2006; Block & Hartman, 1989). Our FFIS also had a higher number of response options which also could have affected the intakes.

The FFIS was well validated for the conventional foods which were eaten daily or 2-3 times a week. However, improvements are needed to increase the correlation between the test and reference method for intakes of some of the processed foods which showed very low coefficients, due to the bias in the reference standard itself. Therefore, this represents a relative validity rather than a true validity. However, repeated administration of the FFIS with a larger sample size is needed to identify and fix the errors which were encountered with the present FFIS due to its maiden administration in an urban setup.

For a large population like Hyderabad city, the validated FFIS can be used to rank individuals based on their habitual intakes of staple foods. The FFIS was easy to administer, less cumbersome with easily recognisable items as compared to the 24-HDR. The FFIS can be used as an energy efficient and reliable tool to obtain information on long-term dietary habits in various socio-economic strata of an urban population. Region-specific FFIS are needed for a country like India where the dietary patterns of various regions are different. An integration of several such region-specific FFIS in India can be used to develop a national food consumption database.

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Conflict of interest

The authors declare that they do not have any competing interest.

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