

Part A. Recent advances in dietary assessment tools

The use of food-frequency questionnaires for various purposes in China

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Abstract

Objective: To compare various food-frequency questionnaires (FFQs) used in nutritional studies in China for various purposes.

Design: In Study 1, a simplified FFQ with 17 questions on food was used in a large rural study. In Study 2, a questionnaire consisting of 84 questions on food consumption of 16 food categories was used in a study comparing dietary consumption data and various health indicators of elderly people in four geographical areas in China. In Study 3, a questionnaire with 149 items in 17 food categories is being validated by comparison with data obtained by repeated 24-hour recalls.

Setting: Study 1 was carried out in one southern site and a northern site in 1996 to 1997. Study 2 was conducted in four different geographical sites in 1998. The on-going study, Study 3, has been carried out in Jiangsu and Beijing since 1999.

Subjects: Study 1 included 12 234 rural Chinese adults aged 40 years. There were 546 elderly people in Study 2. Study 3 is collecting data from 300 healthy adults.

Results: The results of food consumption and nutrient intakes from Study 1 were comparable with those obtained from a previous household dietary survey, in which sensible correlations between diet and diseases were also found. In Study 2, the dietary data from the four geographical areas showed significant differences in food and nutrient intakes among the different areas. The validation of the new FFQ in Study 3 is still going on.

Conclusion: The FFQ is a useful method for the collection of individual food consumption information. The above FFQ forms could be used in studies with different purposes, especially in studying the relationship between diet, nutrition and chronic diseases.

Keywords
Diet assessment
Food-frequency questionnaire
Diet and health
Diet in China

Dietary assessment is commonly used in all types of dietary and nutritional studies. Among the various methods for the collection of food consumption data, the 24-hour recall method is widely used in most studies. However, the information collected by the 24-hour recall method is not able to reflect long-term food consumption, which is particularly important in studies on diet and chronic disease relationships. The food diary approach is able to obtain long-term food consumption information, but it is not feasible in large studies, especially in less educated populations. The food-frequency questionnaire (FFQ) is a qualitative dietary assessment method that obtains retrospective information on the pattern of foods used during a longer, less precisely defined time period. FFQs are also used to assess the habitual intake of foods or specific classes of foods¹. In recent decades, the use of semi-quantitative FFQs in epidemiological studies of diet and disease relationships has increased remarkably. Usual

dietary intake over an extended period of time has proved to be more pertinent in assessing the relationship of nutrition to chronic disease than diet on a recent specific day or week².

However, there are few publications available about the use of FFQs in dietary assessment in China. In recent years, we have used various FFQ forms for different research purposes. Three examples are given in this paper.

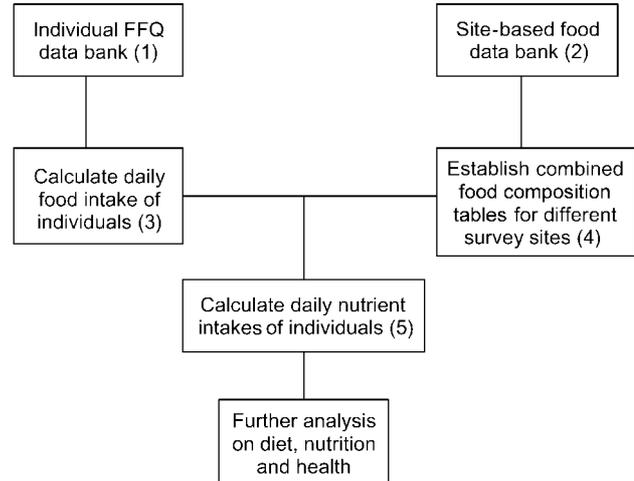
Example 1: a simplified FFQ used in a large rural study, 1996–97

The study was a baseline survey of a population-based prospective study. The subjects consisted of rural residents aged 40 years and older in Nanyang City, Henan Province (NY) in northern China and Anqing City, Anhui Province (AQ) in southern China. In total 12 234 subjects, including 6028 males and 6206 females, were surveyed.

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Table 1 Food items and categories included in the simplified food-frequency questionnaire (FFQ)

1. Meat (pork, beef, mutton and poultry)
2. Fish
3. Legumes and products
4. Fresh vegetables
5. Milk and products
6. Fruits
7. Potatoes
8. Salted vegetables
9. Smoked food
10. Rice
11. Wheat flour
12. Other grains
13. Vegetable oils
14. Animal fats
15. Wine
16. Liquor
17. Beer

**Fig. 1** Process of data analysis using a simplified food-frequency questionnaire (FFQ)**Table 2** Proportion of various meats consumed, by site

Meat	Proportion of total intake (%)	
	NY	AQ
Pork	80	75
Beef	10	10
Mutton	5	0
Chicken	5	10
Duck	0	5
Total	100	100

NY – Henan Province; AQ – Anhui Province.

A simplified questionnaire with 17 questions on food consumption was used. The frequency and quantity of food intake in the past year were queried. The food items or categories included are shown in Table 1. The consumption of staple foods such as rice and wheat flour, and of alcohol beverages such as liquor, beer and wine, was estimated by individual food items. The consumption of meat, eggs, legumes, vegetables, fruit, milk and other grains was estimated by categories. Edible oil consumption was estimated on a family basis and then divided into the amount consumed by each individual family member. However, for those foods that were

Table 3 Average daily food intake, by site and sex (g day^{-1} , mean \pm standard deviation)

Food item	NY		AQ	
	Males	Females	Males	Females
Rice	29.3 \pm 43.8	31.2 \pm 43.1	507.2 \pm 125.5	465.1 \pm 118.8
Wheat flour	492.5 \pm 136.9	434.9 \pm 126.3	9.1 \pm 30.1	7.5 \pm 28.7
Other grains	103.8 \pm 63.4	97.2 \pm 63.6	0.1 \pm 1.7	0.1 \pm 2.3
Fresh vegetables	258.1 \pm 82.4	231.2 \pm 86.7	247.5 \pm 74.6	249.5 \pm 72.8
Salted vegetables	2.6 \pm 9.6	2.1 \pm 8.5	85.4 \pm 68.6	99.1 \pm 68.9
Fish	1.8 \pm 8.8	0.8 \pm 3.4	14.3 \pm 24.9	11.7 \pm 20.4
Eggs	43.2 \pm 44.3	27.9 \pm 34.5	12.2 \pm 21.2	7.3 \pm 18.3

NY – Henan Province; AQ – Anhui Province.

Table 4 Average daily nutrient intakes, by site and sex (mean \pm standard deviation)

Nutrient	NY		AQ	
	Males	Females	Males	Females
Energy (kcal)	2572 \pm 559	2209 \pm 499	2098 \pm 481	1886 \pm 450
Fat (g)	33.7 \pm 7.2	26.6 \pm 13.9	25.1 \pm 14.8	19.9 \pm 10.8
Carbohydrate (g)	472 \pm 107	423 \pm 99	408 \pm 98	374 \pm 93
Fibre (g)	17.7 \pm 3.8	15.7 \pm 3.6	9.6 \pm 2.3	9.3 \pm 2.1
Retinol, RE (μg)	306.3 \pm 119.8	343.9 \pm 97.2	239.9 \pm 73.4	228.2 \pm 64.8
Ascorbic acid (mg)	65.6 \pm 21.9	57.8 \pm 22.2	77.7 \pm 21.4	78.1 \pm 20.8
Vitamin E (mg)	14.5 \pm 3.3	12.4 \pm 2.9	5.5 \pm 2.4	4.8 \pm 1.8

NY – Henan Province; AQ – Anhui Province; RE – retinol equivalents.

Table 5 Differences in food consumption between diabetics and controls (g day⁻¹, mean \pm standard deviation)

Food	Diabetics	Controls	P-value
Fish and products	5.86 \pm 13.17	10.46 \pm 34.71	<0.05
Eggs	35.10 \pm 44.28	18.98 \pm 30.52	<0.01
Meats	20.04 \pm 43.24	15.36 \pm 25.96	<0.05
Starchy tubers	23.24 \pm 46.65	49.97 \pm 80.43	<0.01
Liquor	10.93 \pm 34.69	6.22 \pm 19.05	<0.01

Table 6 Differences in nutrient intakes between diabetics and controls (mean \pm standard deviation)

Nutrient	Diabetics	Controls	P-value
Cholesterol (mg)	235.96 \pm 274.63	138.90 \pm 185.45	<0.01
Fat (g)	29.00 \pm 22.49	24.49 \pm 13.74	<0.01
Retinol, RE (μ g)	273.15 \pm 123.20	237.14 \pm 92.63	<0.01

RE – retinol equivalents.

estimated by categories, the amount of consumption was divided further into the common food items consumed locally, based on a separate village-based market survey. Table 2 provides an example of estimating meat consumption in the two survey sites. Frequencies of consumption recorded in the FFQ were: (1) never; (2) less than once per month; (3) 1–3 times per month; (4) once per week; (5) 2–3 times per week; (6) 4–5 times per week; (7) once per day; (8) 2 times per day; (9) 3 times or more per day. The amount of food consumed by an individual was estimated by items or categories of food, such as the intake of wheat flour

per meal, as: less than 50, 50–100, 150–200, 250–300, 350–400 or 500 or more grams. Intake of eggs per meal was 1 egg, 2 eggs, 3 eggs, 4 eggs or 5 or more eggs. Nutrient intake calculated for individual subjects was based on the food consumption data and the Chinese *Food Composition Table*³.

All data were entered in twice and SAS statistical software version 6.12 (SAS Institute, Inc., Cary, NC) was used for data calculation and analysis. The process of data analysis is shown in Fig. 1. Selected items of food consumption and nutrient intake data from the subjects are shown in Tables 3 and 4. These results are comparable with previous household survey results.

The data obtained were used further in a case–control study on diabetes. Two hundred and seventeen diabetic cases (average age 55.5 \pm 8.6 years) were diagnosed by a fasting blood glucose level of more than 7 mmol l⁻¹. Four hundred and thirty-four controls (average age 55.3 \pm 8.6 years) were matched to the cases by sex, age (\pm 1 year) and village, in a ratio of 2:1. As shown in Table 5, some significant differences were found in the intakes of fish, eggs, meat, starchy tubers and liquor between the cases and controls. Significant differences were also found in nutrient intakes, such as total fat and cholesterol (Table 6).

The above data show that the simplified FFQ approach produces reasonable estimates of food consumption and nutrient intakes in a large survey in rural areas, where the dietary pattern is relatively monotonous and the foods consumed are mostly produced locally.

Table 7 Food items included in the food-frequency questionnaire (FFQ) form

1 Meat	5 Milk & products	9 Salted vegetables	13 Fresh fruits
1.1 Pork	5.1 Fresh milk	5 items	8 items
1.2 Duck	5.2 Milk powder		
1.3 Poultry	5.3 Fat-free milk powder		
1.4 Mutton	5.4 Other milk products		
1.5 Beef			
1.6 Other meat			
2 Fish	6 Cereals	10 Pickled vegetables	14 Nuts
2.1 Freshwater fish	6.1 Rice	5 items	3 items
2.2 Sea fish	6.2 Wheat flour		
2.3 Shrimp	6.3 Millet		
2.4 Shellfish	6.4 Corn		
2.5 Other fish	6.5 Sticky rice		
	6.6 Other cereals		
3 Eggs	7 Starchy tubers	11 Cakes & cookies	15 Edible oils
3.1 Chicken eggs	7.1 Sweet potato	4 items	5 items
3.2 Duck eggs	7.2 Potato		
3.3 Other eggs	7.3 Other tubers		
4 Legumes & products	8 Fresh vegetables	12 Sugar & sweets	16 Salt & soy sauce
4.1 Bean curd	19 items	5 items	16.1 Salt
4.2 Dried bean curd			16.2 Soy sauce
4.3 Soyabean milk			
4.4 Fermented bean curd			
4.5 Dried bean			
4.6 Other bean products			

Example 2: an FFQ used in a geographical study, 1998

The study areas included Sichuan, Shandong, Guangdong and Jiangsu Provinces, which are located in different geographical areas of China. The purpose of the study was to compare differences in the dietary habits and health status of residents in these four areas. A total of 540 subjects aged 50–69 years were surveyed.

A questionnaire with 84 questions on food consumption of 16 categories (Table 7) was used. Trained interviewers asked each subject about the frequency and quantity of food consumed in the past year. The food items included in the questionnaire are shown in Table 7. Frequencies included in the questionnaire form were: (1) 3 times per day; (2) 2 times per day; (3) once per day; (4) 3–4 times per week; (5) 1–2 times per week; (6) 2 times per month; (7) once per month; (8) once per 3 months; (9) once per 6 months; and (10) never. The actual amounts of food consumed were estimated individually.

Selected items of food consumption and nutrient intakes of male subjects calculated based on the Chinese *Food Composition Table*³ are shown in Tables 8 and 9. Significant differences were found in dietary patterns and nutrient intakes among subjects in different areas. On the other hand, egg consumption was positively correlated with cholesterol intake and blood cholesterol level (Table 10).

Example 3: a validation study on a new Chinese FFQ

A validation study for a new Chinese FFQ was started in China in October of 1999. Funded by the American Institute for Cancer Research, this is a collaborative study between the Institute of Nutrition and Food Hygiene, Chinese Academy of Preventive Medicine, Mount Sinai School of Medicine and Harvard School of Public Health. The study was designed to evaluate the reproducibility of the FFQ and its validity, as compared with repeated 24-hour dietary recalls. It is being conducted among 300 Chinese males and females, healthy adults who live in one urban and two rural areas in the southern and northern part of China, respectively. The new FFQ with 149 food items in 17 categories was used twice, i.e. at the beginning and the end of a one-year period. The frequencies of consumption were divided into daily, weekly, monthly and yearly. The actual amount of food consumed was estimated individually. Six 3-day dietary recalls were conducted at two-month intervals over a one-year period to provide a reasonably stable estimate of true intake. The validity of the FFQ will be evaluated by comparing data obtained by the FFQ with those collected by the 24-hour dietary recalls. A flow chart of the study is given in Fig. 2. It is expected that this validation study will provide useful information for further use of FFQs in dietary and nutritional studies in China.

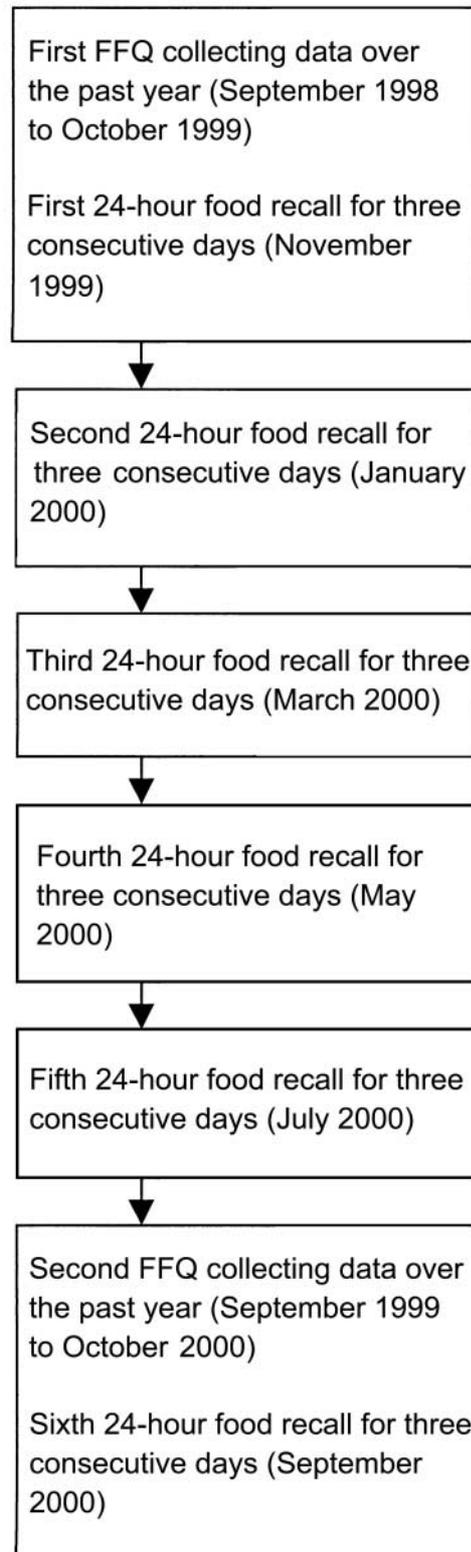


Fig. 2 Flow chart of the validation study for the new Chinese food-frequency questionnaire (FFQ)

Conclusions

The FFQ is a useful method in the collection of individual food consumption information. The number of questions

Table 8 Selected food intake of males in different geographical areas (g day⁻¹, mean \pm standard deviation)

Food item	JN	YZ	GZ	CD
Rice	60.1 \pm 8.7	382.0 \pm 193.1	446.3 \pm 173.7	505.9 \pm 177.5
Wheat flour	426.5 \pm 170.7	79.1 \pm 131.7	9.7 \pm 41.2	56.6 \pm 59.8
Legume products	68.2 \pm 95.2	106.4 \pm 121.2	19.1 \pm 20.0	21.0 \pm 25.0
Fresh vegetables	315.9 \pm 348.5	197.3 \pm 168.0	206.2 \pm 164.9	162.6 \pm 130.8
Fresh fruits	116.2 \pm 143.6	54.2 \pm 54.9	113.0 \pm 101.4	26.3 \pm 48.9
Pork	46.9 \pm 76.2	30.3 \pm 23.6	76.2 \pm 83.1	47.7 \pm 42.6
Poultry	12.7 \pm 23.4	41.8 \pm 126.3	9.1 \pm 8.1	11.3 \pm 25.2
Fish	36.0 \pm 117.7	35.0 \pm 29.1	41.6 \pm 71.7	10.8 \pm 13.3
Eggs	89.9 \pm 117.3	46.1 \pm 57.1	20.8 \pm 19.9	32.6 \pm 39.8
Vegetable oil	19.0 \pm 13.8	36.4 \pm 14.5	23.6 \pm 10.9	14.1 \pm 10.2
Animal fat	9.6 \pm 10.1	2.9 \pm 5.1	2.7 \pm 5.1	35.1 \pm 18.1
Total alcohol	39.3 \pm 39.8	10.2 \pm 20.6	13.3 \pm 27.3	38.0 \pm 42.3

JN – Sichuan Province; YZ – Shandong Province; GZ – Guangdong Province; CD – Jiangsu Province.

Table 9 Selected nutrient intakes of male subjects in different geographical areas (mean \pm standard deviation)

Nutrient	JN	YZ	GZ	CD
Fat (g)	58.5 \pm 26.8	70.9 \pm 22.2	62.8 \pm 32.8	82.6 \pm 30.5
Retinol, RE (μ g)	221.6 \pm 228.4	185.1 \pm 130.9	142.3 \pm 93.7	139.3 \pm 92.5
Ascorbic acid (mg)	44.5 \pm 45.7	35.1 \pm 30.6	60.5 \pm 41.6	36.8 \pm 24.7
Vitamin E (mg)	25.2 \pm 9.1	37.0 \pm 14.3	18.3 \pm 6.5	21.4 \pm 8.3
Calcium (mg)	396.3 \pm 307.1	366.1 \pm 207.7	198.0 \pm 80.5	197.0 \pm 58.4

JN – Sichuan Province; YZ – Shandong Province; GZ – Guangdong Province; CD – Jiangsu Province; RE – retinol equivalents.

Table 10 Comparison of egg consumption, dietary intake of cholesterol and blood cholesterol of subjects in different geographical areas (mean \pm standard deviation)

	JN	YZ	GZ	CD
Males				
Egg consumption (g day ⁻¹)	89.9 \pm 117.3	46.1 \pm 57.1	20.8 \pm 19.9	32.6 \pm 39.8
Cholesterol intake (mg day ⁻¹)	383 \pm 10	281 \pm 213	201 \pm 44	253 \pm 20
Blood cholesterol (mg dl ⁻¹)	183 \pm 36	160 \pm 28	158 \pm 38	176 \pm 35
Females				
Egg consumption (g day ⁻¹)	70.8 \pm 86.0	32.5 \pm 34.0	19.1 \pm 7.5	9.1 \pm 24.0
Cholesterol intake (mg day ⁻¹)	361 \pm 90	231 \pm 14	180 \pm 130	170 \pm 139
Blood cholesterol (mg dl ⁻¹)	201 \pm 42	70 \pm 30	164 \pm 29	174 \pm 31

JN – Sichuan Province; YZ – Shandong Province; GZ – Guangdong Province; CD – Jiangsu Province.

included in the FFQ form could be as few as 17 or as many as 149, depending on the purpose and nature of the study. The food items listed in the FFQ form should be consistent with the food items available in the study area. Based on the current education levels of most Chinese populations, a self-administered FFQ survey is not advisable and a face-to-face interview is the proper approach in most studies.

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