European Journal of Epidemiology 18: 855–861, 2003.
© 2003 Kluwer Academic Publishers. Printed in the Netherlands.

METHODS

Development of a semi-quantitative Food Frequency Questionnaire (FFQ) to assess dietary intake of multiethnic populations

Danit Shahar[1], Iris Shai[1], Hillel Vardi[1], Ayelet Brener-Azrad[1] & Drora Fraser[1,2]

[1]*The S. Daniel Abraham International Center for Health and Nutrition at Ben-Gurion University of the Negev;* [2]*Professor Epidemiology and Health Sciences Evaluation Unit at Ben-Gurion University of the Negev, Beer-Sheva, Israel*

Accepted in revised form 7 March 2003

Abstract. The Food Frequency Questionnaire (FFQ) is one of the most commonly used methods in epidemiological studies to assess long-term nutritional exposure. The purpose of this study is to develop a general FFQ for the Israeli population and present the procedures undertaken to select foods to be included in a questionnaire for a multiethnic population. Random population cluster sampling was done using voter registration lists of the Negev Jewish population, aged 35 years and over, which were divided into three groups based on where they were born, namely: Israel, Asia–Africa and Europe–America. Participants were interviewed for their dietary intake using 24 hour recalls. Foods eaten by our subjects were aggregated into conceptually similar food groups and entered in stepwise regression models to predict variation in nutrient intake. Separate models were created for each origin group. It was found that the dietary intake was significantly lower for energy and vitamin E among European–American born subjects and significantly lower for calcium intake among Asian–African born subjects. Differences between ethnic groups were seen in the list of foods, which explained the between-person variability for energy and zinc. For most nutrients, fewer items were needed to explain the between-person variation in the group of people born in Israel. The final list of foods included 126 items and explained over 90% of the between-person variability in selected nutrients for all three groups. The newly developed FFQ for the Negev population includes 126 items that are sufficient to rank the nutritional exposure of people over 35 years old from the three origin groups in Israel.

Key words: Between-person variability, Dietary assessment, Dietary intake, Ethnic groups, Food Frequency Questionnaire, Origin

Introduction

The need to identify the long-term effects of diet on the development of chronic diseases has resulted in the development of dietary assessment methods to measure past and present intake of foods and nutrients. The ability to discern the relationship between diet and disease depends on the quality of the dietary instrument. This, in turn, depends on how accurately the instrument is able to reflect the dietary patterns of the population living in the area where it is used [1, 2].

A Food Frequency Questionnaire (FFQ) is one of the most commonly used methods in epidemiological studies to assess individual long-term dietary intake of foods and nutrients. The questionnaires are typically self-administered, asking the respondents to report the usual frequency of consumption of items from a list of foods for a specified time period. The method is sufficiently simple to be used in large epidemiological studies. Even though the absolute intake is an estimate, using this method there is ample evidence that FFQ can rank individuals by levels of past nutrient intake in epidemiological studies. The questionnaire is able to rank the population into levels of exposure (tertiles, quintiles, quartiles), which are used in the calculation of relative risk (RR) for the development of the disease in question [1, 3].

The aim of FFQ development is to obtain a convenient, consistent and relevant long-term nutritional assessment tool. As the aim of most nutritional studies is to assess the risk for the common chronic diseases (cardiovascular disease, diabetes, cancer etc.) most FFQs give an overview of the individuals nutritional intake. When the study goal is assessing a single nutrient, or a group of items (e.g. $n-3$ fatty acids) a modified FFQ pertinent to these food items may be used. The purpose of the study is to develop a general FFQ for the Israeli population. The questionnaire will therefore have to represent all the different ethnic groups as well as to discriminate between people's intake for nutrients known to be associated with the main chronic diseases including cardiovascular disease, diabetes, cancer and osteoporosis.

In Israel, which is a typical immigration country, the development of an FFQ is compounded by the multiethnic nature of society and the differing eating patterns of the various ethnic groups. Thus far a single FFQ was developed in the 1970s by Lubin et al. [4, 5] and has not yet been fully validated [4–6]. In order to conduct nutritional epidemiology studies in the Negev (Southern Israel), we performed a survey of a cluster population random sample in the Negev area to assess their dietary intake. The Israeli population is a heterogeneous population by its nature as an immigration country. During the 20th century Jews people from Europe, Asia, Africa and America immigrated to Israel. Each group came with its own traditional and cultural foods. While an Israeli food culture evolved out of a merging of all groups (the melting pot effect), people from different countries of origin still maintain their unique culinary habits. The population can be divided into two major categories: Sephardic Jews from Asia or Africa and Ashkenazi Jews who came from Europe and the Americas. The eating patterns of these groups differ in several ways including the amounts consumed of particular items, ethnic foods and mixed dishes as shown by Hankin et al. [7] in their paper on the development of FFQ for the multiethnic population in Hawaii.

Methods

Negev Nutritional Study (NNS)

A random sample of the Negev population in Israel was obtained using voter registration lists of the Jewish population over 35 years old. Sampling was done using the proportional cluster sampling method. The Negev area (the Southern part of Israel) host an eclectic population that includes people who were born in different countries and belong to different ethnic groups. Origin or ethnic group was defined by place of birth and was broken down into three: those born in Israel, North Africa–Asia, and Europe–Americas.

Data collection
Trained interviewers, using USDA methodology, conducted a 24-hour diet interview using a Hebrew-translated version of the 24-hour questionnaire, USDA food book and portion size booklet, photographs and the Israeli Ministry of Health portion sizes booklet [8, 9]. Additional photos were added to the portion size booklet in order to improve accuracy of portion size estimation. The questionnaire also included questions regarding dieting, physical activity habits and health status. Interviewers were trained in a 4-day course that included learning and practicing interviewing methods with the required adjustments for the Negev population.

Database
Since no database for Israeli foods was available at the beginning of the study, the USDA database was modified to suit the foods eaten by the Negev population. Ethnic specific recipes were added using FIAS [10], a computer program that allows 'cooking' recipes on the computer and thus calculated the nutrient values of recipes, taking into consideration the changes in nutrient content in the cooking process. Each recipe was given a code using the USDA coding method based upon the closest recipe in the USDA database [11]. Food products unique to Israel were added, codes were assigned according to the USDA coding system, and weight per volume was calculated for each product. Portion sizes were defined using USDA portion size booklet, the Israeli Health Ministry booklet [9] and a booklet that included pictures of different slices of breads, mixed dishes and salads.

Data entry
A computer program was developed based on FIAS [10]. All food items were translated into Hebrew and a computer analyst developed a Hebrew program written in Access (© Microsoft Corp.). Coders were trained for nutrition data entry using the USDA data entry system. If a food item was not easily identifiable, a modification option was available enabling the coder to change an existing recipe according to the interviewee's description.

Quality control
Quality control was done in three stages: (1) Each interview was checked for missing data within 1–3 days following the interview. (2) Each questionnaire was edited by a registered dietitian, corrected by the coders and rechecked by a registered dietitian. (3) Cross-interview checks were made to detect unusual nutrient or food model values.

Development of the FFQ

The results of the NNS were used to develop a FFQ using the following steps:

1. Conceptually similar foods were aggregated into groups based on the fat and energy content per portion eaten. Fruits and vegetables were aggregated based on vitamin and mineral content per portion.
2. A registered dietitian evaluated the aggregation process by checking all aggregated food items for outliers.
3. In stepwise multiple regression analysis foods contributing to the between-people variation were identified. Items entered the model based on their specific nutrient content and the frequency of intake in the population. Foods in the model that explained at least 90% of the between-person variability were considered for the final questionnaire. The procedure described was undertaken for 27 nutrients, including energy, cholesterol, folic acid, calcium, zinc, vitamin E and dietary fiber.

4. Contribution to total nutrient intake was calculated for each of the foods and recipes included in the final questionnaire.
5. Separate models were constructed for the three origin groups to assure inclusion of food items or recipes that might contribute to the variability of one origin group as compared with the others.

   The final FFQ included 126 food items. Quantification of food intake was done using usual serving sizes and different portion sizes of selected dishes. The same approach for portion sizes was used in Finland [12] and Denmark [13] in developing their FFQ questionnaires.

The nutrients presented in the analyses are energy, folic acid, saturated fat, zinc, iron and vitamin E. These nutrients served as an example for the stepwise regression modeling.

Statistical analyses

Statistical analyses were conducted using SPSS version 10 software. Means of continuous variables were compared using ANCOVA with age and gender as covariates. Stepwise regression models were used to assess the contribution of each food item to the total intake and to the between-person variability. Weighted means of each food included in the aggregated group was used in the model taking into account the frequency it was eaten by the population.

Results

Table 1 depicts the original sampled population of 1173 participants. Out of the total sample drawn, 84% were interviewed, 3.4% died, 2.7% had language difficulties and therefore could not be interviewed and 9.9% refused to participate. As shown in Table 2, data regarding place of birth was available for 1167 people (99.5% of the sample of 1173 subjects) who were chosen for the study. Two hundred and twenty participants were born in Israel, 465 in Asia–Africa (75% were born in Africa, excluding Ethiopia, 22% in Asia and 3% were born in Ethiopia) and 482 in Europe–Americas (53% were new immigrants from former FSU and 47% were born in the rest of Europe). Participants who were born in Israel were younger than the other groups; BMI was between 26 and 27 for all three groups. Years of formal schooling tended to be lower in the group of participants born in Asia–Africa, 9.5 compared with over 13 years for the groups of participants born in Israel and Europe–Americas.

Table 3 describes age and gender adjusted comparisons of dietary intake between the three groups. Those born in Europe–America consumed significantly fewer calories ($p < 0.05$), calcium ($p < 0.01$) and vitamin E ($p < 0.01$) than the other origin groups. No major differences were shown between the groups for protein, saturated fat, iron, zinc and folic acid.

Table 4 presents the top 12 foods contributing to the between-person variability and total energy intake, by origin group. The foods are presented by their order of entering the stepwise regression model. Twelve foods accounted for 60% of the between-person variation among participants who were born in Israel or Asia–Africa and 55% among European–American born participants. The sum contribution of these foods to the total energy intake was only 22, 30 and 28% for Israeli, Asia–Africa and European born participants, respectively.

Table 5 presents the top 12 foods in their order of entering the regression to predict zinc intake. The list explained 73, 80 and 73% of the between-person variation among participants who were born in Israel, Asia–Africa and Europe–America, respectively. The sum contribution of these foods to the total zinc intake was only 35.1, 33.3 and 32.1% for Israeli, Asian–African and European–American born participants, respectively. Most of the contribution for

Table 1. Sampling scheme of the study population

Interview status		N	Total (%)
Yes		1173	84.0
No	Died	48	3.4
No	Language difficulties	37	2.7
No	Refusal	138	9.9
Total		1396	100.0

Table 2. Demographic characteristics of the study population by country of origin

Characteristics	Total sample	Israeli born	Asian–African born	European–American born
Number of participants	1167	220	465	482
Males/females	521/646	100/120	213/252	208/274
Average age[b]	57.8 ± 13.2	46.6 ± 8.9	59.1 ± 11.6	61.7 ± 13.6
Average BMI[a]	26.5 ± 5.2	26.0 ± 5.5	26.3 ± 5.3	27.0 ± 4.9
Years of education[b]	11.8 ± 4.5	13.5 ± 3.4	9.5 ± 4.6	13.2 ± 4.0

[a] p-Value for the difference between groups < 0.05.
[b] p-Value for the difference between groups < 0.01.

Table 3. Age and gender adjusted comparisons of selected dietary intake characteristics by country of birth

Characteristics	Total sample	Israeli born	Asian–African born	European–American born
Energy intake (Kcal/day)[a]	1707 ± 773	1804.8 ± 806.9	1737.8 ± 816.1	1632.7 ± 690.6
Protein (g/day)	66.4 ± 32.9	65.6 ± 31.8	66.5 ± 33.6	68.0 ± 33.6
Protein percent	16.2 ± 5.0	16.5 ± 4.8	16.0 ± 5.4	16.0 ± 5.2
Carbohydrates	226.4 ± 108.1	220.4 ± 94.2	231.6 ± 116.9	230.8 ± 117.2
Carbohydrates percent	53.9 ± 11.1	54.5 ± 10.7	53.9 ± 12.0	53.4 ± 11.0
Total fat (g/day)	58.9 ± 36.4	57.4 ± 41.1	63.4 ± 36.2	57.4 ± 34.0
Fat percent	31.3 ± 10.1	30.7 ± 9.8	32.3 ± 11.5	31.4 ± 9.7
Saturated fat (g/day)	18.5 ± 12.4	20.6 ± 11.6	18.7 ± 12.1	18.5 ± 12.1
Calcium (mg/day)[b]	602.4 ± 335.4	684.7 ± 409.8	593.8 ± 321.7	588.8 ± 304.3
Folic acid (µg/day)	233.3 ± 179.9	261.4 ± 238.5	238.7 ± 171.2	227.5 ± 153.9
Vitamin E (mg/day)[b]	7.6 ± 8.9	8.2 ± 12.4	8.3 ± 9.5	6.5 ± 5.6
Iron (mg/d)	10.3 ± 6.1	9.9 ± 5.2	9.9 ± 5.2	10.6 ± 6.5
Zinc (mg/d)	7.4 ± 4.4	7.4 ± 4.1	7.6 ± 5.1	7.8 ± 4.3

[a] p-Value for the difference between groups < 0.05.
[b] p-Value for the difference between groups < 0.01.

Table 4. The top 12 foods (by their cumulative R^2) entered the stepwise regression using energy as the dependent variable and their contribution to total intake by place of birth

	Israeli born			Asian–African born			European–American born		
	Food item	R^2	% cont.*	Food item	R^2	% cont.*	Food item	R^2	% cont.*
1.	Soda	0.10	2.6	Soda	0.14	2.7	Bread	0.11	11.4
2.	Cheese or cream cake	0.20	1.1	Fruit drink	0.25	2.7	Dry wine	0.21	0.22
3.	Fruit drink	0.28	3.2	Nuts	0.31	1.1	Fruit drink	0.27	1.7
4.	Bread	0.34	5.4	Mixed dishes	0.37	3.0	Soda	0.31	1.4
5.	Sunflower seeds	0.39	1.2	Sugar cookies	0.43	3.1	Cooked rice	0.36	1.9
6.	Dry wine	0.43	0.55	Bread	0.46	9.0	Milk 3% fat	0.40	2.4
7.	Hummus	0.46	2.8	Vegetable oils	0.49	2.5	French fries	0.43	1.3
8.	Vegetable salads, cooked	0.49	1.2	Coffee cakes	0.52	1.4	Mixed dishes	0.46	1.8
9.	Hard cheese	0.52	1.3	Alcoholic beverages	0.55	0.20	Pound cake	0.48	1.6
10.	Pita bread	0.55	2.1	Rolls or bagels	0.57	2.0	Cooked potatoes	0.50	3.3
11.	Soy sauce	0.58	0.01	Pizza	0.59	1.1	Sugar	0.53	3.3
12.	Cooked potatoes	0.60	1.6	French fries	0.60	1.3	Pasta	0.55	1.2
	Total	0.60	22		0.60	30		0.60	28

* % Contribution to total intake of the population.

the between-person variability came from meat products including beef, mixed beef dishes, chicken and turkey and internal organs.

The order of entering the model differed among the groups. In the Asia–Africa and Europe–America groups, beef was the first item explaining 37 and 25% of the between-person variability respectively. In the Israeli group sunflower seeds were the first item explaining 16% of the between-person variability. Each group was characterized by items that were not consumed by the other groups, hummus and leben (buttermilk) among those who were born in Israel, alcoholic beverages and turkey breast among Asia–Africa subjects and chicken tenders and milk among Europe–Americas subjects.

Figure 1 presents the number of foods needed to reach the level of $R^2 = 0.9$ by place of birth. Fewer items were needed to explain the between-person variation among the group of people born in Israel when looking at vitamin E and folic acid. For all nutrients measured, the highest number of items was needed to explain the between-person variation

Table 5. The top 12 foods (by their cumulative R^2) entered into the stepwise regression using zinc as the dependent variable and their contribution to total intake by place of birth

	Israeli born			Asian–African born			European–American born		
	Food item	R^2	% cont.*	Food item	R^2	% cont.*	Food item	R^2	% cont.*
1.	Sunflower seeds	0.16	4.1	Beef	0.37	7.3	Beef	0.25	5.4
2.	Beef	0.25	5.6	Mixed beef dishes	0.46	5.0	Internal organs	0.34	1.3
3.	Nuts	0.33	1.5	Chicken/ Turkey Skinless	0.52	3.6	Chicken/ Turkey	0.42	8.4
4.	Cereals	0.38	1.4	Chicken/ Turkey	0.58	6.8	Mixed beef dishes	0.47	3.4
5.	Hard cheese	0.44	2.1	Cereals	0.62	1.6	Peanuts	0.52	0.7
6.	Meat balls	0.49	2.7	Sunflower seeds	0.66	2.3	Sunflower seeds	0.57	0.7
7.	Mixed beef dishes	0.53	3.7	Internal organs	0.69	2.1	Meat balls	0.60	2.6
8.	Internal organs	0.57	1.7	Hard cheese	0.73	1.1	Shishlik	0.63	0.2
9.	Chicken/Turkey	0.62	8.4	Nuts	0.75	1.3	Chicken/ Turkey Skinless	0.66	1.8
10.	Peanuts	0.67	1.0	Turkey breast	0.77	0.5	Chicken tenders	0.69	2.8
11.	Hummus	0.70	1.4	Meat balls	0.78	1.6	Milk 3%	0.72	3.7
12.	Leben (Buttermilk)	0.73	1.5	Alcoholic beverages	0.80	0.1	Cereals	0.73	1.1
	Total	0.73	35.1		0.80	33.3		0.73	32.1

* % Contribution to total intake of the population.

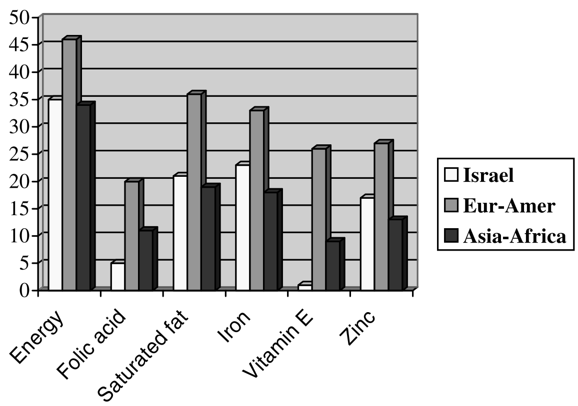

Figure 1. Number of foods needed to get $R^2 = 0.9$ by place of birth for energy, folic acid, saturated fat, iron, vitamin E and zinc.

among European–American born participants. A higher number of foods were needed to classify people by their energy since most foods contain energy. Finally, the list of 126 foods included in the FFQ was assessed for the percent of between-person variability explained by the model for selected nutrients for each ethnic group. For energy, iron, zinc, calcium, vitamin E, total fat, saturated fat, cholesterol, beta carotene, vitamin C, dietary fiber and folic acid, the list of foods explained over 92% of the between-person variability, for all origin groups.

Discussion

Dietary habits within the Negev population in Israel are quite heterogeneous with distinct patterns in different origin groups. Our FFQ was designed to address epidemiological and nutritional hypotheses within this population including different regions of the Negev area. In the present study, the 126 foods included in an Israeli self-administered semi-quantitative food frequency questionnaire were identified using a stepwise regression method. The same approach was used by Overvad [3] and Byers [14]. In these studies, the number of foods included in the questionnaires was 128 and 92, respectively. In a questionnaire developed in Spain [15] 118 items were included and 99 were included in Willett's FFQ [16]. The avoidance of superfluous foods is crucial in heterogeneous populations. Using the above method we were able to limit the items in the questionnaire to 126, a figure close to that used for more homogenous populations such as that of Denmark.

The contribution of individual foods to nutrient intake differs considerably by specific nutrient. Some nutrients, such as zinc and folic acid, have a limited number of sources and therefore are assessed relatively easily via small number of foods. For these nutrients, less than 20 items accounted for more than 90% of the between-person variation in intake in all origin groups. In contrast, 34–46 food items were needed to reach the level of 90% for energy. A similar trend was shown by Stryker et al. [17], where approximately 10 foods accounted for more than 90% of the between-person variation in vitamin B-12, vitamin C, vitamin A and β-carotene, while over 20 foods were needed to get to this level for energy.

Fewer foods are required to explain a given proportion of the between-person variation in intake than to account for the same proportion of the sample's total intake. The same was shown in Refs. [3, 14, 17]. Thus, a list of foods that appears to be quite 'incomplete' on the basis of its contribution to absolute intake may still be effective in discriminating between individuals. In our study the Israel and Asia–Africa participants, soft drinks, soda and juices, explained 18–25% of the between-person variability in caloric intake. Conversely, this group contributed only 4.3–5.4% of the total energy intake of these two groups, indicating that the drinks were *not* a major energy contributor, yet they explained a relatively large amount of the variability between the populations. Among European–American born participants the above gap was minor with soft drinks contributing 10% to the between-person variability.

The final list of foods obtained explains over 90% of the between-person variability for nutrients that are of particular interest in assessing nutritional exposure associated with chronic diseases. These include energy, fat, cholesterol, dietary fiber, antioxidants vitamins (vitamins C, E and β-carotene) that are known nutritional factors associated with cardiovascular disease, diabetes and cancer. The same approach was used in the development of the Harvard FFQ [1, 16] and the questionnaire developed by Byers et al. [14]. In both cases different models were constructed to identify the list of foods needed to explain the between-people variability for different nutrients [1, 14, 16].

Our results revealed that dietary intake and habits were both qualitatively and quantitatively different among the three ethnic groups. The main differences were shown in calorie, calcium and vitamin E intake, which may indicate differences in dietary patterns. Table 5, indicates that fewer [4] food items were needed for those born in Asia–Africa to account for over 60% of the between-person variation in zinc, with high contribution (37%) of beef as the first item entering the regression model. Among participants born in Israel, nine food items were needed to explain over 60% of the between-people variability in zinc and seven food items were needed in European–American born participants.

As for the number of foods required to explain 90% of the between-person variation, these appeared higher for nutrients with many minor sources such as energy and lower for nutrients with fewer food sources such as zinc and particularly vitamin E. Only one food item (sunflower seeds) explained over 90% of the between-person variation in vitamin E in people born in Israel.

The number of foods needed to explain at least 90% of the between-person variation was higher for all nutrients presented for the group of people born in Europe–America. This may reflect the heterogeneity of eating in this group. European–American born people come from different cultures, including immigrants from the FSU, who may have different eating habits than their counterparts.

The large differences shown in dietary intake and eating patterns of the different ethnic groups may raise the option of using a different questionnaire for each group. However, practical concerns, 'food-crossover' and a high (30% <) rate of marriage between the groups support the use of a unified questionnaire for the Jewish population. In an altogether distinct population, namely the Bedouin Arabs living in the south of Israel, a new method of assessment is currently being developed [18].

A major dilemma facing the composers of an FFQ is the length of the questionnaire. Intuitively, shorter questionnaires save time and expense in their administration, improve compliance and enhance the efficiency of data management. On the other hand, an abbreviated FFQ may be less sensitive to ethnic foods and thus be less accurate in classifying the subjects into exposure levels [19]. In our case, exclusion of FSU immigrants may have allowed a shorter FFQ, with fewer food items. The rational for not excluding this group is that their eating pattern is temporary and likely to change with time, eventually 'collapsing' into the 'usual' Israeli eating patterns. Our study describes the construction of FFQ for a multiethnic population in Israel. The questionnaire falls within the expected norms for an FFQ and allows ranking of individual nutritional exposure and, following validation, should be suitable for use in future research.

References

1. Willett W. Food frequency methods. In: Nutrition Epidemiology. New York: Oxford University Press, 1998; 69–91.
2. Block G. A review of validation of dietary assessment methods. Am J Epidemiol 1982; 115: 492–505.
3. Overvad K, Tjonneland A, Haraldsdottir J, Ewertz M, Moller Jensen O. Development of a semiquantitative Food Frequency Questionnaire to assess food, energy and nutrient intake in Denmark. Int J Epidemiol 1991; 20(4): 900–905.
4. Modan M, Lubin F, Lusky A. Interrelationships of obesity, habitual diet, physical activity and glucose intolerance in the four main Israeli Jewish ethnic groups. The Israel glucose intolerance, obesity and hypertension (GOH) study. In: Berry VE, Blondheim SH, Eliahou HE, Shafrir E (eds) Recent Advances in Obesity Research. London: Joub Libbey & Company, LET, 1986; 46–53.
5. Fuchs Z, Viskoper JR, Drexler I, et al. Comprehensive individualized nonpharmacological treatment pro-

gramme for hypertension in physician nurse clinics two year follow up. J Hum Hypertens 1993; 7(6): 585–591.
6. Bohlscheid-Thomas S, Hoting I, Boeing H, Wahrendorf J. Reproducibility and relative validity of food group intake in a food frequency questionnaire developed for the german part of the Epic study. Int J Epidemiol 1997; 26(1): S59–S70.
7. Hankin JH, Wilkens LR, Kolonel LN, Yoshizawa CN. Validation of a quantitative diet history method in Hawaii. Am J Epidemiol 1991; 133: 616–628.
8. US Department of Agriculture. Research Service. Nutrient data laboratory. Composition of foods. SR 12, February 1999.
9. Israel Ministry of Health, Department of Nutrition. Weights and portion size booklet. Publication no. 217, June 2000.
10. USDA Human Nutrition Information Service. Food Intake Analysis System Ver. 3. University of Texas Health Science Center at Houston, School of Public Health, 1996.
11. USDA, Human Nutrition Information Service. Manual of food codes for individual food intake survey release 2. 1986. Springfield, VA: National Service Accession no. PB87-181020.
12. Pietinen P, Hartman AM, Haapa E, et al. Reproducibility and validity of dietary assessment instrument instruments. I. A self-administered food use questionnaire with a portion size picture booklet. Am J Epidemiol 1988; 128: 655–666.
13. Tjonneland A, Overvad K, Haraldsdottir J, Bang S, Ewertz M, Jensen OM. Validation of semiquantitative food frequency questionnaire developed in Denmark. Int J Epidemiol 1991; 20(4): 906–912.
14. Byers T, Marshall J, Fiedler R, Zielenezny and Graham S. Assessing nutrient intake with an abbreviated dietary interview. Am J Epidemiol 1985; 122: 41–50.
15. Martin-Moreno JM, Boyle P, Gorgojo L, et al. Development and validation of a food frequency questionnaire in Spain. Int J Epidemiol 1993; 22(3): 512–519.
16. Willett WC, Sampson L, Stampfer M, et al. Reproducibility and validity of a semiquantitative Food Frequency Questionnaire. Am J Epidemiol 1985; 122: 51–65.
17. Stryker WS, Salvini S, Stampfer MJ, Sampson L, Colditz GA, Willett WC. Contributions of specific foods to absolute intake and between-person variation of nutrient consumption. J Am Diet Assoc 1991; 91: 172–178.
18. Abo-Saad K, Abu-Shareb H, Weizman S, Fraser D. Rapid lifetime, diet and health changes among urban Bedouin Arabs of southern Israel. Food Nutr Agri 2001; 28: 45–52.
19. Subar AF, Ziegler GZ, Thompson FE, et al. Is shorter always better? Relative importance of questionnaire length and cognitive ease on response rates and data quality for two dietary questionnaires. Am J Epidemiol 2001; 153: 404–409.

Address for correspondence: Danit Shahar, The S. Daniel Abraham International Center for Health and Nutrition, Ben-Gurion University of the Negev, P.O. Box 653, Beer-Sheva 84105, Israel
Phone: +972-8-647-7452; Fax: +972-8-647-7637
E-mail: dshahar@bgumail.bgu.ac.il