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METHODS MAKE A DIFFERENCE

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There continues to be a need for dietary assessment methods which can accurately describe the usual diet of individuals or groups. An indication of usual diet is needed to study the relationship of an individual's diet to chronic diseases such as coronary heart disease and cancer. The food frequency method is a standard method of obtaining information on how often an individual consumes a specific food or groups of food over a specified period of time(1). This method of dietary assessment has been the focus of attempts to add the element of quantification, adding how much to how often, which should describe usual diet over a period of time(2). Some investigations have focused on specific nutrients so that the food frequency questionnaires (FFQ) have included only foods that contain those nutrients (3). Others have designed instruments to describe the total dietary intake(4,5,6).

The purpose of the study I will describe was to develop a one-year retrospective food frequency questionnaire, including usual portion size, based on food groups derived from an analysis of food group usage in NFCS 1977-78(7).

The specific study questions were:

1. Are questions about food frequencies and amounts valid indicators of last year's diet? Validity was defined by the degree of correspondence of food frequency, energy intake and nutrient intake between quantified food frequencies for the past year and 16 days of recall/records sampled from the past year.

2. What characteristics of respondents are associated with validity?

The study design required each respondent to provide information five times, four times providing 24-hour recall and three-day records over the course of one year. The fifth time respondents provided food frequency data on the previous year; this interview was conducted about three months after the last record was completed.

Methods:

Sample: The study design required a population evenly distributed between white and black, men and women, and within the age range 25 to 50. 228

respondents completed the study. Table 1 shows the distribution by sex,race, income and education. We also tried to obtain an even split on education, above and below completed high school, rather than a representative sample of the population. Interviewers recruited respondents door-to-door in census tracts with a high proportion of blacks. Age-eligible potential respondents were asked to participate for one year and were told about the requirements for keeping records. Refusal rates were high, around 70 percent in Ypsilanti and 50 percent in Ann Arbor. No detailed records were kept of recruitment refusals but the interviewers felt that more men, and especially black men, refused. Also, fewer blacks than whites completed the study. In the group that completed the study, women have fewer years of education than men and the black women tended to have lower income than other groups. A disproportionately large number of very highly educated black men were included in the final study group.

Dietary Data: The first interview consisted of a 24 hour dietary recall and a brief health and demographic questionnaire. Respondents were given a notebook in which they recorded all food consumed over the following three days. The record was picked up 4 or 5 days later by the interviewer. In the second, third, and fourth rounds, interviewers repeated the same pattern, omitting the health and demographic section, but asking a brief set of questions about life events occurring in the interim between contacts.

Food Frequency Questionnaire: The FFQ was composed of 113 foods or food groups, each listed on a separate slip of paper. The identification and definition of these groups was based on the food group order already built into the data bases, the similarity of their nutrient composition, and the frequency of the foods and patterns of use among foods as they were identified in the Nationwide Food Consumption Survey(7). Butter, margarine, sugar and other items were not separetely identified but included as probes to individual foods.

Some foods are used differently depending upon whether they are eaten singly or in mixtures. Prevalence information determined whether foods with essentially separate identities, such as tomatoes eaten raw, cooked, or in sauces, and ground beef as hamburger or in casserole, should be presented to the respondent as separate items.

Typical serving size was asked for each food, except lettuce and an "other vegetables" group. Serving size was omitted for these foods because it is difficult to generalize about average portion size when the foods in the group are different sizes and shapes.

FFQ Administration: The basic format of the food frequency was a set of 113 slips of paper listing the name of the food or food group on the front and a partly precoded recording form on the back. The food frequency was administered in a sequential sorting procedure; the respondent sorted slips under the direction of a trained interviewer. In the final step the interviewer asked the respondent how much of the food was usually eaten. Tools for estimating quantity also used in the 24-hour recall/record were

within reach of the respondent: measuring cups and spoons, respondent's cup, glass and bowl, a ruler and bean bags representing 1/4, 1/3, 1/2, 3/4 and 1 cup volumes. For those foods that the respondent indicated were eaten seasonally, the interviewer asked for the length of the season. The average time required to complete the food frequency quesionnaire was about one hour.

Results:

Nutrient Intake: A comparison of nutrient values for the mean of the 16 days of recall/records and the FFQ shows a consistent over-reporting by the FFQ for the total sample (Table 2). In addition to the 16 day mean and the FFQ, the first three day mean values are included to permit a comparison to values we might have obtained if we had seen respondents only once during the year and obtained a 24 hour recall and two day record. These values for the three day means, sets of which were selected at random from the four periods, tend to be very close to the 16 day mean values.

When we compared 16 day mean values to the FFQ values within race and sex groups, we saw that white men have better agreement than the other three groups (Table 3). White men also recorded the highest energy intake, by either method. The FFQ values of white men were about 470 calories higher than the 16 day mean. For black men, values were about twice as high on the FFQ, approximately 1000 Kcal greater.

The mean energy intake for this age group in NFCS 1977-78 was 2512 for white men and 2089 for black men (8). Our three day mean values for white men was 2666 calories and 2163 calories for black men; both were higher by about 100 kcal than NFCS values.

Black women show the poorest agreement between the two methods of all four sex-race groups(Table 4). The FFQ value was about 850 calories or 54% higher than the 16 day mean. The mean energy intake for NFCS for this age group was 1596 for white women and 1452 for black women (8). Our 3 day mean of 1845 for white women was 250 kcal higher than the NFCS value but our 3 day mean of 1552 for black women was closer, only 100 kcal higher than the NFCS value for black women of this age group.

FFQ:Recall/Record Ratio: Another way of measuring agreement, or lack of agreement, between the two methods is through expressing the FFQ and 16 day mean as a ratio.

In Table 5 respondents are categorized according to the ratio of their food frequency calories to their food record calories as follows: less than 0.8 which is equivalent to the mean calories from the FFQ being less than those from the records by approximately 400 calories. 0.80 through 1.2 the next ratio category,is equivalent to agreement within approximately 400 calories. There are two other categories, 1.21 through 1.5 in which the FFQ is greater by 401 to 1000 kcal and greater than 1.5 which is equivalent to the FFQ being more than 1000 calories greater than those from the records.

When we examined the percent of respondents in each agreement category by sex-age groups, an overall chi-square test showed the most apparent difference was the large percent of black women in the category greater than 1.5. Overall, 30-40 percent of respondents showed satisfactory agreement ratios of 0.81 to 1.2. About 30 per cent were somewhat high, ratios of 1.21 to 1.5. Thus approximately 60 per cent of the respondents had satisfactory and somewhat high agreement ratios.

Table 6 shows the mean ratios within six demographic variables in order to determine whether demographic characteristics distinguished respondents with good agreement from those with poor agreement.

These demographic characteristics were not related to the ratios for white men and black women, the groups with the best agreement and poorest agreement between methods. The higher ratios indicate higher FFQ estimates. Among black men, mean ratios were significantly higher for those who had an annual income of less than $20,000. Among white women, ratios were higher for those who were not in a professional or managerial job. In addition, ratios were higher for white women who had a low Body Mass Index. Women with higher BMIs had better agreement between methods.

Relationships between each demographic characteristic and ratios were also investigated by analysis of variance and contingency table analysis. No consistent relationships were found. Sex-race specific multiple regressions of the ratio value on these variables yielded no significant multiple R.

We also investigated the effects of dietary diversity within agreement groups. The number of foods reported consumed from the different food groups showed no consistent relationship to either method. Time spent in completing the food frequency showed no significant differences between agreement categories. The number of persons in the household was not related to agreement between methods.

In looking for agreement between measures, we found that even when there was agreement, it seemed to be achieved through a series of trade-offs. For example, within the agreement category of 0.8 to 1.2 we found that agreement was achieved by counterbalancing factors such as the under-reporting of foods on the FFQ with reporting foods on the FFQ that are not on the record. In addition, under-estimate of frequency on the FFQ was counterbalanced by over-estimates of serving size on the FFQ.

Summary

The Food Frequency Questionnaire we designed and tested over-estimated values in comparison to the 16-day food records used as the baseline, recognizing that the validity of the records cannot be established. The degree to which the FFQ over-estimated dietary intake differed by race and sex. There were respondents who had relatively good agreement, white males, for example. Demographic characteristics such as age, education, income, marital status, occupation, and Body Mass Index did not explain agreement, or

lack of agreement. Diet diversity, number of persons in the household, and time spend in completing the FFQ were also unrelated to the degree of agreement.

The lack of success in identifying factors that contributed to agreement is probably due to a variety of factors involved. Agreement, expressed as one total score in the comparison between two methods of measuring dietary intake, reflects the final stage of a series of over- and under-estimates involved in the FFQ process.

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Table 1. Participation and Demographic Characteristics of Study Sample

Characteristic	Men				Women			
	White		Black		White		Black	
	N	%	N	%	N	%	N	%
Full Participation	64		43		73		48	
Age: 25-34	35	54	21	49	37	51	23	48
35-50	29	46	22	51	36	49	25	52
Education								
12 years or less	3	5	1	2	21	29	16	33
1-4 years college	41	64	20	47	35	48	23	48
More than 4 years	19	30	22	51	16	22	9	19
Unknown	1	1	0	0	1	1	0	0
Income: $ 0-9.9	7	11	5	12	7	10	15	31
10-29.9	30	47	18	42	29	40	21	44
30 and over	26	41	20	46	35	48	11	22
No response	1	1	0	0	2	3	1	2

Table 2. Comparison of Nutrient Intake by Food Frequency, Sixteen Day and Three Consecutive Day Mean, Total Sample

	First 3 days, balanced across seasons	16 days	FFQ
Energy, Kcal	2074	2114	2766
Protein, gm	78	79	100
Fat, gm	90	92	119
Carbohydrate, gm	228	231	321
Calcium, mg	839	820	1096
Iron, mg	14	14	20
Vitamin A, IU	5552	5760	12854
Vitamin C, mg	115	120	193

Table 3. Comparison of Mean Nutrient Intake by Food Frequency and Sixteen Day Recall/Record, Men

	White		Black	
	16 day	FFQ	16 day	FFQ
Energy, Kcal	2714	3182	2175	3179
Protein, gm	99	112	79	110
Fat, gm	120	140	93	136
Carbohydrate, gm	290	356	233	367
Calcium, gm	1086	1241	670	1044
Iron, gm	17	23	14	21
Vitamin A, IU	6509	12581	5228	12317
Vitamin C, gm	141	182	114	207

Table 4. Comparison of Mean Nutrient Intake by Food Frequency and Sixteen Day Recall/Record, Women

	White		Black	
	16 day	FFQ	16 day	FFQ
Energy, Kcal	1897	2376	1589	2437
Protein, gm	73	92	60	87
Fat, gm	83	102	70	101
Carbohydrate, gm	210	273	180	304
Calcium, gm	859	1128	540	901
Iron, gm	13	18	10	18
Vitamin A, IU	6084	13174	4747	13212
Vitamin C, gm	119	177	98	217

Table 5. Percentage Distribution of Respondents by the Ratio of Food Frequency Mean Calories To Food Record Mean Calories

Ratio of FFQ Calories to Record Calories	Sex and Race			
	Men		Women	
	White	Black	White	Black
	Percentage Distribution			
Less than 0.8*	20	7	16	13
0.8 - 1.2	38	40	32	21
1.3 - 1.5	25	23	33	23
Greater than 1.5	17	30	19	44

*Approximate conversion to calories:

Ratio of: Less than 0.8 . . . FFQ smaller than record by 400 or more calories
0.8 - 1.2 . . . . . FFQ and record agree within 400 calories
1.3 - 1.5 . . . . . FFQ greater than record by 401 to 1000 calories
greater than 1.5 . .FFQ greater than record by more than 1000 calories

Table 6. Mean Ratio of Food Frequency to Food Record Calories, by Demographic Characteristics, Sex and Race

Demographic Characteristics	Sex and Race			
	Men		Women	
	White	Black	White	Black
Age				
Less than 34 years	1.1	1.7	1.3	1.7
34 and more years	1.3	1.4	1.2	1.5
Marital Status				
Living with someone	1.2	1.3	1.2	1.8
Single	1.2	1.8	1.4	1.4
Education				
Less than 15 years	1.2	1.9		
> 15 years	1.2	1.4		
< 12 years			1.4	1.8
≥ 12 years			1.2	1.5
Occupation				
Professional	1.2	1.4	1.1	2.0
Nonprofessional	1.1	1.7	1.4	1.5
			p<.05	
Income				
Less than $20,000	1.1	1.9	1.4	1.6
$20,000 or more	1.2	1.3	1.2	1.7
		p<.05		
Body Mass Index: $Wt(kg)/ht^2(m)$				
Low**	1.1	1.4	1.4	1.8
High	1.3	1.5	1.1	1.6
			p<.05	

*Low for men are index values equal to or below 23; for women, equal to or below 22. Both values are the upper limits for the BMI ranges for medium frames in the 1959 Metropolitan Life Insurance tables.

High for men are index values above 23 and for women, above 22.