Food preferences and reported frequencies of food consumption as predictors of current diet in young women[1–3]

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ABSTRACT

Background: Self-reported food preferences and frequencies of food consumption have served as proxy measures of the current diet in consumer research and in nutritional epidemiology studies, respectively.

Objective: The objective was to determine whether food preferences and food-frequency scores are associated variables that are predictive of nutrient intakes.

Design: College-age women (*n* = 87) completed a 98-item food-frequency questionnaire and rated preferences for many of the same foods on a 9-point category scale. Estimated intakes of fat, fiber, and vitamin C were obtained by using 3-d food records.

Results: For virtually all item pairs tested, food preferences and reported frequencies of consumption of the same foods were significantly correlated with each other. The median Pearson correlation coefficient was 0.40 (range: −0.04 to 0.62). Correlations improved when foods were aggregated into factor-based food groups. The slope of the relation between food preferences and frequency of consumption varied with food category. Both food preferences and food frequencies predicted dietary outcomes. Fat consumption was predicted equally well by either approach in a multiple regression model. Intakes of fiber and vitamin C were better predicted by food-frequency scores than by stated preferences for vegetables and fruit.

Conclusions: Reported frequencies of food consumption, the core of the food-frequency approach, were associated with food likes and dislikes. Food preferences were a predictor of dietary intakes and may provide an alternative to the food-frequency approach for dietary intake assessment. *Am J Clin Nutr* 1999;70:28–36.

KEY WORDS Food preferences, food-frequency questionnaires, FFQ, dietary intake assessment, consumer research, nutritional epidemiology, women

INTRODUCTION

Self-reported food preferences frequently serve to predict food choices in consumer and marketing research (1–6). Self-reported frequency of food consumption is the preferred method of assessing dietary intakes in epidemiologic studies of chronic disease (7, 8). Long regarded as proxy measures of food choices and dietary habits, food preferences and food frequencies may be correlated with each other.

Much of consumer marketing rests on the premise that self-reported food preferences can predict the frequency of food consumption (1, 2). In affluent societies, where energy intakes are no longer dependent on income, food preferences are regarded as a valid indicator of eating habits (9). In classic early studies of consumer preferences, food acceptability was defined in terms of food consumption and vice versa (10, 11). Food consumption was inferred from stated preference or “liking” of a specific food item, whereas an acceptable food was defined as one that was eaten and eaten with pleasure and satisfaction (12). Later work dissociated preferences from consumption measures, partly because researchers realized that food preferences provided only an approximation of actual food consumption (13–15). Preference measures were later used to assess the appeal of one product compared with another and to predict consumer purchase intent (1–6, 16–18).

Much of the current knowledge of diet-disease relations is based on data obtained by using the food-frequency approach (7, 8, 19–28). Researchers are aware that food-frequency instruments provide only an approximation of actual food consumption (7, 8). The adequacy of food-frequency questionnaire use in low-literacy, low-income, and minority respondents is commonly recognized as being poor (21, 23, 29). Despite problems in estimating amounts of food consumed (8, 24), food-frequency questionnaires have come to play a pivotal role in chronic disease epidemiology (7).

Both food-preference checklists and food-frequency questionnaires are printed surveys that require subjects to form a mental representation of the food item and to generate an appropriate self report. Both food preferences and food frequencies are typically measured by using anchored 9-point category scales. However, whereas food preferences measure an affective component of attitude (1, 2), the generation of the food-frequency response is thought to be based on recall of dietary behavior.

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We hypothesized that self-reported food preferences and self-reported food-frequency scores were, in fact, linked. Our first hypothesis was that food preferences and reported frequencies of food consumption would show a consistent pattern of association. Subjects who did not like a given food would report consuming it rarely or never. In contrast, subjects who reported higher preferences for a given food would also report higher frequencies of consumption. Our second hypothesis was that food preferences and food-frequency scores were not only related, but that either measure could serve to predict food and nutrient intakes and with a comparable degree of success.

Use of food-frequency estimates to predict food and nutrient intakes is the basis of the food-frequency approach to dietary intake assessment (7, 8). Analysis of food preferences to predict dietary choices has long been a method used in consumer research (1–6). If food preferences can also serve to predict nutrient intakes, then food-preference checklists might provide an alternative to the standard food-frequency approach. Assessment of food preferences poses no memory burden on the respondent and may be suitable for use in children, adolescents, and young adults (24). We therefore examined links between food preferences, reported frequencies of food consumption, and measures of current diet in a sample of young women.

SUBJECTS AND METHODS

Subjects

Subjects were 87 nonsmoking women with a mean age of 25.4 y (range: 20–41 y) who were in good physical health and were recruited by advertising in the university community. The sample included 65 whites, 14 Asians, 5 African Americans, 2 Latinas, and 1 other. The subjects' heights and weights were determined and mean body mass indexes (BMIs; in kg/m^2) were calculated. Subjects completed health and demographic questionnaires, the Restraint Scale (30), and the Eating Attitudes Test (31). Women who lived in student dormitories and ate meals in university cafeterias were ineligible for the study. The research protocol was approved by the Institutional Review Board of the University of Michigan School of Public Health. Subjects were compensated for completing 2 study sessions.

Frequency of food consumption

All subjects completed the frequency component of the Health History and Habits Questionnaire developed by Block et al (25). This version of the food-frequency questionnaire uses an open-ended format, providing subjects with the option of answering in terms of frequency per day, week, or month (25). As noted by Willett (19), an open-ended format should provide enhanced precision in reporting because frequency of consumption is a continuous rather than a categorical variable. Subjects were not asked to estimate the portion size of each food item, and the questionnaire was not used to estimate nutrient intakes. Food-frequency estimates were converted to times consumed per month.

The food-frequency approach asks subjects to report the usual consumption of each food from a list of ≈100 foods and food groups (8, 19, 25–28). Data on intake frequency are then collected, sometimes together with estimates of portion size (8, 19, 25–28). Although the present instrument used an open-ended format, many other food-frequency instruments use anchored 9-point category scales that range from "once a month or never" to "twice a day or more" (7). Nutrient intakes are calculated by multiplying the reported frequency of consumption of each food by the amount of the nutrient in a specified (or assumed) portion size and then summing over all foods on the list (8).

Food-preference checklist

The food-preference checklist listed 171 foods representing all major food groups: grains, vegetables, fruit, meat, dairy, desserts, fats and sugars, and beverages. Food items were selected after inspection of some commonly used food-frequency questionnaires (25, 26) and a more extensive food-preference checklist developed for the US Army (16). As in Meiselman et al's study (16), food items on the food-preference checklist were kept as specific as possible. For example, an item such as "other fruit," a common category in food-frequency questionnaires, was not thought to be meaningful. As a result, there was incomplete overlap between the food-frequency questionnaire and the food-preference checklist. Such items as "other fruit," "other cheeses," "other meats," and so on, had no equivalent on the food-preference checklist. Frequency-preference item pairs were selected on the basis of a perfect match ["spinach (raw)" and "raw spinach"], partial inclusion ("French fries, fried potatoes" and "French fries"), or exemplar of a category ("other beans, such as baked beans" and "baked beans"). A complete or partial match was found for 75 of the 98 foods in the food-frequency questionnaire.

Subjects were asked to indicate how much they liked or disliked each food item by using the standard hedonic preference scale (17). The scale, developed in 1957 for the US Army Quartermaster Corps, is a fully anchored 9-point category scale. The scale ranges from "1 = dislike extremely" to "9 = like extremely," with a neutral point at "5 = neither like nor dislike." Options for "never tried" and "would not try" were also included (16, 32).

Principal-components factor analysis was used to reduce food preferences into a smaller number of factor-based scales. Analyses of food-preference data for a larger sample of 157 women from the same subject pool were used to obtain factor structure (33). Separate factor analyses were conducted for meats, fats and dairy products, vegetables, and fruit. These food categories are most predictive of the consumption of dietary fat, fiber, and vitamin C, respectively. Principal-components factor analysis with varimax rotation generally yielded solutions of between 1 and 3 factors per category, which accounted for between 47% and 66% of the variance. Internal consistency of factor-based preference scales for meats, high-fat and low-fat dairy products, vegetables, and fruit was established by using Cronbach's alpha.

Dietary intake assessment

Three days of food records, including at least one weekend day, served as the referent method of dietary intake assessment. Comparison of data obtained with a food-frequency questionnaire with data from multiple days of diet records is standard practice in questionnaire-validation studies. Subjects were instructed on how to keep food records by a registered dietitian. Completed records were reviewed by the dietitian and any ambiguities regarding accuracy or completeness were discussed with the subjects. Data were coded, entered, and analyzed by using the NUTRITIONIST IV program (N-Squared Computing, Salem, OR). Intakes of fat (as a % of energy), fiber (g/MJ), and vitamin C (mg/MJ) were the selected measures of current diet.

TABLE 1
Subject characteristics and energy and nutrient intakes[1]

	Value
Age (y)	25.4 ± 0.6 (20–41)
Height (cm)	162.8 ± 0.7 (143.5–177.2)
Weight (kg)	60.0 ± 0.9 (38.5–83.2)
BMI (kg/m^2)	22.6 ± 0.3 (17.5–34.7)
Restraint score[2]	13.8 ± 0.6 (3–25)
EAT score[3]	11.1 ± 0.7 (3–35)
Energy (kJ)	7757 ± 197 (4226–11 945)
Fat (g)	54 ± 2 (16–99)
Protein (g)	66 ± 2 (27–129)
Carbohydrate (g)	276 ± 8 (140–490)
Cholesterol (mg)	154 ± 10 (6–484)
Fiber (g/MJ)	1.7 ± 0.1 (0.2–4.9)
Vitamin C (mg/MJ)	16 ± 1 (1–49)
Total fat (% of energy)	25.6 ± 0.8 (11–40)

[1] $\bar{x}$ ± SEM; range in parentheses. n = 87.
[2] Reference 30.
[3] Eating Attitudes Test (31).

TABLE 2
Frequencies of food consumption reported by women on the food-frequency questionnaire[1]

	Value
	frequency/mo
Skim milk, 1% milk, or buttermilk	19.4 ± 2.7
Dark bread, including whole wheat, rye	19.0 ± 1.9
White bread, bagels, crackers, etc	17.9 ± 1.7
Butter, margarine, and other fats on vegetables	17.7 ± 3.1
Orange juice or grapefruit juice	17.7 ± 1.9
Fruit juice (other), fortified fruit drinks	17.5 ± 2.7
Coffee	16.2 ± 2.5
Cheeses and cheese spreads (not cottage)	15.0 ± 1.3
Tea (hot or iced)	14.4 ± 2.3
Diet soft drinks	13.6 ± 2.5
Apples, applesauce, pears	12.3 ± 1.5
Rice	11.6 ± 1.0
Green salad	11.3 ± 0.9
Other vegetables including cooked onion, squash	11.1 ± 1.6
Other candy, jelly, honey, brown sugar	10.7 ± 1.2
Salad dressing, mayonnaise	10.3 ± 1.0
Tomatoes, tomato juice	9.9 ± 1.1
Cold cereals	9.5 ± 1.3
Bananas	9.4 ± 1.3
Carrots or mixed vegetables with carrots	9.4 ± 1.0
Chocolate candy	8.9 ± 1.1
Potatoes (boiled, baked, potato salad)	8.8 ± 0.9
Salty snacks (chips, popcorn, etc)	8.4 ± 1.1
Flavored yogurt	8.4 ± 1.0

[1] $\bar{x}$ ± SEM; n = 87.

Statistical analyses

Statistical analyses used SPSS for Windows (version 7.5; SPSS Inc, Chicago). Links between food preferences, reported frequencies of food consumption, and dietary intake variables were tested by using Pearson correlation coefficients. Spearman correlation coefficients between preferences and food-frequency scores produced an analogous pattern of results. A multiple regression model with stepwise regression tested the relative contribution of frequency compared with preference data to dietary outcome variables. These procedures were analogous to those used in past studies to validate intermediate psychosocial variables associated with healthful eating habits (34).

RESULTS

Subjects

Subject characteristics are summarized in **Table 1**. The subjects' mean (±SEM) age was 25.4 y (range: 20–41 y), mean BMI was 22.6, and mean dietary restraint score was 13.8. Past studies with college women obtained mean restraint scores of 12–16 (30). The restraint score of 13.8 in the present study was thus normal for a population of college-age women, as was their score of 11.1 on the EAT scale (31). Generally, EAT scores > 30 reflect severe dieting and may indicate an eating disorder.

Dietary outcomes

Energy and nutrient intakes, obtained by using 3-d food records, are also shown in Table 1. The mean (±SEM) daily energy intake of 7757 kJ (1854 kcal) was comparable with the median intake of 7690 kJ (1838 kcal) for women aged 20–29 y in the third National Health and Nutrition Examination Survey (NHANES III; 35). The mean protein intake (66 g) was the same as the median intake in the NHANES III data (66 g). The subjects in the present study consumed less fat and more carbohydrate than did the NHANES III sample of comparable-aged women. The percentage of fat in the diet of these college students was only 26%, as opposed to 32% in the NHANES III sample.

Frequencies of food consumption

Reported frequencies of food consumption obtained with the food-frequency questionnaire are shown in **Table 2**. The foods are listed in decreasing order of frequency of consumption. Generally, items consumed ≥3 times/wk are classed as core foods, whereas foods consumed at least weekly form part of the subsidiary core (36). Apart from "glasses of water" (data not shown), the most frequently consumed foods were skim milk, white and dark breads, butter or margarine, orange and other fruit juices, coffee, cheeses and cheese spreads, tea, and diet soft drinks. These data agree with other reports on eating habits of college-age women (36) and with the pattern of data obtained with other food-frequency questionnaires.

Food preferences and frequencies of food consumption

Pearson correlation coefficients between preference ratings and reported frequencies of consumption for the same foods are shown in **Table 3**. Significant correlations were obtained for almost all of the food-item pairs. The median correlation coefficient was 0.40 (range: −0.04 to 0.62). In some cases (for beer and coffee), food preferences accounted for 32% of the variance in the estimated frequency of food consumption. However, no significant correlations were obtained for those foods that were consumed rarely or never (cooked cabbage and baked beans) or for some highly preferred foods (pizza and pastries) that were eaten less frequently by young women than preference scores alone indicated. Otherwise, low preference scores were invariably associated with low reported frequencies of consumption. Conversely, high preference scores were generally associated with higher mean frequencies of consumption.

TABLE 3
Correlations between reported frequencies of consumption of items on the Health Habits and History Questionnaire and food preferences obtained by using a 9-point category scale

Food-frequency questionnaire item	Food-preference item	Pearson *r*	95% CI	*P*
Fruit and fruit juices				
Apples, applesauce, pears	Apples	0.33	(0.13, 0.51)	<0.001
Peaches, apricots (fresh)	Apricots	−0.04	(−0.26, 0.18)	NS
Cantaloupe (in season)	Cantaloupe	0.40	(0.20, 0.56)	<0.001
Watermelon (in season)	Watermelon	0.34	(0.14, 0.51)	<0.01
Strawberries (fresh, in season)	Strawberries	0.27	(0.05, 0.46)	<0.05
Oranges	Oranges	0.35	(0.15, 0.53)	<0.001
Orange juice or grapefruit juice	Orange juice	0.40	(0.21, 0.57)	<0.001
Grapefruit	Grapefruit	0.46	(0.28, 0.62)	<0.001
Vegetables				
String beans, green beans	Green beans	0.39	(0.19, 0.55)	<0.001
Peas	Peas	0.40	(0.21, 0.57)	<0.001
Chili with beans	Chili with beans	0.40	(0.20, 0.57)	<0.001
Other beans such as baked beans, kidney beans, lima beans	Baked beans	0.14	(−0.08, 0.35)	NS
Corn	Corn	0.38	(0.18, 0.55)	<0.001
Winter squash, baked squash	Baked yellow squash	0.43	(0.22, 0.60)	<0.01
Tomatoes, tomato juice	Raw tomatoes	0.51	(0.33, 0.65)	<0.001
Broccoli	Broccoli	0.40	(0.21, 0.57)	<0.001
Cauliflower or Brussels sprouts	Cauliflower	0.45	(0.25, 0.60)	<0.001
Spinach (raw)	Spinach (raw)	0.51	(0.33, 0.66)	<0.001
Spinach (cooked)	Spinach (cooked)	0.54	(0.36, 0.68)	<0.001
Cole slaw, cabbage, sauerkraut	Cabbage (cooked)	0.14	(−0.08, 0.35)	NS
Carrots or mixed vegetables with carrots	Carrots (raw)	0.30	(0.09, 0.49)	<0.01
Green salad	Tossed green salad	0.38	(0.18, 0.55)	<0.001
Salad dressing, mayonnaise	Mayonnaise	0.43	(0.23, 0.59)	<0.001
French fries and fried potatoes	French fries	0.35	(0.15, 0.52)	<0.01
Sweet potatoes, yams	Sweet potatoes	0.37	(0.17, 0.55)	<0.01
Other potatoes (boiled, baked, potato salad)	Baked potatoes	0.10	(−0.11, 0.30)	NS
Other vegetables, eg, cooked onions	Cooked onions	0.42	(0.22, 0.59)	<0.001
Meat, fish, and poultry				
Hamburgers, cheeseburgers, meatloaf	Hamburgers	0.40	(0.21, 0.57)	<0.001
Beef steaks, roasts	Beef and steak	0.40	(0.19, 0.57)	<0.001
Pork, including chops and roasts	Pork chops	0.43	(0.23, 0.60)	<0.001
Fried chicken	Fried chicken	0.40	(0.21, 0.57)	<0.001
Chicken or turkey, roasted, stewed, or boiled	Grilled chicken	0.41	(0.22, 0.58)	<0.001
Tuna fish, tuna salad, tuna casserole	Tuna salad	0.41	(0.21, 0.58)	<0.001
Seafood (shrimp)	Shrimp	0.50	(0.30, 0.65)	<0.001
Spaghetti, lasagna, pasta with tomato sauce	Spaghetti	0.26	(0.04, 0.44)	<0.05
Pizza	Pizza	0.41	(0.21, 0.57)	<0.001
Mixed dishes with cheese	Macaroni and cheese	0.07	(−0.15, 0.28)	NS
Lunch items				
Hot dogs	Hot dogs	0.43	(0.23, 0.60)	<0.001
Ham, lunch meats	Lunch meats	0.35	(0.13, 0.53)	<0.01
Vegetable soup, minestrone, tomato soup	Vegetable soup	0.47	(0.28, 0.62)	<0.001
Other soups	Split pea soup	0.19	(−0.04, 0.62)	NS
Breads, salty snacks, and spreads				
White bread, bagels, crackers, etc	White bread	0.19	(−0.02, 0.39)	NS
Dark bread, including whole wheat, rye, pumpernickel	Whole-wheat bread	0.30	(0.09, 0.48)	<0.01
Corn bread, corn muffins, corn tortillas	Corn bread	0.15	(−0.07, 0.35)	NS
Peanuts, peanut butter	Peanut butter	0.38	(0.19, 0.55)	<0.001
Butter on bread or rolls	Butter on bread	0.37	(0.17, 0.54)	<0.01
Margarine on bread or rolls	Margarine on bread	0.42	(0.22, 0.58)	<0.001
Breakfast foods				
High-fiber, bran, or granola cereals, shredded wheat	Shredded wheat	0.10	(−0.12, 0.32)	NS
Cooked cereals	Oatmeal	0.38	(0.19, 0.55)	<0.001
Eggs	Eggs	0.44	(0.26, 0.60)	<0.001
Bacon	Bacon	0.47	(0.28, 0.63)	<0.001
Sausage	Sausage	0.50	(0.31, 0.65)	<0.001

(Continued)

TABLE 3 *(Continued)*

Food-frequency questionnaire item	Food-preference item	Pearson *r*	95% CI	*P*
Sweets				
Ice cream	Ice cream	0.38	(0.18, 0.55)	<0.001
Doughnuts, cookies, cakes, pastry	Pastries	0.17	(−0.05, 0.37)	NS
Pumpkin pie, sweet potato pie	Pumpkin pie	0.53	(0.36, 0.67)	<0.001
Other pies	Apple pie	0.24	(0.02, 0.43)	<0.05
Chocolate candy	Chocolate candy	0.47	(0.29, 0.62)	<0.001
Dairy products				
Cottage cheese	Cottage cheese	0.45	(0.25, 0.61)	<0.001
Other cheeses and cheese spreads	Sharp cheddar	0.27	(0.06, 0.46)	<0.05
Flavored yogurt	Fruit-flavored yogurt	0.51	(0.33, 0.65)	<0.001
Whole milk and whole milk beverages	Whole milk	0.36	(0.16, 0.54)	<0.001
Skim milk, 1% milk, or buttermilk	Skim milk	0.41	(0.21, 0.58)	<0.001
Beverages				
Regular soft drinks	Soft drinks	0.35	(0.15, 0.53)	<0.01
Diet soft drinks	Diet soft drinks	0.58	(0.42, 0.71)	<0.001
Beer	Beer	0.56	(0.39, 0.70)	<0.001
Liquor	Gin	−0.01	(−0.25, 0.23)	NS
Decaffeinated coffee	Decaffeinated coffee	0.45	(0.24, 0.62)	<0.001
Coffee, not decaffeinated	Coffee	0.57	(0.40, 0.70)	<0.001
Tea (iced or hot)	Tea	0.43	(0.23, 0.59)	<0.001
Lemon in tea	Lemon in tea	0.24	(0.02, 0.44)	<0.05
Milk in coffee or tea	Milk in coffee	0.42	(0.19, 0.61)	<0.01
Cream or half-and-half in coffee or tea	Cream in coffee	0.39	(0.15, 0.58)	<0.01
Sugar in coffee or tea	Sugar in coffee	0.56	(0.37, 0.71)	<0.001
Artificial sweetener in coffee or tea	Equal in coffee[1]	0.57	(0.35, 0.73)	<0.001
Glasses of water, not counting coffee or tea	Water	0.31	(0.11, 0.49)	<0.01

[1] The NutraSweet Company, Deerfield, IL.

There were some subjects, however, for whom high preferences for a given food were not reflected in higher reported frequencies of food consumption.

Relation between food-preference and food-frequency data

The selection of low-fat dairy products, vegetables, and fruit, rather than meats and fats, is thought to be among the chief predictors of healthful diets (34). Food subgroups of interest were therefore meats, high-fat and low-fat dairy products, cruciferous and green vegetables, and fruit. These food subscales were established after factor analyses of preference data; internal consistency was established by using Cronbach's alpha. Mean food preferences were then correlated with mean frequencies of consumption for the same foods, as obtained from the food-frequency questionnaire. These data are summarized in **Table 4**.

Classic studies in marketing research have shown that food preferences can predict frequencies of food consumption (13, 14). However, the slope of the relation between food preference, measured by using a 9-point hedonic preference scale, and actual food consumption varied depending on what type of food was being considered. A rating of 6 on a 9-point scale led to different consumption outcomes, depending on whether the food item was a vegetable, dairy product, or meat. In studies of US Army personnel in 1957, meat, bread, and cereals were consumed frequently despite low preference ratings (10), whereas highly ranked fruit and desserts were eaten less frequently than preference data alone might indicate (13, 14).

The present data were consistent with the notion that the slope of the regression line, although not necessarily the magnitude of the correlation between preference scores and intake frequencies varied with product category. A scatterplot of the relation between liking for low-fat dairy items (cottage cheese, skim milk, and plain and flavored yogurt) is shown in **Figure 1**. A rating of 8 on a 9-point scale corresponded to an estimated frequency of consumption of 20 times/mo. In contrast, a rating of 8 for high-fat dairy products and spreads (butter, mayonnaise, cheese, and whole milk) corresponded to an estimated frequency of consumption of only 10 times/mo. In this group of young women, the slope of the relation between preference ratings and estimated frequency of consumption varied with the perceived fat content of the food item.

A hedonic score of 8 for cruciferous vegetables (Brussels sprouts, cauliflower, cabbage, and radishes) corresponded to mean frequency of consumption of only 3 times/mo (**Figure 2**). Similarly, high ratings for high-fat meat products corresponded to a reported consumption of ≈3 times/mo. Whereas the slope of the relation between preference and frequency data varied, correlations between mean preference ratings and mean frequencies of consumption for the same food groups were, without exception, statistically significant. The strength of the association was 0.56 for meats and 0.41 for cruciferous vegetables, accounting for 30.8% and 16.9% of the variance, respectively.

Food preferences predicted nutrient intakes

Supporting the food-frequency approach to dietary intake assessment, reported mean frequencies of food consumption were a significant predictor of dietary outcomes. As shown in Table 4, frequent consumption of meats and high-fat dairy products was associated with a higher percentage of energy from fat. Frequent consumption of low-fat dairy products was associated with lower fat intakes. As expected, a more frequent consumption of vegetables was associated with higher intakes

TABLE 4
Food-preference and food-frequency scores for factor-based food subgroups and their correlations with dietary outcomes from 3-d food records

Subscale names and food items contributing to scores	Cronbach alpha	Score[1]	Fat (% of energy)	Fiber (g/MJ)	Vitamin C (mg/MJ)
Meat					
Preference: bacon, beef steak, cheeseburger, fried chicken, grilled chicken, ham, hamburger, hot dogs, lunchmeat, meatloaf, pork chop, sausage	0.94	5.5 ± 0.2	0.29[2]	−0.39[2]	−0.22
Frequency: bacon, steak, hamburger, cheeseburger, meatloaf, fried chicken, broiled chicken, ham, lunchmeat, pork, sausage	—	1.9 ± 0.02	0.26[2]	−0.34[2]	−0.10
Dairy 1					
Preference: butter with bread, margarine with bread, cream cheese, Swiss cheese, mayonnaise, whole milk	0.65	5.6 ± 0.1	0.40[2]	−0.19	−0.30[2]
Frequency: butter w/bread, all other cheeses, margarine with bread, mayonnaise, whole milk	—	5.9 ± 0.5	0.44[2]	−0.07	−0.11
Dairy 2					
Preference: cottage cheese, flavored yogurt, plain yogurt, skim milk	0.50	5.8 ± 0.1	−0.29[2]	0.23[2]	0.15
Frequency: cottage cheese, flavored yogurt, skim milk	—	13.8 ± 1.5	−0.32[2]	0.36[2]	0.21
Vegetables 1					
Preference: broccoli, Brussels sprouts, cauliflower, cabbage (raw, cooked), radishes	0.81	5.2 ± 0.1	−0.27[2]	0.16	0.03
Frequency: broccoli, Brussels sprouts, cauliflower, coleslaw, cabbage, sauerkraut	—	1.8 ± 0.2	−0.22[2]	0.22[2]	0.13
Vegetables 2					
Preference: artichoke, asparagus, peas, spinach (raw), spinach (cooked)	0.74	6.0 ± 0.2	−0.32[2]	0.27[2]	−0.05
Frequency: peas, spinach (raw), spinach (cooked)	—	1.6 ± 0.2	−0.31[2]	0.35[2]	0.07
Fruit 1					
Preference: apricots, cherries, nectarines, pears, raspberries, strawberries	0.80	7.4 ± 0.1	−0.13	0.11	0.22[2]
Frequency: apricots/nectarines, peaches, strawberries	—	6.8 ± 0.7	−0.12	0.23[2]	0.30[2]
Fruit 2					
Preference: apples, grapes, oranges, orange juice	0.74	7.5 ± 0.1	−0.17	−0.01	0.25[2]
Frequency: apples, applesauce, pears, oranges, orange juice	—	12.8 ± 1.0	−0.08	0.14	0.43[2]

[1] $\bar{x}$ ± SEM.
[2] $P < 0.01$.

of fiber, whereas more frequent fruit consumption was associated with higher intakes of vitamin C. Correlations of comparable magnitude were found in studies of the validation of food-frequency questionnaires (7, 8, 24).

The same dietary outcomes were also predicted by food preferences. The associations between food preferences and intakes of fat, fiber, and vitamin C were almost identical to those obtained with food-frequency scores. Elevated preferences for meats and high-fat dairy products were associated with an increased percentage of energy from fat. Elevated preferences for low-fat dairy products were associated with a lower percentage of energy from fat. Reported higher preferences for vegetables were associated with higher intakes of fiber, whereas preferences for fruit were associated with higher intakes of vitamin C. Both food preferences and food frequencies were significantly associated with fat- and fiber-related dietary intakes, commonly taken to be the key measures of healthful diets.

Fat- and fiber-related dietary intakes also figure prominently in validation studies of food-frequency questionnaires (7, 19, 23). The present strategy was to compare the variance in dietary outcomes that was accounted for by food-preference data with that accounted for by food-frequency data. Multiple regression was used to examine the unique association of each component of the present model with percentage of energy from fat and intakes of dietary fiber (g) and vitamin C (mg), expressed per MJ. Demographic variables thought to affect dietary choices (age, BMI, and dietary restraint) had no effect in this homogeneous sample of college-age women and were not part of the final regression model.

As shown in **Table 5**, food-preference and food-frequency data accounted for 17–33% of the variance in dietary intake data. Food preferences were a strong predictor of fat consumption (24% of the variance), although the addition of food-frequency data increased the R^2 value significantly. In contrast, intakes of fiber and vitamin C were better predicted by reported frequencies of fruit and vegetable consumption than by reported food preferences.

DISCUSSION

With few exceptions, food preferences and reported frequencies of consumption for the same foods were significantly correlated with each other. Although the median correlation for the 75 frequency-preference pairs was 0.4, some correlations were as high as 0.6. In other words, ≤35% of the variance in reported food frequencies was accounted for by food likes and dislikes. Correlations improved (range: 0.4–0.6) when mean preferences

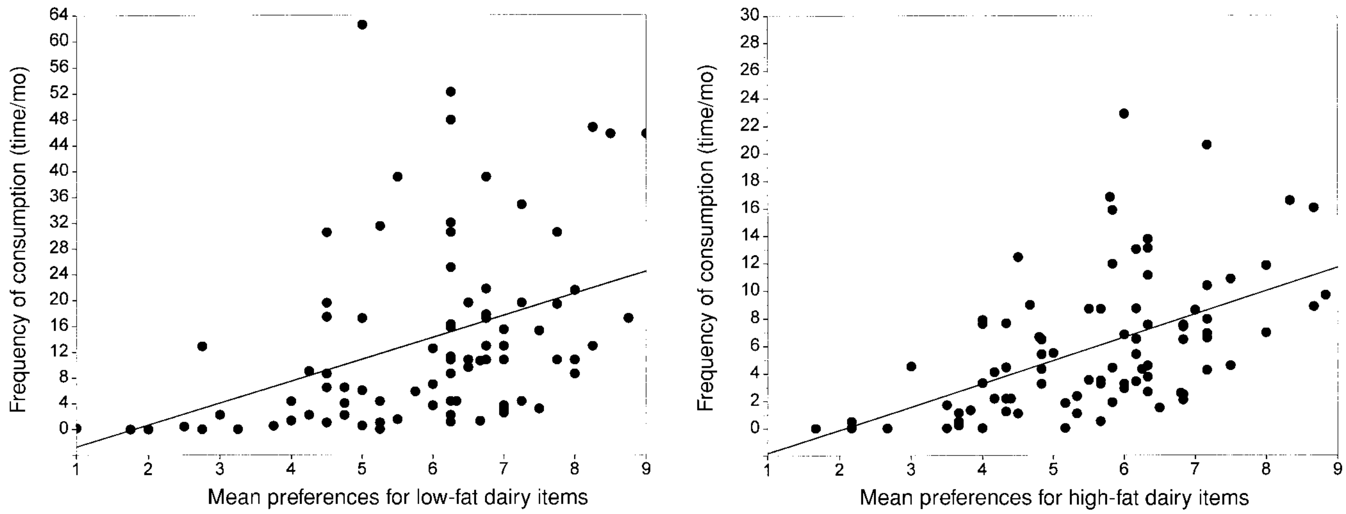

FIGURE 1. Scatterplot of the relation between the reported frequency of consumption of and preferences (on a scale of 1–9) for low-fat and high-fat dairy items.

for factor-based food subgroups were correlated with mean frequencies of consumption for the same foods. For the most part, food preferences and food-frequency scores were positively correlated. Consistent with early consumer studies, the slope of the relation between food preferences and reported frequencies of consumption depended on food category (13).

Food preferences and food frequencies were both predictive of dietary outcome measures. As expected, frequent consumption of meats and dairy fats was associated with higher fat intakes, whereas more frequent consumption of vegetables and fruit predicted higher intakes of fiber and vitamin C, respectively. Fat intakes were predicted equally well by food-preference and food-frequency data. Fiber and vitamin C intakes were predicted better by food-frequency data than by food-preference data for vegetables and fruit. Similar regression methods to predict intake were used in past epidemiologic research (37). For some populations, food-preference methods may provide an alternative to the food-frequency approach.

Much of consumer and marketing research is based on the premise that food preferences predict food consumption (1, 2). The Food Action Rating Scale (13) was an early attempt to link hedonic preferences with food consumption patterns. Consistent with those studies, which were conducted decades before the advent of the food-frequency approach, low food-preference scores, indicative of food rejection, were invariably associated with low reported frequencies of food consumption. Conversely, higher preferences tended to be linked with higher mean frequencies of food consumption. In early consumer research, the slope of the relation between mean food preferences and mean estimated frequencies of food consumption also varied with food category (13, 14). In the present study also, fruit and sweet desserts were rated as highly preferred, but were eaten less often than preference scores alone suggested. A calibration of the preference-frequency relation by food group might help improve the correlation between food-preference and food-frequency data.

Food preferences were measured by using a 9-point hedonic preference scale, developed by the US Army Quartermaster Corps as part of a larger effort to assess the acceptability of foods and beverages (17). Scores on food-preference checklists depend on the panelists' mental representation of the food item and on their attitude or disposition toward a particular food (2). Although the tenet of marketing research has been that food preferences predict food consumption (1, 2), this may also be a case of reciprocal determinism. Food preferences, a psychosocial or attitudinal variable, may reflect positive attitudes toward foods that are already consumed and are a part of the core diet. Self-reported food preferences may thus reflect, as well as predict, dietary choices and eating habits.

Food frequencies were obtained by using the Health Habits and History Questionnaire (25). Food-frequency scores depend on the respondents' mental representation of the food item and on the mean estimated frequency of food consumption. Much

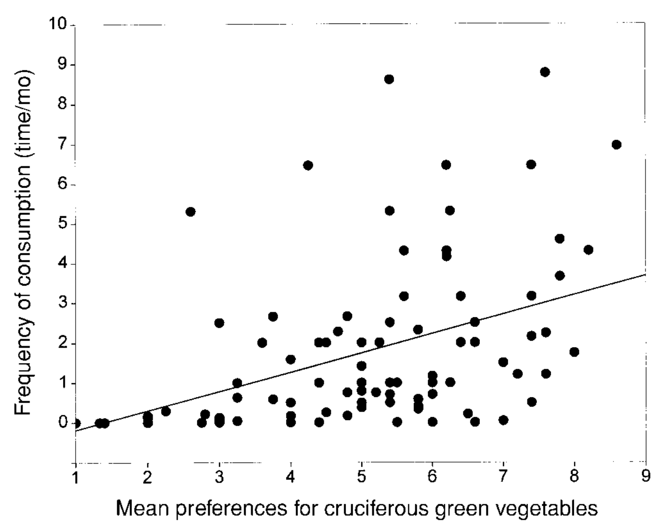

FIGURE 2. Scatterplot of the relation between the reported frequency of consumption of and preferences (on a scale of 1–9) for cruciferous vegetables.

TABLE 5
Multivariate regression model R^2 values and increases in R^2 values for significant predictors of consumption of total fat, dietary fiber, and vitamin C

	R^2	Increase in R^2
Total fat consumption (% of energy)		
Food preferences only: meat, dairy 1, and dairy 2	0.24	—
Food preferences and frequency variables: meat, dairy 1, and dairy 2	0.33	0.09[2]
Dietary fiber consumption (g/MJ)		
Food preferences only: vegetables 1, vegetables 2, and fruit 1	0.08	—
Food preferences and frequency variables: vegetables 1, vegetables 2, and fruit 1	0.17	0.10
Vitamin C consumption (% of mg/MJ)		
Food preferences only: fruit 1 and fruit 2	0.07	—
Food preferences and frequency variables: fruit 1 and fruit 2	0.22	0.15[2]

[1] The factors meat, dairy 1, dairy 2, vegetables 1, vegetables 2, fruit 1, and fruit 2 are defined in Table 4.
[2] $P < 0.05$.

of nutritional epidemiology is based on the premise that food frequencies reflect dietary choices and eating habits. However, frequency counts are imprecise, especially when they involve common foods eaten over an extended period of time (28). Experts agree that errors in food-frequency estimates are the most serious source of error in food-frequency questionnaires (8, 29, 38). Because the reporting of food consumption frequencies is assumed to be a function of memory and cognitive processes, past efforts at improving the quality of food-frequency data largely focused on improving memory cues (39) and on cognitive interviewing techniques (22).

Food-frequency counts are inherently an approximation (19). This approximation is probably not based on recall of dietary behavior. Theorists distinguish between episodic memory, ie, memory for specific events, and recall constructed from general memory about foods. With some exceptions (eg, turkey at Thanksgiving), the consumption of most common foods is not encoded as discrete episodic events over the course of a year (28, 40). In the absence of episodic memory, recall of the usual diet is an imprecise process, most probably based on some perceived notion of a usual or typical diet (28). If people cannot retrieve the frequency count from memory, they have to derive it on some other basis (22, 39).

The frequency count appears to be based, at least in part, on simple food likes and dislikes. In the absence of memory for actual events, food preferences provide consistent information such as "I like it and I eat it" and "I don't like it and I don't eat it" (39, 41, 42). Both food-frequency questionnaires and food-preference checklists are printed surveys that require subjects to form their own mental image of a particular food item. Both depend on generalized semantic memory for foods, and both may be influenced by inferred patterns of food consumption. Both appear subject to similar response-set biases, including social desirability bias. Fully anchored 9-point category scales are the preferred response options for both food-preference checklists and for most of the current food-frequency questionnaires (19, 23). Statements such as "I eat things I like" and "I don't eat things I don't like" have been shown to aid dietary recall in children (39) and may also contribute to the generation of the food-frequency response in adults. However, although food preferences are unquestionably a measure of attitude, reported food frequencies are ostensibly based on memory of past dietary behavior.

One interpretation of the present results is that people's food preferences affect the accuracy of the frequency response. Responses to food-frequency questionnaires are subject to many response-set biases, including social desirability bias (28). People might be more likely to report a higher frequency of consumption for a preferred than for a nonpreferred food, even if the true frequencies were the same. Thus, memory of foods consumed is biased by food likes and dislikes.

Another, and more radical interpretation, is that food preferences and food frequencies are both measures of attitude and both are based on the same underlying disposition toward a given food. Unable to remember how often they consume a particular food or food category over the course of a year, people generate a frequency response based on whether they like the food or not. In this view, food-preference checklists and food-frequency questionnaires are comparable instruments that can provide an approximation of food choices and eating habits. One key to improving the quality of food-frequency instruments, a priority in epidemiologic research, may lie in attitude as opposed to memory research (22). The observation that food preferences and food frequencies are not only linked, but are, in some cases, equally good predictors of the current diet suggests that either measure might be useful in dietary intake assessment.

Whether food preferences predict or reflect current dietary habits is an interesting issue (39). Although the strong influence of taste and food preferences on children's eating habits is generally acknowledged (42), food preferences have not been the main focus of current studies of diet selection and dietary change among adults. Adult food preferences are reported to be influenced by age, sex, health status, education, and income (9, 18). Existing data suggest that food consumption patterns show parallel influences of age, sex, health status, education, and income (43). Generally, age influences both food preferences and food intake patterns in the direction of more healthful diets (44, 45). The relation between food preferences and eating habits is likely modified by some of these variables. The major limitation of the present study was that the sample was limited to a demographically homogeneous group of young college-age women. The influence of demographic variables, known to predict nutrient intakes in broader based studies, was not observed in this sample. The relation between food preferences and reported patterns of food consumption is also known to be stronger in adolescents than in adults, and is likely to be more influenced by dietary restraint than by perceived disease risk. The observed relation between food preferences and food frequencies needs to be explored further in a sample more diverse by age, sex, ethnicity, education, and income. The measurement and calibration of food preferences may hold further potential in the evaluation of nutrition education and intervention programs (46).

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