A Comparison of Food Habit and Food Frequency Data as Predictors of Breast Cancer in the NHANES I/NHEFS Cohort[1]

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ABSTRACT We compared two methods of assessing dietary fat and breast cancer incidence in the first complete follow-up of the National Health Epidemiologic Follow-up Study (NHEFS) cohort. Between 1982 and 1984, 6156 women aged 32–86 y completed the NHEFS survey, which included a 93-item food frequency questionnaire (FFQ). In addition, women answered questions regarding food habits, such as choice of salad dressing, trimming fat from meat, and eating skin on poultry. In the 4 y of follow-up, these women contributed a total of 23,949 person years, during which 53 women reported a breast cancer diagnosis. The rate ratio (RR) and 95% confidence interval (CI) for each quartile of percentage of energy from fat were 1.0, 0.96 (0.5–2.1), 1.0 (0.5–2.2) and 0.98 (0.5–2.1). Thus the breast cancer rates for women in the upper three quartiles, who reported a diet with higher than 30% of energy from fat, were not different from those of women in the lowest quartile of intake (≤29.4% energy from fat). In contrast, the "high-fat" response to three of the four food habit questions identified women at increased risk of developing breast cancer: women who used salad dressings other than low fat had a RR and 95% CI of 1.3 (0.7–2.3), women who reported eating the skin on poultry had a RR and 95% CI of 1.7 (0.9–2.9), and women who did not use lean or extra lean ground beef had a RR and 95% CI of 2.2 (1.2–4.0). These food habit questions may be less subject to misclassification than dietary information of fat intake derived from the FFQ. Further investigation is needed to evaluate what is measured by the food habit questions. J. Nutr. 126: 2757–2764, 1996.

INDEXING KEY WORDS:

- *humans* • *epidemiology* • *breast cancer*
- *dietary habits* • *dietary fat*

Despite strong international correlations between per capita fat availability and breast cancer rates (Armstrong and Doll 1975, Prentice and Sheppard 1990) and extensive animal data associating dietary fat with mammary tumor incidence (Carroll 1975 and 1980, Tannenbaum 1942), the results of numerous case-control (Goodwin and Boyd 1987, Howe et al. 1990) and cohort (Howe et al. 1991, Jones et al. 1987, Kushi et al. 1992b, Willett et al. 1992) studies in North America are inconsistent regarding the association between dietary fat and breast cancer (Rohan and Bain 1987). In particular, among the four cohort studies conducted in North America (Howe 1992), two reported a small inverse association or no effect of fat intake on breast cancer (Jones et al. 1987, Willett et al. 1992) and two reported a small positive association (Howe et al. 1991, Kushi et al. 1992b).

Each of these cohort studies quantified nutrient intake from food frequency questionnaire (FFQ)[3] data (Howe et al. 1991, Kushi et al. 1992b, Willett et al. 1992) or 24-h dietary recall data (Jones et al. 1987). These studies assessed and analyzed fat intake by the nutrient density method (percentage of energy from fat) or with various measures of absolute fat intake (notably the fat residual or total fat) adjusted for total energy or some component of total energy (Kushi et al. 1992a, Pike et al. 1989 and 1992, Willett 1990). Although the three analytic methods (standard multivariate, residual

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[3] Abbreviations used: CI, confidence interval; FFQ, food frequency questionnaire; NCHS, National Center for Health Statistics; NHANES I, First National Health and Nutrition Examination Survey; NHEFS, National HANES Epidemiologic Follow-up Study; RR, rate ratio.

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and energy partition) have been shown to be mathematically equivalent with continuous exposures (Pike et al. 1989 and 1992), the equivalence of the models could not be assumed when the exposure variables were categorized (Kushi et al. 1992a). However, because for categorical variables each of these analytic methods yielded generally similar results within several studies of food-frequency data (Howe et al. 1991, Kushi et al. 1992b, Willett et al. 1992), perhaps the measurement of the exposure was the limiting factor rather than the methods of analyses (Pike et al. 1992).

To avoid some of the problems arising from estimating fat intake from a FFQ, Kristal et al. (1990) proposed a behavioral approach to dietary assessment. They attempted to identify which dietary habits were associated with consuming diets high in fat, given that food habits may be easier to report and less subject to misclassification than a composite fat variable derived from FFQ data (Kristal et al. 1990).

Using data from the first complete follow-up of the National Health Epidemiologic Follow-up Study (NHEFS) cohort, this study compared results from both food frequency and food habit questions in relation to breast cancer incidence. This study used the nutrient density, residual and energy partition methods to create separate analytic variables from the nutrient estimates derived from the FFQ data. With the detailed information available from this cohort, this study assessed the potential confounding of the food frequency and food habit associations by known breast cancer risk factors.

METHODS

Between 1982 and 1984, the National Center for Health Statistics (NCHS) and the National Cancer Institute, in collaboration with other institutes of the National Institutes of Health, conducted the NHEFS of participants in the first National Health and Nutrition Examination Survey (NHANES I) who were between the ages of 25 and 74 y when examined for the NHANES I in 1971–1975. The NHANES I cohort was a national probability sample of the non-institutionalized population in the United States, with oversampling of persons living in census tracts with high poverty rates, women of child-bearing age (25–44 y of age) and elderly persons (65 y of age or older). The NHEFS interview conducted in 1982–1984 defined the baseline cohort for this study (Madans et al. 1986, NCHS 1987a). To be eligible women had to *1*) have completed the version of the NHEFS interview that included a 93-item food frequency questionnaire, *2*) have reported no history of breast cancer or bilateral mastectomy on the 1982–1984 NHEFS questionnaire, and *3*) be either black or white. Thus, in 1982–1984, the eligible cohort comprised 901 black (14.6%) and 5255 white (85.4%) women, of whom 58.4% were 50 y of age or older. The NHANES I and the NHEFS were reviewed and approved by the appropriate institutional review boards. Furthermore, these studies have received approval from the appropriate committees of the National Institutes of Health and the NCHS. Informed consent was obtained from each participant.

Two subsequent surveys, one conducted in 1986 (NCHS 1990) and one in 1987 (NCHS 1992), provided outcome and follow-up information for this NHEFS cohort. Women over 55 y of age at the time of their NHANES I examination were eligible for a 1986 interview, and all women, regardless of age, were eligible for the 1987 interview. Four percent of the cohort (252 women) for whom death certificates were not found, and who were not known to be dead, did not complete (personally or by proxy) a 1986 or 1987 interview and were considered lost to follow-up after the baseline (1982–1984) interview.

The 1986 and 1987 questionnaire asked about medical problems or diagnoses and overnight hospitalizations since the last interview. The NCHS attempted to obtain hospital records (discharge summary and pathology report) for all reported hospitalizations and death certificates for all reported deaths. Fifty-three women reported a diagnosis of breast cancer between the time of the 1982–1984 interview and the 1987 interview. Ninety-one percent (n = 48) of these women reported being hospitalized for breast cancer, with hospital confirmation available for 77% (n = 37). The earliest of the following three dates determined the end of follow-up for women in the cohort: *1*) date of breast cancer diagnosis (from hospital records, if available, or from the interview), *2*) date of death, or *3*) date of last interview. The 6156 women contributed a total of 23,949 person-years of follow-up, with a mean length of follow-up from the 1982–1984 interview of 3.9 y.

Information regarding race, residence (rural, suburban, urban), family income, adult weight, height, family history of breast cancer, age at first birth, number of prior breast biopsies, number of births, use of oral contraceptives, use of menopausal hormones, drinks of alcohol per week and amount of physical activity was obtained from the 1982–1984 questionnaire. The earlier NHANES I 1971–1975 questionnaire provided information about age at menarche, years of education completed, and geographic region of the country. Menopause status information collected in both the 1982–1984 and 1987 interviews defined a time-dependent covariate for menopause status based on age at menopause.

The dietary methods used to determine nutrient values for this analysis were detailed earlier (Ursin et al. 1993). In summary, to assess usual adult diet, the 1982–1984 NHEFS included a 93-item food frequency questionnaire as well as specific questions on food habits (NCHS 1987b). The thirty-five women (0.6%) who did not respond to 10 or more of the 93-food items were excluded from the determination of nutrient values. Effects of nutrient data among these women (107 person-years and 1 case) are not presented in this paper. Of the 1352 women missing information on one to nine food items, only 129 (9.5%) were missing information for more than two items. Values for women missing information for one to nine food items were imputed based on the median consumption of that food item by women in the same age (≤44 y, 45–64 y, ≥65 y) category. Because the 1982–1984 interview did not ask for portion size, the median portion sizes for three age-specific groups of women were calculated from the 24-h dietary recall information obtained between 1976 and 1980 from the second National Health and Nutrition Examination Survey (NHANES II), a distinct national cohort. The nutrient values were derived from the nutrient composition database associated with the NHANES II.

The 1982–1984 interview also included several questions designed to identify individuals whose food habits might be indicative of either a high or low fat diet (NCHS 1987b). Subjects were asked the following: *1*) Do you *usually* use oil and vinegar alone as a [salad] dressing, low calorie dressing, or some other dressing? *2*) Do you usually eat the fat on beef or pork? *3*) Do you usually eat poultry with or without the skin? *4*) When you eat ground beef, do you usually buy regular, lean or extra lean?

For analyses of FFQ data, quartiles were determined from the baseline distribution of the estimated nutrients for the women with dietary information in the cohort. Because including energy from alcohol in total energy did not substantially alter the results, all findings presented are for all sources of energy combined. Food group variables were created from food frequency data without regard to average portion sizes and derived nutrient value. The fat residual value was obtained by the difference between the observed and the expected fat values from the linear regression of fat on energy (Willett 1990).

Poisson regression was used to calculate the rate ratio (RR) and 95% confidence interval (95% CI) for breast cancer associated with potential breast cancer risk factors (Breslow and Day 1987). The time-dependent covariate, age at menopause, determined menopause status at diagnosis and for person-years allocation. The Epicure package Datab and Amfit modules were used to create person-year tables and for Poisson regression analysis (Preston et al. 1990). All rate ratios presented are adjusted for age in 5-y intervals (<40, 40–44, 45–49, 50–54, 55–59, 60–64, 65–69, 70–74, 75–79 and 80+ y).

RESULTS

Table 1 presents the age-adjusted rate ratios for non-dietary breast cancer risk factors in this NHEFS cohort. The point estimates for having a first-degree relative with breast cancer, having had one or more prior breast biopsies, being nulliparous, drinking more than seven alcoholic drinks per week, and being physically inactive suggested these factors were each associated with an increased rate of breast cancer though the confidence intervals may have included the null value. Among parous women, age at first birth was not associated with breast cancer (not shown). However, in this cohort few women (6.8%) reported having a first birth at age 30 or older. The variables presented in Table 1 were considered individually as potential confounders in the dietary analyses. Because none of the estimates for the dietary factors changed as much as 10% after adjustment for any of these non-dietary exposures, only age-adjusted results are presented.

The effects of individual macronutrients and cholesterol on breast cancer also were examined. The point estimates for the highest quartile of intake of total energy, total protein and total carbohydrate all suggested that women in these categories had lower rates of breast cancer than the women in the lowest quartile of intake of the nutrient, with RR and 95% CI of 0.4 (0.2–1.1), 0.4 (0.1–1.0) and 0.5 (0.2–1.3), respectively. Because 75–80% of the women in the highest quartile of intake of total protein or total carbohydrate were also in the highest intake quartile of total energy, similar patterns of effects for each macronutrient were not surprising. Total fat, total protein and total carbohydrate were each highly correlated with total energy in either a categorical or continuous form (all correlation coefficients ≥0.82). In addition, the RR for the women in the upper three intake quartiles (top 75%) of total fat, saturated fat and oleic acid, and the upper two intake quartiles (top 50%) of linoleic acid, were all ≤0.7 when compared with the women in the quartile of lowest intake of each nutrient.

Further analyses attempted to determine whether particular food groups were influential in the reduced breast cancer rates seen in the upper quartiles of intake of each macronutrient. Higher consumption of almost all food groups was associated with lower rates. Higher intakes of both low and high fat food groups were associated with reduced rates of breast cancer. For example, women who reported consuming greater amounts of fruit and vegetables had lower rates of breast cancer, with a RR of 0.7 (95% CI, 0.4–1.5) for women who ate more than three servings daily, compared with women who ate three or fewer servings each day. Likewise, the RR for women who ate beef more than three times each week, compared with women who ate beef three or fewer times each week, was 0.5 (95% CI, 0.3–1.1), and the RR for women who drank more than seven servings of whole milk each week was 0.5 (95% CI, 0.1–2.1) compared with women who drank seven or fewer servings each week.

Table 2 presents the age-adjusted RR for energy and fat as well as for several methods (nutrient density,

TABLE 1

Age-adjusted breast cancer rate ratios for non-dietary factors in the NHEFS

	Cases[1]	Person-years	Rate ratio	(95% CI)
First-degree family history of breast cancer				
No	48	22,505	1.0	—
Yes	5	1443	1.5	(0.6–3.9)
No. breast biopsies				
0	46	21,681	1.0	—
≥1	7	2246	1.5	(0.7–3.3)
No. births				
≥1	42	20,799	1.0	—
0	11	2509	2.0	(1.0–3.9)
Alcohol,[2] *drinks/week*				
0	29	11,259	1.0	—
≤2	12	7435	0.70	(0.4–1.4)
>2, ≤7	4	2990	0.61	(0.2–1.7)
>7	7	2157	1.4	(0.6–3.2)
Physical activity[3]				
Very active	8	6169	1.0	—
Moderately active	33	13,694	1.8	(0.8–3.9)
Quite inactive	12	3899	2.2	(0.9–5.5)
Ever used oral contraceptives				
No	41	15,356	1.0	—
Yes	12	8527	0.74	(0.4–1.7)
Age at menarche[4]				
<12 y	8	3878	1.0	—
12 y	6	5874	0.48	(0.2–1.4)
13 y	20	7193	1.3	(0.6–2.8)
>13 y	17	7880	0.90	(0.4–2.1)
Ever used menopausal hormones				
No	28	11,085	1.0	—
Yes	12	4797	1.0	(0.5–2.0)
Premenopausal/unknown	13	8067	1.3	(0.5–3.7)
Body mass index, *kg/m²*				
<22.35	10	5809	1.0	—
22.35–25.12	16	5946	1.5	(0.7–3.4)
25.13–29.29	12	5901	1.1	(0.5–2.5)
29.3–55.0	14	5856	1.3	(0.6–3.0)
Race				
White	46	20,618	1.0	—
Black	7	3331	0.94	(0.4–2.1)
Education[4]				
<12th grade	22	8864	1.0	—
12th grade	19	9803	0.92	(0.5–1.8)
>12th grade	12	5281	1.1	(0.5–2.2)
Region of country[4]				
Northeast	12	5869	1.0	—
Midwest	13	5797	1.1	(0.5–2.5)
South	19	6797	1.3	(0.7–2.8)
West	9	5485	0.80	(0.4–1.9)
Area of residence				
Rural	18	9160	1.0	—
City	17	8974	0.96	(0.5–1.9)
Suburban	18	5748	1.7	(0.9–3.3)
Family income				
<$7000	15	4924	1.0	—
$7000–14,999	8	4984	0.57	(0.2–1.4)
$15,000–24,999	10	4788	0.84	(0.4–2.0)
$25,000+	14	7267	0.86	(0.4–1.9)

1 Total number of cases for each exposure may vary due to those with missing information, which are not included in this table.
2 Drinks per week is derived from the reported consumption of a can or bottle of beer, a glass of wine, or a shot of liquor per week.
3 Non-recreational activity levels.
4 Obtained at the time of the 1971–1975 NHANES I interview. All other information obtained from the NHEFS questionnaires.

TABLE 2

Age-adjusted rate ratios for breast cancer associated with dietary fat and energy in the NHEFS

	Cases[1]	Person-years	Rate ratio	(95% CI)
Energy, *MJ*				
<4.42	16	5853	1.0	—
4.42–5.44	15	5960	0.95	(0.5–1.9)
5.44–6.62	15	6051	0.96	(0.5–2.0)
6.62–17.9	6	5967	0.42	(0.2–1.1)
Fat, *g*				
<36.9	19	5881	1.0	—
36.9–47.14	13	5951	0.71	(0.4–1.5)
47.15–59.40	9	6012	0.51	(0.2–1.1)
>59.41	11	5997	0.68	(0.3–1.5)
Percentage of energy from dietary fat				
≤29.4%	14	5915	1.0	—
29.5–33.0%	13	6007	0.96	(0.5–2.1)
33.1–36.5%	13	5936	1.0	(0.5–2.2)
≥36.6%	12	5982	0.98	(0.5–2.1)
Fat residual adjusted for total energy				
Quartile I	13	5901	1.0	—
Quartile II	14	6024	0.99	(0.5–2.1)
Quartile III	14	5937	1.1	(0.5–2.3)
Quartile IV	11	5978	0.98	(0.4–2.2)
Fat intake adjusted for non-fat energy, *g*				
≤36.8	19	5881	1.0	—
36.9–47.1	13	5951	0.66	(0.3–1.4)
47.2–59.4	9	6012	0.51	(0.2–1.3)
≥59.5	11	5997	1.0	(0.4–2.7)

[1] Total number of cases for each exposure may vary due to those with missing information, which are not included in this table.

residual and energy partition) of assessing the effects of dietary fat "adjusted" for dietary energy. Breast cancer rates were lower for women in the highest quartile of energy intake. The breast cancer rates associated with fat intake were highest for women in the lowest quartile of intake. For analyses of the effect of fat energy as a percentage of total energy, women in the lowest quartile (≤29.4%) served as the reference group. There was little, if any, variation in age-adjusted breast cancer rates across the quartiles of percentage of energy from fat in this cohort. Additional adjustment of percentage of energy from fat for total energy gave essentially the same results. Similarly, breast cancer rates varied little across the quartiles of fat residual adjusted for total energy. The rate ratios for each quartile of total fat adjusted for non-fat energy were less consistent across quartiles, but still suggested no difference in breast cancer rates between the lowest and highest quartile.

Table 3 presents the analyses of the food habit questions. Three out of four of the questions designed to distinguish high fat dietary habits identified groups of women with increased rates of breast cancer. Women who reported using only oil and vinegar or only low calorie salad dressing had the same rates and were combined in the analyses as the low fat salad dressing users. Women who did not use only low fat salad dressing had a 30% (95% CI, 0.7–2.3) greater rate, women who ate the skin on poultry had a 70% (95% CI, 0.9–2.9) greater rate, and women who bought regular ground beef had a 120% (95% CI, 1.2–4.0) greater rate of breast cancer. The question of whether a woman ate the fat on beef or pork did not distinguish women with higher rates of breast cancer in this cohort. Compared with women who reported two or more "low fat" habits (low calorie salad dressing, or not eating skin on poultry, or only buying lean or extra lean ground beef), women reporting only one such habit had a RR of 2.3 (95% CI, 1.2–4.4) and women who reported no "low fat" habits had a RR of 3.5 (95% CI, 1.7–7.4).

Table 4 presents the mean dietary value and SD for energy, fat and percentage of energy for fat and fruit and vegetable intake across each level of the food habits questions and also for each quartile of percentage of energy from fat. The "low fat" habits were associated with lower energy intake, lower fat intake, lower percentage of energy from fat, and higher intake of fruits and vegetables.

DISCUSSION

There were no apparent differences in breast cancer rates across quartiles of percentage of energy from fat

TABLE 3

Age-adjusted breast cancer rate ratios for food habits question responses in the NHEFS

	Cases[1]	Person-years	Rate ratio	(95% CI)
Type of salad dressing				
Low fat only	15	8131	1.0	—
Other types/combinations	31	13,383	1.3	(0.7–2.3)
Eats skin on poultry				
No	20	11,823	1.0	—
Yes	30	11,648	1.7	(0.9–2.9)
Type of ground beef				
Lean or extra lean	23	16,031	1.0	—
Regular	21	6904	2.2	(1.2–4.0)
Eats fat on beef or pork				
No	40	18,699	1.0	—
Yes	10	4801	1.0	(0.5–2.1)
Number of "lowfat" habits reported[2]				
Two or more	15	12,022	1.0	—
Only 1	23	8377	2.3	(1.2–4.4)
None	14	3410	3.5	(1.7–7.4)

[1] Total number of cases for each exposure may vary due to those with missing information, which are not included in this table.

[2] Composite variable for women reporting either low fat salad dressing, not eating skin on poultry, or buying lean or extra-lean ground beef.

TABLE 4

Mean dietary values (and standard deviations) by food habits in the NHEFS

Food habit	Energy	Fat	Percentage of energy from fat	Fruits and vegetables
Type of salad dressing				
Low calorie only	5.58 (1.72)	47 (16.6)	31.6 (5.2)	44.0 (20.5)
Oil and vinegar only	5.64 (1.74)	49 (16.7)	32.6 (5.6)	43.5 (18.9)
Other/combination	5.79 (1.82)	52 (18.4)	33.7 (5.4)	37.5 (17.8)
Eats skin on poultry				
No	5.56 (1.72)	48 (17.4)	32.1 (5.7)	41.9 (19.6)
Yes	5.79 (1.90)	52 (18.7)	33.6 (5.5)	37.0 (18.3)
Type of ground beef				
Lean or extra lean	5.63 (1.75)	49 (17.7)	32.7 (5.6)	39.2 (18.4)
Regular	5.84 (1.94)	52 (19.0)	33.5 (5.4)	36.9 (18.1)
Eats fat on beef or pork				
No	5.64 (1.73)	49 (17.6)	32.6 (5.6)	40.1 (19.1)
Yes	5.86 (2.08)	53 (19.9)	34.0 (5.6)	36.5 (18.4)
Percentage of energy from fat				
Quartile I	5.51 (1.95)	38 (13.9)	25.6 (3.1)	48.1 (23.0)
Quartile II	5.67 (1.75)	47 (14.7)	31.3 (1.1)	41.9 (17.6)
Quartile III	5.74 (1.75)	53 (16.2)	34.7 (1.0)	36.4 (16.4)
Quartile IV	5.74 (1.79)	60 (19.3)	39.7 (3.1)	31.4 (14.6)

among the 6156 women whose diet was assessed in the 1982–1984 NHEFS of the NHANES I. This study took advantage of the first complete follow-up of the NHEFS cohort, a group identified from the proportional random sample of United States women originally selected for NHANES I. The same conclusion about the relationship between dietary fat measured from the FFQ and breast cancer in this cohort was reached based on any of the three analytic methods: percentage of energy from fat, fat residual adjusted for total energy, or total fat adjusted for non-fat energy. Each of these methods relied on the estimation of fat and energy from the FFQ data, with the same assumptions and potential misclassification (Sempos 1992). However, three out of four of the non-frequency questions about high fat food habits identified women with increased rates of breast cancer. The magnitude of the effects measured by food habit questions in this study was roughly the same as the effects reported for other, more well-established risk factors, including family history, prior breast biopsies and nulliparity (Kelsey and Gammon 1990). The associations with the food habit questions were not changed by adjustment for a variety of non-dietary breast cancer risk factors.

This analysis had limited power due to the relatively short follow-up period of this cohort. Therefore, many of the effects detected in this study were not statistically significant. Nonetheless, the increased rates of breast cancer found in this study for such accepted risk factors as family history, prior breast biopsies and nulliparity, although not statistically significant, were of the same general magnitude as reported in many breast cancer studies (Kelsey and Gammon 1990).

The dietary assessment instrument in this study has not been "validated" by comparison to dietary histories or multiple 24-h recalls as in other populations in which information from methodologic studies indicates that some misclassification persists, even with a well-designed FFQ. In the Nurses' Health Study, the correlation coefficients (Pearson's) between estimates of energy-adjusted macronutrient intake from 4-wk dietary records and estimates from the food frequency data ranged from 0.37 to 0.53 (Willett et al. 1985). In a similar effort to "validate" the Iowa cohort FFQ data the median energy-adjusted correlation coefficient for the macronutrients was 0.45 (Munger et al. 1992). In the same Iowa population, the reporting of alcohol and caffeine intake was highly replicable, with correlation coefficients of 0.99 and 0.95, respectively, suggesting that these are habits that individuals maintain, or at least reported, consistently. The potential for measurement error may have been greater in our study, because portion sizes were not incorporated into the FFQ but derived from the NHANES II database. The potential misclassification of both the exposure (fat) and possible confounders (energy or non-fat nutrients), as calculated from the FFQ, may partially explain the differences between this study's results when FFQ data and the food habit questions are used to identify women with high fat intake (Greenland 1980).

Other cohort studies of breast cancer (Kushi et al. 1992b, Willett et al. 1992) reported no effect associated with increased total energy, whereas in this cohort there was a reduced rate of breast cancer in the highest quartile of energy and in the upper quartiles for most macronutrients and food groups. The reduced rate in the highest quartile of total energy did not seem to be due to women who reported unusually high energy intake, because this pattern persisted even if all women consuming >10.46 MJ/d were removed from the analyses. Although the apparent reduction in rate among women with either increased energy or increased macronutrient intake was not explained by adjustment for any of the non-dietary breast cancer risk factors in this study, the possibility of residual confounding cannot be ruled out. To address the concern that pre-clinical disease may affect the reported diet, analyses were conducted among women diagnosed at least 1 y after the diet was reported. The interpretation of results of the restricted case analyses was similar to those for all cases.

There are several plausible explanations for the results of this study. First, the positive association between the high fat food habit responses and breast cancer rates may be spurious. Continued follow-up of this cohort may resolve this issue in the future. On the other hand, if the results are not spurious, this study suggests that certain food habits and the combination of multiple "low fat" food habits may differentiate breast cancer rates more effectively than fat and energy intake derived from FFQ data. Whether these food habits and the combination of multiple "low fat" food habit questions identify high fat intake in this population, however, is not known. These questions may have measured differences in fat intake, reflected differences in related dietary factors, or been a proxy for unmeasured non-dietary breast cancer risk factors. Although the last possibility of residual confounding must be considered, the measured effects associated with food habits in this study were not explained by adjustment for any of the non-dietary breast cancer risk factors, including alcohol consumption, physical activity, race, education, income, geographic region or area of residence. Because controlling for factors individually had no effect on the results, the inability to control multiple factors simultaneously due to the small size of this study is unlikely to have a major effect on the results. Furthermore, if the food habit questions discern differences in fat intake better than the FFQ-derived variables, this difference may be due to the particular aspects of the FFQ used in this study.

The FFQ results for fat adjusted for energy in this study were consistent with those reported in two larger studies that used "validated" FFQ (Kushi et al. 1992b, Willett et al. 1992). Results from analyses of the food habit questions cannot be compared with other studies, because these other studies have published only their FFQ results. If the food habit questions do identify women with high fat intake, they may be easier to obtain and less susceptible to misclassification than nutrient estimates derived from the FFQ used in this and other studies (Kristal et al. 1990). Additional work is needed to determine whether similar food habit questions distinguish women with higher rates of breast cancer in other epidemiologic studies, to rule out confounding of the effects associated with food habits by non-dietary risk factors, and to evaluate what dietary patterns these questions measure.

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