
Diet During Adolescence and Risk of Breast Cancer Among Young Women

Nancy Potischman, Helen A. Weiss, Christine A. Swanson, Ralph J. Coates, Marilie D. Gammon, Kathleen E. Malone, Donna Brogan, Janet L. Stanford, Robert N. Hoover, Louise A. Brinton*

Background: A variety of breast cancer risk factors pertain to a woman's adolescence and may be related to nutritional influences. We assessed risk of early-onset breast cancer related to diet during adolescence in a case-control study. **Methods:** Study participants were accrued from the following three geographical regions covered by cancer registries: Atlanta, GA; Seattle/Puget Sound, WA; and central New Jersey. Case patients (n = 1647) were newly diagnosed with breast cancer, and control subjects (n = 1501) were identified by random-digit-dialing techniques. In an interview, each subject was asked to recall the frequency of consumption and portion size of 29 key food items at ages 12-13 years. Mothers of a subset of respondents completed questionnaires, and food groups were recalculated after removal of foods with poor agreement between mother and daughter. Logistic regression analyses were used to calculate odds ratios and 95% confidence intervals. **Results:** When high versus low quartiles of consumption were compared, there was a suggestion of a reduced risk associated with high consumption of fruits and vegetables, although this finding was not statistically significant. Slight increases (of borderline statistical significance) in risk of breast cancer were found for intake of chicken or high-fat meat. Intake of animal fat, high-fat foods, high-fat snacks and desserts, or dairy products during adolescence had no apparent influence on breast cancer risk. Removal of foods suspected to be poorly recalled by the daughters did not change any of the risk estimates.

Conclusion: These data do not provide evidence for a strong influence of dietary intakes during adolescence on risk of early-onset breast cancer. [J Natl Cancer Inst 1998;90:226-33]

International variation in rates of breast cancer between countries suggests that environmental factors, perhaps dietary, may influence risk of this disease. Analytic epidemiologic studies, however, have not shown strong effects of consumption by adults of nutrients or food groups (1). Evidence from studies of migrants indicates that environmental factors are important (2). Closer inspection of the risks among migrants has shown that first-generation immigrants from countries in which the incidence of breast cancer is low (i.e., many countries in Asia) to countries in which this incidence is high (i.e., the United States and western Europe) show some elevation in rates, but substantially increased rates are observed among the members of the first generation born in the adoptive country (3). These changes in rates of breast cancer among successive generations have led some to suggest that environmental exposure before adulthood may explain the observed variation in rates across populations (2,4-6).

The observed excess risk of breast cancer among atomic bomb survivors who were less than 20 years old at the time of the bombing strongly suggests a vulnerable time period (7). In a review, Colditz and Frazier (8) provided evidence to support the hypothesis that the exposures during the interval from menarche to the first birth are critical. The biologic evidence most often cited to support the importance of exposures early in life is the likelihood that growth of mammary tissue and lack of substantial differentiation of terminal end buds until the first birth both permit damage from environmental factors to have an impact on breast cancer risk (9).

Several lines of evidence indicate that nutritional factors during adolescence may influence breast cancer risk later in life. In Norway, women who experienced puberty during World War II had a reduced risk of breast cancer (10), suggesting a potentially important role for diet composition, energy balance, or growth rate during breast development. Further-

more, several risk factors for breast cancer are relevant to the adolescent time period; these risk factors include early age at menarche (11), low body weight during adolescence (12-14), and greater height (15). Each of these factors could also be associated with dietary intake, leading to the hypothesis that diet during adolescence is associated with risk of breast cancer.

We had the opportunity to evaluate adolescent diet and breast cancer risk among a large group of women with early-onset breast cancer and among a group of comparable control subjects. We focused on foods related to fat intake and fruit and vegetable intake because these factors had been correlated or associated with disease in international (16) or analytic epidemiologic (1) studies. To correct for problems of recalling diet in the distant past, we collected and used information from mothers of subjects so that we could specifically analyze foods that appeared to be reliably recalled.

Subjects and Methods

Study Subjects

This population-based, case-control study has been described in detail elsewhere (17). In brief, study participants were accrued from the following three geographical regions covered by cancer registries: Atlanta, GA; Seattle/Puget Sound, WA; and central New Jersey. Our analysis was restricted to women younger than age 45 years. Case subjects were newly diagnosed with breast cancer during the period May 1, 1990, through December 31, 1992. Control subjects, ascertained in the same time period, were frequency matched by geographical area and age to the expected distribution of case subjects and were identified through random-digit-dialing techniques (18). The number and ages of age-eligible women residing in the household were de-

*Affiliations of authors: N. Potischman, C. A. Swanson, R. N. Hoover, L. A. Brinton, Division of Cancer Epidemiology and Genetics, National Cancer Institute, Bethesda, MD; H. A. Weiss, London School of Hygiene and Tropical Medicine, U.K.; R. J. Coates, Division of Cancer Prevention and Control, Centers for Disease Control and Prevention, Atlanta, GA; M. D. Gammon, Division of Epidemiology, Columbia University School of Public Health, New York, NY; K. E. Malone, J. L. Stanford, Fred Hutchinson Cancer Research Group, Seattle, WA; D. Brogan, Biostatistics Department, Rollins School of Public Health, Atlanta.

Correspondence to: Nancy Potischman, Ph.D., National Institutes of Health, Executive Plaza North, Rm. 430, Bethesda, MD 20892-7366.

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terminated during a brief telephone-screening interview, and a 90.5% response rate was obtained from 16 254 residential telephone numbers.

In-depth interviews were conducted with 1505 (78.9%) of the 1908 eligible control subjects and with 1668 (86.0%) of the 1939 eligible case subjects. Incorporating the response rate to the brief telephone interview to determine eligibility (90.5%) yielded an overall response rate among control women of 71.4%. Twenty-one case subjects without telephones and four control subjects with a history of breast cancer were excluded, leaving 1647 case subjects and 1501 control subjects for the main analyses. Participants were interviewed regarding demographic, reproductive, and medical factors as well as history of physical activity, weight changes, and intake of alcohol. Diet during adolescence was assessed by asking subjects about consumption of 29 food items (see "Appendix" section) at ages 12–13 years or during grade 7 or 8. If subjects reported consumption of an item, they were asked their usual frequency of consumption with the visual aid of a card listing the following frequency categories: less than once a month, one time a month, two to three times a month, one to two times a week, three to four times a week, five to six times a week, and once a day or more. They were also asked their usual portion size relative to a given amount. Subjects with missing frequency information remained in the analyses (four, 11, and 38 subjects with four or more missing items, two missing items, or one missing item, respectively), but food groups were not calculated if frequency information was missing for any of the constituent food items. After the interview, a variety of anthropometric measurements were made (19). In addition, a self-administered modified version of the National Cancer Institute–Block food-frequency questionnaire (20) regarding recent adult dietary intake was completed by 1588 (96.4%) of the interviewed case subjects and 1451 (96.7%) of the interviewed control subjects.

Mothers

Diet during adolescence was validated through use of questionnaires completed by the mothers of subjects. Permission to contact the mother was requested from each of the 1251 case subjects and 1100 control subjects who were enrolled before April 30, 1992, and were under 45 years of age at diagnosis or at the time of the telephone screening. Twenty-one percent of mothers of case subjects ($n = 266$) and 17% of mothers of control subjects ($n = 184$) were deceased, and nine mothers of case subjects and 11 mothers of control subjects were not the biological mother and could not be contacted for early-life information. There were other adopted subjects whose mothers completed the questionnaire (12 case subjects and six control subjects). Although 976 case mothers and 905 control mothers were potentially eligible to receive the questionnaire, 146 case subjects and 147 control subjects refused permission to contact their mothers. The remaining 1588 mothers (830 mothers of case subjects and 758 mothers of control subjects) were eligible to be mailed a short questionnaire that included questions regarding the daughter's diet during adolescence. Completed questionnaires were returned from 1204 mothers—640 case mothers (66% of living mothers) and 564 control mothers (62% of living mothers).

The questionnaire that was mailed to the mothers

requested information about prenatal and perinatal exposures as well as the identical 29 food items, frequency categories, and portion sizes asked about in the daughters' interview. We requested that the mothers not discuss the questions with their daughters. At the end of the questionnaire, we asked about assistance with completion of the questionnaire; 54 mothers reported help with completion of the questionnaire from the index daughter. Results were similar with or without these 54 mothers and daughters; therefore, they were included in all analyses. Seventy-one of the 1204 mothers had three or more missing food items and were excluded from analyses, leaving 1133 mother–daughter pairs. Mothers with missing frequency for one or two food items remained in the analysis, but food groups were not calculated if information was missing for one of the food items making up the food group.

The response rate to the mothers' questionnaire differed significantly ($P < .001$) by race. A higher proportion of mothers of white women (69%) completed the questionnaire than mothers of African-American women (46%). Therefore, to reduce the possibility of bias from nonresponse in analyses evaluating risk using the mothers' data, we limited our analyses to 986 white mothers (509 case mothers and 477 control mothers with completed questionnaires).

Assessment of Exposure

The dietary instrument was designed to identify key foods related to fat intake and intake of fruits and vegetables but was not intended to provide valid estimates of nutrient or caloric intakes. Food items were classified into *a priori* hypothesized intake groupings. Three groups (i.e., high-fat meat, dairy products, and high-fat snacks and desserts) were created, and there was no overlap of food items so that various sources of fat in the diet could be described. Animal fat was composed of all foods in the high-fat meat and dairy food groups plus eggs, whereas high-fat foods were a compilation of all of these fat food groups with the addition of margarine and peanut butter. Monthly consumption of all items in the food group was calculated on the basis of frequency. Additional analyses were conducted incorporating portion-size information into the estimates of servings per month. Frequency of intake for a food item was multiplied by 0.5, 1, or 2 for small, medium, or large portion sizes, respectively, to yield an estimate of the number of servings. Results are presented both for frequency only and for frequency plus portion size information. For evaluation of congruence of monthly intakes between mothers and daughters, frequency only was used unless otherwise specified, since portion size was missing for many items from mothers.

Statistical Analyses

Logistic regression was used to obtain odds ratios (ORs) and 95% confidence intervals (CIs) as estimates of relative risks (21). Quartiles were defined according to the distribution of monthly intake of the food group among control subjects. Quartile variables were scored ordinally and treated as continuous for tests for trend. Age was included in all models as a continuous variable and was defined as age at diagnosis for case subjects and age at telephone screening for control subjects. Risk factors identi-

fied in this study (17,19,22–24) included race, first-degree family history of breast cancer, previous breast biopsy, age at first live birth, number of live births, menopausal status, body mass index, age at menarche, alcohol consumption, education level, oral contraceptive use, physical exercise at age 12 or 13 years, average lifetime physical exercise, and cigarette smoking. These risk factors were evaluated as potential confounders with the use of chi-squared analysis that tested the association between food groups and breast cancer risk factors among control subjects. In addition to variables for age and study site, the following risk factors significantly associated (i.e., $P < .01$) with several adolescent food groups were included in the models: race, education level, age at first birth, number of births, oral contraceptive use, average lifetime exercise, adolescent exercise, and alcohol consumption. Risk factors associated with only one food group were not included in the main analyses, and further adjustment of the appropriate food group for the additional confounders did not alter results presented. Spearman correlation coefficients were used to assess the relationship between adolescent and adult food groups.

Results

ORs for consumption of food groups by all subjects are provided in Table 1. Risk estimates and 95% CIs adjusted for age, race, and study site were similar to those for the full models presented. Using frequency only to compute monthly intakes, we saw no statistically significant or persuasive trends. In addition, ORs for the highest quartile of intake were not significantly or substantially different from those for the lowest quartile. A possible exception was for chicken and fish consumption, where the elevation in risk was related only to high consumption of chicken (OR = 1.28; 95% CI = 1.0–1.7—for >6.5 versus ≤ 2.5 times per month) and not to fish consumption. Further adjustment of the chicken and fish group for the potential confounders of body mass index and current smoking, which were modestly related to this food group among control subjects, did not alter the results (OR = 1.22; 95% CI = 1.0–1.5—for highest versus lowest quartile). Incorporation of portion size into monthly estimates of intake tended to expand the distributions of intakes, but results were generally similar to those for frequency only. The distribution of chicken and fish consumption indicated that both the 50th and 75th quartile cut points were at 13 times per month by use of frequency only, but incorporation of portion-size information expanded the distribution so that the cut points were 13 and 16 times per month. When informa-

Table 1. Adjusted* odds ratios (ORs) and 95% confidence intervals (95% CIs) for all daughters (1647 case subjects and 1501 control subjects)

Food group (food item No.)†	Quartile‡	Frequency only			Frequency plus portion size		
		Case subjects	Control subjects	OR (95% CI)	Case subjects	Control subjects	OR (95% CI)
High-fat meat (1, 11, 12, 13, 14)	1	388	384	1.00 (referent)	352	374	1.00 (referent)
	2	442	386	1.07 (0.9–1.3)	454	376	1.23 (1.0–1.5)
	3	428	366	1.09 (0.9–1.4)	422	382	1.11 (0.9–1.4)
	4	379	362	1.01 (0.8–1.3)	408	364	1.18 (1.0–1.5)
Dairy (2, 3, 24, 28)	1	396	385	1.00 (referent)	374	375	1.00 (referent)
	2	400	371	1.06 (0.9–1.3)	440	383	1.16 (0.9–1.4)
	3	401	369	1.02 (0.8–1.3)	460	375	1.24 (1.0–1.5)
	4	437	373	1.11 (0.9–1.4)	359	363	0.96 (0.8–1.2)
High-fat snacks and desserts (3, 4, 5, 8, 19)	1	419	376	1.00 (referent)	421	378	1.00 (referent)
	2	422	378	0.97 (0.8–1.2)	440	373	1.03 (0.9–1.4)
	3	414	377	0.95 (0.8–1.2)	393	374	0.91 (0.7–1.1)
	4	389	368	0.94 (0.8–1.2)	390	371	0.94 (0.8–1.2)
Animal fat (1, 2, 3, 11, 12, 13, 14, 23, 24, 28)	1	369	376	1.00 (referent)	404	375	1.00 (referent)
	2	404	377	1.07 (0.9–1.3)	406	371	1.02 (0.8–1.3)
	3	419	370	1.11 (0.9–1.4)	398	373	0.94 (0.8–1.2)
	4	434	373	1.14 (0.9–1.4)	415	372	1.01 (0.8–1.2)
High-fat foods (1, 2, 3, 4, 5, 8, 11, 12, 13, 14, 19, 23, 24, 27, 28, 29)	1	382	374	1.00 (referent)	395	372	1.00 (referent)
	2	470	374	1.15 (0.9–1.4)	439	372	1.06 (0.9–1.3)
	3	380	376	0.95 (0.8–1.2)	379	368	0.92 (0.7–1.1)
	4	393	369	1.01 (0.8–1.3)	409	373	1.00 (0.8–1.2)
Fruits and vegetables (6, 7, 18, 20, 21, 22)	1	428	372	1.00 (referent)	432	372	1.00 (referent)
	2	389	379	0.87 (0.7–1.1)	405	376	0.91 (0.7–1.1)
	3	392	366	0.90 (0.7–1.1)	412	374	0.91 (0.7–1.1)
	4	430	372	0.94 (0.8–1.2)	390	365	0.89 (0.7–1.1)
Fruits, vegetables, and legumes (6, 7, 17, 18, 20, 21, 22)	1	422	375	1.00 (referent)	444	376	1.00 (referent)
	2	415	375	0.94 (0.8–1.2)	388	374	0.85 (0.7–1.1)
	3	374	365	0.86 (0.7–1.1)	413	364	0.90 (0.7–1.1)
	4	426	372	0.95 (0.8–1.2)	391	371	0.87 (0.7–1.1)
Chicken and fish (15, 16)	1	587	587	1.00 (referent)	387	378	1.00 (referent)
	2	683	587	1.12 (1.0–1.3)	809	707	1.05 (0.9–1.3)
	3	0	0		47	47	1.01 (0.6–1.6)
	4	374	324	1.20 (1.0–1.5)	401	366	1.04 (0.8–1.3)

*Adjusted for age, site, race, education level, combination variable for age at first full-term birth and number of full-term births, oral contraceptive use, average lifetime exercise, exercise at ages 12–13 years, and current alcohol consumption. Subjects with missing data for some food groups were included in analyses, but their results are not presented in the tables.

†See "Appendix" section.

‡Cut points for quartiles for frequency only (times per month); frequency plus portion size (servings per month). High-fat meat: ≤22, ≤31, ≤44, >44; ≤21, ≤31, ≤45, >45. Dairy: ≤31, ≤49, ≤69, >69; ≤30, ≤53, ≤82, >82. High-fat snacks and desserts: ≤19, ≤34, ≤53, >53; ≤21, ≤40, ≤67, >67. Animal fat: ≤65, ≤89, ≤112, >112; ≤66, ≤96, ≤127, >127. High-fat foods: ≤113, ≤145, ≤178, >178; ≤116, ≤157, ≤203, >203. Fruits and vegetables: ≤54, ≤78, ≤101, >101; ≤55, ≤80, ≤108, >108. Fruits, vegetables, and legumes: ≤60, ≤83, ≤108, >108; ≤62, ≤86, ≤114, >114. Chicken and fish: ≤9.0, ≤13, ≤13, >13; ≤7.5, ≤13, ≤16, >16.

tion regarding portion size was included, high intake of chicken and fish showed no association with risk of disease, and intake of high-fat meat above the reference showed slight increases in risk. Estimates of risk were below unity for consumption of fruits, vegetables, and legumes, but no trend was observed ($P = .20$).

To identify those foods that appeared to be reliably recalled by the daughters, we compared agreement between the mothers' and daughters' reported frequency of consumption (Table 2). Data are presented for exact agreement, but mother–daughter agreement was evaluated by the concordance of being within one frequency category of each other on

the food-frequency questionnaires. For example, if the daughter reported intake as five to six times per week and the mother reported that exact frequency, or the neighboring frequencies of three to four times per week or one or more per day, then the mother and daughter were considered to be in agreement for that food item. Intake of chicken had the best agreement; 1029 (91%) of the 1133 mother–daughter pairs reported intakes within one frequency category of each other, and 51% reported exactly the same frequency. Results were similar to those presented using agreement of only four general categories of frequency (less than one per month, one to three per month,

one to four per week, or five or more per week) but requiring exact agreement by mother–daughter pairs. Agreement of food items in analyses that excluded the five most discordant mother–daughter pairs or the 18 mother–daughter pairs with more than 20 items discordant by more than one frequency category was also similar to that in Table 2. The last eight food items in Table 2, those with more than 40% disagreement between mothers and daughters by use of the greater-than-one frequency category difference criteria, were eliminated from consideration, and food groups were recalculated only on the basis of the other foods.

Table 2. Percent agreement with the use of eight food-frequency categories on food-frequency questionnaires among 1133 mother-daughter pairs

Food item	Daughter = mother \pm 1*, [†]	Exact agreement [‡] , [‡]
Chicken	1029 (91%)	610 (51%)
Sweet potatoes	917 (81%)	508 (42%)
Hamburgers	909 (80%)	463 (39%)
Diet cola	877 (77%)	804 (67%)
Fish	900 (79%)	489 (41%)
Beef and pork	887 (78%)	448 (37%)
Eggs	881 (78%)	429 (36%)
Pizza	836 (74%)	451 (38%)
Vegetables	840 (74%)	392 (33%)
Bacon	835 (74%)	400 (33%)
Potatoes (not French fries)	802 (71%)	355 (30%)
Cheese	802 (71%)	359 (30%)
French fries	786 (69%)	353 (29%)
Ice cream	783 (69%)	365 (30%)
Beans	772 (68%)	353 (29%)
Hot dogs	751 (66%)	331 (28%)
White bread	736 (65%)	398 (33%)
Peanut butter	733 (65%)	376 (31%)
Whole milk	713 (63%)	530 (44%)
Fruits	687 (61%)	334 (28%)
Margarine	693 (61%)	467 (39%)
Cookies	653 (58%)	295 (25%)
Salads	652 (58%)	303 (25%)
Butter	605 (53%)	401 (33%)
Doughnuts	621 (55%)	265 (22%)
Fruit juice	602 (53%)	331 (28%)
Snack foods	602 (53%)	259 (22%)
Regular cola	588 (52%)	300 (25%)
Whole-grain bread	566 (50%)	356 (30%)

*Mother's and daughter's responses were within one frequency category of each other.

[†]Percents = percent of 1133 mother-daughter pairs.

[‡]Mother's and daughter's responses were in exactly the same frequency category.

ORs for all daughters for food groups affected by the removal of the most unreliable foods are shown in Table 3, and two food groups (high-fat meat and chicken and fish) are not presented because none of the constituent food items were considered unreliable. Results in Table 3 were generally similar to those in Table 1. No relationship between intake of high-fat snacks and desserts, animal fat, or high-fat foods was noted. Intake of dairy products was associated with increased risk only in the quartile above the reference category, and slightly reduced risks were observed for groupings above the reference category for fruits and vegetables and fruits, vegetables, and legumes.

To make further use of the mothers' data and to more accurately classify the high and low quartiles, we evaluated monthly intakes of food groups, based on frequency only, that were concordant between the mother and daughter reports.

The comparisons of interest were the mother-daughter pairs who were both categorized into the highest quartile of a food group, compared with those who were both in the lowest quartile, based on quartile definition and ranking among mothers and among daughters. Since there were few women in some quartiles, models adjusted for only age and site were used to estimate risk. Table 4 shows no relationship between high and low intakes of dairy products, animal fat, or high-fat foods. Consistent with analyses of all daughters, this subgroup of white daughters with mothers' data suggests a possible elevation in risk for higher levels of consumption of high-fat meat (OR = 1.22; 95% CI = 0.6-2.3) and a possible reduction in risk associated with high intakes of fruits and vegetables (OR = 0.64; 95% CI = 0.4-1.1). High intake of chicken and fish was associated with increased risk (OR = 2.08; 95% CI = 1.1-4.1), which remained elevated, although not statistically significant, when portion size was included in the analysis (OR = 1.70; 95% CI = 0.9-3.4—for the high group). High-fat snacks and desserts showed a slight (but not statistically significant) elevation in risk, which had not been noted in previous analyses. However, small numbers of subjects in some quartiles of food groups make interpretation difficult.

A variety of other analyses were conducted to evaluate the weak associations noted for intake of high-fat meat and fruits and vegetables. To compare diets characterized by high intake of high-fat meat and low intake of fruits and vegetables with diets characterized by low intake of high-fat meat and high intake of fruits and vegetables, we created a combination variable using the two food groups. No strong associations or trends were evident, however. To further evaluate trends and the extremes of intakes, we divided high-fat meats and fruits, vegetables, and legumes into deciles. No trends were evident, and results were not materially different from those obtained by the quartile analyses. We observed no association for the ratio of red meat to chicken and fish, healthy lifestyle indicators (vegetables, fruits, fruit juice, chicken, whole-grain bread, and fish), and low-nutrient foods (regular colas, diet colas, white bread, doughnuts, cookies, snack foods, and French fries). Results

from analyses of adult diet indicated a nonsignificant reduction in risk associated with high intakes of a vegetable food group and little association with adult intakes of fruits and vegetables or fat (data not shown). The correlation between adult vegetable intake and adolescent fruit and vegetable intake was .32, and adjustment for adult vegetable intake did not alter the results for adolescent fruit and vegetable intake (OR = 0.85, 0.88, and 0.85 for quartiles 2, 3, and 4, respectively, compared with quartile 1). Analyses of adolescent intake within strata of adult fat intake and adult vegetable intake did not show any effect modification by adult intakes (data not presented).

Analyses of adult diet have indicated that there is a potential bias in reporting among case subjects who were undergoing chemotherapy (25). We therefore stratified the case subjects according to whether they did ($n = 996$) or did not ($n = 651$) receive chemotherapy. A possible elevation in risk of breast cancer was associated with high consumption of chicken and fish (>13 times per month compared with zero to nine times per month) for both groups of case subjects (OR = 1.19 [95% CI = 0.9-1.5] and OR = 1.23 [95% CI = 0.9-1.6], respectively). High intake of fruits and vegetables (>108 times per month compared with ≤ 60 times per month) was not associated with risk among chemotherapy-treated case subjects (OR = 1.0; 95% CI = 0.8-1.2) but was associated with reduced risk among case subjects not treated with chemotherapy, although this finding was not statistically significant (OR = 0.81; 95% CI = 0.6-1.1). There were no differences in risks by chemotherapy status for high-fat meat consumption.

Discussion

Many previous epidemiologic studies of individuals have focused on the association of adult dietary fat consumption with breast cancer risk and generally have failed to find associations that could corroborate the hypothesis that the international variation in breast cancer mortality is related to dietary fat intake (1). A weak protective effect of adult fruit and vegetable intake has been noted in some analytic studies (1), but the magnitude of this effect is insufficient to explain the five-

Table 3. Adjusted* odds ratios (ORs) and 95% confidence intervals (CIs) for all daughters (1647 case subjects and 1501 control subjects) with food groups after exclusion of unreliable recalled foods†

Food group (food item No.)‡	Quartile§	Frequency only			Frequency plus portion size		
		Case subjects	Control subjects	OR (95% CI)	Case subjects	Control subjects	OR (95% CI)
Dairy (2, 3, 24)	1	375	379	1.00 (referent)	381	386	1.00 (referent)
	2	504	401	1.23 (1.0–1.5)	493	371	1.33 (1.1–1.6)
	3	388	353	1.09 (0.9–1.4)	408	385	1.08 (0.9–1.3)
	4	375	367	1.00 (0.8–1.2)	360	357	0.98 (0.8–1.2)
High-fat snacks and desserts (3, 19)	1	478	459	1.00 (referent)	421	390	1.00 (referent)
	2	513	438	1.12 (0.9–1.4)	396	366	1.99 (0.8–1.2)
	3	252	245	0.96 (0.8–1.2)	459	410	1.02 (0.8–1.2)
	4	402	358	1.08 (0.9–1.3)	366	333	1.01 (0.8–1.3)
Animal fat (1, 2, 3, 11, 12, 13, 14, 23, 24)	1	399	376	1.00 (referent)	390	376	1.00 (referent)
	2	417	384	1.01 (0.8–1.2)	455	371	1.14 (0.9–1.4)
	3	424	365	1.06 (0.9–1.3)	387	377	0.95 (0.8–1.2)
	4	393	373	0.96 (0.8–1.2)	399	370	0.99 (0.8–1.2)
High-fat foods (1, 2, 3, 11, 12, 13, 14, 19, 23, 24, 27, 29)	1	431	382	1.00 (referent)	410	375	1.00 (referent)
	2	428	370	1.00 (0.8–1.2)	447	382	1.06 (0.9–1.3)
	3	386	376	0.88 (0.7–1.1)	404	362	0.98 (0.8–1.2)
	4	381	367	0.89 (0.7–1.1)	363	371	0.87 (0.7–1.1)
Fruits and vegetables (7, 18, 20, 22)	1	465	385	1.00 (referent)	452	377	1.00 (referent)
	2	391	373	0.81 (0.7–1.0)	380	374	0.79 (0.6–1.0)
	3	372	371	0.79 (0.6–1.0)	399	373	0.86 (0.7–1.1)
	4	419	371	0.88 (0.7–1.1)	416	374	0.91 (0.7–1.1)
Fruits, vegetables, and legumes (7, 17, 18, 20, 22)	1	442	376	1.00 (referent)	452	383	1.00 (referent)
	2	399	381	0.86 (0.7–1.1)	394	369	0.86 (0.7–1.1)
	3	372	371	0.81 (0.7–1.0)	387	373	0.85 (0.7–1.1)
	4	434	373	0.95 (0.8–1.2)	413	374	0.91 (0.7–1.1)

*Adjusted for age, site, race, education level, combination variable for age at first full-term birth and number of full-term births, oral contraceptive use, average lifetime exercise, exercise at ages 12–13 years, and current alcohol consumption. Subjects with missing data for some food groups were included in analyses, but their results are not presented in the tables.

†The remaining food groups in Table 1 are unaltered on excluding unreliable foods and therefore do not appear in this table.

‡See "Appendix" section.

§Quartile cut points for frequency only (times per month); frequency plus portion size (servings per month). Dairy: ≤22, ≤39, ≤49, >49; ≤22, ≤43, ≤69, >69. High-fat snacks and desserts: ≤5, ≤9, ≤15, >15; ≤5, ≤9, ≤20, >20. Animal fat: ≤59, ≤79, ≤100, >100; ≤58, ≤84, ≤114, >114. High-fat foods: ≤78, ≤84, ≤109, ≤134, >134; ≤78, ≤109, ≤146, >146. Fruits and vegetables: ≤40, ≤54, ≤69, >69; ≤42, ≤57, ≤76, >76. Fruits, vegetables, and legumes: ≤45, ≤60, ≤74, >74; ≤46, ≤63, ≤82, >82.

fold international differences. For these reasons, as well as the evidence from a detailed analysis of risks in migrant populations (3), diet during childhood or early adulthood has been suggested as the potential critical dietary factor (1,8). In our study, consumption of high-fat foods during adolescence was not associated with increased risk of disease, although a non-significant elevation in risk was noted for consumption of high-fat meat in some analyses. Fruits and vegetables or fruits, vegetables, and legumes were associated with a slight, although not statistically significant, reduction in risk. Chicken consumption appeared to be associated with increased risk in several analyses. Whether the latter is a real effect, an effect related to unusual characteristics of the reference group (i.e., those who ate little chicken), or a chance finding remains unclear. Although growth promoters with estrogenic activity, such as dieth-

ylstilbestrol, had been used in chickens for a short time while these women were adolescents, these growth factors were also used for beef at that time (26). We created a new food group of beef products (items 11 and 12 in "Appendix" section), and no increased risk was observed for high (≥21 times per month) compared with low (<10 times per month) consumption (data not presented). Therefore, it is unlikely that estrogen-related factors contributed to the observed risk for chicken consumption. There was some elevation in risk for dairy product consumption, but there was no reason to expect that moderate intakes of dairy products result in increased risk relative to that of nonconsumers and heavy consumers.

To our knowledge, there are only two previous reports of diet during adolescence and breast cancer risk. The first report (27) indicated no significant association between childhood or teen dietary

intake of fat and premenopausal breast cancer, whereas the second report (28) found a nonsignificant reduction in risk of premenopausal breast cancer associated with higher dietary fat intake during adolescence. In the latter study, the investigators developed a questionnaire that focused on obtaining information on the fat and fiber intake of the subjects; the results indicated that there was a reduced risk of premenopausal breast cancer among subjects who consumed higher amounts of a fiber food group composed principally of fruits and vegetables. The first study (27) focused on fat and carotenes, evaluated individual food items, and did not report a reduced risk of premenopausal breast cancer associated with carotene sources.

High intake of fruits and vegetables may be a marker of other dietary patterns, including lower average caloric intake and possibly a slower growth rate during adolescence. Hunter and Willett (1) hy-

Table 4. Odds ratios (ORs) and 95% confidence intervals (CIs) for breast cancer among daughters with mothers who were in exact agreement for the extreme quartiles (986 white daughters)

Food group	Intake*	Case subjects	Control subjects	OR† (95% CI)
High-fat meat	Low-low	46	34	1.00 (referent)
	Other	416	413	0.75 (0.5-1.2)
	High-high	47	30	1.22 (0.6-2.3)
Dairy	Low-low	58	49	1.00 (referent)
	Other	377	367	0.81 (0.5-1.2)
	High-high	74	61	0.94 (0.6-1.6)
High-fat snacks and desserts	Low-low	45	43	1.00 (referent)
	Other	412	394	1.05 (0.7-1.6)
	High-high	52	40	1.32 (0.7-2.4)
Animal fat	Low-low	42	36	1.00 (referent)
	Other	424	400	0.89 (0.6-1.4)
	High-high	43	41	0.84 (0.4-1.6)
High-fat foods	Low-low	31	29	1.00 (referent)
	Other	437	411	0.91 (0.5-1.6)
	High-high	41	37	0.97 (0.5-1.9)
Fruits and vegetables	Low-low	61	46	1.00 (referent)
	Other	389	370	0.73 (0.5-1.1)
	High-high	59	61	0.64 (0.4-1.1)
Fruits, vegetables, and legumes	Low-low	60	50	1.00 (referent)
	Other	397	375	0.80 (0.5-1.2)
	High-high	52	52	0.73 (0.4-1.3)
Chicken and fish	Low-low	70	65	1.00 (referent)
	Other	406	398	0.95 (0.7-1.4)
	High-high	33	14	2.08 (1.1-4.1)

*Low-low indicates that both the mother and daughter reported intake in the lowest quartile of monthly intake. High-high indicates that both mother and daughter reported intake in the highest quartile of monthly intake.

†Adjusted for age and site.

pothesized that higher energy intake and higher growth rate during adolescence increase breast cancer risk; this possibility is consistent with the results of international correlational studies of fat intake and breast cancer mortality and the associations of greater height with risk of breast cancer. We could not directly test this hypothesis.

While the suggestion that environmental factors at a young age may be particularly important to breast cancer risk has been made for some time (2,4-6), to our knowledge, this is only the third study to assess the dietary hypothesis. This undoubtedly reflects the daunting task of attempting to retrospectively assess dietary patterns at a remote point during a subject's life. While our effort was certainly impaired by these difficulties, we also had certain advantages to help minimize some of these problems. The large size of this study reduced the possibility of chance findings, and we focused on young women (<45 years of age) whose recollections of dietary patterns in adolescence may be better than those of women in the usual breast cancer age range. We also retrieved information from mothers of

study subjects about the same exposures, which allowed us to identify foods that generated responses that appeared reliably recalled and, therefore, perhaps less subject to misclassification. This method also allowed us to focus on subjects who reported values in the extremes, but whose responses were corroborated by their mothers.

If dietary exposures during adolescence were important for breast cancer risk, we would have anticipated risk estimates of greater magnitude than those observed. Diet during adolescence may be important to breast cancer risk but appeared to be unrelated or only weakly related in this study for several reasons. The dietary instrument in this study may have been too limited in characterizing the diet or dietary patterns that are important. This fact, combined with errors in recall, could lead to marked misclassification and attenuation of risks. Although recall of diet in the distant past may be difficult for some women, reproducibility and validity studies indicate that subjects can accomplish this task reasonably well for epidemiologic purposes (29,30). We expected that removing poorly remembered foods

would have reduced the random error and enhanced our ability to detect associations. Analyses of revised food groups showed risk estimates and CIs that were virtually identical to those for the original food groups, suggesting minimal impact of recall errors. Furthermore, the analysis of data from the small proportion of concordant mother and daughter pairs in the extreme quartiles revealed similar results to those for all daughters, lending credence to the general findings. The consistent reduction in risk for intake of fruits and vegetables, given the limited number of very general food items in the questionnaire and the errors of misclassification, suggests that even lower risk estimates might be obtained from more detailed dietary assessments. Alternatively, it may be that dietary intake is relevant at even earlier time periods, since the determinants of menarche and the major determinants of adult height may precede this time period (31,32). Finally, given the suspected differences in breast cancer etiologies for premenopausal and postmenopausal disease (33) and the strong impetus from international and migrant studies to evaluate diet early in life, it may be that diet during adolescence may play a stronger role in postmenopausal disease. Preliminary analyses from one study (34) does suggest an influence of diet during adolescence on postmenopausal but not on premenopausal disease. Women diagnosed with early-onset breast cancer are more likely to be genetically predisposed to the disease (33). Thus, the influence of diet may vary by genetic as well as menopausal status. We were unable to address these issues.

As with all case-control studies, there is a potential for recall bias among case subjects. Although it is unlikely that case subjects would know about the hypotheses related to adolescent diet, any bias regarding adult diet may have influenced reporting of past diet. It is unlikely that the case mothers would be biased in their recall or biased in the same way as their daughters, however. Thus, the agreement of findings with the use of the daughter-only data or the combined mother and daughter data suggests that recall bias among daughters was minimal. The previously noted overreporting of intakes among case subjects on chemotherapy (25) may also have been operating for reporting on adolescent intake of fruits and

vegetables but not intake of chicken and fish. The exclusion of these case subjects with suspected biased reporting lends further credence to the relationships noted among the case subjects who were not treated with chemotherapy.

Although prospectively collected exposure data will no doubt be available in the distant future, case-control studies provide valuable evidence at this time. Detailed analyses of exposures early in life present numerous difficulties, and this analysis addressed the major issues. These data revealed no strong associations for any food groups. The consistent associations of intake of fruits and vegetables and chicken intake are provocative and should be investigated in other studies with more detailed dietary instruments. Finally, evaluation of nutritional influences during other early-life time periods may be more revealing.

Appendix: List of 29 food items on food-frequency questionnaires of diet during adolescence

1. Pizza
2. Whole milk (including on cereal)
3. Ice cream, milk shakes
4. Doughnuts and pastries
5. Cookies, cakes
6. Fruit juice (not Kool-Aid or HiC)
7. Fruits (not including juices)
8. Snack foods (chips, popcorn, peanuts, etc.)
9. Diet colas (Tab)
10. Regular colas
11. Hamburgers, cheeseburgers, other ground beef (including meatloaf, beef casseroles, and meatballs)
12. Beef (steaks or roasts) and pork (chops or roasts)
13. Hot dogs, ham, and lunch meats
14. Bacon
15. Fish (including tuna fish and fishsticks)
16. Chicken
17. Beans, such as baked beans, pinto beans, kidney beans, and lima beans
18. Sweet potatoes and yams
19. French fried potatoes
20. Other potatoes (baked, etc.)
21. Salads (green leafy)
22. Vegetables (as a side dish, not including potatoes)
23. Eggs

24. Cheese (cottage cheese, hard cheese, American cheese, and Velveeta cheese)
25. White bread
26. Whole-grain bread (including rye and wheat)
27. Margarine (including on vegetables and bread)
28. Butter (including on vegetables and bread)
29. Peanut butter

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Note

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