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# Dietary patterns, food groups, and rectal cancer risk in Whites and African Americans

**Christina Dawn Williams**[1], **Jessie A. Satia**[1,2,3], **Linda S. Adair**[1], **June Stevens**[1,2], **Joseph Galanko**[3], **Temitope O. Keku**[3], and **Robert S. Sandler**[2,3]

[1] Department of Nutrition, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, Chapel Hill, NC

[2] Department of Epidemiology, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, Chapel Hill, NC

[3] Department of Medicine, Center for Gastrointestinal Biology and Disease, and Division of Gastroenterology and Hepatology, University of North Carolina at Chapel Hill, Chapel Hill, NC

## Abstract

**Background—**Associations between individual foods and nutrients and colorectal cancer have been inconsistent, and few studies have examined associations between food, nutrients, dietary patterns, and rectal cancer. We examined the relationship between food groups and dietary patterns and risk of rectal cancer in non-Hispanic Whites and African Americans.

**Methods—**Data were from the North Carolina Colon Cancer Study-Phase II and included 1520 Whites (720 cases,800 controls) and 384 African Americans (225 cases,159 controls). Diet was assessed using the Diet History Questionnaire. Multivariate logistic regression models were used to estimate odds ratios (OR) and 95% confidence intervals (95% CI).

**Results—**Among Whites, non-whole grains and white potatoes were associated with elevated risk of rectal cancer, while fruit, vegetables, dairy, fish, and poultry were associated with reduced risk. In African Americans, high consumption of citrus fruit and added sugar suggested elevated risk. We identified three major dietary patterns in Whites and African Americans. The High Fat/Meat/Potatoes pattern was observed in both race groups, but was only positively associated with risk in Whites (OR: 1.84, 95% CI 1.03–3.15). The Vegetable/Fish/Poultry and Fruit/Whole-Grain/Dairy patterns in Whites had significant inverse associations with risk. In African Americans, there was a positive dose-response for the Fruit/Vegetables pattern ($P_{trend}$ <0.0001), and an inverse linear trend for the Legumes/Dairy pattern ($P_{trend}$ <0.0001).

**Conclusion—**Our findings indicate that associations of certain food groups and overall dietary patterns with rectal cancer risk differ between Whites and African Americans, highlighting the importance of examining diet and cancer relationships in racially diverse populations.

### Keywords

dietary patterns; food groups; racial disparities; rectal cancer

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Requests for reprints: Jessie A. Satia, Department of Nutrition, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, 2209 McGavran-Greenberg Hall, CB#7461, Chapel Hill, NC 27599 Phone: (919)843-3641; Fax: (919) 966-8392; jsatia@unc.edu.

## Introduction

Colorectal cancer (CRC) is the third most common cancer in the United States (U.S.) among men and women (1). Incidence and mortality rates are highest among African Americans compared to other U.S. race/ethnic groups. While some of this disparity can be attributed to access to care and socioeconomic differences (2), other reasons remain largely unknown. It is generally accepted that diet plays an etiologic role in colorectal cancer development; however, studies examining associations of specific foods and nutrients with CRC risk have been inconsistent. Moreover, most studies have focused on colon cancer only or the combination of colon and rectal cancer, while less attention has been given to the risk of rectal cancer specifically.

The majority of diet and cancer studies examine associations of individual nutrients with disease risk. Examining individual nutrients in relationship to cancer risk is beneficial for gaining insight into possible mechanisms of dietary components. This individual nutrient approach, however, is not adequate for considering the synergistic effect of highly correlated nutrients and other compounds found in foods (3). Other studies have focused on food groups, which take into account the way the foods are typically consumed. Nonetheless, it has been suggested that dietary patterns represent a more logical approach, as the analysis of dietary patterns takes into consideration the synergistic effect of both foods and nutrients, neither of which is consumed in isolation. Dietary patterns include numerous dietary exposures and are often associated with other health behaviors, such as physical activity, smoking, and cancer screening (4). A common approach to identifying dietary patterns is factor analysis, which reduces a large number of variables into a small number of factors based on their degree of correlation (5). These factors then represent dietary patterns in the study population and are used as predictors in subsequent analyses of risk. Comparisons between the food/nutrient and dietary pattern approaches among previous studies have been difficult due to differences in study design, study populations, and statistical methods.

As noted above, few studies have examined associations of diet with rectal cancer risk separately, as most have combined rectal and colon cancers. However, true mechanisms underlying the etiology of colon and rectal tumors may be different (6,7). The objective of this work is to examine associations of food groups and dietary patterns (based on factor analysis) with risk of rectal cancer in a population-based case-control study of non-Hispanic Whites (Whites) and African Americans in North Carolina. To our knowledge, this is the first population-based study to examine these relationships in a racially diverse U.S. population.

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## Materials and Methods

### Study design and population

The North Carolina Colon Cancer Study-Phase II is a population-based case control study in a 33-county area in central North Carolina. These counties include rural, suburban, and urban areas and are socioeconomically diverse. Participants were selected using a randomized recruitment strategy that over-sampled African Americans and involved matching on 5-year age, sex, and race. This study was approved by the University of North Carolina's Institutional Review Board.

### Cases

Rectal cancer cases were identified by the North Carolina Central Cancer Registry rapid ascertainment system and included those with cancers of the rectum, sigmoid, and rectosigmoid junction (ICD 154). Eligibility criteria for cases included: age 40–79 at time of diagnosis, diagnosed with a primary adenocarcinoma between May 2001 and September 2006, have a

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North Carolina driver's license or identification (because controls under 65 were selected from Department of Motor Vehicle rosters), and able to give informed consent and complete the interview. All diagnoses were confirmed by the study pathologist through review of pathology slides and reports. Cases with a non-invasive carcinoma or a previous diagnosis of colorectal cancer were excluded. After notification of the primary physician, eligible cases were sent a letter describing the study and a race-matched enrollment specialist contacted them to explain the study and obtain their consent to participate. Interviews were scheduled for consenting cases. There were a total of 1831 cases sampled, 1417 of whom were eligible to participate. Of the eligible cases, 118 (8%) were unable to be contacted, 242 (17%) refused, and 1057 (75%) were interviewed. The response rate, (number of persons interviewed divided by the total number of eligible persons), was 76% and 70% for Whites and African Americans, respectively.

### Controls

Using lists provided by the agencies, controls were randomly identified from the North Carolina Department of Motor Vehicles (NC DMV) (for those less than age 65) and from the Center for Medicaid and Medicare Services (CMS, formerly known as the Health Care Financing Administration), for those age 65 and older. Eligible controls were 40–79 years old at the time of selection, resided in the 33-county study area, and had no previous diagnosis of colorectal cancer. Similar to cases, potential controls were sent an introductory letter and contacted by a race-matched enrollment specialist and in-person interviews were scheduled for controls who agreed to participate. Among eligible controls (1,827 out of 2,345 sampled), 325 (18%) could not be contacted, 483 (26%) refused, and 1019 (56%) were interviewed. The response rates were 58% and 46% for White and African American controls, respectively.

### Data collection

All data were collected by trained nurse-interviewers in participants' home or other convenient location.

### Dietary intake

Usual dietary intake was assessed using the Diet History Questionnaire (DHQ) developed and tested for validity by the National Cancer Institute (8–10). This instrument was validated in study samples that were racially diverse, with African Americans representing 10–14% of these study samples (9,10). The DHQ consists of 124 separate food items and assesses the frequency of consumption and portion size consumed for each food item. Participants were asked to estimate their food and beverage intake in the past 12 months. The 12-month period was chosen to take into account seasonal variation in food consumption. Cases were asked to estimate their usual frequency and portion size over the 12 month period prior to diagnosis, and controls were asked to estimate consumption during the 1 year prior to interview. Daily intakes of nutrients and total energy were calculated with software provided by the NCI and developed for the survey instrument. Nutrient intakes were determined using the frequency of consumption, reported portion size, and nutrient content. For the food group analysis, we examined the following U.S. Department of Agriculture (USDA) pyramid food groups (11): total grains, whole grains, non-whole grains (e.g. white bread, pasta, cereal), total vegetables, dark green vegetables, deep yellow vegetables, dry beans and peas, white potatoes, starchy vegetables, tomatoes, other vegetables(e.g. cabbage, cauliflower, Brussels sprouts, onions), total fruits, citrus fruits(including melons and berries), other fruits, total dairy, milk, yogurt, cheese, total meat, beef/pork/lamb (i.e. red meat), processed meats, organ meats, fish and other seafood, poultry, eggs(i.e. eggs, egg whites, egg substitutes), soy products, nuts (e.g. peanuts, walnuts, seeds), added sugar (sugars added during processing, cooking, or at the table), and discretionary fat (i.e. excess fat in foods and fat added to foods). Average weekly intakes were calculated for each food group. There was a large proportion of non-consumers for the yogurt, organ meat, and soy food groups (58%, 49%, 76%, respectively). For this reason, we dichotomized (consumers vs. non-consumers) these foods in the food group analysis, and combined the yogurt group with the milk food group and excluded the organ meat and soy food groups in the factor analysis.

## Other participant characteristics

The participant questionnaire queried age at diagnosis, sex, race, education, annual income, use of non-steroidal anti-inflammatory drugs, smoking history, and first degree family history of colorectal cancer.

The analyses were restricted to participants who completed all components of the study (n=1987). Participants with unreliable reported energy intakes (<800 kcal/day and >5000 kcal/day for men and <600 kcal/day and >4000 kcal/day for women) were also excluded (n=83 (50 men, 33 women)) because they were considered implausible based on daily energy requirements (12). Thus, the analytic sample for this report included 1520 Whites (720 cases, 800 controls) and 384 African Americans (225 cases, 159 controls).

## Statistical analyses

Descriptive statistics (means, standard deviations, and frequencies) were computed for all study variables by case-control status and race to describe the demographic and dietary characteristics of the study population. Results were stratified by race because tests for interaction indicated the presence of effect modification by race for some of the demographic and dietary variables. Each food group was categorized into quartiles based on the distribution among race-specific controls. Odds ratios (OR) and 95% confidence intervals (95% CI) were calculated using unconditional logistic regression models to determine the association between the food groups and rectal cancer risk. These food group models included an offset term to account for the randomized recruitment and to allow us to obtain unbiased odds ratios, as well as the following covariates: age (continuous), sex, socioeconomic status (represented by education (less than or equal to high school, some college, college graduate/advanced degree) and income (categorized)), BMI 1 year ago (i.e., in the year prior to interview for controls and diagnosis for cases) (normal, overweight, obese), physical activity (continuous), family history (yes, no), non-steroidal anti-inflammatory drug use (yes, no), and total energy intake (continuous).

Dietary patterns were identified separately among White and African American controls using 21 predefined food groups in a principal components factor analysis. This analysis was conducted using the PROC FACTOR procedure in SAS. To determine the number of factors to retain, we considered eigenvalues >1, the scree plot, and the interpretability of the factors. Extraction of these factors was followed by orthogonal rotation (the varimax rotation option in SAS) to obtain uncorrelated factors and enhance interpretability. For each dietary pattern (factor), a factor score was calculated for cases and controls by summing intakes of the food items weighted by their factor loadings. Pearson and Spearman correlation coefficients were used to examine the correlation of factor scores for each dietary pattern with other participant characteristics and dietary variables. Partial Pearson correlation coefficients adjusted for energy were obtained for the dietary variables. Factor scores were categorized into quartiles based on the distribution in the control population for African Americans and Whites separately. To determine the relationship between these dietary patterns and rectal cancer, we used unconditional logistic regression models to obtain odds ratios and 95% confidence intervals. Test for trend was conducted by incorporating a variable for the median values of factor scores among race-specific controls observed for each food group quartile into a logistic regression model. The trend test was weighted by the inverse of the variance for the quartiles.

All logistic regression models were adjusted for the same covariates as in the food group models.

All analyses were performed using SAS 9.1 software (SAS Institute, Inc., Cary, NC). Statistical tests were two-sided and $p<0.05$ was considered statistically significant.

## Results

The distribution of cases and controls by race is shown in Table 1. Among Whites, controls were older and more educated, had a slightly lower mean BMI 1 year ago, and used more non-steroidal anti-inflammatory drugs than cases. Among African Americans, the mean age was less for cases than controls, while cases had a higher mean BMI. In addition, a larger proportion of African American cases had a family history of CRC compared to controls. All of these participant characteristics were significantly associated with the risk of rectal cancer in multivariate models, except annual income, smoking status, and family history (data not shown).

Tables 2 and 3 give the covariate-adjusted race-specific odds ratios (OR) and 95% confidence intervals for each food group among Whites and African Americans, respectively. The odds ratios presented are not mutually adjusted for the other food groups, although estimates were similar when we controlled for the other primary food groups. For Whites, high intakes of non-whole grains and white potatoes were significantly positively associated with rectal cancer risk (Table 2). Conversely, fruit, dark green vegetables, deep yellow vegetables, other starchy vegetables, other vegetables, dairy foods, fish, and poultry were significantly associated with reduced risk for rectal cancer. High consumption of dark green vegetables had the strongest inverse association (OR: 0.41, 95% CI 0.29–0.58). The highest quartile of red meat intake had an OR less than 1, but was not statistically significant. High intake of other fruit and added sugar were associated with elevated risk in African Americans (OR: 3.25 95% CI 1.52–6.96 for other fruit; OR: 2.65 95% CI 1.11–6.34 for added sugar) (Table 3). There was a significant lower risk associated with the second quartile of intake of total vegetables, other vegetables, total meat, and discretionary fat in African Americans.

Three dietary patterns were identified separately among White and African American controls using principal components analysis. These 3 patterns explained 39% of the variance in Whites and 43% of the variance in African Americans. Table 4 presents the factor loadings for the food groups on each dietary pattern for each race group. The first dietary pattern, High Fat/Meat/Potatoes, was similar for both Whites and African Americans and had strong positive loadings for discretionary fat, non-whole grains, white potatoes, red and processed meat, cheese, and added sugar. The second and third factors were only slightly different for Whites and African Americans. For Whites, the second dietary pattern was characterized by high loadings of most vegetables, as well as fish and poultry, and was therefore labeled the “Vegetable/Fish/Poultry” (abbreviated as Veg/Fish/Poultry) pattern. The third dietary factor in Whites was labeled “Fruit/Whole Grain/Dairy” because of its high positive loadings of fruit, whole grains, and milk/yogurt. In African Americans, fruits also loaded heavily on the second factor in addition to vegetables. This factor was labeled “Fruit/Vegetables”. The third factor in African Americans had strong loadings of nuts, beans and peas, and milk/yogurt, and was labeled “Legumes/Dairy”.

Table 5 shows correlations of the three separate dietary patterns in Whites and African Americans with selected participant characteristics and dietary variables. Age was inversely correlated with the High Fat/Meat/Potatoes pattern for both race groups, whereas education and income were positively correlated with the Veg/Fish/Poultry pattern in Whites. The dietary variables presented are those related to energy intake (i.e. total energy, fat, carbohydrate, protein, alcohol). Folate and fiber were included because of their high content in fruits and vegetables. The High Fat/Meat/Potatoes pattern had the highest correlation with total energy in Whites (r=0.86) and African Americans (r=0.82), while inversely related to carbohydrates, alcohol, folate, and fiber. The Veg/Fish/Poultry pattern in Whites had a strong positive correlation with protein, and the Fruit/Vegetable pattern in African Americans was highly correlated with folate and fiber.

Associations (odds ratios and their 95% CI) of the dietary patterns (according to quartiles of factor scores) with rectal cancer risk, stratified by race, are given in Table 6. Estimates based on race-specific quartile cut-points are shown, although similar associations were observed when quartile cut-points were matched across ethnic groups. Among Whites, high factor scores for the High Fat/Meat/Potatoes pattern had odds ratios suggestive of elevated rectal cancer risk (OR: 1.84, 95% CI 1.08–3.15). The second and third patterns in Whites were significantly associated with reduced risk of rectal cancer. The ORs for the highest quartiles for the Veg/Fish/Poultry and Fruit/Whole-grain/Dairy patterns were 0.47 (95% CI 0.33–0.67) and 0.65 (95% CI 0.45–0.93), respectively. In African Americans, the High Fat/Meat/Potatoes and Legumes/Dairy patterns were suggestive of reduced risk, while the Fruit/Vegetables pattern suggested elevated risk. None of the quartile estimates reached statistical significance. There was, however, evidence of a positive linear trend for the Fruit/Vegetables pattern and an inverse dose-response for the Legumes/Dairy patterns ($p<0.0001$ for both). We did not observe any effect modification by gender for any of the food group totals or dietary patterns.

## Discussion

This population-based case-control study examined the relationship of food groups and dietary patterns with the risk of rectal cancer in Whites and African Americans. High intakes of fruit, vegetables, and dairy were associated with reduced rectal cancer risk in Whites, while African Americans had an elevated risk associated with other fruit and added sugar. We identified three major dietary patterns and investigated the relationship between these patterns and rectal cancer. The first dietary pattern, High Fat/Meat/Potatoes, was similar for Whites and African Americans, while the other two patterns differed slightly. To our knowledge, this is the first study to examine these associations in African Americans.

Increased consumption of whole grain foods, as well as fruit, vegetables, and dairy products, has generally been associated with reduced colon and rectal cancer risk in epidemiologic studies (13–15), although results have not been entirely consistent. The potentially protective role of these food groups has been attributed to their fiber content and micronutrients such as vitamins, carotenoids, calcium, and folate (16–18). Our study showed that fruit, some vegetables, and dairy foods were associated with reduced risk in Whites. Our findings support evidence from a case-control study by Slattery, et al. that reported significant rectal cancer risk reductions for high consumption of fruit and vegetables in a predominantly White population (15).

The relationship between fruit and vegetables and rectal cancer risk in our study varied by race and food subgroups. Contrary to our results which showed risk reductions associated with specific fruits and vegetables among Whites, Michels et al. did not find a protective effect for total fruit and vegetable intake, or any subgroups of fruit and vegetables, on colon and rectal cancer incidence (19). High fruit consumption in African Americans correlated with significantly higher risk of rectal cancer. This strong positive association remained after adjustment for other dietary variables such as citrus fruit, added sugar, and total carbohydrate intake. The elevated risk may be due to high intakes of high-calorie fruit juice or low intakes of fresh fruit.

Interestingly, high intake of the red meat in our study population was not significantly associated with rectal cancer risk. It has been hypothesized that the high heme iron content in red meat enhances free radical production and tumor cell proliferation (20,21), and that the fat content of red meat may increase the production of bile acids, also causing cellular proliferation (22). Some studies have shown elevated rectal cancer risk to be associated with high consumption of red meat (23,24) and processed meat (24,25). Our results are in agreement with findings by Wei, et al. which also showed no association between increased consumption of red meat and rectal cancer risk (7), although our findings do suggest elevated risk for high intake of processed meat in Whites.

Fish and other seafood may play an important role in rectal cancer risk reduction perhaps due to their rich omega-3 polyunsaturated fatty acid (PUFA) content, which may reduce the production of pro-inflammatory eicosanoids (26,27). Although the effects of fish and poultry on colon and rectal cancer risk have been examined less often compared to red meat, at least five studies have shown fish and poultry to be associated with reduced risk of colorectal cancer (23,24,28–30). Three of these studies reported an inverse relationship between these food groups and risk of rectal cancer specifically (23,24,28), as we did in this present study among Whites. Fish and poultry had a non-significant positive association with risk in African Americans, which may reflect how these foods were prepared. However, the results did not change when we adjusted for total fat intake.

Three dietary patterns were identified separately among White and African American controls using principal components factor analysis. The High Fat/Meat/Potatoes dietary pattern was similar in both race groups. Comparable dietary patterns in some cohort studies have found no association of this pattern with colon or rectal cancer risk (31,32). However, other studies in which this pattern was labeled “Western” and “red meat” have reported significant elevated risk of colon cancer and CRC, respectively (4,33). Our results for Whites are consistent with these findings because high factor scores among Whites for the High Fat/Meat/Potatoes pattern were associated with elevated risk.

In addition to a type of “Western” dietary pattern, researchers have often identified a presumably healthy pattern that has been labeled “healthy”, “prudent”, and “vegetable” patterns in some studies (34–38). Among Whites in our study, potentially healthy patterns emerged as two distinct dietary patterns, i.e. the Veg/Fish/Poultry and the Fruit/Whole Grain patterns; both were associated with reduced risk of rectal cancer. Interestingly, the Veg/Fish/Poultry pattern had weak factor loadings for fruits and dairy products, and the Fruit/Whole Grain pattern had only weak to modest loadings for most vegetables. This suggests that it may not be appropriate to combine fruit and vegetables as an individual food group. In African Americans, the two presumably healthy patterns were the Fruit/Vegetables pattern and the Legumes/Dairy pattern. There was a positive linear relationship between the Fruit/Vegetable pattern and rectal cancer. This could be due to the heavy loadings of fruit, especially citrus fruit, which also showed a significant positive trend in risk in the food group analysis. The Legumes/Dairy pattern in African Americans suggested a protective effect on risk, as was expected.

These dietary patterns only accounted for 39% and 43% of the total variance in Whites and African Americans, respectively, which suggests that other patterns exist. There were a total of 5 factors in Whites and 7 factors in African Americans that had eigenvalues greater than 1.0, and together these factors explained 50% and 65% of the variance, respectively. However, these factors not presented were difficult to interpret. The low proportion of variance explained by the 3 factors in race group could also be due, in part, to the limited number of foods entered in the factor analysis, or a reflection of the overall complexity of the diet.

Our findings provide evidence that rectal cancer risk differs between African Americans and Whites for certain foods and dietary patterns. Unfortunately, there are virtually no studies of diet and colon and rectal cancer associations in African Americans. Similar racial differences were reported by Satia-Abouta, et al. in a population-based study of food groups and colon cancer (14). Few studies have conducted comparisons of dietary patterns for Whites and African Americans (39–41). The dietary patterns in our study were similar to those identified in the Multiethnic Cohort Study, which also used the USDA food groups for the factor analysis (41). Bell and colleagues reported that food patterns among Whites and African Americans did not differ. Although the patterns were generally similar in both race groups in our study, there were some different associations with rectal cancer risk. The observed heterogeneity in risk may in part be due to racial variation in dietary intake of certain foods and nutrients as reported in some studies (42–44). We used race-specific cut-points for food groups and dietary patterns to account for possible differences in consumption, although this could have affected our assessment of racial differences in risk. We cannot exclude the possibility that socioeconomic status contributes to this racial disparity; however, we controlled for both education and income in our analyses.

Our study has many strengths, including its population-based design and the inclusion of a large number of rectal cancer cases. Also, the randomized recruitment strategy used to select participants minimized the possibility of selection bias in our results. Over-sampling allowed us to increase the number of African Americans in our study sample in an effort to assess racial differences. Both food group analysis and factor analysis were examined in the same population and included the same covariates.

There are also some limitations to our study. The use of predefined food groups in the factor analysis may have introduced error in our risk estimates. Grouping foods prevents the food items within the group from having different loadings on the dietary patterns identified and may obscure differences in consumption. However, the consistent use of food groupings may enable us to better compare studies of dietary patterns. Food frequency questionnaires, like that used in this study, are subject to measurement error and may not have included some typically consumed Southern foods (45) or foods common to certain races/ethnicities. Due to our case-control study design, recall bias is a possibility. Response bias may also have been introduced in our study, especially because the response rate was lower among African Americans than Whites, and lower among controls compared to cases. Although we over-sampled African Americans, the sample size for this subpopulation was relatively small (N=384). This resulted in less power to detect significant associations in African Americans and unstable risk estimates. Therefore, these findings should be interpreted with caution and need to be confirmed in a larger sample of African Americans.

In summary, this study used two different approaches to investigate the relationship between diet and rectal cancer risk: food group analysis and factor analysis. Our results showed that several food groups and dietary patterns are associated with rectal cancer risk. Some of the food groups yielded different associations with risk than the overall pattern with which it was highly correlated. Complex correlations between foods may be better captured by dietary patterns, which may also prove to be more amenable to translation into dietary recommendations, and easier to apply to improve the efficacy of nutrition intervention and prevention programs. Notably, our results suggest that dietary risk factors may differ by race, which highlights the importance of examining diet and cancer associations in racially diverse study populations.

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## Table 1

Characteristics of participants by case/control status and race (North Carolina Colon Cancer Study-Phase II)

| | Whites (N=1520) | | African Americans (N=384) | |
|---|---|---|---|---|
| | **Cases (n=720)** | **Controls (n=800)** | **Cases (n=225)** | **Controls (n=159)** |
| Sex (%) | | | | |
| Male | 58 | 61 | 52 | 52 |
| Age (years) (%) | | | | |
| 40–49 | 19 | 12 | 21 | 18 |
| 50–59 | 28 | 27 | 29 | 23 |
| 60–69 | 32 | 34 | 34 | 42 |
| 70–79 | 22 | 27 | 16 | 18 |
| Mean(SD) | 59.6(10.3) | 61.7(9.8) | 58.0(10.0) | 60.3(9.8) |
| Education (%) | | | | |
| <=High School | 50 | 39 | 62 | 59 |
| Some College | 25 | 26 | 22 | 26 |
| College grad/Adv degree | 25 | 35 | 16 | 16 |
| Annual Income (%) | | | | |
| <$20,000 | 21 | 18 | 47 | 52 |
| $20,000–$34,999 | 21 | 18 | 19 | 16 |
| $35,000–$49,999 | 15 | 15 | 11 | 8 |
| $50,000–$74,999 | 20 | 23 | 13 | 15 |
| >$75,000 | 24 | 27 | 11 | 10 |
| Body Mass Index (1yr ago) (%) | | | | |
| Normal (18.5–24.9 kg/m$^2$) | 23 | 30 | 18 | 18 |
| Overweight (25.0–29.9 kg/m$^2$) | 39 | 41 | 32 | 36 |
| Obese (≥30.0 kg/m$^2$) | 39 | 29 | 51 | 46 |
| Mean(SD) | 29.2(6.3) | 28.0(5.5) | 31.6(7.7) | 29.9(6.5) |
| Smoking Status (%) | | | | |
| Current Smoker | 16 | 14 | 23 | 17 |
| Former Smoker | 47 | 49 | 38 | 42 |
| Never Smoker | 37 | 38 | 39 | 41 |
| Mean(SD) years of smoking | 26.9(15.6) | 25.5(16.7) | 24.3(16.3) | 25.2(17.9) |
| Physical activity (MET-min/day*) (%) | | | | |
| Quartile 1 | 25.4 | 24.5 | 30.7 | 28.9 |
| Quartile 2 | 24.4 | 23.5 | 25.5 | 28.9 |
| Quartile 3 | 21.1 | 26.5 | 16.0 | 19.5 |
| Quartile 4 | 29.1 | 25.3 | 27.8 | 22.8 |
| Mean(SD) | 2250.0(661.8) | 2152.7(473.4) | 2178.4(545.5) | 2152.8(494.2) |
| NSAID use† (%) | | | | |
| Yes | 35 | 46 | 24 | 23 |
| First-degree family history of colorectal cancer (%) | | | | |
| Yes | 13 | 11 | 12 | 5 |

*Metabolic equivalent minutes per day

†greater than or equal to 15 non-steroidal anti-inflammatory drugs (NSAID) per month in the past 5 years

**Table 2**

Odds ratios and 95% confidence intervals for rectal cancer among Whites according to food groups (North Carolina Colon Cancer Study-Phase II)*

| Food Group (servings/week) | Q1 | Q2 | Q3 | Q4 | P for trend |
|---|---|---|---|---|---|
| Total grains | 154/202 (20.7)‡ | 161/199 (32.3) | 181/199 (41.5) | 224/200 (60.7) | |
| OR (95% CI) | 1.00 | 1.09 (0.77–1.55) | 1.21 (0.84–1.75) | 1.44 (0.92–2.25) | 0.09 |
| Whole grains | 204/200 (2.8) | 182/203 (6.3) | 174/198 (10.2) | 160/199 (16.4) | |
| OR (95% CI) | 1.00 | 1.03 (0.74–1.42) | 0.92 (0.66–1.27) | 0.93 (0.66–1.31) | 0.55 |
| Non-whole grains | 140/200 (14.7) | 149/201 (23.6) | 200/200 (32.3) | 231/199 (48.0) | |
| OR (95% CI) | 1.00 | 1.19 (0.83–1.71) | 1.46 (1.01–2.12) | 1.60 (1.01–2.53) | 0.04 |
| Total fruit | 243/204 (7.35) | 190/201 (14.3) | 136/199 (21.0) | 151/199 (32.2) | |
| OR (95% CI) | 1.00 | 0.83 (0.60–1.13) | 0.63 (0.45–0.87) | 0.62 (0.44–0.86) | 0.0021 |
| Citrus fruit | 223/200 (1.89) | 218/199 (5.6) | 145/201 (9.7) | 134/200 (16.4) | |
| OR (95% CI) | 1.00 | 0.97 (0.71–1.33) | 0.71 (0.51–0.99) | 0.61 (0.43–0.86) | 0.0012 |
| Other fruit | 232/202 (3.01) | 161/198 (7.1) | 177/200 (11.5) | 150/200 (18.5) | |
| OR (95% CI) | 1.00 | 0.74 (0.54–1.03) | 0.83 (0.60–1.14) | 0.67 (0.48–0.94) | 0.04 |
| Total vegetables | 207/202 (14.7) | 186/202 (23.7) | 149/165 (31.4) | 178/201 (44.6) | |
| OR (95% CI) | 1.00 | 0.97 (0.70–1.34) | 0.76 (0.53–1.09) | 0.73 (0.50–1.06) | 0.07 |
| Tomato | 197/201 (1.3) | 190/205 (2.4) | 168/197 (3.6) | 165/197 (6.5) | |
| OR (95% CI) | 1.00 | 1.00 (0.73–1.38) | 0.89 (0.63–1.25) | 0.86 (0.60–1.23) | 0.35 |
| Dark green vegetables | 277/206 (0.6) | 173/196 (1.7) | 152/198 (3.1) | 118/200 (6.4) | |
| OR (95% CI) | 1.00 | 0.68 (0.50–0.93) | 0.59 (0.43–0.81) | 0.41 (0.29–0.58) | <0.0001 |
| Deep yellow vegetables | 286/229 (0.5) | 149/181 (1.0) | 148/196 (1.8) | 137/194 (3.6) | |
| OR (95% CI) | 1.00 | 0.72 (0.52–0.99) | 0.60 (0.43–0.83) | 0.65 (0.46–0.90) | 0.02 |
| Beans and peas | 169/179 (0.1) | 211/233 (0.6) | 176/188 (1.2) | 164/200 (2.7) | |
| OR (95% CI) | 1.00 | 1.02 (0.74–1.41) | 0.97 (0.69–1.37) | 0.91 (0.64–1.30) | 0.52 |
| White potatoes | 112/209 (1.3) | 168/198 (3.3) | 178/189 (5.6) | 262/204 (9.3) | |
| OR (95% CI) | 1.00 | 1.57 (1.10–2.23) | 1.83 (1.27–2.63) | 2.55 (1.74–3.73) | <0.0001 |
| Other starchy vegetables | 204/204 (0.8) | 167/186 (1.8) | 185/210 (3.0) | 164/200 (5.2) | |
| OR (95% CI) | 1.00 | 0.77 (0.56–1.07) | 0.84 (0.61–1.17) | 0.64 (0.45–0.91) | 0.026 |
| Other vegetables | 232/204 (5.0) | 159/197 (8.3) | 173/200 (11.8) | 156/199 (18.5) | |
| OR (95% CI) | 1.00 | 0.76 (0.54–1.05) | 0.79 (0.56–1.09) | 0.66 (0.47–0.94) | 0.04 |
| Total dairy | 203/202 (3.6) | 208/201 (6.7) | 170/198 (10.9) | 139/199 (17.4) | |
| OR (95% CI) | 1.00 | 0.82 (0.59–1.12) | 0.66 (0.47–0.93) | 0.47 (0.32–0.69) | <0.0001 |
| Cheese | 189/191 (0.6) | 208/214 (1.5) | 155/194 (2.6) | 168/201 (5.9) | |
| OR (95% CI) | 1.00 | 1.02 (0.74–1.41) | 0.69 (0.48–0.99) | 0.73 (0.50–1.06) | 0.06 |
| Milk | 183/205 (1.4) | 190/198 (3.7) | 204/197 (6.6) | 143/200 (12.7) | |
| OR (95% CI) | 1.00 | 0.97 (0.70–1.35) | 1.02 (0.73–1.42) | 0.66 (0.46–0.95) | 0.017 |
| Yogurt | 435/430 (0.0) | 285/370 (0.42) | | | |
| OR (95% CI)† | 1.00 | 0.69 (0.53–0.89) | | | --- |
| Total meat | 154/200 (4.2) | 208/202 (7.0) | 184/198 (10.2) | 174/200 (15.7) | |
| OR (95% CI) | 1.00 | 1.29 (0.92–1.82) | 0.97 (0.67–1.40) | 0.78 (0.50–1.21) | 0.07 |
| Red meat | 148/199 (1.30) | 187/203 (2.7) | 198/198 (4.4) | 187/200 (7.8) | |
| OR (95% CI) | 1.00 | 1.14 (0.81–1.60) | 1.22 (0.85–1.74) | 0.85 (0.56–1.28) | 0.26 |
| Organ meat† | 380/425 (0.0) | 340/375 (0.23) | | | |
| OR (95% CI)† | 1.00 | 0.89 (0.70–1.13) | | | --- |
| Processed meat | 131/204 (0.3) | 178/202 (0.8) | 208/198 (1.6) | 203/196 (3.1) | |
| OR (95% CI) | 1.00 | 1.16 (0.82–1.64) | 1.45 (1.03–2.05) | 1.27 (0.87–1.85) | 0.26 |
| Fish | 233/194 (0.3) | 194/209 (0.9) | 157/197 (1.5) | 136/200 (2.7) | |
| OR (95% CI) | 1.00 | 0.72 (0.53–0.99) | 0.68 (0.48–0.94) | 0.52 (0.36–0.73) | 0.0004 |
| Poultry | 185/202 (0.6) | 210/199 (1.3) | 175/194 (2.2) | 150/205 (4.0) | |
| OR (95% CI) | 1.00 | 1.15 (0.83–1.59) | 0.96 (0.68–1.34) | 0.68 (0.47–0.98) | 0.01 |
| Eggs | 175/192 (0.6) | 175/209 (1.4) | 149/202 (2.5) | 221/197 (4.2) | |
| OR (95% CI) | 1.00 | 1.05 (0.75–1.47) | 0.81 (0.57–1.14) | 1.07 (0.76–1.50) | 0.86 |
| Nuts | 192/216 (0.2) | 188/189 (0.7) | 199/198 (1.5) | 141/197 (4.2) | |
| OR (95% CI) | 1.00 | 1.24 (0.90–1.71) | 1.26 (0.90–1.76) | 0.92 (0.64–1.32) | 0.24 |

| Food Group (servings/week) | Q1 | Q2 | Q3 | Q4 | P for trend |
|---|---|---|---|---|---|
| Soy | 558/578 (0.0) | 162/222 (0.07) | | | |
| OR (95% CI)[†] | 1.00 | 0.91 (0.70–1.20) | | | --- |
| Added sugar (g) | 163/200 (177.5) | 144/200 (314.0) | 171/200 (489.0) | 242/200 (832.7) | |
| OR (95% CI) | 1.00 | 0.84 (0.60–1.19) | 0.90 (0.63–1.28) | 1.19 (0.80–1.77) | 0.19 |
| Discretionary fat (g) | 146/200 (237.6) | 153/200 (373.7) | 205/200 (514.2) | 216/200 (745.9) | |
| OR (95% CI) | 1.00 | 0.99 (0.69–1.42) | 1.37 (0.92–2.05) | 1.32 (0.76–2.28) | 0.21 |

[*] adjusted for age, sex, education, income. BMI 1 year ago, physical activity, family history, non-steroidal anti-inflammatory drug use, and total energy intake

[†] OR represents consumers vs. non-consumers (referent)

[‡] number of cases/number of controls (median intake in controls)

**Table 3**

Odds ratios and 95% confidence intervals for rectal cancer among African Americans according to food groups (North Carolina Colon Cancer Study-Phase II)*

| Food Group (servings/week) | Q1 | Q2 | Q3 | Q4 | P for trend |
|---|---|---|---|---|---|
| Total grains | 64/40 (20.1)‡ | 60/40 (35.5) | 44/40 (45.5) | 57/39 (65.4) | |
| OR (95% CI) | 1.00 | 0.70 (0.35–1.41) | 0.55 (0.24–1.28) | 0.52 (0.19–1.40) | 0.19 |
| Whole grains | 72/41 (2.9) | 59/40 (6.3) | 52/39 (10.6) | 42/39 (18.9) | |
| OR (95% CI) | 1.00 | 1.19 (0.59–2.39) | 0.91 (0.45–1.83) | 0.67 (0.21–1.42) | 0.20 |
| Non-whole grains | 44/40 (14.4) | 71/40 (25.7) | 49/40 (37.5) | 61/39 (53.5) | |
| OR (95% CI) | 1.00 | 1.18 (0.58–2.43) | 0.83 (0.35–2.00) | 1.08 (0.37–3.12) | 0.99 |
| Total fruit | 42/40 (7.9) | 33/40 (13.7) | 73/41 (22.8) | 77/38 (38.5) | |
| OR (95% CI) | 1.00 | 0.91 (0.42–1.97) | 2.22 (1.05–4.72) | 1.90 (0.88–4.10) | 0.05 |
| Citrus fruit | 37/40 (2.3) | 60/40 (5.7) | 57/41 (10.6) | 71/38 (21.7) | |
| OR (95% CI) | 1.00 | 1.97 (0.94–4.17) | 1.67 (0.79–6.54) | 1.54 (0.71–3.35) | 0.68 |
| Other fruit | 41/40 (3.1) | 41/39 (7.4) | 43/41 (11.7) | 100/39 (20.4) | |
| OR (95% CI) | 1.00 | 1.18 (0.53–2.62) | 1.33 (0.61–2.90) | 3.25 (1.52–6.96) | 0.0004 |
| Total vegetables | 64/40 (11.7) | 26/40 (19.3) | 60/40 (27.4) | 75/39 (45.9) | |
| OR (95% CI) | 1.00 | 0.36 (0.17–0.79) | 0.79 (0.38–1.64) | 0.90 (0.40–2.04) | 0.58 |
| Tomato | 63/46 (0.6) | 55/31 (1.4) | 47/43 (2.4) | 60/39 (4.2) | |
| OR (95% CI) | 1.00 | 0.83 (0.40–1.72) | 0.58 (0.29–1.19) | 0.85 (0.40–1.81) | 0.64 |
| Dark green vegetables | 61/40 (0.7) | 39/40 (1.8) | 50/40 (3.6) | 75/39 (8.7) | |
| OR (95% CI) | 1.00 | 0.54 (0.25–1.15) | 0.58 (0.28–1.20) | 1.00 (0.48–2.08) | 0.42 |
| Deep yellow vegetables | 63/47 (0.3) | 45/31 (0.8) | 59/42 (1.5) | 58/39 (3.4) | |
| OR (95% CI) | 1.00 | 1.08 (0.52–2.26) | 0.72 (0.35–1.48) | 0.78 (0.36–1.66) | 0.45 |
| Beans and peas | 70/46 (0.1) | 71/35 (0.6) | 37/39 (1.3) | 47/39 (2.6) | |
| OR (95% CI) | 1.00 | 1.18 (0.60–2.31) | 0.57 (0.27–1.17) | 0.49 (0.23–1.07) | 0.02 |
| White potatoes | 50/41 (1.0) | 63/39 (2.8) | 45/40 (4.5) | 67/39 (8.9) | |
| OR (95% CI) | 1.00 | 0.96 (0.46–1.99) | 0.51 (0.23–1.14) | 0.97 (0.42–2.26) | 0.89 |
| Other starchy vegetables | 62/40 (0.8) | 52/42 (1.5) | 43/37 (2.7) | 68/40 (5.3) | |
| OR (95% CI) | 1.00 | 0.94 (0.46–1.94) | 0.61 (0.29–1.29) | 0.87 (0.40–1.87) | 0.75 |
| Other vegetables | 54/42 (3.6) | 38/38 (6.5) | 60/39 (8.8) | 73/40 (17.7) | |
| OR (95% CI) | 1.00 | 0.39 (0.18–0.82) | 0.75 (0.36–1.57) | 0.87 (0.39–1.90) | 0.66 |
| Total dairy | 37/40 (1.5) | 49/40 (3.4) | 66/40 (6.8) | 73/39 (13.3) | |
| OR (95% CI) | 1.00 | 0.93 (0.44–1.97) | 1.04 (0.47–2.32) | 1.18 (0.53–2.62) | 0.55 |
| Cheese | 49/36 (0.2) | 46/46 (0.8) | 68/39 (1.7) | 62/38 (4.6) | |
| OR (95% CI) | 1.00 | 0.633 (0.30–1.31) | 0.84 (0.39–1.81) | 1.04 (0.44–2.46) | 0.50 |
| Milk | 37/36 (0.6) | 62/44 (2.1) | 60/39 (4.1) | 66/40 (8.6) | |
| OR (95% CI) | 1.00 | 0.94 (0.45–1.96) | 0.78 (0.35–1.75) | 0.90 (0.41–1.95) | 0.85 |
| Yogurt | 142/104 (0.0) | 83/55 (0.21) | | | |
| OR (95% CI)† | 1.00 | 1.08 (0.62–1.87) | | | --- |
| Total meat | 56/40 (4.2) | 34/39 (7.0) | 78/41 (11.6) | 57/39 (18.9) | |
| OR (95% CI) | 1.00 | 0.42 (0.19–0.92) | 1.03 (0.50–2.14) | 0.59 (0.22–1.56) | 0.65 |
| Red meat | 58/41 (1.0) | 39/39 (2.3) | 65/39 (3.7) | 63/40 (8.8) | |
| OR (95% CI) | 1.00 | 0.52 (0.25–1.08) | 0.97 (0.48–1.97) | 0.72 (0.30–1.71) | 0.70 |
| Organ meat | 65/56 (0.0) | 160/103 (0.09) | | | |
| OR (95% CI)† | 1.00 | 1.09 (0.63–1.87) | | | --- |
| Processed meat | 44/41 (0.3) | 84/38 (1.0) | 43/42 (2.0) | 54/38 (3.5) | |
| OR (95% CI) | 1.00 | 1.73 (0.86–3.49) | 0.48 (0.21–1.08) | 0.89 (0.37–2.11) | 0.23 |
| Fish | 43/39 (0.3) | 61/41 (0.9) | 69/41 (2.0) | 52/38 (3.2) | |
| OR (95% CI) | 1.00 | 1.68 (0.80–3.54) | 1.29 (0.62–2.58) | 1.14 (0.51–2.54) | 0.88 |
| Poultry | 49/40 (0.7) | 69/43 (1.7) | 52/36 (2.9) | 55/40 (5.0) | |
| OR (95% CI) | 1.00 | 1.27 (0.63–2.55) | 1.18 (0.57–2.44) | 1.17 (0.53–2.59) | 0.82 |
| Eggs | 57/42 (0.7) | 45/38 (1.8) | 57/40 (3.1) | 66/39 (6.6) | |
| OR (95% CI) | 1.00 | 0.78 (0.38–1.60) | 1.18 (0.59–2.35) | 1.53 (0.73–3.20) | 0.16 |
| Nuts | 60/41 (0.1) | 62/37 (0.4) | 36/40 (0.9) | 67/41 (2.4) | |

| Food Group (servings/week) | Q1 | Q2 | Q3 | Q4 | P for trend |
|---|---|---|---|---|---|
| OR (95% CI) | 1.00 | 0.90 (0.44–1.81) | 0.40 (0.18–0.86) | 0.73 (0.34–1.58) | 0.57 |
| Soy | 176/128 (0.0) | 49/31 (0.04) | | | |
| OR (95% CI)[†] | 1.00 | 0.97 (0.52–1.81) | | | --- |
| Added sugar (g) | 38/40 (188.7) | 41/39 (351.7) | 55/41 (645.1) | 91/39 (1036.3) | |
| OR (95% CI) | 1.00 | 1.20 (0.57–2.50) | 1.64 (0.74–3.66) | 2.65 (1.11–6.34) | 0.02 |
| Discretionary fat (g) | 57/40 (222.5) | 42/40 (387.7) | 67/40 (551.2) | 59/39 (823.2) | |
| OR (95% CI) | 1.00 | 0.45 (0.21–0.97) | 0.51 (0.21–1.25) | 0.31 (0.09–1.11) | 0.10 |

*adjusted for age, sex, education, income, BMI 1 year ago, physical activity, family history, non-steroidal anti-inflammatory drug use, and total energy intake

†OR represents consumers vs. non-consumers (referent)

‡number of cases/number of controls (median intake in controls)

## Table 4

Factor loading matrix for the 3 major dietary patterns identified among race-specific controls in the North Carolina Colon Cancer Study-Phase II*

| | Whites | | | African Americans | | |
|---|---|---|---|---|---|---|
| | **Factor 1: "High fat/Meat/ Potatoes"** | **Factor 2: "Veg/Fish/Poultry"** | **Factor 3: "Fruit/Whole-grain/Dairy"** | **Factor 1: "High fat/Meat/ Potatoes"** | **Factor 2: "Fruit/Vegetables"** | **Factor 3: "Legumes/Dairy"** |
| Discretionary fat | 0.86 | - | - | 0.80 | - | 0.45 |
| Non-Whole grains | 0.77 | - | 0.22 | 0.73 | - | 0.39 |
| Beef/Pork/Lamb | 0.72 | 0.21 | - | 0.76 | - | - |
| White potatoes | 0.65 | - | - | 0.60 | - | - |
| Added sugar | 0.57 | −0.31 | - | 0.47 | - | - |
| Processed meat | 0.49 | - | - | 0.68 | - | - |
| Cheese | 0.49 | 0.24 | - | 0.55 | 0.20 | - |
| Eggs | 0.40 | - | −0.20 | 0.50 | - | - |
| Nuts | 0.31 | - | 0.28 | - | - | 0.72 |
| Beans and peas | 0.27 | 0.22 | 0.26 | 0.26 | - | 0.69 |
| Other vegetables | 0.21 | 0.73 | 0.26 | 0.20 | 0.69 | 0.35 |
| Dark green vegetables | - | 0.71 | - | −0.30 | 0.61 | 0.30 |
| Poultry | 0.22 | 0.54 | - | 0.37 | 0.30 | - |
| Fish | - | 0.51 | - | 0.25 | - | - |
| Deep yellow vegetables | - | 0.47 | 0.37 | - | 0.70 | 0.24 |
| Tomato | 0.34 | 0.37 | 0.27 | 0.38 | 0.50 | - |
| Other fruit | - | - | 0.70 | - | 0.68 | - |
| Citrus fruit | - | - | 0.56 | - | 0.48 | −0.21 |
| Whole grains | - | - | 0.56 | - | 0.20 | 0.31 |
| Milk/Yogurt | - | - | 0.51 | - | - | 0.48 |
| Other starchy vegetables | 0.28 | 0.27 | 0.37 | 0.37 | 0.59 | - |
| *variance explained* | *3.75%* | *2.39%* | *2.14%* | *4.12%* | *2.89%* | *2.10%* |

* factor loadings < |0.20| are indicated by "-"

## Table 5

Correlation coefficients for relations between dietary patterns and other selected variables

| | Whites | | | African Americans | | |
|---|---|---|---|---|---|---|
| | Factor 1: “High fat/ Meat/Potatoes” | Factor 2: “Veg/Fish/Poultry” | Factor 3: “Fruit/Whole-grain/Dairy” | Factor 1: “High fat/ Meat/Potatoes” | Factor 2: “Fruit/Vegetables” | Factor 3: “Legumes/Dairy” |
| Age† | −0.18 (−0.23, −0.13) | −0.08 (−0.13, −0.03) | 0.17 (0.12, 0.22) | −0.15 (−0.24, −0.05) | 0.11 (0.01, 0.21) | 0.09 (−0.01, 0.19)‡ |
| Education* | −0.14 (−0.19, −0.09) | 0.30 (0.25, 0.35) | 0.05 (−0.00, 0.10) | −0.07 (−0.17, 0.03)‡ | 0.12 (0.02, 0.21) | −0.04 (−0.14, 0.06)‡ |
| BMI 1 yr ago† | 0.11 (0.06, 0.16) | 0.02 (−0.03, 0.07)‡ | −0.07 (−0.12, −0.02) | −0.09 (−0.19, 0.01)‡ | 0.08 (−0.02, 0.18)‡ | −0.05 (−0.15, 0.05)‡ |
| Annual income* | 0.01 (−0.04, 0.07)‡ | 0.26 (0.22, 0.31) | −0.07 (−0.12, −0.02) | 0.03 (−0.08, 0.13)‡ | −0.01 (−0.11, 0.10)‡ | 0.07 (−0.03, 0.18)‡ |
| Daily intakes | | | | | | |
| Energy(kcal)† | 0.86 (0.85, 0.87) | 0.10 (0.05, 0.15) | 0.35 (0.31, 0.40) | 0.82 (0.79, 0.85) | 0.28 (0.18, 0.37) | 0.43 (0.35, 0.51) |
| Total fat(g)† | 0.51 (0.47, 0.54) | 0.09 (0.04, 0.14) | −0.43 (−0.47, −0.39) | 0.28 (0.19, 0.37) | −0.16 (−0.25, −0.06) | 0.27 (0.17, 0.36) |
| Carbohydrates(g)† | −0.28 (−0.33, −0.24) | −0.35 (−0.40, −0.31) | 0.60 (0.56, 0.63) | −0.25 (−0.34, −0.14) | 0.18 (0.09, 0.28) | −0.17 (−0.27, −0.07) |
| Protein(g)† | 0.10 (0.05, 0.15) | 0.58 (0.55, 0.61) | −0.10 (−0.15, −0.05) | 0.18 (0.08, 0.27) | 0.29 (0.19, 0.38) | 0.15 (0.05, 0.24) |
| Alcohol(g)† | −0.31 (−0.35, −0.26) | 0.15 (0.10, 0.20) | −0.20 (−0.25, −0.15) | −0.18 (−0.27, −0.08) | −0.13 (−0.23, −0.03) | −0.10 (−0.20, 0.00) |
| Folate(μg)† | −0.43 (−0.47, −0.39) | 0.46 (0.42, 0.50) | 0.49 (0.45, 0.53) | −0.45 (−0.53, −0.37) | 0.66 (0.60, 0.71) | 0.29 (0.19, 0.38) |
| Fiber(g)† | −0.52 (−0.55, −0.48) | 0.50 (0.46, 0.54) | 0.66 (0.63, 0.68) | −0.54 (−0.61, −0.46) | 0.77 (0.72, 0.80) | 0.41 (0.32, 0.49) |

* Spearman correlation coefficients presented for these variables.

† Pearson correlation coefficients presented for these variables. Correlations for all nutrients are partial correlations adjusted for energy.

‡ P-value ≥ 0.05

## Table 6

Odds ratios and 95% confidence intervals for rectal cancer according to dietary pattern quartiles, by race (North Carolina Colon Cancer Study-Phase II) *

| Dietary Pattern | Q1 | Q2 | Q3 | Q4 | P for trend |
|---|---|---|---|---|---|
| Whites | | | | | |
| High fat/Meat/Potatoes | | | | | |
| Cases/controls | 126/200 | 148/200 | 221/200 | 225/200 | |
| OR (95% CI) | 1.00 | 1.25 (0.86–1.80) | 1.80 (1.21–2.68) | 1.84 (1.08–3.15) | <0.0001 |
| Veg/Fish/Poultry | | | | | |
| Cases/controls | 266/200 | 214/200 | 118/200 | 122/200 | |
| OR (95% CI) | 1.00 | 1.00 (0.74–1.35) | 0.57 (0.40–0.80) | 0.47 (0.33–0.67) | <0.0001 |
| Fruit/Whole-grain/Dairy | | | | | |
| Cases/controls | 221/200 | 196/200 | 155/200 | 148/200 | |
| OR (95% CI) | 1.00 | 1.04 (0.76–1.43) | 0.78 (0.56–1.09) | 0.65 (0.45–0.93) | <0.0001 |
| African Americans | | | | | |
| High fat/Meat/Potatoes | | | | | |
| Cases/controls | 45/39 | 59/41 | 59/39 | 62/40 | |
| OR (95% CI) | 1.00 | 0.81 (0.39–1.70) | 0.79 (0.33–1.91) | 0.89 (0.27–3.00) | 0.80 |
| Fruit/Vegetables | | | | | |
| Cases/controls | 52/40 | 37/40 | 59/39 | 77/40 | |
| OR (95% CI) | 1.00 | 0.77 (0.35–1.70) | 1.01 (0.49–2.07) | 1.50 (0.71–3.18) | <0.0001 |
| Legumes/Dairy | | | | | |
| Cases/controls | 57/39 | 46/40 | 57/41 | 65/39 | |
| OR (95% CI) | 1.00 | 0.83 (0.40–1.73) | 0.79 (0.39–1.59) | 0.74 (0.35–1.59) | <0.0001 |

* adjusted for age, sex, education, income, BMI 1 year ago, physical activity, family history, non-steroidal anti-inflammatory drug use, and total energy intake