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ORIGINAL REPORT

Associations of Pre- and Postdiagnosis Diet Quality With Risk of Mortality Among Men and Women With Colorectal Cancer

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A B S T R A C T

Purpose
Dietary patterns, indicators of overall diet quality, are associated with colorectal cancer (CRC) incidence but less consistently with mortality among CRC survivors. We prospectively evaluated associations of diet quality pre- and postdiagnosis with risk of mortality among men and women with CRC.

Patients and Methods
In the Cancer Prevention Study-II Nutrition Cohort, 2,801 participants were cancer free at baseline in 1992/1993 and subsequently diagnosed with invasive, nonmetastatic CRC during follow-up through June 2013. Pre- and postdiagnosis diet data were available for 2,671 and 1,321 participants, respectively, among whom 1,414 and 722 died. Concordance with the Dietary Approaches to Stop Hypertension (DASH), American Cancer Society nutrition guidelines (ACS-score), prudent, and Western dietary patterns was used to evaluate diet quality.

Results
Extreme scoring group comparisons showed that prediagnosis ACS-score was inversely associated with all-cause (hazard ratio high v low [$HR_{High v Low}$], 0.78; 95% CI, 0.65 to 0.95) and CRC-specific ($HR_{High v Low}$, 0.74; 95% CI, 0.54 to 1.03) mortality, whereas the Western diet score was associated with higher all-cause mortality ($HR_{High v Low}$, 1.30; 95% CI, 1.03 to 1.64). For postdiagnosis diet, the ACS-score was associated with lower risk of all-cause ($HR_{High v Low}$, 0.62; 95% CI, 0.47 to 0.83) and CRC-specific ($HR_{High v Low}$, 0.35; 95% CI, 0.17 to 0.73) mortality, the DASH score was inversely associated with all-cause ($HR_{High v Low}$, 0.79; 95% CI, 0.62 to 0.99) and CRC-specific ($HR_{High v Low}$, 0.56; 95% CI, 0.35 to 0.89) mortality, and the prudent score was inversely associated with all-cause mortality ($HR_{High v Low}$, 0.72; 95% CI, 0.56 to 0.93). Among participants with a low diet quality before diagnosis, improved DASH (HR, 0.54; 95% CI, 0.31 to 0.92) and prudent (HR, 0.53; 95% CI, 0.29 to 0.95) scores from pre- to postdiagnosis were inversely associated with CRC-specific mortality.

Conclusion
Dietary patterns reflective of high intakes of plant foods and low intakes of animal products before and after CRC diagnosis are associated with longer survival.

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INTRODUCTION

There are more than 1.4 million colorectal cancer (CRC) survivors in the United States who need information on modifiable behaviors that may improve their CRC prognosis.[1] Epidemiologic studies suggest a strong influence of diet quality in CRC etiology.[2,3] Evidence also suggests that some pre- and postdiagnosis dietary components are related to survival in men and women with CRC.[4-6] Studies of dietary patterns to assess overall diet quality in relation to overall and CRC-specific

mortality are inconsistent.[7-12] Methodological inconsistencies in the timing of exposure assessment relative to diagnosis, exposure, and outcome definitions and small sample sizes have limited the comparability of these results, which makes the development of evidence-based recommendations for CRC survivors difficult.

To date, no individual study has assessed associations of both prediagnosis and postdiagnosis diet quality or a change in diet quality with risk of mortality among CRC survivors. By using data from the large, prospective Cancer Prevention Study-II (CPS-II) Nutrition Cohort of

men and women, we examined the associations of two hypothesis-driven dietary pattern scores and two data-driven dietary patterns assessed before and after a CRC diagnosis with risk of overall, CRC-specific, and cardiovascular disease (CVD)–specific mortality.

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PATIENTS AND METHODS

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Study Population

Study participants were identified from among the 184,185 men and women in the CPS-II Nutrition Cohort, a prospective study of cancer incidence and mortality initiated in 1992/1993.[13] Participants completed a 10-page self-administered questionnaire at enrollment to ascertain information on risk factors. Follow-up questionnaires were sent biennially starting in 1997 to update information. The institutional review board at Emory University approved the CPS-II Nutrition Cohort study.

We identified 4,439 participants with no history of CRC at baseline who were diagnosed with invasive cancer of the colon or rectum by the end of incidence follow-up on June 30, 2013. Exclusions were made for the following reasons: diagnosis identified through the National Death Index (NDI) that could not be verified with cancer registries (n = 346)[14], prior diagnosis of cancer other than nonmelanoma skin cancer at baseline (n = 429), implausible diagnosis date (n = 14), missing or unknown stage (n = 153), distant metastatic stage at diagnosis (n = 474), non-adenocarcinoma (n = 56), and death date same as diagnosis date (n = 2). An additional 294 participants were excluded because of poor reporting of diet (fewer than 550 or more than 3,500 kcal/d for women, fewer than 650 or more than 4,000 kcal/d for men, or 10 or more line items left blank), which brought the final sample size for the prediagnosis analytic cohort to 2,671.

Among the 2,671 men and women included in the prediagnosis sample, 1,191 completed a valid food frequency questionnaire (FFQ) after their diagnosis. An additional 130 participants completed a postdiagnosis FFQ but not a prediagnosis FFQ; thus, they were included in the postdiagnosis analysis only, which brought the final sample size for the postdiagnosis analysis to 1,321.

Assessment of Dietary Intakes

Average dietary intakes over the previous year were self-reported on validated FFQs administered in 1992 or 1993 (baseline), 1999, and 2003. The 1992/1993 baseline diet data from the modified Block FFQ were used to calculate prediagnosis dietary patterns.[15,16] Postdiagnosis dietary patterns were calculated from modified Willett FFQs in 1999 or 2003, whichever came first after the patient's CRC diagnosis.[17,18]

Dietary Quality

Both hypothesis- and data-driven dietary patterns were used to assess diet quality. Hypothesis-driven dietary patterns were based on nutritional recommendations and/or knowledge of diet-disease associations. The Dietary Approaches to Stop Hypertension (DASH) diet was originally developed in randomized trials to reduce blood pressure but also has been used in other contexts.[19] The DASH score is based on high sex-specific quintile rankings of intakes for fruits, vegetables, whole grains, low-fat dairy products, and legumes/seeds and low rankings for saturated fat, sodium, and added sugars. The American Cancer Society Guidelines on Nutrition and Physical Activity for Cancer Prevention[20] have been previously adapted to create a dietary pattern score (ACS-score).[21,22] The ACS-score is based on consumption of at least five servings per day of fruits and vegetables, a high variety of fruits and vegetables, whole grains more so than refined grains, and limited red/processed meat. Scoring criteria for the DASH and ACS-scores are listed in Appendix Table A1 (online only).

We identified prudent and Western dietary patterns in CPS-II at both the pre- and postdiagnosis time points using a data-driven approach. Principal component analysis identifies food groups that explain the most variation in intakes. Factor loadings represent the correlation between a food group with the overall pattern and are used as the food group's scoring weight in calculating a dietary pattern score. In the CPS-II Nutrition Cohort, principal component analysis–derived patterns were determined with 37 food groups and an orthogonal rotation to derive uncorrelated patterns that have a clearer interpretation. The prudent pattern is characterized by high intakes of fruits and vegetables, whole grains, legumes, and fish. The Western pattern is characterized by high intakes of refined grains, red and processed meats, eggs, solid fats, and salty snacks. Detailed information on the factor loadings for each dietary pattern are listed in Appendix Table A2 (online only).

Study Outcomes

Vital status, cause of death, and date of death were determined through linkage to the NDI through December 31, 2014. Cause of death was obtained for 99.3% of all known deaths in the CPS-II Nutrition Cohort. The primary outcomes were all-cause and CRC-specific mortality (International Classification of Diseases, 10th Revision, codes C18 to C20). Secondary outcomes were death as a result of CVD (International Classification of Diseases, 10th Revision, codes I00 to I99) and all other remaining causes combined. The cause-specific outcomes were mutually exclusive and defined by the singular underlying cause of death reported in the NDI.

Statistical Analysis

Cox proportional hazards regression models were used to calculate hazard ratios (HRs) and 95% CIs. Quartiles were calculated for DASH, prudent, and Western dietary patterns. The ACS-score was grouped for values of 0 to 2, 3 to 4, 5 to 6, and 7 to 9. The first quartile or lowest scoring group was the referent for all analyses. For continuous models, a 1-standard deviation (SD) increase in each diet score was calculated to allow for comparability between the scores. The median score of each category was assigned to all participants within that category and entered as a continuous exposure in Cox models to test for linear trends. For prediagnosis diet quality, person-time was calculated from the date of CRC diagnosis to the first instance of death, censoring, or end of study. Person-time in the postdiagnosis diet quality analysis was calculated from the date of postdiagnosis FFQ completion to the first instance of death, censoring, or end of study. Delayed-entry Cox models were used in the postdiagnosis models to account for the time between cancer diagnosis and postdiagnosis FFQ completion. Multivariable models included age at diagnosis, year of diagnosis, sex, tumor stage, total caloric intake, body mass index (BMI), education, smoking status, and cancer treatment. Physical activity, alcohol consumption, ethnicity, nonsteroidal anti-inflammatory drug use, postmenopausal hormone use (women only), multivitamin use, family history of CRC, and comorbidities (diabetes, stroke, myocardial infarction, or hypertension) also were evaluated as potential confounders, but these made minimal differences to the results and were not included in the final models. In postdiagnosis models, total caloric intake and BMI were from the same questionnaire as the postdiagnosis FFQ. Postdiagnosis models included a variable for weight change (from pre- to postdiagnosis) as a proxy for illness-related weight loss. Likelihood ratio tests assessed time-dependent effects. Subgroup analyses for prediagnosis diet were performed across strata of age at diagnosis (younger than 70 years, 70 years or older), sex (female, male), cancer site (colon, rectum), stage (localized, regional), baseline BMI (less than 25.0 kg/m^2, greater than or equal to 25 kg/m^2), and physical activity (fewer than 10 metabolic equivalents of task hours/week, greater than or equal to 10 metabolic equivalents of task hours/week); power was inadequate for postdiagnosis stratified analyses.

Change in diet quality from pre- to post-CRC diagnosis was examined among the 1,191 men and women with both pre- and postdiagnosis dietary data, using low and high scores defined at the median cut point for each score. Men and women below the median at both time points (low/low) served as the referent.

Sensitivity analyses evaluated the robustness of our findings to potential biases. The potential for reverse causation in prediagnosis models

was determined by excluding participants diagnosed within 2 years of completing the baseline FFQ and separately by excluding those who self-reported a history of diabetes, hypertension, myocardial infarction, or stroke. Prediagnosis models also were examined only among men and women diagnosed with distant metastatic CRC. In the postdiagnosis models, participants who completed their FFQ within 12 months of CRC diagnosis were excluded to account for the potential influence of adverse treatment effects on diet, and in another model, the first 2 years of follow-up after completion of the postdiagnosis FFQ were excluded. Finally, prediagnosis diet may confound the relationship between postdiagnosis diet and mortality and therefore was included as a covariable in a sensitivity analysis. All statistical analyses were conducted using SAS 9.3 software (SAS Institute, Cary, NC).

RESULTS

Mean ages at baseline and CRC diagnosis were 64 years (SD, 5.8 years) and 73 years (SD, 7.0 years), respectively. Baseline characteristics of pre- and postdiagnosis analytic cohorts are listed in Table 1. Among the entire cohort (n = 2,801), 75.3% of tumors occurred in the colon, and slightly more were localized (n = 1,407) than regional (n = 1,394). Dietary patterns were moderately correlated at both time points (Appendix Table A3, online only). In the prediagnosis cohort, 1,414 deaths occurred, with 494 attributable to CRC and 321 to CVD. The average time from completion of the baseline FFQ to CRC diagnosis was 9.0 years (minimum, 27 days; maximum, 20.7 years). The mean follow-up time from diagnosis to end of follow-up was 6.5 years (minimum, 2 days; maximum, 21.0 years) among participants who died and 11.4 years (minimum, 1.5 years; maximum, 22.1 years) among those who were alive at the end of follow-up in the prediagnosis analytic cohort.

In the postdiagnosis analytic cohort, 722 total deaths occurred, with 177 attributable to CRC and 195 to CVD. The mean time from diagnosis to completion of the FFQ was 2.6 years (median, 2.3 years; minimum, 2 days; maximum, 9.9 years). Mean follow-up time after completion of FFQ was 6.4 years (minimum, 19 days; maximum, 15.2 years) among participants who died and 13.5 years (minimum, 10.9 years; maximum 15.3 years) among those who were alive at the end of follow-up.

Prediagnosis Diet Quality

The highest compared with the lowest ACS-score category was associated with a 22% lower risk of all-cause mortality (95% CI, 5% to 35%; Table 2). Significant inverse trends were observed for the ACS-score in relation to all-cause (P_{trend} = .008) and CRC-specific (P_{trend} = .03) mortality. For the highest quartile of prediagnosis Western dietary pattern, there was a 30% (95% CI, 3% to 64%) higher risk of death compared with the lowest quartile. No discernable differences were observed for the associations between diet quality and all-cause mortality across strata of age at diagnosis, sex, cancer site, stage, BMI, or physical activity (data not shown).

Postdiagnosis Diet Quality

Higher postdiagnosis scores for DASH, ACS-score, and prudent dietary patterns were significantly associated with lower all-cause mortality (Table 3). Participants with the highest versus lowest scores were at 21%, 38%, and 28% lower risk of all-cause

Table 1. Population Characteristics of Pre- and Postdiagnosis Analytic Cohorts of Men and Women With CRC in the Cancer Prevention Study-II Nutrition Cohort

Characteristic	Cohort, No. (%)	
	Prediagnosis	Postdiagnosis
No. of participants	2,671	1,321
Continuous*		
DASH score†	23.9 (4.81)	24 (4.91)
ACS dietary guidelines score‡	4.2 (2.09)	4.3 (2.02)
Prudent diet score§	—	—
Western diet score§	—	—
Age at baseline	64.1 (5.83)	64.6 (5.73)
Age at diagnosis	73.6 (7.01)	70.6 (6.06)
BMI,‖ kg/m²	26.4 (4.28)	26.1 (4.55)
METs,‖ hours/week	12.6 (12.77)	14.7 (14.54)
Caloric intake,‖ kcal/d	1,588.7 (600.52)	1,728.1 (573.66)
Categorical		
Sex		
Female	1,228 (46.0)	577 (43.7)
Male	1,443 (54.0)	744 (56.3)
Stage		
Localized	1,344 (50.3)	731 (55.3)
Regional	1,327 (49.7)	590 (44.7)
Site		
Colon	2,012 (75.3)	950 (71.9)
Rectum	659 (24.7)	371 (28.1)
Treatment		
Single modality	1,127 (42.2)	622 (47.1)
Double modality	634 (23.7)	441 (33.4)
Triple modality	156 (5.8)	77 (5.8)
None	38 (1.4)	17 (1.3)
Unknown/missing	716 (26.8)	164 (12.4)
Ethnicity		
White	2,611 (97.8)	1,291 (97.7)
Black	30 (1.1)	17 (1.3)
Other	24 (0.9)	10 (0.8)
Unknown/missing	6 (0.2)	3 (0.2)
Smoking status		
Never	1,061 (39.7)	497 (37.6)
Former	1,377 (51.6)	707 (53.5)
Current	219 (8.2)	100 (7.6)
Unknown/missing	14 (0.5)	17 (1.3)
Family history of CRC		
No	2,503 (93.7)	1,236 (93.6)
Yes	168 (6.3)	85 (6.4)
Education		
Less than high school	176 (6.6)	95 (7.2)
High school graduate	739 (27.7)	357 (27)
Some college	804 (30.1)	405 (30.7)
College graduate	940 (35.2)	456 (34.5)
Unknown/missing	12 (0.4)	8 (0.6)

Abbreviations: BMI, body mass index; CRC, colorectal cancer; DASH, Dietary Approaches to Stop Hypertension; MET, metabolic equivalent of task.
*Reported as mean (standard deviation).
†Scoring range from 8 to 40 points.
‡Scoring range from 0 to 9 points.
§Centered at a mean of 0 and scaled to a standard deviation of 1 as a part of principal component analysis derivation.
‖Variables derived from surveys corresponding to pre- and postdiagnosis diet assessment.

mortality for DASH (95% CI, 1% to 38%), ACS-score (95% CI, 17% to 53%), and prudent (95% CI, 7% to 44%) dietary patterns, respectively. Inverse associations of DASH (P_{trend} = .01) and ACS-score (P_{trend} = .01) with risk of CRC-specific mortality were observed, whereas a significant trend was found with increasing Western diet quartiles (P_{trend} = .04). The highest compared with the lowest ACS-score showed a 65% lower risk of CRC mortality

Table 2. HRs for the Association With Prediagnosis Dietary Patterns and Scores With Mortality Among Men and Women With CRC

	Total Mortality		CRC-Specific Mortality		CVD-Specific Mortality		All Other Mortality	
Dietary Pattern	No. of Deaths	HR (95% CI)	No. of Deaths	HR (95% CI)	No. of Deaths	HR (95% CI)	No. of Deaths	HR (95% CI)
DASH quartiles (score range)								
First (10-20)	363	1.00 (ref)	130	1.00 (ref)	73	1.00 (ref)	160	1.00 (ref)
Second (21-23)	283	0.92 (0.78 to 1.08)	103	1.02 (0.78 to 1.33)	61	0.87 (0.61 to 1.24)	119	0.87 (0.68 to 1.11)
Third (24-27)	428	1.01 (0.87 to 1.17)	145	0.99 (0.77 to 1.27)	107	1.16 (0.84 to 1.58)	176	0.95 (0.76 to 1.20)
Fourth (28-39)	340	0.92 (0.78 to 1.08)	116	0.97 (0.74 to 1.28)	80	0.86 (0.60 to 1.21)	144	0.88 (0.69 to 1.12)
P_{trend}		.45		.82		.62		.40
Continuous*		0.96 (0.91 to 1.02)		0.95 (0.86 to 1.05)		0.94 (0.84 to 1.06)		0.96 (0.88 to 1.05)
ACS-score								
0-2	325	1.00 (ref)	121	1.00 (ref)	64	1.00 (ref)	140	1.00 (ref)
3-4	489	0.95 (0.82 to 1.10)	177	0.98 (0.77 to 1.25)	100	0.94 (0.68 to 1.30)	212	0.96 (0.76 to 1.19)
5-6	394	0.90 (0.77 to 1.04)	129	0.84 (0.65 to 1.09)	106	1.09 (0.79 to 1.52)	159	0.85 (0.67 to 1.09)
7-9	206	0.78 (0.65 to 0.95)	67	0.74 (0.54 to 1.03)	51	0.84 (0.56 to 1.26)	88	0.80 (0.60 to 1.06)
P_{trend}		.008		.03		.77		.07
Continuous*		0.92 (0.87 to 0.97)		0.92 (0.83 to 1.00)		0.96 (0.85 to 1.08)		0.91 (0.83 to 0.99)
Prudent quartiles								
First (−2.03 to −0.67)	379	1.00 (ref)	125	1.00 (ref)	84	1.00 (ref)	170	1.00 (ref)
Second (−0.66 to −0.17)	333	0.85 (0.73 to 1.00)	129	1.03 (0.80 to 1.34)	66	0.77 (0.55 to 1.07)	138	0.77 (0.61 to 0.97)
Third (−0.16-0.48)	350	0.88 (0.75 to 1.03)	124	0.94 (0.72 to 1.22)	83	0.91 (0.66 to 1.26)	143	0.81 (0.64 to 1.03)
Fourth (0.49-8.59)	352	0.85 (0.73 to 1.00)	116	0.85 (0.64 to 1.13)	88	0.86 (0.61 to 1.20)	148	0.82 (0.64 to 1.05)
P_{trend}		.11		.18		.63		.23
Continuous*		0.96 (0.90 to 1.02)		0.93 (0.84 to 1.03)		0.98 (0.87 to 1.11)		0.97 (0.88 to 1.06)
Western quartiles								
First (−1.97 to −0.73)	316	1.00 (ref)	119	1.00 (ref)	69	1.00 (ref)	128	1.00 (ref)
Second (−0.72 to −0.17)	340	1.14 (0.97 to 1.34)	121	1.15 (0.88 to 1.51)	84	1.20 (0.85 to 1.69)	135	1.14 (0.88 to 1.47)
Third (−0.16-0.53)	372	1.19 (0.99 to 1.42)	125	1.20 (0.89 to 1.62)	93	1.10 (0.75 to 1.60)	154	1.23 (0.93 to 1.62)
Fourth (0.54-5.14)	386	1.30 (1.03 to 1.64)	129	1.30 (0.88 to 1.91)	75	0.86 (0.51 to 1.44)	182	1.63 (1.14 to 2.31)
P_{trend}		.03		.20		.47		.006
Continuous*		1.08 (0.98 to 1.19)		1.06 (0.90 to 1.25)		1.05 (0.85 to 1.30)		1.14 (0.98 to 1.32)

NOTE. Multivariable model adjusted for age at diagnosis, year of diagnosis, sex, stage, total caloric intake, body mass index, education, smoking status, and treatment.
Abbreviations: ACS-score, American Cancer Society nutrition guidelines; CRC, colorectal cancer; CVD, cardiovascular disease; DASH, Dietary Approaches to Stop Hypertension; HR, hazard ratio; ref, referent.
*HR for a 1-standard deviation increase in the score.

(95% CI, 27% to 83%) and 41% lower risk of mortality as a result of all other remaining causes combined (95% CI, 11% to 61%). No association between the prudent diet and CRC-specific mortality was observed, but there was a significant inverse trend with all other remaining causes of death (P_{trend} = .02).

Change in Diet Quality From Pre- to Postdiagnosis

Although the results were not all statistically significant for the DASH, ACS-score, and prudent dietary patterns, HRs were consistently less than 1 for the low/high group and high/high group compared with the low/low group in relation to total and CRC-specific mortality (Table 4). Conversely, participants with high Western diet scores either before or after diagnosis were at increased risk of total and CRC-specific mortality compared with those with low scores at both time points (low/low).

Sensitivity Analyses

No substantive differences in HRs were observed in sensitivity analyses (Appendix Tables A4 to A9, online only).

DISCUSSION

In this prospective cohort of 2,801 men and women diagnosed with CRC, pre- and postdiagnosis diets that were consistent with

the ACS Guidelines on Nutrition and Physical Activity for Cancer Prevention were inversely associated with all-cause and CRC-specific mortality. Additional diet patterns and scores that also were based on plant foods and low red and processed meat consumption corroborated these main findings, which suggests the importance of diet quality as a potentially modifiable tool to improve prognosis among men and women with CRC. In this first study to our knowledge that considered change in diet quality across the CRC continuum, these results suggest that high diet quality after diagnosis, even if poor before, may be associated with a lower risk of mortality.

Results of other studies that used dietary patterns to evaluate diet quality in relation to mortality among CRC survivors have been inconsistent.[7-12] In the prospective National Institutes of Health-AARP Diet and Health Study, the highest prediagnosis scoring group of the Healthy Eating Index-2005, which measures adherence to the 2005 dietary guidelines for Americans,[23] was associated with 40% and 36% lower risk of all-cause and CRC-specific mortality, respectively, among 1,514 rectal cancer survivors.[7] However, no statistically significant associations were observed for colon cancer. Postdiagnosis diet was not evaluated. In another study of prediagnosis diet quality among 4,204 CRC survivors, the alternate Mediterranean diet was the only one of four dietary patterns associated with overall and CRC-specific survival, and the association was limited to women only.[8] Sex-specific results in the current analysis did not suggest meaningful differences.

Table 3. HRs for the Association With Postdiagnosis Dietary Patterns and Scores With Mortality Among Men and Women With CRC

Dietary Pattern	Total Mortality		CRC-Specific Mortality		CVD-Specific Mortality		All Other Mortality	
	No. of Deaths	HR (95% CI)	No. of Deaths	HR (95% CI)	No. of Deaths	HR (95% CI)	No. of Deaths	HR (95% CI)
DASH quartiles (score range)								
First (10-20)	189	1.00 (ref)	61	1.00 (ref)	42	1.00 (ref)	86	1.00 (ref)
Second (21-23)	154	0.85 (0.68 to 1.07)	34	0.52 (0.33 to 0.81)	35	0.83 (0.51 to 1.33)	85	1.08 (0.78 to 1.49)
Third (24-27)	209	0.74 (0.59 to 0.91)	43	0.51 (0.33 to 0.78)	69	0.88 (0.58 to 1.34)	97	0.82 (0.60 to 1.12)
Fourth (28-37)	170	0.79 (0.62 to 0.99)	39	0.56 (0.35 to 0.89)	49	0.78 (0.49 to 1.25)	82	0.91 (0.65 to 1.29)
P_{trend}		.02		.01		.37		.34
Continuous*		0.89 (0.82 to 0.97)		0.75 (0.63 to 0.90)		0.94 (0.80 to 1.11)		0.94 (0.83 to 1.05)
ACS-score								
0-2	165	1.00 (ref)	42	1.00 (ref)	34	1.00 (ref)	89	1.00 (ref)
3-4	238	0.80 (0.65 to 0.99)	66	0.95 (0.63 to 1.44)	68	1.00 (0.65 to 1.54)	104	0.67 (0.49 to 0.90)
5-6	240	0.85 (0.69 to 1.05)	59	0.86 (0.56 to 1.31)	62	0.93 (0.59 to 1.44)	119	0.82 (0.61 to 1.11)
7-9	79	0.62 (0.47 to 0.83)	10	0.35 (0.17 to 0.73)	31	0.92 (0.54 to 1.57)	38	0.59 (0.39 to 0.89)
P_{trend}		.003		.01		.70		.03
Continuous*		0.80 (0.68 to 0.95)		0.64 (0.45 to 0.91)		0.96 (0.69 to 1.32)		0.80 (0.63 to 1.01)
Prudent quartiles								
First (−1.92 to −0.70)	198	1.00 (ref)	54	1.00 (ref)	43	1.00 (ref)	101	1.00 (ref)
Second (−0.69 to −0.18)	190	0.80 (0.65 to 0.99)	40	0.63 (0.41 to 0.99)	53	1.02 (0.66 to 1.58)	97	0.80 (0.59 to 1.08)
Third (−0.17-0.48)	162	0.69 (0.55 to 0.87)	44	0.71 (0.45 to 1.12)	45	0.80 (0.51 to 1.27)	73	0.63 (0.45 to 0.88)
Fourth (0.49-5.40)	172	0.72 (0.56 to 0.93)	39	0.62 (0.37 to 1.06)	54	0.89 (0.54 to 1.47)	79	0.67 (0.47 to 0.97)
P_{trend}		.01		.17		.46		.02
Continuous*		0.89 (0.81 to 0.98)		0.85 (0.69 to 1.03)		0.92 (0.76 to 1.10)		0.89 (0.77 to 1.03)
Western quartiles								
First (−2.20 to −0.72)	157	1.00 (ref)	38	1.00 (ref)	42	1.00 (ref)	77	1.00 (ref)
Second (−0.71 to −0.14)	179	1.25 (0.99 to 1.57)	34	0.97 (0.59 to 1.60)	59	1.54 (0.99 to 2.40)	86	1.23 (0.88 to 1.71)
Third (−0.14-0.57)	195	1.26 (0.98 to 1.61)	50	1.47 (0.88 to 2.44)	48	1.12 (0.69 to 1.83)	97	1.22 (0.86 to 1.74)
Fourth (0.58-7.90)	191	1.23 (0.91 to 1.65)	55	1.72 (0.95 to 3.12)	46	1.14 (0.63 to 2.06)	90	1.10 (0.72 to 1.68)
P_{trend}		.26		.04		.96		.79
Continuous*		1.06 (0.95 to 1.18)		1.14 (0.93 to 1.40)		1.02 (0.81 to 1.27)		1.04 (0.89 to 1.22)

NOTE. Multivariable model adjusted for age at diagnosis, year of diagnosis, sex, stage, total caloric intake, body mass index, education, smoking status, change in weight since 1992, and treatment.
Abbreviations: ACS-score, American Cancer Society nutrition guidelines; CRC, colorectal cancer; CVD, cardiovascular disease; DASH, Dietary Approaches to Stop Hypertension; HR, hazard ratio; ref, referent.
*HR for a 1-standard deviation increase in the score.

In an investigation of postdiagnosis diet quality in the Nurses' Health Study, the Alternate Healthy Eating Index-2010 was associated with a 29% lower risk of all-cause mortality among 1,201 women, but null associations were observed for the alternate Mediterranean, Western, and prudent dietary patterns.[10] We similarly observed a null association between the postdiagnosis Western dietary pattern and mortality; however, the postdiagnosis prudent dietary pattern was inversely associated with risk.

To our knowledge, this study was the first to evaluate associations of pre- and postdiagnosis diet quality with risk of mortality among CRC survivors, which allowed for the examination of change in diet quality from pre- to postdiagnosis. Consistently observed inverse associations suggest that prognosis may improve with better postdiagnosis diet, even when prediagnosis diet quality was relatively low. These results were supported further in postdiagnostic models that identified statistically significant associations between diet quality and mortality that were independent of prediagnosis diet quality. Additional large studies with robust diet and covariable data are needed to replicate (or refute) these findings.

The ACS-score was the only dietary pattern we evaluated that was derived specifically for cancer prevention, which may explain why its results were more strongly inverse than the other dietary patterns. A recent investigation among patients with stage III CRC reported that the fruit/vegetable and whole-grain components of the ACS-score were associated with higher survival, whereas the limiting of red and processed meat intake was associated with higher total mortality.[24] Total servings and the variety of fruits and vegetables combine to make up one of the three components in ACS-score and may reflect the association between fiber[25] and phytochemicals[26] with CRC etiology, the latter of which increases greatly with more variety of colors and types of fruits and vegetables.[27] The World Cancer Research Fund and American Institute for Cancer Research reported that whole grains probably decrease the risk of CRC incidence,[2] although whether they are associated with mortality after CRC diagnosis remains unclear.[28,29] In addition, the World Cancer Research Fund and American Institute for Cancer Research report convincing evidence that processed meat consumption and probable evidence that red meat consumption increase the risk of CRC.[2] We found that consistently high red and processed meat consumption pre- and postdiagnosis compared with consistently low consumption was associated with lower CRC survival in a previous CPS-II study.[21] Other ACS prevention guidelines that recommend increased physical activity, maintenance of a healthy BMI, and abstinence from smoking also have been associated with better prognosis of CRC in prior CPS-II investigations.[30-32]

Strengths of the current study include its large sample size, prospective design, and detailed information on potential

Table 4. HRs for Change in Diet Quality Pre- and Postdiagnosis of CRC With Mortality

Dietary Pattern	Total Mortality		CRC-Specific Mortality		CVD-Specific Mortality		All Other Mortality	
	No. of Deaths	HR (95% CI)	No. of Deaths	HR (95% CI)	No. of Deaths	HR (95% CI)	No. of Deaths	HR (95% CI)
DASH								
Low/low	191	1.00 (ref)	58	1.00 (ref)	38	1.00 (ref)	95	1.00 (ref)
Low/high	99	0.77 (0.59 to 0.99)	20	0.54 (0.31 to 0.92)	33	1.10 (0.67 to 1.82)	46	0.78 (0.53 to 1.13)
High/low	120	1.17 (0.91 to 1.49)	27	0.80 (0.48 to 1.31)	32	1.38 (0.83 to 2.29)	61	1.26 (0.88 to 1.79)
High/high	241	0.88 (0.71 to 1.09)	50	0.59 (0.38 to 0.90)	72	1.03 (0.66 to 1.60)	119	0.98 (0.72 to 1.33)
ACS-score								
Low/low	267	1.00 (ref)	73	1.00 (ref)	62	1.00 (ref)	132	1.00 (ref)
Low/high	102	0.85 (0.67 to 1.08)	26	0.71 (0.44 to 1.15)	25	0.80 (0.49 to 1.30)	51	0.94 (0.67 to 1.32)
High/low	97	0.92 (0.72 to 1.18)	21	0.74 (0.44 to 1.24)	32	1.10 (0.69 to 1.75)	44	0.94 (0.65 to 1.35)
High/high	185	0.82 (0.67 to 1.01)	35	0.55 (0.36 to 0.86)	56	0.88 (0.59 to 1.32)	94	0.94 (0.70 to 1.25)
Prudent								
Low/low	231	1.00 (ref)	58	1.00 (ref)	52	1.00 (ref)	121	1.00 (ref)
Low/high	86	0.77 (0.58 to 1.00)	17	0.53 (0.29 to 0.95)	31	1.15 (0.71 to 1.88)	38	0.73 (0.49 to 1.09)
High/low	116	1.22 (0.96 to 1.56)	23	0.81 (0.47 to 1.37)	36	1.65 (1.04 to 2.63)	57	1.27 (0.90 to 1.78)
High/high	218	0.83 (0.67 to 1.04)	57	0.79 (0.50 to 1.23)	56	0.81 (0.52 to 1.26)	105	0.83 (0.61 to 1.13)
Western								
Low/low	191	1.00 (ref)	33	1.00 (ref)	57	1.00 (ref)	101	1.00 (ref)
Low/high	108	1.42 (1.09 to 1.85)	30	2.66 (1.50 to 4.70)	33	1.39 (0.86 to 2.27)	45	1.08 (0.73 to 1.60)
High/low	101	1.41 (1.09 to 1.84)	26	2.58 (1.46 to 4.54)	32	1.48 (0.92 to 2.38)	43	1.03 (0.70 to 1.51)
High/high	251	1.25 (0.98 to 1.60)	66	2.20 (1.27 to 3.82)	53	0.90 (0.55 to 1.46)	132	1.13 (0.80 to 1.60)

NOTE. Multivariable model adjusted for age at diagnosis, year of diagnosis, sex, stage, total caloric intake, body mass index, education, smoking status, change in weight since 1992, and treatment. Consistency in diet quality was assessed by combining the two categories below the median and the two categories above the median of that dietary pattern at pre- and postdiagnosis dietary assessment. Low/low, below the median score at pre- and postdiagnosis; low/high, below the median at prediagnosis but improving to above the median at postdiagnosis; high/low, above the median at prediagnosis but regressing to below the median at postdiagnosis; high/high, above the median at pre- and postdiagnosis.

Abbreviations: ACS-score, American Cancer Society nutrition guidelines; CRC, colorectal cancer; CVD, cardiovascular disease; DASH, Dietary Approaches to Stop Hypertension; HR, hazard ratio; ref, referent.

confounders. A unique strength was the ability to evaluate both pre- and postdiagnosis diet quality. Limitations of this study include a lack of information on cancer recurrence and tumor molecular phenotype, the latter of which would allow us to classify participants with varying etiologies that might interact with diet.[33] We did not have detailed treatment data, but on the basis of the limited treatment data available, they did not seem to be associated with diet quality. Self-reported dietary intakes are susceptible to bias, particularly when diet is reported after diagnosis. Some eligible participants (n = 159) did not respond to a postdiagnosis FFQ, which could bias the results, although this number was small, and sensitivity analyses did not suggest that bias was present. We evaluated the potential for reverse causation and other biases in multiple sensitivity analyses and did not observe evidence of such biases. The potential for unmeasured and residual confounding is inherent to the observational study design; however, there is limited feasibility of conducting a similar investigation in a randomized trial because of constraints on adherence and study duration.

Results from this study support recommendations for high diet quality before and after diagnosis to improve survival among men and women diagnosed with invasive, nonmetastatic CRC. Collectively, the results from all dietary patterns suggest that consumption of a diet high in plant products and fiber while limiting red and processed meat and added sugars both before and after diagnosis may be beneficial. Adherence to recommendations that are based on dietary associations with cancer, such as the ACS's

dietary guidelines for cancer prevention, may be particularly useful in improving prognosis as a result of observed associations of its individual dietary components with cancer risk, which may stem from underlying pro- or anticarcinogenic mechanisms. More studies with adequate power and information on dietary intakes at multiple time points relative to CRC diagnosis are needed to confirm or refute these results.

AUTHOR CONTRIBUTIONS

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AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

Associations of Pre- and Postdiagnosis Diet Quality With Risk of Mortality Among Men and Women With Colorectal Cancer

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No relationship to disclose

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No relationship to disclose

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No relationship to disclose

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Appendix

Dietary Pattern	Scoring Criteria	Score Range
Table A1. Scoring Criteria for DASH and ACS Nutrition Guideline Patterns		
DASH		8-40
Vegetables	On the basis of sex-specific quintile rankings of servings/d	1-5
Nuts and legumes	Quintiles	1-5
Fruit	Q1 = 1 point	1-5
Whole grains	Q2 = 2 points	1-5
Low-fat dairy	Q3 = 3 points	1-5
	Q4 = 4 points	
	Q5 = 5 points	
Sodium	On the basis of sex-specific quintile rankings of servings/d;	1-5
Red/processed meat	mg/d for sodium	1-5
Sweetened beverages	Quintiles (reverse)	1-5
	Q1 = 5 points	
	Q2 = 4 points	
	Q3 = 3 points	
	Q4 = 2 points	
	Q5 = 1 point	
ACS nutrition guidelines		0-9
Fruits/vegetables	Servings/d: 1 point for consuming five or more servings	0-3
	Variety: 1-2 points on the basis of sex-specific second and third tertile ranking of number of unique fruits and vegetables consumed at least two to three times a month	
	T1 = 0 points	
	T2 = 1 point	
	T3 = 2 points	
Whole grains in preference to refined grains	On the basis of sex-specific quartiles of the ratio of servings/d of whole grains to refined grains	0-3
	Quartiles	
	Q1 = 0 points	
	Q2 = 1 point	
	Q3 = 2 points	
	Q4 = 3 points	
Red/processed meat	On the basis of sex-specific quartiles of servings/d	0-3
	Quartiles (reverse)	
	Q1 = 3 points	
	Q2 = 2 points	
	Q3 = 1 point	
	Q4 = 0 points	

Abbreviations: ACS, American Cancer Society; DASH, Dietary Approaches to Stop Hypertension.

Table A2. Factor Loadings for Food Groups in the Principal Component Analysis–Derived Dietary Patterns

Food Group	Prediagnosis Dietary Pattern		Postdiagnosis Dietary Pattern	
	Prudent	Western	Prudent	Western
Citrus fruits	**0.47**	−0.10	0.33	−0.02
Melons and berries	**0.41**	−0.05	0.36	−0.10
Other fruits	**0.62**	−0.01	**0.52**	−0.13
Fruit juice	0.25	0.07	0.24	−0.02
Dark green vegetables	**0.49**	0.01	**0.54**	−0.05
Cruciferous vegetables	**0.67**	0.01	**0.68**	−0.03
Red/orange vegetables	**0.65**	−0.05	**0.71**	−0.06
Tomatoes	**0.46**	0.08	**0.49**	0.12
Starchy vegetables	0.20	**0.56**	0.26	**0.45**
Other vegetables	**0.63**	0.13	**0.74**	0.12
Whole grains	**0.44**	−0.07	0.39	0.00
Refined grains	0.20	**0.54**	0.03	**0.46**
Red meat (beef, lamb, pork, etc)	−0.04	**0.67**	0.09	**0.55**
Cured/processed meats	−0.12	**0.66**	−0.05	**0.61**
Organ meats	0.04	0.30	—	—
Poultry	0.35	0.09	**0.40**	0.17
Fried fish	0.03	0.34	−0.02	0.32
Other fish	0.43	−0.09	**0.48**	0.14
Eggs	−0.04	**0.46**	0.08	**0.48**
Soybean products	—	—	0.17	−0.10
Nuts and seeds	0.05	0.30	0.20	0.29
Beans and legumes	**0.42**	0.16	**0.50**	0.18
High-fat dairy	−0.09	0.36	−0.01	**0.43**
Low-fat dairy	0.26	−0.04	0.22	−0.04
Oils	0.08	0.25	0.24	0.03
Solid fats	0.00	**0.56**	−0.03	**0.46**
Beer	−0.11	0.19	−0.07	0.29
Wine	0.06	−0.04	0.13	0.02
Liquor	−0.06	0.03	0.02	0.17
Coffee	—	—	−0.07	0.31
Tea	—	—	0.23	0.01
Pizza	−0.09	0.20	0.01	0.28
Salty snacks	−0.09	**0.40**	0.20	0.33
Sweet snacks and candy	−0.05	0.37	0.05	0.37
High-energy beverages	−0.13	0.31	−0.07	0.20
Low-energy beverages	—	—	0.00	0.19
Condiments	0.19	0.36	**0.41**	0.21

NOTE. Because of differences in pre- and postdiagnosis food frequency questionnaires, not all food groups could be calculated at each time point. Bold indicates the strongest food group contributors to the dietary pattern.

Table A3. Pearson Correlation Coefficients for Dietary Patterns Assessed and Pre- and Postdiagnosis

Time Point	Dietary Pattern, r (P)			
	DASH	ACS-Score	Prudent	Western
Prediagnosis				
DASH	1.00			
ACS-score	0.69 (< .001)	1.00		
Prudent	0.67 (< .001)	0.59 (< .001)	1.00	
Western	−0.20 (< .001)	−0.37 (< .001)	0.00 (1.00)	1.00
Postdiagnosis				
DASH	1.00			
ACS-score	0.74 (< .001)	1.00		
Prudent	0.66 (< .001)	0.59 (< .001)	1.00	
Western	−0.20 (< .001)	−0.28 (< .001)	0.00 (1.00)	1.00

Abbreviations: ACS-score, American Cancer Society nutrition guidelines; DASH, Dietary Approaches to Stop Hypertension.

Table A4. HRs for the Association With Prediagnosis Dietary Patterns and Scores With Mortality Among Men and Women With CRC, Excluding Participants Diagnosed in the First Two Years of Follow-Up After Food Frequency Questionnaire Completion

	Total Mortality		CRC-Specific Mortality	
Dietary Pattern	No. of Deaths	HR (95% CI)	No. of Deaths	HR (95% CI)
DASH				
Q1	321	1.00 (ref)	116	1.00 (ref)
Q2	251	0.90 (0.75 to 1.06)	84	0.93 (0.70 to 1.25)
Q3	384	1.05 (0.89 to 1.22)	128	1.04 (0.80 to 1.37)
Q4	291	0.90 (0.76 to 1.07)	99	0.94 (0.71 to 1.26)
P_{trend}		.46		.84
ACS-score				
0-2	285	1.00 (ref)	105	1.00 (ref)
3-4	434	0.95 (0.81 to 1.11)	151	0.94 (0.72 to 1.21)
5-6	348	0.89 (0.76 to 1.05)	113	0.84 (0.63 to 1.10)
7-9	180	0.82 (0.67 to 1.01)	58	0.77 (0.55 to 1.09)
P_{trend}		.04		.09
Prudent				
Q1	335	1.00 (ref)	109	1.00 (ref)
Q2	294	0.85 (0.72 to 1.01)	113	1.03 (0.78 to 1.36)
Q3	311	0.90 (0.76 to 1.06)	105	0.97 (0.73 to 1.30)
Q4	307	0.86 (0.72 to 1.02)	100	0.87 (0.64 to 1.17)
P_{trend}		.16		.28
Western				
Q1	275	1.00 (ref)	98	1.00 (ref)
Q2	299	1.14 (0.96 to 1.36)	108	1.17 (0.87 to 1.56)
Q3	327	1.17 (0.96 to 1.41)	106	1.19 (0.86 to 1.65)
Q4	346	1.28 (1.00 to 1.64)	115	1.34 (0.88 to 2.03)
P_{trend}		.07		.19

NOTE. No. excluded was 240. Multivariable model adjusted for age at diagnosis, year of diagnosis, sex, stage, total caloric intake, body mass index, education, smoking status, and treatment.

Abbreviations: ACS-score, American Cancer Society nutrition guidelines; CRC, colorectal cancer; DASH, Dietary Approaches to Stop Hypertension; HR, hazard ratio; Q, quartile; ref, referent.

Table A5. HRs for the Association With Prediagnosis Dietary Patterns and Scores With Mortality Among Men and Women With CRC, Excluding Those Who Self-Reported a History of Hypertension, Stroke, Myocardial Infarction, or Diabetes

Dietary Pattern	Total Mortality		CRC-Specific Mortality	
	No. of Deaths	HR (95% CI)	No. of Deaths	HR (95% CI)
DASH				
Q1	197	1.00 (ref)	73	1.00 (ref)
Q2	142	0.88 (0.70 to 1.11)	55	1.07 (0.73 to 1.55)
Q3	199	0.92 (0.74 to 1.14)	72	0.94 (0.66 to 1.34)
Q4	157	0.83 (0.66 to 1.05)	53	0.86 (0.58 to 1.28)
P_{trend}		.16		.40
ACS-score				
0-2	167	1.00 (ref)	70	1.00 (ref)
3-4	243	0.95 (0.77 to 1.18)	90	0.93 (0.66 to 1.30)
5-6	194	0.85 (0.68 to 1.06)	63	0.78 (0.54 to 1.13)
7-9	91	0.72 (0.54 to 0.95)	30	0.60 (0.37 to 0.96)
P_{trend}		.01		.02
Prudent				
Q1	206	1.00 (ref)	67	1.00 (ref)
Q2	161	0.71 (0.57 to 0.88)	65	0.93 (0.65 to 1.35)
Q3	158	0.77 (0.62 to 0.97)	63	0.89 (0.61 to 1.30)
Q4	170	0.78 (0.61 to 0.99)	58	0.82 (0.54 to 1.24)
P_{trend}		.13		.34
Western				
Q1	165	1.00 (ref)	63	1.00 (ref)
Q2	162	1.06 (0.84 to 1.34)	57	1.16 (0.79 to 1.71)
Q3	185	1.18 (0.91 to 1.52)	65	1.34 (0.88 to 2.03)
Q4	183	1.46 (1.05 to 2.04)	68	1.70 (0.99 to 2.89)
P_{trend}		.02		.05

NOTE. No. excluded was 1,134. Multivariable model adjusted for age at diagnosis, year of diagnosis, sex, stage, total caloric intake, body mass index, education, smoking status, and treatment.
Abbreviations: ACS-score, American Cancer Society nutrition guidelines; CRC, colorectal cancer; DASH, Dietary Approaches to Stop Hypertension; HR, hazard ratio; Q, quartile; ref, referent.

Table A6. HRs for the Association With Postdiagnosis Dietary Patterns and Scores With Mortality Among Men and Women With CRC, With Additional Adjustment for Prediagnosis Diet Quality

Dietary Pattern	Total Mortality		CRC-Specific Mortality	
	No. of Deaths	HR (95% CI)	No. of Deaths	HR (95% CI)
DASH				
Q1	170	1.00 (ref)	55	1.00 (ref)
Q2	141	0.87 (0.68 to 1.11)	30	0.52 (0.32 to 0.86)
Q3	189	0.72 (0.57 to 0.91)	34	0.42 (0.26 to 0.69)
Q4	151	0.68 (0.52 to 0.89)	36	0.50 (0.29 to 0.85)
P_{trend}		.002		.007
ACS-score				
0-2	150	1.00 (ref)	37	1.00 (ref)
3-4	214	0.78 (0.62 to 0.98)	57	1.00 (0.63 to 1.57)
5-6	217	0.79 (0.62 to 1.00)	52	0.85 (0.52 to 1.38)
7-9	70	0.55 (0.39 to 0.77)	9	0.38 (0.17 to 0.87)
P_{trend}		< .001		.05
Prudent				
Q1	178	1.00 (ref)	47	1.00 (ref)
Q2	169	0.77 (0.61 to 0.97)	34	0.59 (0.36 to 0.96)
Q3	151	0.62 (0.48 to 0.80)	39	0.56 (0.33 to 0.96)
Q4	153	0.60 (0.44 to 0.81)	35	0.50 (0.27 to 0.95)
P_{trend}		< .001		.07
Western				
Q1	133	1.00 (ref)	30	1.00 (ref)
Q2	159	1.21 (0.94 to 1.55)	29	0.91 (0.52 to 1.59)
Q3	178	1.24 (0.95 to 1.63)	44	1.36 (0.77 to 2.42)
Q4	181	1.21 (0.88 to 1.68)	52	1.54 (0.79 to 2.98)
P_{trend}		.32		.14

NOTE. No. of participants was 1,191. Multivariable model adjusted for age at diagnosis, year of diagnosis, sex, stage, total caloric intake, body mass index, education, smoking status, change in weight since 1992, treatment, and prediagnosis quartile ranking for dietary pattern of interest.

Abbreviations: ACS-score, American Cancer Society nutrition guidelines; CRC, colorectal cancer; DASH, Dietary Approaches to Stop Hypertension; HR, hazard ratio; Q, quartile; ref, referent.

Table A7. HRs for the Association With Dietary Patterns and Scores With Mortality Among Men and Women With CRC, Excluding Those Who Completed the Postdiagnosis Food Frequency Questionnaire Less Than One Year After Diagnosis

Dietary Pattern	Total Mortality		CRC-Specific Mortality	
	No. of Deaths	HR (95% CI)	No. of Deaths	HR (95% CI)
DASH				
Q1	139	1.00 (ref)	46	1.00 (ref)
Q2	121	0.79 (0.61 to 1.02)	23	0.47 (0.28 to 0.82)
Q3	167	0.76 (0.59 to 0.97)	27	0.38 (0.22 to 0.65)
Q4	130	0.79 (0.60 to 1.03)	28	0.55 (0.32 to 0.95)
P_{trend}		.09		.02
ACS-score				
0-2	121	1.00 (ref)	28	1.00 (ref)
3-4	182	0.78 (0.61 to 1.00)	48	0.81 (0.49 to 1.35)
5-6	190	0.87 (0.68 to 1.11)	41	0.75 (0.45 to 1.26)
7-9	64	0.65 (0.47 to 0.90)	7	0.31 (0.13 to 0.74)
P_{trend}		.02		.01
Prudent				
Q1	151	1.00 (ref)	39	1.00 (ref)
Q2	145	0.90 (0.70 to 1.15)	31	0.92 (0.55 to 1.54)
Q3	126	0.70 (0.54 to 0.90)	28	0.65 (0.37 to 1.14)
Q4	135	0.70 (0.52 to 0.93)	26	0.62 (0.33 to 1.18)
P_{trend}		.005		.09
Western				
Q1	114	1.00 (ref)	25	1.00 (ref)
Q2	140	1.27 (0.97 to 1.67)	23	0.96 (0.51 to 1.82)
Q3	154	1.27 (0.95 to 1.69)	35	1.48 (0.77 to 2.84)
Q4	149	1.17 (0.83 to 1.65)	41	1.79 (0.85 to 3.78)
P_{trend}		.55		.07

NOTE. No. excluded was 300. Multivariable model adjusted for age at diagnosis, year of diagnosis, sex, stage, total caloric intake, body mass index, education, smoking status, change in weight since 1992, treatment, and prediagnosis quartile ranking for dietary pattern of interest.

Abbreviations: ACS-score, American Cancer Society nutrition guidelines; CRC, colorectal cancer; DASH, Dietary Approaches to Stop Hypertension; HR, hazard ratio; Q, quartile; ref, referent.

Table A8. HRs for the Association With Dietary Patterns and Scores With Mortality Among Men and Women With CRC, Excluding the First Two Years of Follow-Up After Completion of the Postdiagnosis Food Frequency Questionnaire

Dietary Pattern	Total Mortality		CRC-Specific Mortality	
	No. of Deaths	HR (95% CI)	No. of Deaths	HR (95% CI)
DASH				
Q1	143	1.00 (ref)	37	1.00 (ref)
Q2	120	0.86 (0.66 to 1.11)	17	0.41 (0.22 to 0.78)
Q3	175	0.78 (0.61 to 0.99)	22	0.35 (0.19 to 0.62)
Q4	143	0.84 (0.65 to 1.09)	23	0.49 (0.27 to 0.89)
P_{trend}		.16		.01
ACS-score				
0-2	133	1.00 (ref)	26	1.00 (ref)
3-4	182	0.73 (0.58 to 0.93)	37	0.82 (0.48 to 1.43)
5-6	194	0.84 (0.66 to 1.06)	30	0.69 (0.39 to 1.22)
7-9	72	0.66 (0.48 to 0.90)	6	0.30 (0.12 to 0.78)
P_{trend}		.02		.01
Prudent				
Q1	150	1.00 (ref)	30	1.00 (ref)
Q2	151	0.87 (0.68 to 1.11)	21	0.71 (0.38 to 1.30)
Q3	126	0.70 (0.54 to 0.91)	22	0.67 (0.36 to 1.25)
Q4	154	0.87 (0.65 to 1.15)	26	0.76 (0.38 to 1.51)
P_{trend}		.24		.49
Western				
Q1	125	1.00 (ref)	20	1.00 (ref)
Q2	146	1.27 (0.98 to 1.64)	20	0.98 (0.50 to 1.90)
Q3	157	1.26 (0.96 to 1.67)	24	1.23 (0.61 to 2.49)
Q4	153	1.23 (0.88 to 1.71)	35	1.85 (0.84 to 4.09)
P_{trend}		.32		.09

NOTE. No. excluded was 141. Multivariable model adjusted for age at diagnosis, year of diagnosis, sex, stage, total caloric intake, body mass index, education, smoking status, change in weight since 1992, treatment, and prediagnosis quartile ranking for dietary pattern of interest.

Abbreviations: ACS-score, American Cancer Society nutrition guidelines; CRC, colorectal cancer; DASH, Dietary Approaches to Stop Hypertension; HR, hazard ratio; Q, quartile; ref, referent.

Table A9. HRs for the Association With Prediagnosis Dietary Patterns and Scores With Mortality Among Men and Women With Distant Metastatic CRC

Dietary Pattern	Total Mortality		CRC-Specific Mortality	
	No. of Deaths	HR (95% CI)	No. of Deaths	HR (95% CI)
DASH				
Q1	94	1.00 (ref)	86	1.00 (ref)
Q2	75	1.01 (0.69 to 1.49)	63	0.95 (0.63 to 1.43)
Q3	121	0.65 (0.46 to 0.92)	108	0.61 (0.42 to 0.88)
Q4	88	0.67 (0.46 to 0.97)	80	0.64 (0.44 to 0.95)
P_{trend}		.02		.02
ACS-score				
0-2	86	1.00 (ref)	76	1.00 (ref)
3-4	134	1.06 (0.75 to 1.50)	123	1.10 (0.77 to 1.58)
5-6	114	0.95 (0.65 to 1.37)	98	0.86 (0.58 to 1.28)
7-9	44	0.71 (0.44 to 1.15)	40	0.71 (0.43 to 1.18)
P_{trend}		.12		.06
Prudent				
Q1	95	1.00 (ref)	84	1.00 (ref)
Q2	93	1.07 (0.74 to 1.53)	83	1.05 (0.71 to 1.54)
Q3	93	0.82 (0.54 to 1.26)	80	0.77 (0.49 to 1.21)
Q4	97	1.20 (0.70 to 2.03)	90	1.19 (0.69 to 2.08)
P_{trend}		.60		.60
Western				
Q1	96	1.00 (ref)	85	1.00 (ref)
Q2	94	1.07 (0.76 to 1.50)	83	1.05 (0.74 to 1.50)
Q3	95	0.85 (0.60 to 1.19)	85	0.80 (0.56 to 1.15)
Q4	93	0.85 (0.59 to 1.22)	84	0.82 (0.56 to 1.20)
P_{trend}		.24		.20

NOTE. No. of distant metastases was 400. Multivariable model adjusted for age at diagnosis, year of diagnosis, sex, stage, total caloric intake, body mass index, education, smoking status, and treatment.

Abbreviations: ACS-score, American Cancer Society nutrition guidelines; CRC, colorectal cancer; DASH, Dietary Approaches to Stop Hypertension; HR, hazard ratio; Q, quartile; ref, referent.