

BRIEF COMMUNICATION

The Association Between Dietary Quality and Overall and Cancer-Specific Mortality Among Cancer Survivors, NHANES III

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Abstract

Given the recent emphasis on the totality of the diet by national guidelines, we examined the relationship between the quality of diet and overall and cancer-specific mortality among cancer survivors. From the Third National Health and Nutrition Examination Survey (NHANES III), 1191 participants diagnosed with cancer were identified. Healthy Eating Index (HEI) scores were utilized; higher HEI score indicated better adherence to dietary recommendations. During a median follow-up of 17.2 years, a total of 607 cancer-specific deaths occurred. A high-quality diet (highest-quartile HEI score) was associated with decreased risk of overall (hazard ratio [HR] = 0.59, 95% confidence interval [CI] = 0.45 to 0.77) and cancer-specific (HR = 0.35, 95% CI = 0.19 to 0.63) mortality when compared with a poor-quality diet (lowest-quartile HEI score). Among individual dietary components, the highest-quartile score for saturated fat intake was associated decreased cancer-specific mortality (HR = 0.55, 95% CI = 0.36 to 0.86). Our results highlight the importance of a "total diet" approach to improving survival among cancer patients.

The Dietary Guidelines for Americans (2015–2020) (1), MyPlate guidelines (2), Academy of Nutrition and Dietetics (3), and Healthy People 2020 (4) have emphasized that a high-quality "total diet"—and not just individual foods—plays a pivotal role in health outcomes. In the past, dietary investigations have tended to focus on the impact of specific nutrients, foods, or bioactive food components on cancer incidence and mortality. A growing body of evidence (5–9) suggests that a high-quality and prudent diet are beneficial for specific cancer survivors (10), which necessitates further investigation regarding the importance of overall diet quality and its association with oncologic outcomes. Therefore, we examined the association between the overall quality of dietary intake and all-cause and cancer-specific mortality using a nationally representative sample of cancer survivors.

We analyzed the Third National Health and Nutrition Examination Survey (NHANES III), conducted between the years

1988 and 1994 (n = 33 994). Participants in the NHANES are non-institutionalized US civilians who are identified using a complex, stratified, multistage probability sampling technique. The survey includes an interview and an examination component. The interview component contains the standardized questionnaires on demographics, socioeconomic status, diet, and health. The medical examinations include data regarding medical, dental, and physiological measurements and laboratory tests. A detailed description of the survey is available elsewhere (11). Mortality from the date of the NHANES III participation through December 2011 was obtained from the National Center for Health Statistics Linked Mortality Files.

Participants age 18 years or older who were reportedly diagnosed with cancer (ie, replied "yes" when asked "has a doctor or health care professional ever told you that you had skin or other cancer?") were included. Demographics, cancer diagnosis, and dietary intake data were self-reported. An overall Healthy

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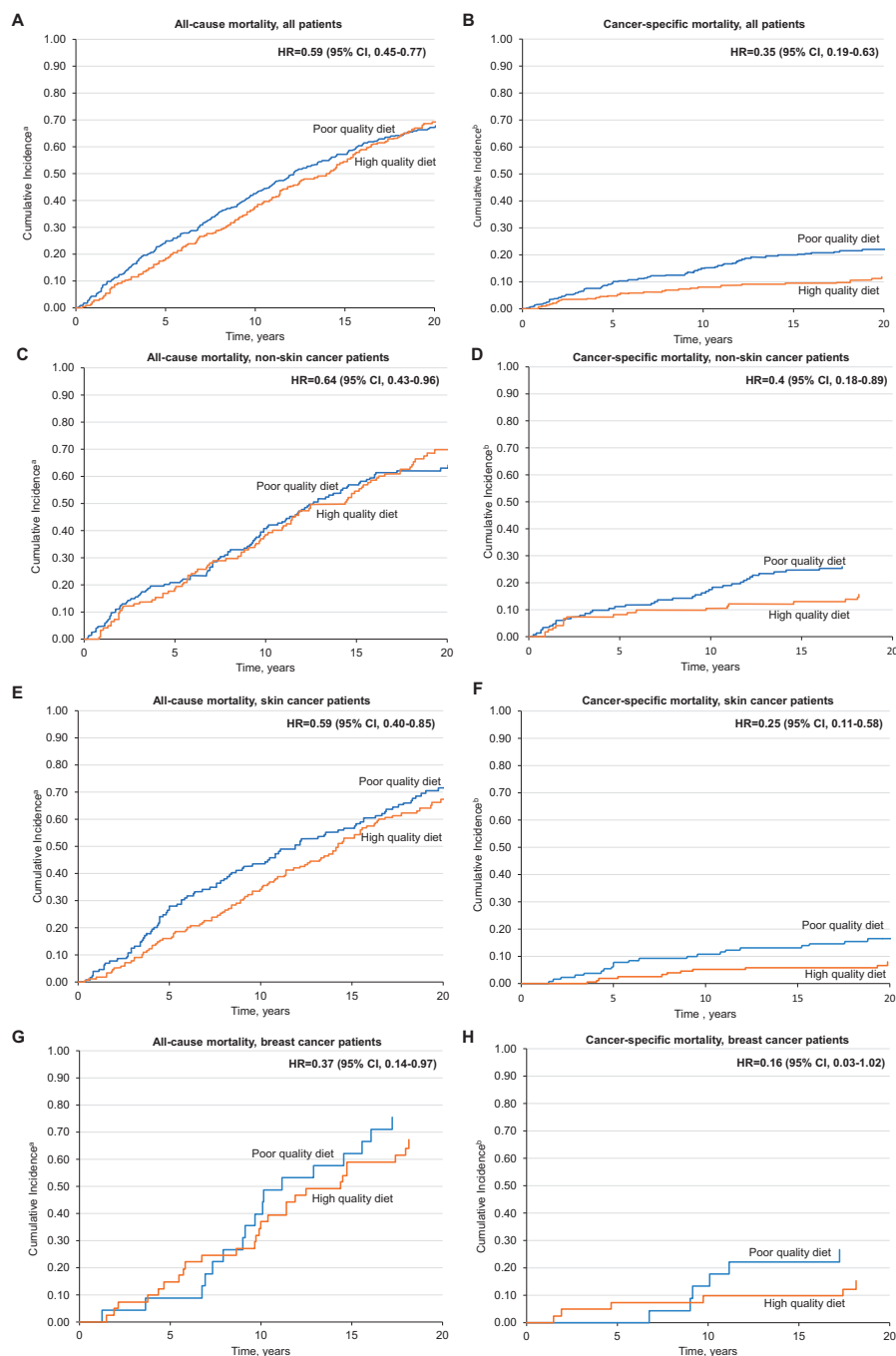


Figure 1. Cumulative incidence for all-cause and cancer-specific mortality by high- and poor-quality dietary intake in cancer-diagnosed patients, NHANES III. Figure 1 illustrates cumulative incidence curves for high-quality and poor-quality dietary intake. The overall Healthy Eating Index (HEI) score was computed, and cases in the highest quartile (overall HEI score ≥ 77) were identified as those consuming a high-quality diet, whereas those in the lowest quartile (overall HEI score ≤ 57.5) were identified as those consuming a poor-quality diet. **A)** Cumulative incidence curves for all-cause mortality among all cancer-diagnosed patients ($n = 590$). **B)** Cumulative incidence curves for cancer-specific mortality among all cancer-diagnosed patients ($n = 590$). **C)** Cumulative incidence curves for all-cause mortality among patients diagnosed with nonskin cancers ($n = 278$). **D)** Cumulative incidence curves for cancer-specific mortality among patients diagnosed with nonskin cancers ($n = 278$). **E)** Cumulative incidence curves for all-cause mortality among patients diagnosed with skin cancer ($n = 290$). **F)** Cumulative incidence curves for cancer-specific mortality among patients diagnosed with skin cancer ($n = 290$). **G)** Cumulative incidence curves for all-cause mortality among patients diagnosed with breast cancer ($n = 65$). **H)** Cumulative incidence curves for cancer-specific mortality among patients diagnosed with breast cancer ($n = 65$). ^aCumulative incidence curves (unweighted) derived using the Cox proportional hazards model. ^bCumulative incidence curves (unweighted) derived using a competing risks model. CI = confidence interval; HR = hazard ratio.

Eating Index (HEI) score was between 0 and 100, which was calculated via summation of 10 equally weighted dietary components scored between 0 and 10 using a single 24-hour dietary

recall (12). A score of 0 is assigned for zero servings, and the maximum score indicates that the recommended servings were consumed. Higher HEI scores are associated with better-quality

diets. The NHANES III data use the 1994–1996 version of HEI. The score is calculated using queries developed in Microsoft Access. Details of these query strategies are available elsewhere (13).

Date and cause of mortality were identified from the mortality data file. The causes of mortality were defined using the International Classification of Diseases coding (ICD-10). Overall mortality included death due to any reason. Mortality was considered cancer specific if the reported cause was “malignant neoplasm” (ICD-10: C00-C97).

We calculated the median, lower quartile, and upper quartile scores for each of the 11 dietary scores (the 10 HEI dietary components and the overall HEI). Hazards ratios adjusted for baseline characteristics (age, sex, income, education, and body mass index) and comorbidities (hypertension, hyperlipidemia, diabetes, and cardiovascular diseases) were estimated to compare the mortality risk between those in the upper (indicating high-quality dietary intake) and lower (indicating poor-quality dietary intake) quartiles for each dietary component. To exclude the participants who may have had underlying cancers at the time of interview, we performed sensitivity analysis where we censored deaths that occurred within a five-year follow-up window. All outcomes were assessed for the subgroups of skin cancer patients, non-skin cancer patients, and breast cancer patients. The analyses were conducted using SAS 9.4 (Cary, NC) and adjusted using NHANES sampling weights.

A total of 1191 NHANES III participants diagnosed with cancer with complete HEI scores were identified. The majority of the patients were white (95%), female (60.3%), and between age 40 and 69 years (52.5%). The two most common oncologic diagnoses were skin cancer (55%) and breast cancer (11%). The median overall HEI score was 68 (lower quartile = 47.5, upper quartile = 77). Median scores for the 10 HEI components were vegetable (7.3), meat (7), grain (6.5), fruit (4.7), dairy (6.5), total fat (7.6), saturated fat (8.6), cholesterol (10), sodium (8.7), and variety (10). A total of 607 cancer-specific deaths occurred during a median follow-up of 17.2 years.

Overall and cancer-specific mortality risks are presented in Figure 1. A high overall HEI score was inversely associated with overall mortality (hazard ratio [HR] = 0.59, 95% confidence interval [CI] = 0.45 to 0.77). We found a similar association for cancer-specific mortality (HR = 0.35, 95% CI = 0.19 to 0.63). Findings for cancer-specific mortality were consistent among the subgroups of nonskin cancer (HR = 0.4, 95% CI = 0.18 to 0.89) and skin cancer (HR = 0.25, 95% CI = 0.11 to 0.58) (Figure 1). The result of sensitivity analysis (ie, when deaths within a five-year window were censored) for cancer-specific mortality was consistent (HR = 0.33, 95% CI = 0.18 to 0.54) with the main analysis. Among the individual dietary components, only saturated fat intake was associated with cancer-specific mortality (Table 1), but the effect size for this component (HR = 0.55 for both) was less pronounced than the overall HEI score.

Nutritional guidelines for the general populations in several countries emphasize the need for a “total diet” approach to healthy eating, but guidelines for cancer patients have tended to focus on specific food components. Our study adds to a growing body of knowledge suggesting that an overall high-quality dietary intake has a strong association with improved cancer-specific mortality among individuals diagnosed with cancer. Our findings lend evidence to the emerging concept that a total diet approach to healthful eating may be more impactful than strategies based on specific nutritional components.

Our findings should be interpreted within the context of their limitations. Dietary intake data in the NHANES are self-reported. The HEI scores in our analysis are based on only one 24-hour

Table 1. Mortality by HEI components and overall HEI, NHANES III

HEI components	Hazards ratio* (95% CI)	
	All-cause mortality†	Cancer-specific mortality‡
Vegetables	0.67 (0.52 to 0.86)	0.65 (0.38 to 1.14)
Meat	0.82 (0.60 to 1.11)	0.66 (0.37 to 1.20)
Grain	0.92 (0.71 to 1.20)	1.25 (0.82 to 1.91)
Fruit	0.71 (0.51 to 0.98)	0.58 (0.32 to 1.03)
Dairy	0.78 (0.65 to 0.94)	0.86 (0.57 to 1.30)
Fat	0.90 (0.71 to 1.15)	0.65 (0.42 to 1.02)
Saturated fat	0.72 (0.60 to 0.86)	0.55 (0.36 to 0.86)
Cholesterol	1.00 (0.83 to 1.19)	1.03 (0.74 to 1.43)
Sodium	1.04 (0.81 to 1.35)	0.75 (0.46 to 1.23)
Variety	0.76 (0.63 to 0.97)	0.67 (0.41 to 1.10)
Overall	0.59 (0.45 to 0.77)	0.35 (0.19 to 0.63)

*NHANES III weighted hazards ratio for high-quality vs poor-quality dietary intake among US adults diagnosed with cancer, adjusted for age, sex, income, education, body mass index, and comorbidities (hypertension, hyperlipidemia, diabetes, and cardiovascular diseases). CI = confidence interval; HEI = Healthy Eating Index.

†Hazard ratios estimated using Cox proportional hazards models.

‡Hazard ratios estimated using competing risk models.

dietary recall and may not represent habitual dietary behavior. Information on cancer was limited to diagnosis of cancer and cancer type (eg, it was not possible to differentiate skin cancer types); stage of cancer was not available. Finally, our results may be confounded due to reasons other than diet, such as lifestyle (eg, physical activity), cancer surveillance, and treatment.

In conclusion, overall high-quality dietary intake may protect against death among cancer survivors. Identifying optimal combinations of foods and the mechanisms by which such combinations affect cancer outcomes should be the focus of population health and oncology research.

Notes

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