

Diet-Quality Indexes Are Associated with a Lower Risk of Cardiovascular, Respiratory, and All-Cause Mortality among Chinese Adults

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Abstract

Background: Diet-quality indexes have been associated with a lower risk of chronic disease mortality in Western populations, but it is unclear whether these indexes reflect protective dietary patterns in Asian populations.

Objective: We examined the association between Alternative Healthy Eating Index–2010 (AHEI-2010), alternate Mediterranean diet (aMED), Dietary Approaches to Stop Hypertension (DASH), and Healthy Diet Indicator (HDI) scores and the risk of all-cause cardiovascular disease (CVD), cancer, and respiratory disease mortality.

Methods: We used data from a prospective cohort of 57,078 Singapore Chinese men and women (aged 45–74 y) who were free of cancer and CVD at baseline (1993–1998) and who were followed up through 2014. The diet-quality index scores were calculated on the basis of data from a validated 165-item food-frequency questionnaire. Cox regression models with adjustment for potential confounders including sociodemographic and lifestyle variables, body mass index, and medical history were used to estimate HRs and 95% CIs.

Results: During a total of 981,980 person-years of follow-up, 15,262 deaths (CVD: 4871; respiratory: 2690; and cancer: 5306) occurred. Comparing the highest with the lowest quintiles, the multivariable adjusted HRs (95% CIs) for all-cause mortality were 0.82 (0.78, 0.86) for AHEI-2010, 0.80 (0.76, 0.85) for aMED, 0.80 (0.75, 0.84) for DASH, and 0.88 (0.83, 0.92) for HDI scores (all *P*-trend < 0.001). Higher diet index scores were associated with a 14–28% lower risk of CVD and respiratory mortality, but only a 5–12% lower risk of cancer mortality. Higher consumption of vegetables, fruit, nuts, and long-chain n–3 (ω -3) fatty acids, lower consumption of red meat, and avoidance of high alcohol consumption were the diet index components associated with a lower risk of mortality.

Conclusion: Adherence to several recommended dietary patterns that emphasize healthy plant-based foods was associated with a substantially lower risk of chronic disease mortality in an Asian population. The Singapore Chinese Health Study was registered at www.clinicaltrials.gov as NCT03356340. *J Nutr* 2018;148:1323–1332.

Keywords: diet-quality, mortality, risk factors, epidemiology, nutrition

Introduction

Noncommunicable diseases, such as cardiovascular diseases (CVDs), diabetes, cancer, and chronic lung diseases, account for nearly 70% of all deaths globally (1, 2). Diet appears to play a major role in the development of several of these diseases (3). The traditional approach in nutritional epidemiology has

focused largely on the investigation of effects of specific nutrients or food groups on disease risk (4, 5). However, the study of dietary patterns has emerged as a complementary approach to capture the combined effect of a variety of foods and nutrients (4, 6, 7). Commonly used approaches to identify dietary patterns include data-driven and hypothesis-driven methods (8). Data-driven methods such as factor and cluster analysis are exploratory, reflecting dietary habits in specific study populations (4, 9). In contrast, hypothesis-driven methods define indexes of

This study was Supported by the US National Cancer Institute at the NIH (grants UM1 CA182876 and R01 CA144034). W-PK was supported by the National Medical Research Council, Singapore (NMRC/CSA/0055/2013).

Author disclosures: NN, W-PK, J-MY, and RMvD, no conflicts of interest.

Supplemental Tables 1–8 are available from the “Supplementary data” link in the online posting of the article and from the same link in the online table of contents at <https://academic.oup.com/jn/>.

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Abbreviations used: AHEI, Alternative Healthy Eating Index; aMED, alternate Mediterranean diet; CVD, cardiovascular disease; DASH, Dietary Approaches to Stop Hypertension; HDI, Healthy Diet Indicator; ICD, International Classification of Diseases; SCHS, Singapore Chinese Health Study.

overall diet-quality a priori on the basis of scientific evidence on the relation between food and nutrient intakes and health outcomes (4, 6, 7, 10–13).

Several diet-quality indexes have been developed to evaluate the role of dietary patterns in chronic disease mortality. These include the Alternative Healthy Eating Index (AHEI) (13, 14), the alternate Mediterranean diet (aMED) (15), the Dietary Approaches to Stop Hypertension (DASH) (16), and the Healthy Diet Indicator (HDI), which reflects the WHO's dietary guidelines (17). These indexes were mostly based on data from studies in Western populations and were associated with a lower risk of all-cause (18–22), CVD (14, 18, 19, 22, 23), and cancer (18–20, 22) mortality in US and European populations. However, little is known about the relation of these diet indexes with all-cause or cause-specific mortality in Asian populations. In addition, respiratory death is a major cause of death in East Asian countries (24) and has not been examined in relation to these diet indexes. In a study conducted in China, AHEI-2010 and DASH scores were associated with lower CVD and all-cause mortality. However, several components of these dietary scores could not be calculated due to the very low consumption of whole grains and sugar-sweetened beverages and lack of data on *trans* fat in local food-composition tables (25). Asian populations generally have markedly different dietary habits than Western populations, such as a higher consumption of soy foods and rice and a lower consumption of dairy products, red meat, and alcohol (25, 26). Data on optimal dietary patterns to reduce premature mortality in Asian populations are limited. We therefore examined the associations between the AHEI-2010, aMED, DASH, and HDI diet indexes and the risk of mortality from all-causes, CVD, respiratory disease, and cancer in an Asian population.

Methods

Study population

The Singapore Chinese Health Study (SCHS) is a prospective cohort study that was initiated to investigate dietary, genetic, and environmental determinants of chronic diseases in an ethnic Chinese population. The study design and implementation have been described previously (27, 28). Briefly, 63,257 Chinese men ($n = 27,959$) and women ($n = 35,298$) aged 45–74 y, who belonged to 1 of the major Chinese dialect groups (Hokkein or Cantonese), and resided at public housing estates (where 86% of the Singaporeans reside) were enrolled between 1993 and 1998. Information on demographic characteristics, lifestyle factors, and medical history were obtained at recruitment with the use of a structured interviewer-administered questionnaire. The institutional review boards at the National University of Singapore and the University of Pittsburgh approved the study. This study was registered at www.clinicaltrials.gov as NCT03356340.

Dietary assessment

At baseline, the habitual dietary intake of the study participants over the past year was assessed by trained interviewers with the use of a validated, 165-item, semiquantitative FFQ designed specifically for the Singapore Chinese population. Information on the usual frequency of consumption of each food item was determined by using 8 categories that ranged from “never or hardly ever” to “two or more times day.” Information on serving size (generally 3 options: small, medium, or large) was obtained with the aid of photographs. Total energy and nutrient intakes were computed from the Singapore food-composition database, which was developed in conjunction with the study cohort. The FFQ had been validated against two 24-h dietary recalls among a random sample of 810 cohort participants. The correlation coefficients between the FFQ and 24-h dietary recalls ranged between 0.24 and 0.79 for energy intake and selected nutrients. For most nutrients, the differences

in mean intakes measured by the FFQ and 24-h diet recalls were within 10% (27). Furthermore, several components of the dietary pattern scores were associated with plasma FA concentrations, as expected based on the FA composition of these foods in a subsample of SCHS. Higher fish intake (per 50-g/d increment) was associated with higher EPA ($\beta = 0.09$, $P < 0.01$) and DHA ($\beta = 0.48$, $P < 0.01$) concentrations expressed as a percentage of plasma total FAs. A higher intake of red meat (per 50 g/d) was associated with higher plasma arachidonic acid (AA; 20:4n-6) ($\beta = 0.50$, $P < 0.01$) concentrations and soy intake (per 50 g/d) was associated with higher plasma α -linolenic acid (ALA; 18:3n-3) ($\beta = 0.01$, $P < 0.05$) concentrations. Higher intake of PUFAs (per 1% of total energy intake) was associated with higher plasma linoleic acid (LA; 18:2n-6) ($\beta = 0.25$, $P < 0.01$) and ALA ($\beta = 0.02$, $P < 0.01$) concentrations (29).

Diet-quality indexes

We constructed the components of the AHEI-2010, aMED, DASH, and HDI indexes, and calculated index scores on the basis of food groups or nutrients from the SCHS food-composition database. Dietary components and standards for scoring are shown in **Supplemental Table 1**. For the calculation of diet-quality scores, we converted daily consumption of foods in grams to standard serving equivalents. For example, we used 67 g (0.5 cup of typical local vegetables) to represent 1 serving of vegetables (14, 30), 16 g to represent 1 serving of whole grains (e.g., 1 slice of whole-wheat bread, 0.5 cup of oatmeal) (31), 28 g to represent 1 serving of nuts or 1 tablespoon (16 g) to represent 1 serving of peanut butter (14), 90 g to represent 1 serving of fish (30), and 10 g to represent 1 serving of alcohol (30). In our analyses, we excluded potatoes and preserved vegetables from total vegetables, preserved or dried fruit from total fruit, and sweetened soy products and sweetened bean soup from legumes to represent healthful dietary pattern components.

AHEI-2010 score. The AHEI, originally proposed by McCullough et al. (13), was developed based on foods and nutrients predictive of chronic disease risk. We used the updated version of the AHEI, the AHEI-2010 (14), which includes 11 foods and nutrients and scores each diet component on the basis of predetermined scoring criteria. Each component ranged from 0 (worst) to 10 (best) points and the total score ranged from 0 (poor adherence) to 110 (excellent adherence). Due to lack of information on *trans* fat intake in our study population, the *trans* fat component was not included in the calculation of the AHEI-2010 score. Hence, the total score ranged from 0 to 100 in our study.

aMED score. The original Mediterranean diet score was developed to investigate the association between dietary habits of Mediterranean communities and chronic disease risk (32, 33). We used the aMED (15), a modified version of the Mediterranean diet index that includes 9 components. Participants with intakes at or greater than the study population-specific median for each protective component received 1 point; otherwise, they received 0 points. Reverse scoring was applied to detrimental components. In addition, 1 point was assigned for alcohol intake of 10–25 g/d for men and 5–15 g/d for women. The total score ranged from 0 to 9, with a higher score representing greater adherence to the aMED.

DASH score. The DASH index, as outlined by Fung et al. (16), was originally designed for hypertension management. This index includes 8 components, each worth 5 points, for a total of 40 points. Scoring is based on quintiles and participants in the highest quintile of each protective component received 5 points, whereas detrimental components were reverse scored.

HDI score. The HDI was developed based on the 1990 WHO dietary guidelines (34) and designed to reflect an optimal diet for the prevention of chronic diseases (35). We used the updated version of the HDI that aligns with the 2003 WHO dietary guidelines (17). The HDI includes 7 components; each component score ranged from 0 to 10 and the total score ranged from 0 (minimum) to 70 (maximum).

Assessment of covariates

In-person interviews were conducted at baseline to obtain information on other covariates, including demographic characteristics, height, weight, physical activity, smoking, alcohol consumption, sleep duration, reproductive history (women only), and medical history (physician-diagnosed hypertension, heart attack or angina, diabetes, and cancer) by using a structured questionnaire. We collected information on smoking status and intensity of smoking (if a participant ever smoked cigarettes). A 4-level variable was created for smoking, including never smoking, past smoking, current smoker of <13 cigarettes/d, or current smoker of ≥ 13 cigarettes (more than half a pack)/d. We calculated the BMI as weight (kilograms) divided by height (meters) squared. Physical activity was assessed by asking participants about the number of hours per week they spent on moderate and strenuous activities over the past year. The physical activity section of the questionnaire was modeled after the European Prospective Investigation into Cancer and Nutrition (EPIC) study physical activity questionnaire, which has been shown to be reasonably accurate and reproducible (36).

Mortality ascertainment

All-cause, CVD, respiratory, and cancer deaths from the date of the baseline interview through 31 December 2014 were identified through linkage with the nationwide registry of births and deaths in Singapore. The International Classification of Diseases (ICD) 9th (ICD9) (37) or 10th (ICD10) (38, 39) revision codes were used to classify causes of deaths from CVD [ICD9 (390–459) or ICD10 (I00–I99)], respiratory diseases including pneumonia and influenza [ICD9 (480–488) or ICD10 (J09–J18)], and chronic obstructive pulmonary disease [ICD9 (490–496) or ICD10 (J40–47)] and cancer [ICD9 (140–208) or ICD10 (C00–C97)].

Statistical analysis

We excluded participants who had cancer at baseline identified either by self-report or through linkage with the nationwide Singapore Cancer Registry ($n = 1936$) and participants with a self-reported history of heart attack or angina or stroke ($n = 3220$) at baseline. We also excluded 1023 participants who reported extreme energy intakes (<600 or >3000 kcal/d for women and <700 or >3700 kcal/d for men). Hence, the analysis included 57,078 participants.

Baseline characteristics were calculated with the use of descriptive statistics across quintiles of each diet-quality index score. We examined what individual foods were associated with high diet index scores by modeling each diet-quality score as a dependent variable and entering all food items assessed on the FFQ as independent variables in stepwise regression analysis. We also calculated Pearson correlations between different diet index scores. Cox proportional hazards regression was used to assess the association between diet-quality scores and all-cause, CVD, respiratory, and cancer mortality. Person-years were calculated for each study participant from the date of the baseline interview to the date of death, date of loss to follow-up, or 31 December 2014, whichever occurred first. The HRs and 95% CIs were estimated per quintile of each of the diet-quality indexes by using the lowest quintile as the reference category.

In the multivariable models, we adjusted for the following potential confounders: age at interview (years), sex (men or women), dialect group (Hokkien or Cantonese), education (no formal education, primary school, or secondary or higher), smoking (never, former, or current smoker of <13 or ≥ 13 cigarettes/d), physical activity (<0.5 h of moderate and strenuous activity/wk, 0.5 to <4 h of moderate activity/wk or 0.5 to <2 h of strenuous activity/wk, or ≥ 4 h of moderate activity/wk or ≥ 2 h of strenuous activity/wk), sleep duration [short (≤ 6 h), normal (7–8 h), or long (≥ 9 h)], BMI (kg/m^2), history of diabetes (yes or no), history of hypertension (yes or no), and total energy intake (kilocalories per day). The DASH and HDI do not have a separate component for alcohol; therefore, models that involved the DASH or HDI score further adjusted for alcohol intake (never/hardly ever, mild, moderate, or above moderate). Tests for trends were performed by assigning the median value of each diet index in each quintile and modeling this as a continuous variable.

We also performed several additional data analyses to evaluate the robustness of our results and to gain more insight into the observed associations. First, the potential effect modification of associations between diet-quality scores and mortality was examined for sex, BMI (<23 or ≥ 23), current smoking (yes or no), history of diabetes (yes or no), and history of hypertension (yes or no) by including multiplicative interaction terms in multivariable models. Second, we conducted an analysis of diet-quality indexes and mortality in never smokers only to examine the possibility of residual confounding by smoking habits. Third, we examined associations between the individual components of the diet-quality indexes and mortality to better understand possible reasons for differences in results between dietary indexes. In multivariable analyses for individual foods, we further adjusted for all other considered foods. Similarly, in multivariable analyses of individual nutrients, we further adjusted for other nutrients. Finally, we explored whether modifications to dietary indexes for East Asian populations should be considered with the use of a comprehensive index (AHEI-2010) as an example. In East Asians, soy intake is generally much higher than in Western populations and this results in a limited contribution of nuts to the “nuts and legumes” component. In addition, lower alcohol intake may be prudent in East Asians compared with other ethnic groups as a result of genetic differences in alcohol metabolism (40). In the modified AHEI-2010, we therefore used nuts only instead of the combination of legumes and nuts and defined the optimal intake of alcohol as <1 serving/d for both men and women (i.e., 10 points) and fewer points for higher intakes. All of the analyses were performed with the use of Stata version 11.0 (StataCorp). All *P* values were 2-sided, and *P* < 0.05 was considered significant.

Results

During an average follow-up of 17 y, a total of 15,262 deaths were documented, including 4871 CVD deaths, 2690 respiratory disease deaths, and 5306 cancer deaths. Pneumonia and chronic obstructive pulmonary disease were the predominant respiratory conditions contributing to respiratory disease mortality in the study cohort. A large proportion (77%) of respiratory deaths were due to pneumonia. The most common causes of cancer death among men were lung (33.8%), colorectal (13.0%), and liver (12.5%) cancer and in women were lung (22.0%), colorectal (15.7%), and breast (10.5%) cancer.

Baseline characteristics according to quintiles of the AHEI-2010, aMED, DASH, and HDI scores are presented in [Table 1](#). For all diet indexes, participants with the highest diet-quality scores were more likely to be women (except for HDI), highly educated, nonsmokers, and physically active. Distributions of individual dietary components according to the lowest and highest quintiles of the diet-quality indexes are presented in [Supplemental Table 2](#). As expected, participants with higher diet-quality scores had a more favorable nutrient profile than those with lower scores. Higher scores for AHEI-2010 and aMED indexes, which included moderate alcohol consumption in the scoring, were associated with higher alcohol intake, whereas higher scores for DASH and HDI indexes were associated with lower alcohol intake. Except for the HDI, all other indexes showed a moderate to high correlation with one other. The correlation coefficient for the HDI was 0.29 with AHEI-2010, 0.31 with aMED, or 0.33 with DASH. The correlation coefficients for other indexes were 0.65 between AHEI-2010 and aMED, 0.58 between aMED and DASH, and 0.72 between AHEI-2010 and DASH.

To provide insight into the specific foods that contributed to each diet-quality index, we identified individual foods that best explained variations in the diet index scores ([Supplemental Table 3](#)). Soy foods, boiled or steamed fish, peanut butter, nuts,

TABLE 1 Baseline characteristics according to quintiles of the AHEI-2010, aMED, DASH, and HDI scores in the Singapore Chinese Health Study participants¹

Characteristics	AHEI-2010		aMED		DASH		HDI	
	Q1	Q5	Q1	Q5	Q1	Q5	Q1	Q5
<i>n</i>	11,415	11,416	11,607	11,392	8102	12,280	11,415	11,416
Median score (min–max)	41.0 (17.0–44.0)	59.3 (56.0–81.0)	2 (0–2)	6 (6–9)	18.0 (8–19)	30.0 (28–39)	40.8 (15.7–44.0)	59.4 (56.4–70.0)
Age at interview, y	56.1 ± 8.1	55.6 ± 7.7	57.3 ± 8.1	54.9 ± 7.5	54.9 ± 7.7	56.4 ± 7.8	56.2 ± 8.0	55.6 ± 7.7
BMI, kg/m ²	23.0 ± 3.3	23.1 ± 3.2	23.0 ± 3.3	23.1 ± 3.2	23.1 ± 3.3	22.9 ± 3.2	23.1 ± 3.3	23.1 ± 3.1
Energy intake, kcal/d	1565 ± 565	1661 ± 505	1303 ± 425	1823 ± 532	1595 ± 522	1567 ± 472	1466 ± 587	1769 ± 494
Cantonese dialect, %	42.8	51.6	38.9	54.3	40.4	52.1	39.2	53.9
Women, %	46.2	58.8	53.6	57.4	39.4	67.7	56.2	49.7
Higher education, ² %	25.4	37.7	18.8	40.7	25.1	34.8	24.7	35.6
Current smoker, %	28.7	12.7	27.2	12.6	34.3	9.1	27.2	14.5
Moderate or strenuous activity, ³ %	20.1	36.5	18.0	38.0	17.6	37.9	21.5	33.5
Alcohol consumers, %	16.5	27.2	17.5	22.6	29.3	13.2	23.4	18.7
Sleep duration, %								
Normal (7–8 h/d)	58.0	61.6	58.9	62.2	59.8	60.2	57.5	62.1
Short (≤6 h/d)	34.0	32.5	33.9	31.9	32.3	34.1	34.9	32.0
Long (≥9 h/d)	8.0	5.9	7.2	5.9	7.9	5.7	7.5	5.8
History of hypertension, %	20.1	22.8	21.0	21.9	19.1	23.1	19.9	23.6
History of diabetes mellitus, %	6.5	8.6	7.3	8.2	6.0	9.4	8.2	7.1

¹Values are means ± SDs for continuous variables and percentages for categorical variables unless specified. AHEI-2010, Alternative Healthy Eating Index–2010; aMED, alternate Mediterranean diet; DASH, Dietary Approaches to Stop Hypertension; HDI, Healthy Diet Indicator; max, maximum; min, minimum; Q, quintile.

²Secondary school and above.

³At least 0.5 h of moderate or strenuous physical activity/wk.

various fruit and vegetables, whole-wheat bread, and hot breakfast cereals were associated with a higher score for the AHEI-2010, aMED, and DASH. Soft drinks, fruit juice, flavored rice, fried rice, rice rolls, noodles, pork belly, and luncheon meat were associated with a lower score for the AHEI-2010 and DASH. Similar to the other indexes, the HDI was associated with higher intakes of fruit, vegetables, and whole grains and lower intakes of soft drinks and pork. However, in contrast to other indexes the HDI was also associated with higher intakes of refined-grain products and margarine and lower intakes of additional animal foods (eggs, milk, fish, and poultry).

The HRs for all-cause mortality according to AHEI-2010, aMED, DASH, and HDI scores are shown in [Table 2](#). Higher scores for all diet-quality indexes were significantly associated with a lower risk of all-cause mortality. Participants in the highest quintile compared with the lowest quintile had a 26–33% lower risk of all-cause mortality after adjustment for age, sex, and total energy intake. The associations were attenuated after additional adjustment for lifestyle factors and medical history, but remained significant. The HRs (95% CIs) for all-cause mortality were 0.82 (0.78, 0.86) for AHEI-2010, 0.80 (0.76, 0.85) for aMED, 0.80 (0.75, 0.84) for DASH, and 0.88 (0.83, 0.92) for HDI scores, comparing the highest with the lowest quintiles (all *P*-trend < 0.001).

Associations between diet-quality indexes and risks of CVD, respiratory disease, and cancer mortality are shown in [Table 3](#). Across all indexes, participants in the highest quintile compared with the lowest quintile had a 19–28% lower risk of CVD mortality, a 14–28% lower risk of respiratory mortality, and a 5–12% lower risk of cancer mortality after adjustment for potential confounders. Associations of diet-quality indexes with cancer mortality were weaker than for CVD or respiratory disease mortality. In general, the HDI had a weaker association with risk of mortality from all causes, CVD, and respiratory diseases than did the other indexes.

In stratified analyses by sex, all diet-quality indexes were inversely associated with all-cause mortality in both men and

women by a similar magnitude ([Supplemental Table 4](#)). The only significant interaction with sex was observed for the association between HDI and cancer mortality ([Supplemental Table 5](#)). We did not observe significant interactions with diet indexes for smoking status, BMI, history of diabetes, and history of hypertension. To examine possible residual confounding by smoking habits, we evaluated the associations between overall diet-quality and mortality outcomes among never smokers. Restriction to never smokers did not substantially change the results, with the exception of attenuated associations between the diet-quality indexes and cancer mortality ([Supplemental Tables 6 and 7](#)).

We also examined food groups ([Figure 1](#)) and nutrients ([Figure 2](#)) that are components of the 4 diet-quality indexes in relation to mortality outcomes. After adjusting for potential confounders, higher intakes of vegetables, fruit, and nuts and lower intakes of red meats were associated with a lower risk of mortality from all causes, CVD, and respiratory diseases. For nutrients, higher intakes of dietary fiber and long-chain n–3 PUFAs and a lower intake of sodium were significantly associated with a lower risk of CVD and all-cause mortality. A mild or moderate intake of alcohol was associated with lower CVD mortality, whereas moderate and high alcohol intakes were associated with higher cancer mortality.

The results for the AHEI-2010 modified for East Asian populations in relation to all-cause and cause-specific mortality are shown in [Supplemental Table 8](#). The use of nut consumption instead of nuts and legumes combined slightly strengthened the inverse association between the AHEI-2010 and CVD mortality. In addition, the use of a lower cutoff for optimal alcohol consumption strengthened the inverse association between the AHEI-2010 and cancer mortality. When both the nut and the alcohol components were modified, the results changed minimally for all-cause and CVD mortality, but the inverse associations with cancer mortality became stronger. Participants in the highest quintile compared with the lowest quintile of this modified AHEI-2010 had a 22% lower risk of all-cause

TABLE 2 Risk of all-cause mortality by quintiles of AHEI-2010, aMED, DASH, and HDI scores in the Singapore Chinese Health Study participants¹

Quintile (range of scores)	Deaths, <i>n</i>	Person-years of follow-up	Basic model, ² HR (95% CI)	Full model, ³ HR (95% CI)
AHEI-2010				
Q1 (17.0–44.0)	3,521	189,288	1.00	1.00
Q2 (44.1–48.0)	3,265	193,982	0.91 (0.88, 0.95)	0.93 (0.88, 0.98)
Q3 (48.1–51.6)	3,055	196,858	0.85 (0.81, 0.89)	0.89 (0.85, 0.93)
Q4 (51.7–55.9)	2,864	199,271	0.79 (0.76, 0.83)	0.86 (0.82, 0.90)
Q5 (56.0–81.0)	2,557	202,578	0.72 (0.69, 0.76)	0.82 (0.78, 0.86)
<i>P</i> -trend			<0.001	<0.001
aMED				
Q1 (0–2)	3,866	191,950	1.00	1.00
Q2 (3)	3,352	189,407	0.92 (0.88, 0.97)	0.96 (0.92, 1.01)
Q3 (4)	3,252	207,848	0.87 (0.83, 0.91)	0.93 (0.89, 0.98)
Q4 (5)	2,496	189,321	0.79 (0.75, 0.83)	0.88 (0.83, 0.92)
Q5 (6–9)	2,296	203,452	0.69 (0.65, 0.73)	0.80 (0.76, 0.85)
<i>P</i> -trend			<0.001	<0.001
DASH				
Q1 (8–19)	2,418	136,022	1.00	1.00
Q2 (20–22)	3,710	217,734	0.87 (0.83, 0.92)	0.91 (0.86, 0.96)
Q3 (23–24)	2,849	179,136	0.80 (0.76, 0.85)	0.87 (0.82, 0.92)
Q4 (25–27)	3,460	233,318	0.75 (0.72, 0.79)	0.85 (0.80, 0.89)
Q5 (28–39)	2,825	215,768	0.67 (0.64, 0.71)	0.80 (0.75, 0.84)
<i>P</i> -trend			<0.001	<0.001
HDI				
Q1 (15.7–44.0)	3,401	190,181	1.00	1.00
Q2 (44.0–48.3)	3,167	195,595	0.90 (0.86, 0.94)	0.96 (0.91, 1.01)
Q3 (48.4–52.1)	2,998	196,971	0.82 (0.78, 0.86)	0.90 (0.86, 0.94)
Q4 (52.2–56.3)	2,999	197,935	0.81 (0.77, 0.85)	0.91 (0.86, 0.95)
Q5 (56.4–70.0)	2,697	201,294	0.74 (0.70, 0.77)	0.88 (0.83, 0.92)
<i>P</i> -trend			<0.001	<0.001

¹AHEI-2010, Alternative Healthy Eating Index–2010; aMED, alternate Mediterranean diet; DASH, Dietary Approaches to Stop Hypertension; HDI, Healthy Diet Indicator; Q, quintile.

²Adjusted for age at interview (years), sex (men or women), and total energy intake (kilocalories per day).

³In addition to the basic model, we adjusted for dialect (Hokkien or Cantonese), level of education (none, primary, or secondary or above), smoking status (never; ex-smoker; current-smoker of <13 or ≥13 cigarettes/d), physical activity (<0.5 h of moderate and strenuous activity/wk, 0.5 to <4 h of moderate activity/wk or 0.5 to <2 h of strenuous activity/wk, or ≥4 h of moderate activity/wk or ≥2 h of strenuous activity/wk), sleep duration [short (≤6 h/d), normal (7–8 h/d), or long (≥9 h/d)], BMI (kg/m²), history of diabetes mellitus (yes or no), and history of hypertension (yes or no). The full model for the DASH and HDI score was further adjusted for alcohol consumption [never/hardly ever, mild (<0.5 servings/d), moderate (between 0.5 and 2.0 servings/d for men and between 0.5 and 1.5 servings/d for women), above moderate intake (≥2.0 servings/d for men and ≥1.5 servings/d for women)].

mortality (*P*-trend < 0.001), a 26% lower risk of CVD mortality (*P*-trend < 0.001), a 28% lower risk of respiratory disease mortality (*P*-trend < 0.001), and a 10% lower risk of cancer mortality (*P*-trend = 0.02).

Discussion

In this large prospective cohort study in Singapore Chinese, we observed a 12–20% lower risk of all-cause mortality for higher scores on the AHEI-2010, aMED, DASH, and HDI. Participants with higher scores on any of the indexes had a 19–28% lower risk of CVD mortality and a 14–28% lower risk of respiratory disease, but only a 5–12% lower risk of cancer mortality. Analyses of individual components of the dietary quality scores suggested that higher intakes of vegetables, fruit, nuts, and long-chain n–3 FAs and lower intakes of red meat and sodium contributed to the inverse associations between dietary quality scores and mortality. Moderate alcohol consumption (0.5–2.0 servings/d for men and 0.5–1.5 servings/d for women, with 1 serving defined as 10 g/d) is included as a beneficial component of the AHEI-2010 and aMED indexes. Although moderate alcohol consumption was associated

with lower CVD mortality, it was associated with higher cancer mortality in our study population. In contrast, mild alcohol consumption was not associated with a higher risk of cancer mortality.

Except for the HDI, all indexes had a moderate to high correlation with one another. The AHEI-2010, aMED, and DASH all emphasize higher intakes of vegetables, fruit, whole grains, nuts, and legumes and a lower intake of red meat, thus mainly focusing on food groups. In contrast, the HDI that is based on WHO recommendations focuses more on nutrients such as FAs, cholesterol, mono- and disaccharides, and protein. There were also different approaches to include alcohol as part of dietary indexes. For the AHEI-2010 and aMED, moderate alcohol intake is included as a component that contributes to higher dietary quality scores, whereas alcohol is not a scoring component for the HDI and DASH. Furthermore, different classification methods for score components based on quintiles, medians, or fixed cutoff intakes may have contributed to differences in dietary pattern scores. Despite the differences, the AHEI-2010, aMED, and DASH dietary patterns generally showed similar associations with mortality outcomes. This suggests that all of these patterns capture key aspects of healthful diets in our Asian population.

TABLE 3 Risk of CVD, respiratory disease, and cancer mortality by quintiles of diet-quality scores in the Singapore Chinese Health Study participants¹

Quintile (range of scores)	CVD mortality						Respiratory disease mortality						Cancer mortality					
	Basic model ²			Full model ³			Basic model ²			Full model ³			Basic model ²			Full model ³		
	Deaths, n	Person-years	HR (95% CI)	Deaths, n	Person-years	HR (95% CI)	Deaths, n	Person-years	HR (95% CI)	Deaths, n	Person-years	HR (95% CI)	Deaths, n	Person-years	HR (95% CI)	Deaths, n	Person-years	HR (95% CI)
AHEI-2010																		
Q1 (17.0–44.0)	1123	189,288	1.0	1.0	658	189,288	1.0	1.0	1.0	1179	189,288	1.0	1.0	189,288	1.0	1.0	1.0	
Q2 (44.1–48.0)	1086	193,982	0.94 (0.87, 1.03)	0.96 (0.88, 1.04)	575	193,982	0.86 (0.77, 0.96)	0.89 (0.80, 1.00)	0.89 (0.80, 1.00)	1080	193,982	0.91 (0.84, 0.99)	0.95 (0.87, 1.03)	193,982	0.91 (0.84, 0.99)	0.95 (0.87, 1.03)	0.95 (0.87, 1.03)	
Q3 (48.1–51.6)	988	196,858	0.86 (0.79, 0.94)	0.89 (0.81, 0.97)	561	196,858	0.83 (0.74, 0.93)	0.90 (0.80, 1.01)	0.90 (0.80, 1.01)	1033	196,858	0.87 (0.80, 0.94)	0.94 (0.87, 1.02)	196,858	0.87 (0.80, 0.94)	0.94 (0.87, 1.02)	0.94 (0.87, 1.02)	
Q4 (51.7–55.9)	890	199,271	0.78 (0.71, 0.85)	0.82 (0.75, 0.90)	487	199,271	0.72 (0.64, 0.81)	0.80 (0.71, 0.90)	0.80 (0.71, 0.90)	1065	199,271	0.89 (0.82, 0.97)	1.00 (0.92, 1.09)	199,271	0.89 (0.82, 0.97)	1.00 (0.92, 1.09)	1.00 (0.92, 1.09)	
Q5 (56.0–81.0)	784	202,578	0.71 (0.65, 0.78)	0.77 (0.70, 0.85)	409	202,578	0.61 (0.54, 0.69)	0.72 (0.64, 0.82)	0.72 (0.64, 0.82)	949	202,578	0.80 (0.73, 0.87)	0.95 (0.87, 1.04)	202,578	0.80 (0.73, 0.87)	0.95 (0.87, 1.04)	0.95 (0.87, 1.04)	
P-trend			<0.001	<0.001			<0.001	<0.001	<0.001			<0.001	0.55		<0.001		0.55	
aMED																		
Q1 (0–2)	1265	191,950	1.0	1.0	727	191,950	1.0	1.0	1.0	1292	191,950	1.0	1.0	191,950	1.0	1.0	1.0	
Q2 (3)	1086	189,407	0.93 (0.85, 1.01)	0.95 (0.88, 1.04)	627	189,407	0.92 (0.83, 1.03)	0.97 (0.87, 1.08)	0.97 (0.87, 1.08)	1085	189,407	0.88 (0.81, 0.96)	0.93 (0.86, 1.01)	189,407	0.88 (0.81, 0.96)	0.93 (0.86, 1.01)	0.93 (0.86, 1.01)	
Q3 (4)	1026	207,848	0.86 (0.79, 0.94)	0.90 (0.83, 0.98)	563	207,848	0.81 (0.73, 0.91)	0.90 (0.80, 1.01)	0.90 (0.80, 1.01)	1144	207,848	0.88 (0.82, 0.96)	0.98 (0.90, 1.06)	207,848	0.88 (0.82, 0.96)	0.98 (0.90, 1.06)	0.98 (0.90, 1.06)	
Q4 (5)	788	189,321	0.79 (0.72, 0.87)	0.86 (0.78, 0.94)	404	189,321	0.70 (0.62, 0.79)	0.81 (0.71, 0.92)	0.81 (0.71, 0.92)	932	189,321	0.83 (0.76, 0.90)	0.97 (0.88, 1.06)	189,321	0.83 (0.76, 0.90)	0.97 (0.88, 1.06)	0.97 (0.88, 1.06)	
Q5 (6–9)	706	203,452	0.69 (0.63, 0.76)	0.77 (0.70, 0.85)	369	203,452	0.60 (0.52, 0.69)	0.72 (0.63, 0.83)	0.72 (0.63, 0.83)	853	203,452	0.72 (0.65, 0.79)	0.88 (0.80, 0.97)	203,452	0.72 (0.65, 0.79)	0.88 (0.80, 0.97)	0.88 (0.80, 0.97)	
P-trend			<0.001	<0.001			<0.001	<0.001	<0.001			<0.001	0.07		<0.001		0.07	
DASH																		
Q1 (8–19)	763	136,022	1.0	1.0	409	136,022	1.0	1.0	1.0	871	136,022	1.0	1.0	136,022	1.0	1.0	1.0	
Q2 (20–22)	1221	217,734	0.90 (0.82, 0.98)	0.90 (0.83, 0.99)	680	217,734	0.91 (0.80, 1.03)	0.95 (0.84, 1.08)	0.95 (0.84, 1.08)	1250	217,734	0.85 (0.78, 0.93)	0.92 (0.84, 1.00)	217,734	0.85 (0.78, 0.93)	0.92 (0.84, 1.00)	0.92 (0.84, 1.00)	
Q3 (23–24)	913	179,136	0.80 (0.73, 0.88)	0.83 (0.76, 0.92)	496	179,136	0.78 (0.68, 0.88)	0.85 (0.75, 0.98)	0.85 (0.75, 0.98)	998	179,136	0.82 (0.75, 0.90)	0.94 (0.85, 1.03)	179,136	0.82 (0.75, 0.90)	0.94 (0.85, 1.03)	0.94 (0.85, 1.03)	
Q4 (25–27)	1101	233,318	0.75 (0.68, 0.82)	0.80 (0.72, 0.88)	618	233,318	0.74 (0.65, 0.84)	0.85 (0.75, 0.97)	0.85 (0.75, 0.97)	1208	233,318	0.77 (0.71, 0.84)	0.93 (0.85, 1.02)	233,318	0.77 (0.71, 0.84)	0.93 (0.85, 1.02)	0.93 (0.85, 1.02)	
Q5 (28–39)	873	215,768	0.65 (0.59, 0.72)	0.72 (0.65, 0.80)	487	215,768	0.64 (0.56, 0.73)	0.78 (0.68, 0.89)	0.78 (0.68, 0.89)	979	215,768	0.69 (0.63, 0.75)	0.89 (0.82, 0.98)	215,768	0.69 (0.63, 0.75)	0.89 (0.82, 0.98)	0.89 (0.82, 0.98)	
P-trend			<0.001	<0.001			<0.001	<0.001	<0.001			<0.001	0.07		<0.001		0.07	
HDI																		
Q1 (15.7–44.0)	1108	190,181	1.0	1.0	579	190,181	1.0	1.0	1.0	1216	190,181	1.0	1.0	190,181	1.0	1.0	1.0	
Q2 (44.0–48.3)	984	195,595	0.86 (0.79, 0.94)	0.89 (0.82, 0.97)	581	195,595	0.96 (0.86, 1.08)	1.05 (0.93, 1.18)	1.05 (0.93, 1.18)	1088	195,595	0.87 (0.80, 0.94)	0.96 (0.88, 1.04)	195,595	0.87 (0.80, 0.94)	0.96 (0.88, 1.04)	0.96 (0.88, 1.04)	
Q3 (48.4–52.1)	982	196,971	0.83 (0.76, 0.91)	0.89 (0.81, 0.97)	544	196,971	0.84 (0.75, 0.95)	0.93 (0.83, 1.05)	0.93 (0.83, 1.05)	994	196,971	0.76 (0.70, 0.83)	0.87 (0.80, 0.95)	196,971	0.76 (0.70, 0.83)	0.87 (0.80, 0.95)	0.87 (0.80, 0.95)	
Q4 (52.2–56.3)	963	197,935	0.81 (0.74, 0.88)	0.88 (0.80, 0.96)	520	197,935	0.79 (0.70, 0.89)	0.89 (0.79, 1.01)	0.89 (0.79, 1.01)	1033	197,935	0.78 (0.71, 0.84)	0.92 (0.84, 1.00)	197,935	0.78 (0.71, 0.84)	0.92 (0.84, 1.00)	0.92 (0.84, 1.00)	
Q5 (56.4–70.0)	834	201,294	0.72 (0.66, 0.79)	0.81 (0.74, 0.89)	466	201,294	0.72 (0.63, 0.81)	0.86 (0.76, 0.98)	0.86 (0.76, 0.98)	975	201,294	0.72 (0.66, 0.79)	0.92 (0.84, 1.01)	201,294	0.72 (0.66, 0.79)	0.92 (0.84, 1.01)	0.92 (0.84, 1.01)	
P-trend			<0.001	<0.001			<0.001	<0.001	<0.001			<0.001	0.40		<0.001		0.40	

¹AHEI-2010, Alternate Healthy Eating Index-2010; aMED, alternate Mediterranean diet; CVD, cardiovascular disease; DASH, Dietary Approaches to Stop Hypertension; HDI, Healthy Diet Indicator; Q, quintile.

²Adjusted for age at interview (years), sex (men or women), and total energy intake (kilocalories per day).

³In addition to the basic model, we adjusted for dialect (Hokkien or Cantonese), level of education (none, primary, or secondary or above), smoking status (never, ex-smoker, current-smoker of <13 or ≥13 cigarettes/d), physical activity (<0.5 h of moderate and strenuous activity/wk, 0.5 to <4 h of moderate activity/wk or ≥4 h of moderate activity/wk or ≥2 h of strenuous activity/wk), sleep duration (short [≤6 h/d], normal [7–8 h/d], or long [≥9 h/d]), BMI (kg/m²), history of diabetes mellitus (yes or no), and history of hypertension (yes or no). The full model for the DASH and HDI score was further adjusted for alcohol consumption [never/hardly ever, mild (<0.5 servings/d), moderate (between 0.5 and 2.0 servings/d for men and between 0.5 and 1.5 servings/d for women), above moderate intake (≥2.0 servings/d for men and ≥1.5 servings/d for women)].

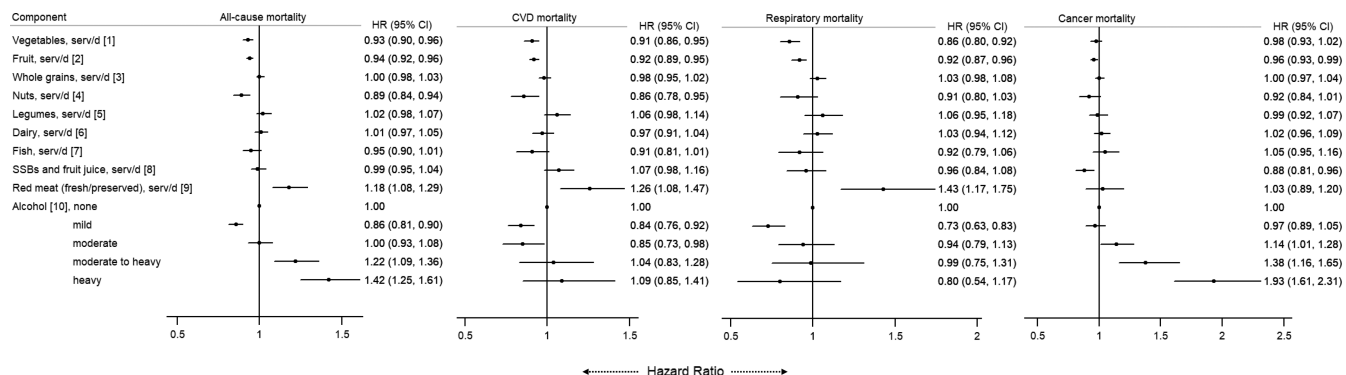


FIGURE 1 Associations of all-cause and cause-specific mortality with food groups of diet-quality indexes in the Singapore Chinese Health Study. HRs were adjusted for age at interview, sex, total energy intake, dialect (Hokkien or Cantonese), level of education (none, primary, or secondary or above), smoking status (never; ex-smoker; or current smoker or <13 or ≥13 cigarettes/d), physical activity (<0.5 h of moderate and strenuous activity/wk, 0.5 to <4 h of moderate activity/wk or 0.5 to <2 h of strenuous activity/wk, or ≥4 h of moderate activity/wk or ≥2 h of strenuous activity/wk), sleep duration, BMI (kg/m²), history of diabetes mellitus, history of hypertension, intakes in servings per day of vegetables, fruit, whole grains, nuts, legumes, dairy products, fish, SSBs and fruit juice, red meat, and alcohol (none, mild, moderate, moderate to heavy, and heavy intake). [1] One serving of vegetables = 67 g (0.5 cup of typical local vegetables); [2] 1 serving = 1 medium piece of fruit; [3] 1 serving = 16 g of whole grains; [4] 1 serving = 28 g of nuts or 1 tablespoon (16 g) of peanut butter; [5] 1 serving is 1 medium-size tofu item; [6] 1 serving is 250 mL or 1 cup of milk; [7] 1 serving is 90 g of fish; [8] 1 serving is 1 glass, packet, or typical local portion of SSB/fruit juice; [9] 1 serving is 113.4 g of unprocessed meat or 42.5 g of processed meat; [10] 1 serving of alcohol = 10 g (mild alcohol intake: <0.5 servings/d; moderate intake: 0.5–2.0 servings/d for men and 0.5–1.5 servings/d for women; moderate to heavy intake: 2.0–3.5 servings/d for men and 1.5–2.5 servings/d for women; and heavy intake: ≥3.5 servings/d for men and ≥2.5 servings/d for women). CVD, cardiovascular disease; serv, servings; SSB, sugar-sweetened beverage.

In our study, all 4 evaluated dietary indexes were associated with a substantially lower risk of all-cause mortality, which agrees with studies conducted in other populations (18–22). In the US Multiethnic Cohort Study (19), the highest scores for the AHEI-2010, DASH, and aMED were associated with a 19–22% lower risk of all-cause mortality, which is very similar to the 18–20% lower risk that we observed. In our study, higher adherence to diet-quality indexes was significantly associated with CVD and respiratory disease mortality but not with cancer mortality. Possible reasons for the weaker associations with cancer mortality could be that cancer is a heterogeneous endpoint.

Diet may play a more important role in the etiology of certain cancers, such as colorectal cancer, compared with other specific types of cancer (14). In contrast to our findings, AHEI-2010, aMED, and DASH scores were similarly associated with a lower risk of CVD and cancer mortality in the US NIH-AARP Diet and Health Study and the Multiethnic Cohort (19, 22). Interestingly, we observed more similar results for the AHEI-2010 and cancer mortality after modifying the alcohol component. However, our findings are in agreement with results from other studies in which dietary quality scores were more strongly associated with CVD than with cancer mortality (14, 20).

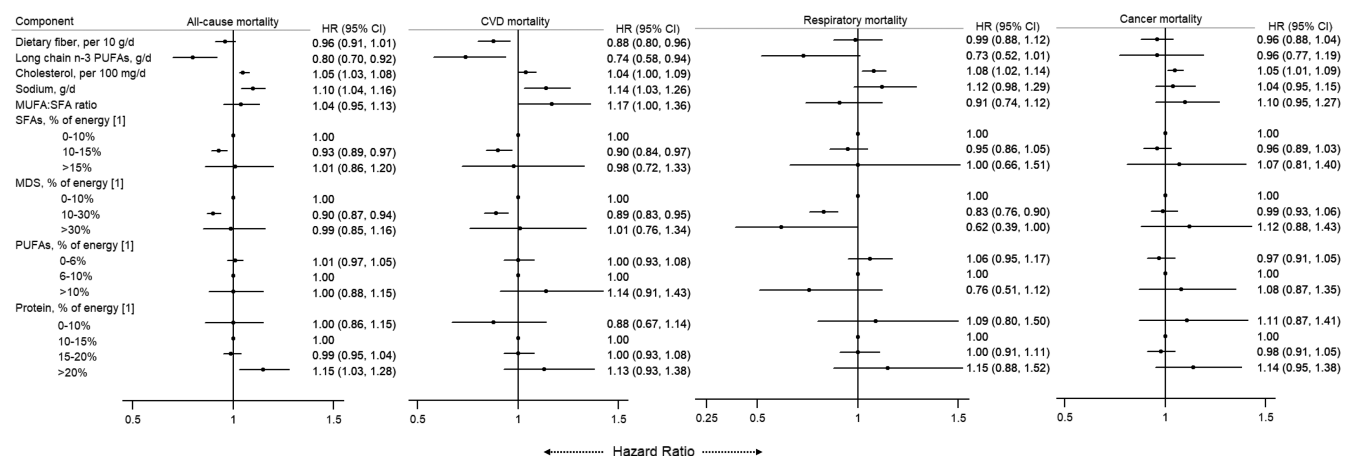


FIGURE 2 Associations of all-cause and cause-specific mortality with nutrient components of diet-quality indexes in the Singapore Chinese Health Study. HRs were adjusted for age at interview (years), sex (men or women), and total energy intake (kilocalories per day), dialect (Hokkien or Cantonese), level of education (none, primary, or secondary or above), smoking status (never; ex-smoker; or current smoker or <13 or ≥13 cigarettes/d), physical activity (<0.5 h of moderate and strenuous activity/wk, 0.5 to <4 h of moderate activity/wk or 0.5 to <2 h of strenuous activity/wk, or ≥4 h of moderate activity/wk or ≥2 h of strenuous activity/wk), sleep duration [short (≤6 h/d), normal (7–8 h/d), or long (≥9 h/d)], BMI (kg/m²), history of diabetes mellitus (yes or no), history of hypertension (yes or no), intake of dietary fiber (per 10 g/d), long-chain n-3 PUFAs (grams per day), cholesterol (per 100 mg/d), sodium (grams per day), SFAs (0–10%, 10–15%, or >15% of energy), MDSs (0–10%, 10–30%, or >30% of energy), PUFAs (0–6%, 6–10%, or >10% of energy), protein (0–10%, 10–15%, 15–20%, or >20% of energy), and alcohol (none, mild, moderate, moderate to heavy, or heavy intake). We excluded SFAs in the multivariable analyses of MUFA-to-SFA ratio. [1] % of energy excluding energy from alcohol. CVD, cardiovascular disease; MDS, mono- and disaccharide.

In a previous study in a Chinese population in Shanghai, higher scores for the AHEI-2010 and DASH also predicted lower mortality from all causes (16–32%) and CVD (21–44%) but not cancer (25). However, this study did not include the whole-grain and sugar-sweetened beverage component of the dietary quality indexes due to very low intakes. Our study population had higher intakes of whole grains and sugar-sweetened beverages, making it possible to include these food groups in the calculation of diet-quality scores.

Although the HDI score was inversely associated with the risk of mortality from all causes and cause-specific mortality in our study, associations were weaker and less consistent than with other diet-quality indexes. Consistent with our findings, the HDI score was inversely associated with all-cause mortality (21) and CVD mortality (23), but not with cancer mortality in other populations (23, 41). In contrast, greater adherence to the HDI score was not significantly associated with all-cause mortality in Central and Eastern European populations (23) and CVD mortality in a pooled analysis that included 10 prospective cohort studies from Europe and the United States (17).

Several epidemiologic studies have supported a role of dietary intakes in the development of respiratory diseases (42) and related mortality (43, 44), but little is known on the impact of overall diet-quality on respiratory mortality. In the Nurses' Health Study and the Health Professionals Follow-Up study, the highest AHEI-2010 diet score was associated with a 31–40% lower risk of chronic obstructive pulmonary disease (45). Interestingly, in our study, all dietary quality indexes were associated with a substantially lower risk of respiratory disease mortality.

In the analyses of individual dietary factors, the consumption of nuts was significantly associated with lower CVD and all-cause mortality, but these associations were substantially weaker for legumes. The lack of substantial association between legume consumption and CVD mortality is consistent with the previously reported lack of association between soy intake and CVD mortality in our study (46). This suggests that using the combined category “nuts and legumes” in diet-quality indexes may not be recommended. Specifically recommending nuts may be particularly relevant in Chinese populations in whom the intake of legumes in the form of soy products is often much higher than the intake of nuts. However, the differences in association with mortality for the AHEI-2010 scores with only “nuts” or “nuts and legumes” as a component were small and need to be confirmed in other Asian populations.

In our study, moderate alcohol consumption was associated with a higher risk of cancer mortality. These results suggest that the associations between moderate alcohol consumption and total cancer mortality are stronger in our population as than in Western populations (47–49). In East Asians, a large part of the population carries genetic variants that lead to a slower breakdown of the carcinogenic alcohol metabolite acetaldehyde (40, 50). In epidemiologic studies in Japan, individuals with 1 copy of the inactive variant were 6–10 times more likely to develop esophageal cancer than individuals with the fully active aldehyde dehydrogenase 2 enzyme who drank comparable amounts of alcohol (51). Thus, alcohol recommendations reflected in the AHEI-2010 and aMED indexes may be too high with regard to cancer mortality risk for East Asian populations (52). Therefore, we conducted an analysis with the AHEI-2010 index adapted for East Asian populations by considering light alcohol consumption or abstinence (<1 drink/d) instead of moderate consumption as the recommended level of intake. This adapted AHEI-2010 index was associated with a significantly lower cancer mortality.

Strengths of our study included the prospective study design, large sample size, detailed assessment of diet and potential confounders, long-term follow-up, comprehensive ascertainment of mortality through a nationwide death registry, and the evaluation of diet-quality scores in an Asian study setting. Potential limitations of our study included measurement error inherent in the assessment of diet and potential confounders with the use of self-reported information. Dietary assessment was done only at baseline and subsequent changes in the dietary intake during follow-up were not recorded. However, because of the prospective design, changes occurring in the diet would be expected to lead to nondifferential misclassification and most likely attenuate the observed associations. Due to lack of data on *trans* fat consumption in our study population, we did not include the originally proposed *trans* fat component in the calculation of the AHEI-2010. However, the very low plasma *trans* fat concentration in our study population suggests a minimal impact of *trans* fat on the AHEI-2010 score in our analysis (53). Dairy consumption was generally low in our study population, and hence we included all dairy products instead of low-fat dairy in the calculation of the DASH score. Furthermore, the results for the sodium component should be interpreted with caution because it is difficult to capture discretionary salt use in cooking or at the table through questionnaires. Finally, although we carefully adjusted for important confounders such as demographic and lifestyle factors in our analyses, the possibility of residual confounding due to imperfectly measured or unknown confounders cannot be excluded.

In conclusion, our findings suggest that higher adherence to dietary recommendations as reflected in the AHEI-2010, aMED, DASH, and HDI was associated with a substantially lower risk of CVD, respiratory disease, and all-cause mortality in a Chinese population. Previous studies mainly focused on CVD and cancer mortality, but our findings suggest that higher dietary quality may also substantially reduce respiratory mortality. The associations between diet-quality and mortality outcomes were of a similar magnitude, except for the slightly weaker associations for the HDI. The specific foods and dishes that characterize a high diet-quality score will likely be different for Chinese compared with Western populations. However, our results suggest that the broader food groups and nutrients encompassed within dietary quality indexes can be recommended to Chinese and possibly other Asian populations. Our study findings suggest that the association between moderate alcohol consumption and a higher risk of cancer death may be stronger in East Asian than in Western populations. As a result, it may be prudent to recommend lower alcohol intakes as part of dietary quality scores for East Asian populations. In general, our findings support adhering to the dietary quality indexes that emphasize a variety of healthy plant-based foods (vegetables, fruit, nuts) and long-chain n–3 PUFAs, low consumption of red meat, and avoidance of heavy alcohol intake for lowering the risk of all-cause and chronic disease mortality.

Acknowledgments

We acknowledge the founding, longstanding principal investigator of the Singapore Chinese Health Study, Mimi C Yu. We also thank Siew-Hong Low of the National University of Singapore for supervising the field work of the Singapore Chinese Health Study and Renwei Wang for the development and maintenance of the cohort-study database. The authors' responsibilities were as follows—NN and RMvD: designed the research, developed the analytical plan, and took responsibility for the integrity of the data and the accuracy of the data analysis; NN:

performed the statistical analyses and had primary responsibility for writing the manuscript; W-PK, J-MY, and RMvD: directed the study; RMvD: was the guarantor of the study; and all authors: interpreted the findings, edited the manuscript, had full access to all of the data in the study, and read and approved the final manuscript.

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