ORIGINAL RESEARCH

Diet Quality and Cardiovascular Disease Risk in Postmenopausal Women With Type 2 Diabetes Mellitus: The Women's Health Initiative

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Background—Dietary patterns are associated with cardiovascular disease (CVD) risk in the general population, but diet–CVD association in populations with diabetes mellitus is limited. Our objective was to examine the association between diet quality and CVD risk in a population with type 2 diabetes mellitus.

Methods and Results—We analyzed prospective data from 5809 women with prevalent type 2 diabetes mellitus at baseline from the Women's Health Initiative. Diet quality was defined using alternate Mediterranean, Dietary Approach to Stop Hypertension, Paleolithic, and American Diabetes Association dietary pattern scores calculated from a validated food frequency questionnaire. Multivariable Cox's proportional hazard regression was used to analyze the risk of incident CVD. During mean 12.4 years of follow-up, 1454 (25%) incident CVD cases were documented. Women with higher alternate Mediterranean, Dietary Approach to Stop Hypertension, and American Diabetes Association dietary pattern scores had a lower risk of CVD compared with women with lower scores (Q5 v Q1) (hazard ratio $[HR]_{aMed}$ 0.77, 95% CI 0.65–0.93; HR_{DASH} 0.69, 95% CI 0.58–0.83; HR_{ADA} 0.71, 95% CI 0.59–0.86). No association was observed between the Paleolithic score and CVD risk.

Conclusions—Dietary patterns that emphasize higher intake of fruits, vegetables, whole grains, nuts/seeds, legumes, a high unsaturated:saturated fat ratio, and lower intake of red and processed meats, added sugars, and sodium are associated with lower CVD risk in postmenopausal women with type 2 diabetes mellitus. **(*J Am Heart Assoc*. 2019;8:e013249. DOI: 10.1161/JAHA.119.013249.)**

Key Words: cardiovascular disease prevention • diabetes mellitus • diet • nutrition • women

Diabetes mellitus is a major public health burden affecting 30.3 million (1 in 8) US adults. If trends continue, it is projected that as many as 1 in 3 will have diabetes mellitus by the year 2050.[1,2] Diabetes mellitus is a major risk factor for cardiovascular disease (CVD) as adults with type 2 diabetes mellitus are more than twice as likely to develop CVD than adults without diabetes mellitus, and >70% of individuals with diabetes mellitus will die of CVD.[3] People with type 2 diabetes mellitus often have concomitant major risk factors for CVD including dyslipidemia, hypertension, and obesity,[4] which have demonstrated links with dietary intake. The relationship between diet and cardiovascular health in the general population is well established.[5] However, little is known about the relation between dietary patterns and CVD outcomes among populations with type 2 diabetes mellitus.

Diet has been studied as part of multifactorial lifestyle interventions for CVD risk in people with type 2 diabetes mellitus, limiting inference about the role of diet alone.[6–8] Several small randomized intervention studies conducted in people with type 2 diabetes mellitus showed modest improvement in CVD risk factors with Dietary Approach to Stop Hypertension (DASH) and Mediterranean diets[9,10] and a subgroup analysis of the Prevención con Dieta Mediterránea study demonstrated the benefit of a Mediterranean diet on CVD risk in individuals with type 2 diabetes mellitus.[11] A

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Accompanying Tables S1 through S6 are available at https://www.ahajournals.org/doi/suppl/10.1161/JAHA.119.013249

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Clinical Perspective

What Is New?

- Self-reported dietary intakes more closely aligned with Mediterranean, Dietary Approach to Stop Hypertension, and American Diabetes Association dietary patterns are associated with lower risk of incident cardiovascular disease in postmenopausal women with type 2 diabetes mellitus, whereas there was no association between a Paleolithic dietary pattern and cardiovascular disease risk in this population.
- Dietary patterns that emphasize higher intake of fruits, vegetables, dairy, whole grains, nuts/seeds, legumes, a high unsaturated:saturated fat ratio, and low intake of red and processed meats, added sugars, and sodium are associated with reduced incident cardiovascular disease risk in postmenopausal women with type 2 diabetes mellitus.

What Are the Clinical Implications?

- Diet quality represents an important modifiable risk factor for cardiovascular disease in both the general population and high-risk individuals such as those with type 2 diabetes mellitus.

recent prospective cohort study by Liu et al provided evidence linking diet quality to CVD outcomes in populations with type 2 diabetes mellitus[12] and another study found a small reduction in CVD mortality risk with greater adherence to a Mediterranean diet in individuals with type 2 diabetes mellitus.[13] To further add to this evidence base, we examined the association between diet quality, as measured by 4 dietary pattern scores, and CVD risk over time in postmenopausal women with type 2 diabetes mellitus from the WHI (Women's Health Initiative), a population-based prospective cohort study. This population represents a particularly high-risk group, as evidence suggests that women with diabetes mellitus have a greater risk of CVD relative to men and postmenopausal women are at higher risk than premenopausal women.[14]

Methods

Study Population

The WHI is a longitudinal national health study conducted at 40 clinical centers across the United States. Between 1993 and 1998, 161 808 postmenopausal women aged 50 to 79 years were enrolled into clinical trials or an observational study. Postmenopausal status was defined as no menstrual period for at least 12 months for women aged 50 to 54 years and at least 6 months for women 55 years or older at the time of enrollment.[15] Additional details of the study design and methods have been published elsewhere.[16] Institutional review boards at all participating institutions approved the study protocols and procedures and all participants provided written informed consent. Because of the sensitive nature of the data collected for this study, requests to access the data set from qualified researchers trained in human subject confidentiality protocols may be sent to the Publications and Presentations Program Coordinator at the WHI Clinical Coordinating Center (p&p@whi.org). The analytic code is available by request from the corresponding author.

This analysis included women from the WHI who reported having type 2 diabetes mellitus at baseline. Participants were asked if a physician had ever told them they had "sugar diabetes or high blood sugar" when they were not pregnant, and about treatment with insulin or oral antidiabetic medications. Baseline diabetes mellitus was defined as an affirmative answer to the above question or reported use of medication to treat diabetes mellitus. A validation study of the accuracy of self-reported diabetes mellitus in the WHI based on medication and laboratory data found the self-report to be valid and reliable.[17]

A total of 9618 women reported having diabetes mellitus at baseline. Since the WHI did not differentiate type 1 from type 2 diabetes mellitus, women who reported an age of diabetes mellitus diagnosis <21 years (n=140) or who were missing data on age at diagnosis (n=69) were excluded from the analysis in an attempt to select only women with prevalent type 2 diabetes mellitus. Additionally, women who reported a history of CVD at baseline (n=3286) or who reported extreme energy intake using the upper and lower 1% of the sample distribution as cutoffs (<465 or >3931 kcal/d) (n=314) were excluded. The final study sample included 5809 women.

Assessment of Diet Quality

Dietary intake was assessed with a validated food frequency questionnaire.[18] The food frequency questionnaire was designed to capture usual intake over the past 3 months and consisted of 3 sections: 122 composite and single food line items, which included questions on the frequency of consumption and portion sizes; 19 adjustment questions related to type of fat intake; and 4 summary questions asking about usual intake of fruits, vegetables, and added fats. Questionnaires were collected at baseline for all subjects and at specified follow-up visits on a rotating basis for a subsample of the cohort each year. Only baseline dietary data were used for this analysis because of potential biases and sample size limitations of the follow-up data. As described in previous WHI dietary analyses, a nutrient database consisting of 30 nutrients was derived from the food frequency questionnaire using the University of Minnesota Nutrition Coding Center nutrient database (Nutrition Coordinating Center, Minneapolis, MN) and additional food group measures were derived using the US Department of Agriculture MyPyramid Equivalents Database 2.0.[19]

Diet quality was measured using 4 dietary pattern scores: the alternate Mediterranean (aMed) and DASH diets, and 2 patterns hypothesized to be relevant to glycemic control and diabetes mellitus management: the American Diabetes Association (ADA) dietary recommendations and a Paleolithic (Paleo) diet. Higher scores indicate a diet more closely aligned with the specified dietary pattern. The aMed and DASH diet scores were calculated as previously described.[19] The ADA dietary pattern score was developed based on the 2019 ADA Standards of Medical Care in Diabetes.[20] Participants were assigned a quintile rank for 10 dietary components, 7 beneficial (fruit [excluding juice], vegetables, whole grains, fish, dairy, nuts/seeds/legumes, and fatty acid ratio [monounsaturated fatty acids + polyunsaturated fatty acids/saturated fatty acids]) and 2 adverse (sodium and sugar-sweetened beverages) for diabetes mellitus management as well as moderate alcohol intake. The total ADA score was then calculated according to quintile rankings, where an individual in the highest quintile of intake for a beneficial food group receives 5 points, and the lowest quintile receives 1, and vice versa for adverse foods. Alcohol intake ≤10 g/d received 2 points and >10 g/d received 0.

The Paleo score was calculated in a similar manner. Each participant was assigned a quintile rank for 13 food categories relevant to the underlying theoretical construct of a Paleo-type diet.[21,22] The composite score was calculated according to quintile rankings, with higher scores given for higher intakes of foods that are considered characteristics of a Paleo diet (vegetables, fruit, meat, fish, nuts, and green leafy vegetables) and for low or no consumption of foods that are not considered characteristic of a Paleo diet (processed meats, dairy, grains/starches, empty calories [calculated in WHI as calories from discretionary solid fats and added sugar], alcohol, sodium, and sugar-sweetened beverages) (see Table S1 for further details).

Cardiovascular Disease Ascertainment

The primary outcome for this analysis is incident CVD, defined as the first occurrence of an acute myocardial infarction (MI) requiring overnight hospitalization, definite silent MI, coronary heart disease (CHD) death, coronary revascularization, peripheral artery disease, congestive heart failure, or ischemic or hemorrhagic stroke. CHD (defined in WHI as the first occurrence of a clinical MI, definite silent MI, or a death caused by definite or possible CHD) and stroke (ischemic and hemorrhagic) were also analyzed individually as separate outcomes. Cardiovascular disease outcomes were ascertained in the WHI through self-reported medical questionnaires completed by participants every 6 to 12 months, depending on study assignment. Medical records for all overnight hospitalizations and outpatient coronary revascularization procedures were reviewed by central physician adjudicators or trained local adjudicators.[23]

Covariates

At baseline, participants completed interview and self-administered standardized questionnaires to ascertain medical history, demographic and health behavior information, including age, race/ethnicity, education level, annual income, marital status, smoking history, and physical activity. Using the validated WHI physical activity questionnaire, participants reported the frequency, duration, and intensity of recreational physical activity, including walking, mild, moderate, and strenuous activity.[24] From these data, metabolic equivalents of physical activities in metabolic equivalents-hours/wk (kcal/wk per kg) were computed.[25]

In the medical history questionnaire, women were asked (yes/no), "Has a doctor told you that you have or have you had high cholesterol requiring pills?" Baseline hypertensive status was self-selected as "never hypertensive," "untreated hypertensive," or "treated hypertensive." Subjects were also asked, "Has a doctor ever told you that you had heart problems, problems with your blood circulation, or blood clots?" Previous validation studies have found self-report of CVD at baseline in the WHI to be reliable.[26,27]

At the baseline clinic visit, trained and certified WHI clinical staff measured height, weight, and blood pressure using standardized procedures. Weight was measured using a calibrated balance-beam scale and height using a fixed stadiometer. From these measurements, body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. Blood pressure was measured twice after a 5-minute rest period using a conventional mercury sphygmomanometer and appropriately sized cuffs. Baseline systolic and diastolic blood pressures were recorded as the average of the 2 measurements.[28]

Statistical Analysis

Baseline characteristics were described by quintile of dietary pattern score using means with standard deviation for continuous variables and frequencies with percentages for categorical variables. To compare baseline characteristics, χ^2 tests were used for categorical variables and analysis of variance for continuous variables. Participants had low rates of missing data for pertinent covariates (<4%). Missing values were imputed by age and race subgroups.[29] A sensitivity analysis including only women with complete data was done to validate this approach and produced results similar to the main findings.

Cox proportional hazard models were used to evaluate the association between diet quality and CVD. Separate models were fit for each dietary pattern score to estimate the hazard ratios (HRs) and 95% CIs of incident CVD. The time to event was measured as the number of days since enrollment to the first occurrence of a cardiovascular event. Otherwise, participants were censored at the time of a woman's last documented follow-up contact, whether because of loss of follow-up, death (noncardiovascular), or end of study. Dietary pattern scores were entered into the models as continuous variables and HRs and 95% CIs calculated per standard deviation change in each score. Additionally, participants were ranked into quintiles of dietary pattern score, with the lowest quintile of each score serving as the reference group. Two multivariable models adjusted for preselected potential confounders were used. Model 1 adjusted for age, race/ethnicity, education, income, marital status, physical activity, cigarette smoking, BMI, geographical region, and WHI study arm. Model 2 additionally adjusted for age at diabetes mellitus diagnosis, energy intake, insulin use, systolic and diastolic blood pressures, and history of high cholesterol requiring medication. Laboratory triglycerides and cholesterol measurements were collected on only 6% of clinical trial participants and 1% of observational study participants; thus, measured blood pressure and reported hypercholesterolemia status were used to account for baseline CVD risk. As a sensitivity analysis, we repeated the analysis in individuals with repeated measures of cholesterol-lowering medication use during follow-up. The DASH dietary pattern score analysis was also adjusted for alcohol intake since alcohol is not part of the score.

To inform the interpretation of the results, we repeated the analyses for incident CHD and stroke. The proportional hazards assumption was tested by including an interaction term with log (base-e) transformed time for each covariate. In the CVD models, there was evidence that smoking and blood pressure violated the proportional hazards assumption. In the stroke models, age at diabetes mellitus onset, income, and hormone therapy study participation violated the assumption. To address this, the time-dependent interaction terms were added to the fully adjusted models for the nonproportional covariates. No violations were found in the CHD analysis.

Analyses were conducted to test for potential effect modification by race/ethnicity, BMI, duration of diabetes mellitus, insulin use, smoking, high cholesterol, and hypertension status. This was done by separately including a term for the interaction between the variable of interest and each dietary pattern score in the fully adjusted models as well as stratified analyses, when subgroups contained adequate sample sizes. Since BMI was identified as a potential mediator of the relationship between diet and CVD in this population, a sensitivity analysis was done removing BMI from the multivariable models. Another sensitivity analysis was performed excluding women who participated in the WHI dietary modification trial (n=1859), which included an intervention designed to reduce total fat intake, and increase fruit, vegetable, and whole-grain intake, as previously described.[30] To address potential misclassification of type 2 diabetes mellitus with a cutoff of 21 years of age at diagnosis, we excluded women with reported age at diagnosis <30 years. Another sensitivity analysis excluded incident cases of CVD within the first 3 years of follow-up to address possible reverse causation. CHD and stroke analyses were replicated using less stringent exclusion criteria, excluding only women with a self-reported history of MI, coronary artery bypass graft, or percutaneous transluminal coronary angioplasty in the CHD analysis (n=8154), and stroke or transient ischemic attack in the stroke analysis (n=8463). All analyses were performed using SAS 9.4 (SAS Institute Inc, Cary, NC).

Results

The 5809 women in this sample had a mean (SD) age of 64.0 (6.9) years and mean BMI of 31.9 (6.8) kg/m^2. Approximately 33.1% of the women were from racial/ethnic groups other than white, with blacks representing the largest of these groups (20.6%). Only 6.5% of the women were current smokers at baseline, 10.2% reported untreated hypertension, while 48.9% reported treated hypertension, and 21.4% reported a history of hypercholesterolemia requiring medication.

Baseline participant characteristics by dietary pattern scores are presented in Table 1. Women in the upper quintiles of the DASH, aMed, and ADA dietary pattern scores were older, more likely to be white or Asian/Pacific Islander, had higher income, education, and physical activity levels, were more likely to be in the observational study arm, less likely to be current smokers, and had lower mean BMI compared with those in the lowest quintiles. There was no difference in insulin use, hypertensive status, or hypercholesterolemia across quintiles. Women in the upper quintile of the Paleo dietary pattern score were older, more likely to be black or Asian/Pacific Islander, had higher education, income, and physical activity levels, were more likely to have a history of insulin use and hypercholesterolemia, less likely to be current smokers, and had lower mean BMI. The dietary patterns under study had modest, positive correlations as shown in Table S2. Descriptive characteristics of estimated nutrient and food group intakes by quintile of dietary pattern score are presented in Tables S3 through S6.

Table 1. Baseline Characteristics of WHI Participants With Type 2 Diabetes Mellitus According to DASH, aMed, ADA, and Paleo Dietary Pattern Score Quintiles

Characteristic*	Q1	Q2	Q3	Q4	Q5	*P* Value†
Quintile of DASH diet score						
Number of participants	1257	1234	969	1305	1044	
DASH diet score	18.9 (2.1)	23.1 (0.8)	25.5 (0.5)	27.9 (0.8)	31.7 (1.7)	<0.0001
Age, y	62.0 (6.7)	63.4 (6.7)	64.6 (6.9)	64.7 (6.9)	65.5 (6.6)	<0.0001
Race, %						
American Indian/Alaska Native	36 (2.9)	15 (1.2)	8 (0.8)	9 (0.7)	2 (0.2)	
Asian/Pacific Islander	40 (3.2)	59 (4.8)	41 (4.2)	78 (6.0)	50 (4.8)	
Black	383 (30.5)	279 (22.6)	197 (20.3)	201 (15.4)	134 (12.8)	<0.0001
Hispanic/Latino	136 (10.8)	117 (9.5)	44 (4.5)	64 (4.9)	31 (3.0)	
White	648 (51.6)	742 (60.1)	669 (69.0)	934 (71.6)	813 (77.9)	
Other	14 (1.1)	22 (1.8)	10 (1.0)	19 (1.5)	14 (1.3)	
Education, %						
<High school	230 (18.3)	131 (10.6)	82 (8.5)	95 (7.3)	48 (4.6)	
High school/GED	309 (24.6)	296 (24.0)	184 (19.0)	252 (19.3)	169 (16.2)	<0.0001
>High school, <4 y college	491 (39.1)	520 (42.1)	431 (44.5)	532 (40.8)	380 (36.4)	
≥4 y college	227 (18.1)	287 (23.3)	272 (28.1)	426 (32.6)	447 (42.8)	
Smoking status, %						
Never	655 (52.1)	687 (55.7)	528 (54.5)	703 (53.9)	573 (54.9)	
Past	469 (37.3)	450 (36.5)	395 (40.8)	540 (41.4)	433 (41.5)	<0.0001
Current	133 (10.6)	97 (7.9)	46 (4.8)	62 (4.8)	38 (3.6)	
Income ($), %						
<10 000	185 (14.7)	106 (8.6)	71 (7.3)	80 (6.1)	54 (5.2)	
10–34 999	589 (46.9)	558 (45.2)	468 (48.3)	567 (43.5)	462 (44.3)	
35–74 999	355 (28.2)	416 (33.7)	317 (32.7)	482 (36.9)	382 (36.6)	<0.0001
≥75 000	64 (5.1)	103 (8.4)	87 (9.0)	135 (10.3)	119 (11.4)	
Unknown	46 (5.1)	51 (4.1)	26 (2.7)	41 (3.1)	27 (2.6)	
Marital status, %						
Never married	62 (4.9)	57 (4.6)	50 (5.7)	50 (3.8)	74 (7.1)	
Divorced/separated	253 (20.1)	199 (16.1)	172 (17.8)	190 (14.6)	182 (17.4)	0.0007
Widowed	254 (20.2)	279 (22.6)	288 (23.5)	293 (22.5)	212 (20.3)	
Married/committed relationship	688 (54.7)	699 (56.7)	519 (53.6)	772 (59.2)	576 (55.2)	
Clinical trial participation, %						
HRT	325 (25.9)	257 (20.8)	194 (20.0)	264 (20.2)	220 (21.1)	0.002
DM	478 (38.0)	459 (37.2)	355 (36.6)	368 (28.2)	199 (19.1)	<0.0001
CAD	324 (25.9)	317 (25.7)	235 (24.3)	311 (23.8)	199 (19.1)	0.001
Observational study, %	581 (46.2)	607 (49.2)	504 (52.0)	736 (56.4)	662 (63.4)	<0.0001
BMI, kg/m^2	33.6 (6.9)	32.4 (6.7)	31.9 (6.1)	31.3 (6.6)	30.3 (6.9)	<0.0001
Physical activity (MET-h/wk)	5.9 (9.0)	8.6 (11.8)	9.5 (11.9)	10.8 (12.4)	13.9 (14.0)	<0.0001
Age at T2D diagnosis, %						
21–39 y	132 (10.5)	113 (9.2)	78 (8.1)	102 (7.8)	66 (6.3)	

Continued

Table 1. Continued

Characteristic*	Q1	Q2	Q3	Q4	Q5	*P* Value†
40–59 y	770 (61.3)	697 (56.5)	513 (52.9)	678 (52.0)	506 (48.5)	<0.0001
≥60 y	355 (28.2)	424 (34.4)	378 (39.0)	525 (40.2)	472 (45.2)	
Insulin shots (% ever used)	326 (25.9)	311 (25.2)	224 (23.1)	316 (24.2)	241 (23.1)	0.42
Hypertension, %						
Untreated hypertensive	126 (10.0)	114 (9.2)	104 (10.7)	132 (10.1)	115 (11.0)	0.26
Treated hypertensive	632 (50.3)	620 (50.2)	491 (50.7)	617 (47.3)	480 (46.0)	
Hx hypercholesterolemia requiring medication, %	256 (20.4)	260 (21.1)	210 (21.7)	286 (21.9)	229 (21.9)	0.86
Quintile of aMed diet score‡						
Number of participants	1202	1141	1211	1106	1149	
aMed diet score	1.6 (0.6)	3.0 (0.0)	4.0 (0.0)	5.0 (0.0)	6.5 (0.7)	<0.0001
Age, y	63.3 (6.9)	64.0 (7.0)	64.2 (6.8)	64.0 (6.9)	64.4 (6.8)	0.0009
Race, %						
American Indian/Alaska Native	30 (2.5)	15 (1.3)	10 (0.8)	13 (1.2)	2 (0.2)	
Asian/Pacific Islander	17 (1.4)	33 (2.9)	52 (4.3)	73 (6.6)	93 (8.1)	
Black	265 (22.2)	264 (23.1)	239 (19.7)	208 (18.8)	218 (19.0)	<0.0001
Hispanic/Latino	130 (10.8)	90 (7.9)	78 (6.4)	53 (4.8)	41 (3.6)	
White	743 (61.8)	727 (63.7)	820 (67.7)	741 (67.0)	775 (67.5)	
Other	17 (1.4)	12 (1.1)	12 (1.0)	18 (1.6)	20 (1.7)	
Education, %						
<High school	180 (15.0)	136 (11.9)	120 (9.9)	86 (7.8)	64 (5.6)	
High school/GED	311 (25.9)	279 (24.5)	245 (20.2)	207 (18.7)	168 (14.6)	<0.0001
>High school, <4 y college	496 (41.3)	471 (41.3)	487 (40.2)	440 (39.8)	460 (40.0)	
≥4 y college	215 (17.9)	255 (22.4)	359 (29.6)	373 (33.7)	457 (39.8)	
Smoking status, %						
Never	652 (54.2)	623 (54.6)	631 (52.11)	618 (55.9)	622 (54.1)	
Past	443 (36.9)	431 (37.78)	500 (41.3)	437 (39.5)	476 (41.4)	<0.0001
Current	107 (8.9)	87 (7.6)	80 (6.6)	51 (4.6)	51 (4.4)	
Income ($), %						
<10 000	150 (12.5)	103 (9.0)	101 (8.3)	78 (7.1)	64 (5.6)	
10–34 999	581 (48.3)	570 (50.0)	539 (44.5)	496 (44.9)	458 (39.9)	
35–74 999	351 (29.2)	340 (29.8)	417 (34.4) 120 (9.9)	386 (34.9)	458 (39.9)	<0.0001
≥75 000	69 (5.7)	79 (6.9)	34 (2.8)	110 (10.0)	130 (11.3)	
Unknown	51 (4.2)	49 (4.3)		36 (3.3)	39 (3.4)	
Marital status, %						
Never married	62 (5.2)	43 (3.8)	50 (4.2)	62 (5.6)	76 (6.6)	
Divorced/separated	215 (17.9)	209 (18.3)	190 (15.7)	203 (18.4)	179 (15.6)	0.009
Widowed	285 (23.7)	258 (22.6)	273 (22.5)	215 (19.4)	235 (20.5)	
Married/committed relationship	640 (53.2)	631 (55.3)	698 (57.6)	626 (56.6)	659 (57.4)	
Clinical trial participation, %						
HRT	292 (24.3)	257 (22.5)	240 (19.8)	230 (20.8)	241 (21.0)	0.07
DM	421 (35.0)	368 (32.3)	399 (33.0)	332 (30.0)	339 (29.5)	0.03
CAD	295 (24.5)	285 (25.0)	288 (23.8)	247 (22.3)	271 (23.6)	0.63

Continued

Table 1. Continued

Characteristic*	Q1	Q2	Q3	Q4	Q5	*P* Value†
Observational study, %	591 (49.2)	612 (53.6)	641 (52.9)	617 (55.8)	629 (54.7)	0.017
BMI, kg/m^2	32.8 (6.6)	32.3 (6.7)	31.8 (6.8)	31.7 (6.9)	31.0 (6.7)	<0.0001
Physical activity (MET-h/wk)	6.8 (9.5)	8.2 (11.3)	10.1 (13.3)	10.9 (13.1)	12.1 (12.4)	<0.0001
Age at type 2 diabetes mellitus diagnosis, %						
21–39 y	106 (8.8)	108 (9.5)	110 (9.1)	88 (8.0)	79 (6.9)	
40–59 y	709 (59.0)	607 (53.2)	658 (54.3)	588 (53.2)	602 (52.4)	0.002
≥60 y	387 (32.2)	426 (37.3)	443 (36.6)	430 (38.9)	468 (40.7)	
Insulin shots (% ever used)	309 (25.7)	292 (25.6)	299 (24.7)	247 (22.3)	271 (23.6)	0.29
Hypertension, %						
Untreated hypertensive	133 (11.1)	112 (9.8)	123 (10.2)	109 (9.9)	114 (9.9)	
Treated hypertensive	599 (49.8)	567 (46.7)	574 (47.4)	542 (49.0)	558 (48.6)	0.85
Hx hypercholesterolemia requiring medication, %	236 (19.6)	258 (22.6)	266 (22.0)	240 (21.7)	241 (21.0)	0.46
Quintile of ADA diet score‡						
Number of participants	1323	849	1361	1275	1001	
ADA diet score	24.1 (1.9)	27.5 (0.5)	30.0 (0.8)	32.9 (0.8)	36.7 (1.7)	<0.0001
Age, y	63.4 (7.0)	63.4 (7.0)	64.4 (6.8)	64.3 (6.8)	64.2 (6.7)	0.0001
Race, %						
American Indian/Alaska Native	36 (2.7)	12 (1.4)	6 (0.4)	12 (0.9)	4 (0.4)	
Asian/Pacific Islander	50 (3.8)	34 (4.0)	68 (5.0)	65 (5.1)	51 (5.1)	
Black	381 (28.8)	195 (23.0)	272 (20.0)	203 (15.9)	143 (14.3)	<0.0001
Hispanic/Latino	147 (11.1)	87 (10.3)	82 (6.0)	52 (4.1)	24 (2.4)	
White	691 (52.2)	510 (60.1)	916 (67.3)	923 (72.4)	766 (76.5)	
Other	18 (1.4)	11 (1.3)	17 (1.3)	20 (1.6)	13 (1.3)	
Education, %						
<High school	216 (16.3)	90 (10.6)	137 (10.1)	100 (7.8)	43 (4.3)	
High school/GED	329 (24.9)	187 (22.0)	311 (22.9)	235 (18.4)	148 (14.8)	<0.0001
>High school, <4 y college	525 (39.7)	353 (41.6)	547 (40.2)	529 (41.5)	400 (40.0)	
≥4 y college	253 (19.1)	219 (25.8)	366 (26.9)	411 (32.2)	410 (41.0)	
Smoking status, %						
Never	744 (56.2)	478 (56.3)	740 (54.4)	676 (53.0)	508 (50.8)	
Past	457 (34.5)	315 (37.1)	530 (38.9)	547 (42.9)	438 (43.8)	<0.0001
Current	122 (9.2)	56 (6.6)	91 (6.7)	52 (4.1)	55 (5.5)	
Income ($), %						
<10 000	176 (13.3)	76 (9.0)	114 (8.4)	84 (6.6)	46 (4.6)	
10–34 999	651 (49.2)	414 (48.8)	612 (45.0)	576 (45.2)	391 (29.1)	
35–74 999	350 (26.4)	254 (29.9)	481 (35.3)	450 (35.3)	417 (41.7)	<0.0001
≥75 000	83 (6.3)	69 (8.1)	106 (7.8)	131 (10.2)	119 (11.9)	
Unknown	63 (4.8)	36 (4.2)	48 (3.5)	34 (2.7)	28 (2.8)	
Marital status, %						
Never married	61 (4.6)	38 (4.5)	62 (4.6)	68 (5.3)	64 (6.4)	

Continued

Table 1. Continued

Characteristic*	Q1	Q2	Q3	Q4	Q5	*P* Value†
Divorced/separated	259 (19.6)	151 (17.8)	245 (18.0)	189 (14.8)	152 (15.2)	
Widowed	319 (24.1)	194 (22.9)	300 (22.0)	255 (20.0)	198 (19.8)	0.0007
Married/committed relationship	684 (51.7)	466 (54.9)	754 (55.4)	763 (59.8)	587 (58.6)	
Clinical trial participation, %						
HRT	322 (24.3)	174 (20.5)	303 (22.3)	263 (20.6)	198 (19.8)	0.05
DM	420 (59.7)	442 (36.6)	468 (34.6)	316 (27.57)	213 (20.1)	<0.0001
CAD	267 (25.6)	304 (25.2)	337 (24.9)	270 (23.56)	208 (19.6)	0.006
Observational study, %	476 (45.7)	609 (50.4)	700 (51.8)	656 (57.24)	649 (61.1)	<0.0001
BMI, kg/m^2	32.2 (6.7)	31.9 (6.6)	31.9 (6.8)	31.6 (6.7)	32.0 (6.9)	0.21
Physical activity (MET-h/wk)	7.1 (10.2)	9.1 (12.8)	10.1 (12.7)	10.6 (12.3)	11.3 (12.3)	<0.0001
Age at type 2 diabetes mellitus diagnosis, %						
21–39 y	130 (9.8)	99 (11.7)	103 (7.6)	98 (7.7)	61 (6.1)	
40–59 y	769 (58.1)	458 (53.9)	737 (54.2)	674 (52.9)	526 (52.5)	<0.0001
≥60 y	424 (32.0)	292 (34.4)	521 (38.3)	503 (39.5)	414 (41.4)	
Insulin shots (% ever used)	359 (27.1)	208 (24.5)	332 (24.4)	288 (22.6)	231 (23.1)	0.07
Hypertension, %						
Untreated hypertensive	141 (10.7)	70 (8.2)	158 (11.6)	135 (10.6)	87 (8.7)	
Treated hypertensive	672 (50.8)	411 (48.4)	659 (48.4)	603 (47.3)	495 (49.5)	0.07
Hx hypercholesterolemia requiring medication, %	286 (21.6)	166 (19.6)	304 (22.3)	274 (21.5)	211 (21.1)	0.64
Quintile of Paleo diet score‡						
Number of participants	1237	1031	1123	1323	1095	
Paleo diet score	32.0 (2.8)	37.1 (0.8)	40.0 (0.8)	43.5 (1.1)	48.6 (2.5)	<0.0001
Age, y)	62.8 (6.8)	63.3 (7.0)	64.1 (6.9)	64.7 (6.8)	64.9 (6.6)	<0.0001
Race, %						
American Indian/Alaska Native	29 (2.3)	14 (1.4)	6 (0.5)	10 (0.8)	11 (1.0)	
Asian/Pacific Islander	17 (1.4)	35 (3.4)	56 (5.0)	76 (5.7)	84 (7.7)	
Black	222 (18.0)	184 (17.9)	226 (20.1)	283 (21.4)	279 (25.5)	<0.0001
Hispanic/Latino	133 (10.8)	65 (6.3)	83 (7.4)	72 (5.4)	39 (3.6)	
White	824 (66.6)	722 (70.0)	735 (65.5)	860 (65.0)	665 (60.7)	
Other	12 (1.0)	11 (1.1)	17 (1.5)	22 (1.7)	17 (1.6)	
Education, %						
<High school	172 (13.9)	95 (9.2)	98 (8.7)	127 (9.6)	94 (8.6)	
High school/GED	288 (23.3)	220 (21.3)	248 (22.1)	274 (20.7)	180 (16.4)	<0.0001
>High school, <4 y college	509 (41.2)	452 (43.8)	437 (38.9)	534 (40.4)	222 (38.5)	
≥4 y college	268 (21.7)	264 (25.6)	340 (30.3)	388 (29.3)	399 (36.4)	
Smoking status, %						
Never	619 (50.0)	535 (51.9)	612 (54.5)	769 (58.1)	611 (55.8)	
Past	503 (40.7)	430 (41.7)	441 (39.3)	485 (36.7)	428 (39.1)	<0.0001
Current	115 (9.3)	66 (6.4)	70 (6.2)	69 (5.2)	56 (5.1)	
Income ($), %						
<10 000	117 (11.2)	123 (10.2)	121 (9.0)	70 (6.1)	65 (6.1)	
10–34 999	505 (48.5)	559 (46.3)	607 (44.9)	515 (44.9)	458 (43.1)	

Continued

Table 1. Continued

Characteristic*	Q1	Q2	Q3	Q4	Q5	*P* Value†
35–74 999	316 (30.3)	385 (31.9)	444 (32.9)	432 (37.7)	375 (35.3)	0.0009
≥75 000	67 (6.4)	90 (7.5)	124 (9.2)	96 (8.4)	131 (12.3)	
Unknown	37 (3.6)	51 (4.2)	55 (4.1)	33 (2.9)	33 (3.1)	
Marital status, %						
Never married	58 (4.7)	48 (4.7)	61 (5.4)	58 (4.4)	68 (6.2)	
Divorced/separated	243 (19.6)	178 (17.3)	187 (16.7)	207 (15.7)	181 (16.5)	0.12
Widowed	267 (21.6)	206 (20.0)	236 (21.0)	312 (23.6)	245 (22.4)	
Married/committed relationship	669 (54.1)	599 (58.1)	639 (56.9)	746 (56.4)	601 (54.9)	
Clinical trial participation, %						
HRT	289 (23.4)	220 (21.3)	263 (23.4)	272 (20.6)	216 (19.8)	0.11
DM	484 (39.1)	360 (34.9)	395 (35.2)	372 (28.1)	248 (22.7)	<0.0001
CAD	337 (27.2)	242 (23.5)	295 (26.3)	302 (22.8)	210 (19.2)	<0.0001
Observational study, %	577 (46.7)	535 (51.9)	552 (49.2)	757 (57.2)	669 (61.1)	<0.0001
BMI, kg/m^2	33.3 (6.9)	32.5 (6.7)	31.7 (6.5)	31.3 (6.6)	30.8 (6.9)	<0.0001
Physical activity (MET-h/wk)	7.3 (10.8)	8.3 (11.2)	9.7 (12.3)	9.7 (11.3)	13.2 (14.2)	<0.0001
Age at type 2 diabetes mellitus diagnosis, %						
21–39 y	117 (9.5)	90 (8.7)	98 (8.7)	100 (7.6)	86 (7.6)	
40–59 y	700 (56.6)	578 (56.1)	603 (53.7)	700 (52.9)	583 (53.2)	0.1
≥60 y	420 (34.0)	363 (35.2)	422 (37.6)	523 (39.5)	426 (38.9)	
Insulin shots (% ever used)	251 (20.3)	253 (24.5)	300 (26.7)	331 (25.0)	283 (25.8)	0.003
Hypertension, %						
Untreated hypertensive	126 (10.2)	110 (10.7)	114 (10.2)	133 (10.1)	108 (9.9)	0.83
Treated hypertensive	610 (49.3)	501 (48.6)	529 (47.1)	671 (50.7)	529 (48.3)	
Hx hypercholesterolemia requiring medication, %	216 (17.5)	226 (21.9)	236 (21.0)	313 (23.66)	250 (22.8)	0.002

ADA indicates American Diabetes Association; aMED, alternate Mediterranean diet; BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); CAD, calcium and vitamin D trial; DASH, Dietary Approach to Stop Hypertension; DM, dietary modification trial; GED, general education development; HRT, hormone replacement therapy; Hx, history; MET, metabolic equivalents; MET-h/wk (kcal/wk per kilogram body weight), energy expenditure from recreational activity (includes walking, mild, moderate, and strenuous physical activity); T2D, type 2 diabetes mellitus; WHI, Women's Health Initiative.
*Data are unadjusted means (SD) unless noted as percentage, then frequency and corresponding percentage based on the number of women in each quintile are shown.
†*P* value is based on χ^2 for categorical variables and analysis of variance for continuous variables.

During the mean (SD) follow-up of 12.4 (5.3) years, 1454 (25.0%) incident cases of CVD were documented. Table 2 presents the HRs and 95% CI of the association between the DASH, aMed, ADA, and Paleo dietary patterns and incident CVD. Higher DASH, aMed, and ADA diet scores were associated with a lower risk of CVD over time, whereas there was no association between a Paleo dietary pattern score and CVD. The analyses examining the association by SD of the respective scores were directionally consistent with the quintile analyses.

Table 2 also presents the results for CHD and stroke as separate outcomes. During follow-up, 635 (10.9%) women experienced incident CHD and 372 (6.4%) women had a stroke. A strong inverse monotonic association was found between higher DASH, aMed, and ADA-based diet scores and risk for CHD, whereas the association with incident stroke was directionally inverse but without the monotonicity observed with CHD risk. The Paleo score was not associated with CHD or stroke. Results for both CHD and stroke were similar when the analysis was replicated using a larger sample of women where the exclusion criteria included only a history of CHD or stroke, respectively, instead of total CVD at baseline.

Stratified analyses and formal tests for interaction did not show evidence for any effect modification for dietary pattern scores by race/ethnicity, BMI, duration of diabetes mellitus, insulin use, smoking, high cholesterol, or hypertension status. Regarding the strength and direction of the results when excluding BMI from the models, women who participated in

Table 2. Association Between Dietary Patterns and Incident Cardiovascular Disease, Coronary Heart Disease, and Stroke Risk in Postmenopausal Women With Type 2 Diabetes Mellitus From WHI, 1993 to 2015

	Dietary Pattern Quintile						
	Q1	Q2	Q3	Q4	Q5	Per SD	*P* trend
DASH*							
n CVD/person y	340/4 529 908	298/4 831 603	243/3 839 325	341/5 180 100	232/4 442 774		
Model 1†,‡ HR (95% CI)	1.0 [reference]	0.86 (0.73–1.01)	0.86 (0.72–1.02)	0.89 (0.76–1.05)	0.70 (0.58–0.84)	0.91 (0.86–0.96)	<0.001
Model 2‡,§ HR (95% CI)	1.0 [reference]	0.85 (0.72–0.99)	0.85 (0.72–1.01)	0.87 (0.75–1.02)	0.69 (0.58–0.83)	0.90 (0.85–0.95)	<0.001
n CHD/person y	324/5 145 663	307/5 287 395	301/4 245 559	257/5 730 241	265/4 819 620		
Model 1† HR (95% CI)	1.0 [reference]	0.93 (0.73–1.18)	0.88 (0.68–1.14)	0.91 (0.71–1.16)	0.75 (0.57–0.98)	0.90 (0.83–0.98)	0.02
Model 2§ HR (95% CI)	1.0 [reference]	0.93 (0.73–1.19)	0.88 (0.68–1.14)	0.89 (0.69–1.13)	0.75 (0.57–0.98)	0.90 (0.82–0.98)	0.01
n Stroke/person y	94/5 191 879	67/5 363 202	54/4 300 558	100/5 759 430	57/4 886 419		
Model 1†,‖ HR (95% CI)	1.0 [reference]	0.69 (0.50–0.95)	0.64 (0.45–0.90)	0.90 (0.67–1.22)	0.57 (0.40–0.80)	0.88 (0.79–0.99)	0.03
Model 2§,‖ HR (95% CI)	1.0 [reference]	0.67 (0.49–0.93)	0.63 (0.45–0.90)	0.89 (0.66–1.21)	0.56 (0.40–0.80)	0.88 (0.79–0.99)	0.03
aMed							
n CVD/person y	324/4 322 465	307/4 425 918	301/4 787 578	257/4 438 426	265/4 849 323		
Model 1†,‡ HR (95% CI)	1.0 [reference]	0.93 (0.79–1.09)	0.90 (0.77–1.05)	0.84 (0.71–0.99)	0.82 (0.69–0.97)	0.94 (0.89–0.99)	0.02
Model 2‡,§ HR (95% CI)	1.0 [reference]	0.90 (0.77–1.05)	0.86 (0.73–1.01)	0.82 (0.69–0.97)	0.77 (0.65–0.93)	0.92 (0.87–0.98)	0.005
n CHD/person y	150/4 823 154	124/4 967 735	136/5 267 909	106/4 883 322	119/5 286 358		
Model 1† HR (95% CI)	1.0 [reference]	0.78 (0.61–0.99)	0.86 (0.68–1.09)	0.72 (0.56–0.93)	0.78 (0.61–0.99)	0.93 (0.85–1.01)	0.07
Model 2§ HR (95% CI)	1.0 [reference]	0.75 (0.59–0.95)	0.81 (0.63–1.02)	0.68 (0.52–0.88)	0.69 (0.53–0.91)	0.89 (0.82–0.98)	0.01
n Stroke/person y	85/4 894 920	79/49 615 01	74/5 396 884	70/4 911 566	64/5 336 617		
Model 1†,‖ HR (95% CI)	1.0 [reference]	0.89 (0.65–1.21)	0.79 (0.57–1.08)	0.83 (0.60–1.14)	0.70 (0.50–0.97)	0.88 (0.79–0.98)	0.02
Model 2§,‖ HR (95% CI)	1.0 [reference]	0.88 (0.65–1.20)	0.78 (0.56–1.07)	0.82 (0.58–1.14)	0.67 (0.47–0.96)	0.87 (0.77–0.97)	0.01
ADA*							
n CVD/person y	363/4 471 022	222/3 263 680	309/5 367 683	314/5 285 505	246/4 235 820		
Model 1†,‡ HR (95% CI)	1.0 [reference]	0.94 (0.80–1.12)	0.74 (0.64–0.87)	0.83 (0.71–0.96)	0.81 (0.69–0.96)	0.92 (0.87–0.97)	0.002
Model 2‡,§ HR (95% CI)	1.0 [reference]	0.89 (0.75–1.06)	0.69 (0.59–0.81)	0.76 (0.64–0.90)	0.71 (0.59–0.86)	0.87 (0.82–0.93)	<0.0001
n CHD/person y	160/5 282 697	89/3 676 860	149/5 805 357	139/5 804 399	98/4 659 165		
Model 1† HR (95% CI)	1.0 [reference]	0.85 (0.65–1.10)	0.81 (0.65–1.02)	0.81 (0.64–1.03)	0.71 (0.55–0.92)	0.89 (0.82–0.97)	0.006
Model 2§ HR (95% CI)	1.0 [reference]	0.78 (0.60–1.02)	0.73 (0.58–0.93)	0.71 (0.55–0.91)	0.57 (0.42–0.76)	0.82 (0.75–0.90)	<0.0001
n Stroke/person y	91/5 335 946	53/3 713 432	81/5 885 697	86/5 882 214	61/4 684 199		
Model 1†,‖ HR (95% CI)	1.0 [reference]	0.87 (0.62–1.22)	0.79 (0.58–1.07)	0.87 (0.64–1.18)	0.79 (0.56–1.11)	0.91 (0.82–1.01)	0.09
Model 2§,‖ HR (95% CI)	1.0 [reference]	0.84 (0.60–1.19)	0.77 (0.56–1.05)	0.85 (0.61–1.18)	0.74 (0.51–1.09)	0.89 (0.78–1.00)	0.06

Continued

Table 2. Continued

	Dietary Pattern Quintile					Per SD	*P* trend
	Q1	Q2	Q3	Q4	Q5		
Paleo							
n CVD/person y	306/4 807 665	283/4 069 294	299/4 335 000	315/5 326 313	251/4 285 438		
Model 1[†,‡] HR (95% CI)	1.0 [reference]	1.13 (0.96–1.33)	1.11 (0.95–1.31)	0.95 (0.81–1.11)	0.96 (0.81–1.14)	0.98 (0.93–1.03)	0.37
Model 2[‡,§] HR (95% CI)	1.0 [reference]	1.08 (0.92–1.27)	1.07 (0.90–1.26)	0.90 (0.76–1.06)	0.91 (0.75–1.09)	0.96 (0.90–1.01)	0.13
n CHD/person y	127/5 360 103	127/4 508 421	135/4 776 909	136/5 867 494	110/4 715 551		
Model 1[†] HR (95% CI)	1.0 [reference]	1.22 (0.95–1.56)	1.21 (0.95–1.55)	0.99 (0.77–1.27)	1.02 (0.79–1.33)	0.98 (0.90–1.06)	0.61
Model 2[§] HR (95% CI)	1.0 [reference]	1.18 (0.92–1.52)	1.22 (0.95–1.57)	1.01 (0.78–1.31)	1.04 (0.78–1.39)	0.99 (0.90–1.08)	0.80
n Stroke/person y	79/5 406 310	76/4 560 649	80/4 839 861	69/5 969 754	68/4 724 914		
Model 1[†,‖] HR (95% CI)	1.0 [reference]	1.15 (0.84–1.58)	1.11 (0.81–1.52)	0.75 (0.54–1.05)	0.94 (0.67–1.32)	0.93 (0.84–1.04)	0.21
Model 2[§,‖] HR (95% CI)	1.0 [reference]	1.08 (0.78–1.48)	1.04 (0.75–1.44)	0.69 (0.49–0.97)	0.84 (0.58–1.21)	0.90 (0.79–1.01)	0.07

ADA indicates American Diabetes Association; CHD, coronary heart disease (first occurrence of a clinical myocardial infarction [MI], definite silent MI, or a death caused by definite or possible CHD); CVD, cardiovascular disease (defined as the first occurrence of an acute MI requiring overnight hospitalization, silent MI determined from serial ECGs, CHD death, coronary revascularization, peripheral artery disease, congestive heart failure, or ischemic or hemorrhagic stroke); DASH, Dietary Approach to Stop Hypertension; HR, hazard ratio; WHI, Women's Health Initiative.

*DASH models additionally adjusted for alcohol.

[†]Model 1 HRs estimated from Cox's proportional hazard models adjusting for age, race, education, income, marital status, physical activity, smoking, body mass index, WHI study arm, and geographical region.

[‡]CVD models additionally adjusted for smoking×time, systolic blood pressure (BP)×time, diastolic BP×time.

[§]Model 2 HRs estimated from Cox's proportional hazard models adjusting for Model 1 covariates + age at type 2 diabetes mellitus diagnosis, energy intake, insulin use, blood pressure, and history of high cholesterol.

[‖]Stroke models additionally adjusted for income×time, age at type 2 diabetes mellitus onset×time, hormone replacement therapy clinical trial arm×time.

the dietary modification trial and incident CVD cases documented within the first 3 years of follow-up were not materially different from the findings of the main analysis. Results were also similar to the main findings when time-varying cholesterol-lowering medication use was included in the models. The sensitivity analysis addressing misclassification bias by including only women who reported an age of onset of diabetes mellitus ≥30 years, instead of 21 years, did not differ from the main analysis (data not shown).

Discussion

These results demonstrate that higher aMed, DASH, and ADA dietary pattern scores were associated with lower risk of incident CVD in postmenopausal women with type 2 diabetes mellitus. These relationships were directionally consistent for both CHD and stroke separately as outcomes, yet the associations with CHD were monotonic in nature. No association was observed between a Paleo diet score and CVD risk.

The common thread among dietary patterns and lower CVD risk in this population is an emphasis on higher intake of fruits, vegetables, dairy (milk, yogurt, and cheese), whole grains, nuts/seeds, legumes, a high unsaturated:saturated fat ratio, and lower intake of red and processed meats, added sugars and sodium. These findings are consistent with previous investigations of diet–CVD risk in the general population without diabetes mellitus,[5,31] but evidence examining this relationship prospectively in individuals with type 2 diabetes mellitus is limited. Evidence from experimental studies comes from a randomized trial where intensive 12-month Mediterranean or ADA dietary interventions in a community-based setting were effective for weight loss and reducing hemoglobin A1c, triglycerides, and total- and LDL-cholesterol levels.[9] Also, an 8-week randomized crossover clinical trial contrasting a DASH versus control diet resulted in improvements in a wide range of CVD risk factors with a DASH versus control diet.[32,33] Our findings are consistent with a recent observational study by Liu et al in individuals with type 2 diabetes mellitus from the Nurse's Health Study and Health Professionals Follow-up Study showing an inverse association between diet quality, defined by the 2010 Alternate Healthy Eating Index, and both CVD incidence and mortality when comparing individuals in the highest quintile of Alternate Healthy Eating Index score with those in the lowest ($HR_{Incidence}$ 0.84; 95% CI 0.74–0.97; $HR_{Mortality}$ 0.77; 95% CI 0.62–0.97).[12] Since the ADA is one of the primary organizations informing dietary recommendations for individuals with type 2 diabetes mellitus, we chose to examine the association between an ADA score and CVD risk, as opposed to the similarly scored Alternate Healthy Eating Index, in an effort to characterize a more translatable relationship.

In addition to the paucity of studies on dietary patterns and CVD risk in individuals with type 2 diabetes mellitus, a major limitation to the current body of evidence is the reliance on CVD risk factors versus clinical end point outcomes. Only 2 well-conducted intervention trials have demonstrated the effectiveness of diet for CVD risk reduction using clinical outcomes in high-risk individuals. The Lyon Diet Heart Study found a reduced risk for the recurrence of CVD complications following a first MI in individuals randomized to a Mediterranean diet compared with a prudent Western-type diet (adjusted HR 0.63; 95% CI 0.46–0.87).[34] The Prevención con Dieta Mediterránea study demonstrated a protective effect of a Mediterranean diet supplemented with nuts or extra virgin olive oil compared with a standard low-fat diet for major CVD events in high-risk individuals (extra virgin olive oil HR 0.70, 95% CI 0.54–0.92; nuts HR 0.72, 95% CI 0.54–0.96); results of a subgroup analysis including only subjects with type 2 diabetes mellitus were consistent with the main study findings (HR 0.71; 95% CI 0.53–0.96).[11] Although these studies were not done exclusively in populations with type 2 diabetes mellitus, the use of clinical events as the main outcomes, as opposed to CVD risk factors, provides a strong evidence base for the efficacy of the Mediterranean diet for risk reduction in high-risk populations.

We were interested in examining a Paleo dietary pattern score because of its theoretical lower carbohydrate content from the exclusion of grains, legumes, and dairy,[21] as dietary carbohydrate restriction is suggested to benefit type 2 diabetes mellitus management.[35] In our study, however, a Paleo dietary pattern was not associated with CVD risk. Although the idea of a modern-day Paleo diet did not develop until the mid-1990s, the calculated scores ranged from 19 to 60 and followed a normal distribution. Proponents of the Paleo diet assert that humans are genetically adapted to foods assumed to have been available before the establishment of agriculture, mainly wild-animal and uncultivated-plant sources of foods, and thus the dietary changes introduced by modern food-producing practices may lead to chronic diseases such as obesity, type 2 diabetes mellitus, and CVD.[36] Limited research on the Paleo diet has been reported in the scientific literature. Several pilot intervention trials have suggested a beneficial effect of a Paleo diet on glycemic control and CVD risk in individuals with type 2 diabetes mellitus,[37–39] but prospective evidence from larger cohorts to support these findings with actual disease outcomes is lacking. Unlike the other dietary pattern scores in this study, intake of whole grains and legumes was unnecessary to achieve a high Paleo score and dairy intake was negatively scored. Our findings suggest that dietary carbohydrate quantity and quality are important for CVD risk in people with diabetes mellitus, consistent with the 2019 ADA guidelines that identify vegetables, legumes, fruits, dairy (milk and yogurt), and whole grains as optimal sources of dietary carbohydrate.[20]

There are several limitations to consider. First, measurement error and other potential biases are present in self-reported diet, most often leading to nondifferential misclassification between diet and disease end points.[40] The analysis is based on baseline data only and thus, we were unable to account for the potential effect of diet quality changes over time because only a small number of women had follow-up diet data uniformly assessed. Previous research, however, has demonstrated that dietary patterns are generally stable over time.[41–43] Repeated measures of lifestyle factors, medication use, and medical history could also improve the precision and interpretation of the results. The women in this study were, on average, obese (based on mean BMI classification). Both generalized and food-specific underreporting have been clearly demonstrated in obese populations under study.[44] Since mean BMI tended to decrease across quintiles with increasing diet quality, reporting errors may have introduced systematic errors that led to an underestimation of the true effect size. The reliance on self-report for some covariates may have introduced bias and residual confounding in the analyses. Although diabetes mellitus status was validated, all prevalent cases may not have been captured without additional blood glucose measurements. Additionally, hemoglobin A1c was not measured in WHI, so we were unable to adjust for baseline glycemic control. To address this, we included insulin use as a proxy for disease severity in the fully adjusted models. To account for baseline CVD risk, we used self-reported history of hypercholesterolemia as a proxy for clinical measurements of blood lipids, as these were measured in only a small subset of the study population. Since it is plausible that these clinical risk factors may also represent mediators of the observed associations, the availability of precisely measured clinical values may have improved estimates and provided further insight into the nature of the diet–CVD relationship. Finally, it is not possible to control for all confounding factors in observational studies; thus residual confounding may have influenced the results.

In conclusion, dietary patterns emphasizing fruits, vegetables, dairy, whole grains, nuts/seeds, legumes, a high unsaturated:saturated fat ratio, and low intake of red and processed meats, added sugars, and sodium were associated with reduced incident CVD risk in postmenopausal women with type 2 diabetes mellitus.

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Author Contributions

K.H. and A.O. wrote the manuscript and researched data. L.J., N.W., J.S., C.E., M.A., L.G., and O.Z. reviewed/edited the manuscript.

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SUPPLEMENTAL MATERIAL

Table S1. Mediterranean, DASH, ADA and Paleo dietary pattern score characteristics.

	aMed*	DASH†	ADA*	Paleo†
Positively Scored Components	Fruits Vegetables Legumes Nuts Whole grains Fish MUFA:SFA ratio Alcohol‡	Fruits Vegetables Nuts/legumes Low-fat dairy Whole grains	Fruits Vegetables Dairy Whole grains Nuts/Legumes Fish (PUFA+MUFA)/SFA Alcohol§	Fruits Vegetables Nuts Fish Meat Green leafy vegetables
Negatively Scored Components	Red/processed meats	Sodium Sweetened beverages Red/processed meats	Sodium Sweetened beverages	Grains/starches Processed meats Dairy Alcohol Sodium Sweetened beverages Empty calories
Score Range	0-9	8-40	9-47	13-65

*The aMed and ADA scores assign 1 point for intake above the cohort-specific median for positively scored components and below the median for negative components.

† The DASH and Paleo scores award points for high intake of positively scored and low intake of negatively scored components, according to quintile rankings. Individuals in the highest quintile of intake for a beneficial food group receive 5 points, and the lowest quintile receives 1. Individuals in the lowest quintile of intake for adverse food groups receive 5 points, while those in the highest receive 1.

‡ Alcohol intake of 5-15 grams/day receives 1 point.

§ Alcohol intake of $\leq$ 10 grams/day receives 2 points.

Abbreviations: ADA, American Diabetes Association; DASH, Dietary Approach to Stop Hypertension; Paleo, Paleolithic; MUFA, monounsaturated fatty acid; PUFA, polyunsaturated fatty acid; SFA, saturated fatty acid

Table S2. Pearson's correlations between four *a priori* dietary pattern scores calculated from baseline FFQ data of postmenopausal women with prevalent type 2 diabetes in the WHI.

	DASH	aMed	ADA	Paleo
DASH	1.00	0.63	0.67	0.50
aMed	0.63	1.00	0.74	0.33
ADA	0.67	0.74	1.00	0.17
Paleo	0.50	0.33	0.17	1.00

$P < 0.0001$ for all correlations.

Table S3. Nutrient and food group characteristics of the DASH dietary pattern score by quintile of WHI participants with type 2 diabetes.

	Quintile of DASH Diet Score					
Nutrient Intake*	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	***P***
Total Energy (Calories)	1622.5 (709.5)	1542.6 (705.9)	1613.1 (663.2)	1652.9 (662.3)	1665.3 (569.6)	<0.0001
Carbohydrate (g)	106.3 (20.8)	114.2 (21.0)	119.6 (20.7)	127.4 (20.2)	139.1 (20.3)	<0.0001
Total Sugar (g)	47.4 (20.4)	49.5 (18.4)	53.5 (17.3)	58.6 (16.5)	67.0 (15.9)	<0.0001
Fiber (g)	7.4 (2.1)	9.3 (2.6)	10.5 (3.3)	11.9 (3.5)	14.0 (3.7)	<0.0001
Protein (g)	43.2 (9.6)	44.2 (8.7)	44.8 (8.5)	45.2 (8.3)	45.3 (7.4)	<0.0001
Total Fat (g)	44.8 (8.0)	41.4 (8.3)	39.1 (8.4)	36.0 (8.2)	31.7 (8.2)	<0.0001
Saturated Fat (g)	14.8 (3.3)	13.5 (3.3)	12.7 (3.4)	11.6 (3.2)	9.9 (2.9)	<0.0001
Monounsaturated Fat (g)	17.2 (3.3)	15.9 (3.6)	14.8 (3.6)	13.6 (3.5)	11.9 (3.5)	<0.0001
Polyunsaturated Fat (g)	9.0 (2.8)	8.7 (2.7)	8.3 (2.6)	7.8 (2.3)	7.3 (2.3)	<0.0001
Dietary Cholesterol (mg)	187.3 (83.9)	168.3 (73.1)	152.8 (58.4)	142.6 (59.6)	118.3 (49.5)	<0.0001
Sodium (mg)	1732.5 (304.8)	1788.1 (3.09.7)	1789.8 (323.9)	1798.6 (299.0)	1793.4 (293.9)	<0.0001
Alcohol (g)	1.1 (4.0)	1.2 (4.2)	1.4 (4.7)	1.2 (3.7)	1.1 (3.6)	0.53
Food Group Intake*						
Added Sugar†	5.5 (3.7)	4.5 (2.7)	4.3 (2.2)	4.3 (2.1)	4.3 (1.8)	<0.0001
Total Dairy‡	0.7 (0.5)	0.9 (0.5)	1.0 (0.7)	1.1 (0.6)	1.3 (0.6)	<0.0001
Total Fruit‡	0.6 (0.5)	0.9 (0.7)	1.0 (0.8)	1.3 (0.8)	1.6 (0.7)	<0.0001
Total Vegetables‡	0.8 (0.3)	0.9 (0.4)	1.0 (0.5)	1.1 (0.5)	1.3 (0.5)	<0.0001
Starchy Vegetables‡	0.2 (0.1)	0.2 (0.1)	0.2 (0.1)	0.2 (0.1)	0.2 (0.1)	0.005
Dark Green Vegetables‡	0.04 (0.05)	0.05 (0.06)	0.06 (0.09)	0.08 (0.1)	0.1 (0.1)	<0.0001
Total Grains§	3.0 (1.0)	3.2 (1.1)	3.2 (1.1)	3.2 (1.0)	3.2 (1.0)	<0.0001
Whole Grains§	0.4 (0.4)	0.6 (0.5)	0.8 (0.6)	0.9 (0.6)	1.1 (0.6)	<0.0001
Legumes‡	0.04 (0.06)	0.05 (0.06)	0.05 (0.06)	0.06 (0.07)	0.07 (0.08)	<0.0001
Nuts/Seeds‖	0.1 (0.2)	0.2 (0.3)	0.2 (0.3)	0.3 (0.4)	0.4 (0.4)	<0.0001
Meat#	1.5 (0.9)	1.2 (0.7)	1.1 (0.7)	0.9 (0.6)	0.6 (0.5)	<0.0001
Poultry**	0.7 (0.6)	0.7 (0.6)	0.7 (0.6)	0.7 (0.6)	0.7 (0.6)	0.81
Fish††	0.4 (0.4)	0.4 (0.4)	0.4 (0.4)	0.4 (0.4)	0.4 (0.4)	<0.0001

* Estimated daily nutrient and food group intakes reported as quintile mean (SD); values for all nutrients (except Total Energy) and food groups are per 1,000 Calories.

† Teaspoon equivalents

‡ Cup equivalents

§ Ounce equivalents

‖ Ounce equivalents of lean meat

\# Ounces of cooked lean meat from beef, pork, lamb, game and veal

** Ounces of cooked poultry

†† Ounces of cooked fish

Table S4. Nutrient and food group characteristics of the alternate Mediterranean (aMed) dietary pattern score by quintile of WHI participants with type 2 diabetes.

	Quintile of aMed Diet Score					
Nutrient Intake*	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	***P***
Total Energy (Calories)	1330.3 (598.0)	1441.2 (584.3)	1619.6 (641.6)	1784.4 (688.4)	1935.2 (562.6)	<0.0001
Carbohydrate (g)	112.1 (23.3)	118.0 (23.5)	121.7 923.2)	124.2 (22.4)	128.7 (21.2)	<0.0001
Total Sugar (g)	51.8 (21.0)	54.1 (19.7)	55.1 (19.6)	56.0 (18.3)	57.7 (16.2)	<0.0001
Fiber (g)	8.4 (3.1)	9.8 (3.5)	10.6 (3.6)	11.5 (3.8)	12.5 (3.6)	<0.0001
Protein (g)	44.4 (9.7)	44.1 (8.9)	44.4 (8.5)	45.0 (8.2)	44.6 (7.4)	0.18
Total Fat (g)	42.1 (9.1)	40.0 (9.5)	38.6 (9.2)	37.2 (9.1)	35.8 (8.6)	<0.0001
Saturated Fat (g)	14.7 (3.7)	13.2 (3.5)	12.4 (3.4)	11.7 (3.2)	10.8 (3.0)	<0.0001
Monounsaturated Fat (g)	15.8 (3.7)	15.3 (4.1)	14.7 (4.0)	14.2 (3.9)	13.9 (3.7)	<0.0001
Polyunsaturated Fat (g)	8.1 (2.6)	8.3 (2.9)	8.3 (2.7)	8.2 (2.6)	8.3 (2.3)	0.25
Dietary Cholesterol (mg)	181.5 (84.9)	164.0 (70.1)	151.2 (68.5)	146.2 (64.8)	131.0 (49.1)	<0.0001
Sodium (mg)	1711.3 (316.7)	1745.7 (315.4)	1786.5 (309.3)	1822.6 (303.8)	1836.5 (268.1)	<0.0001
Alcohol (g)	1.1 (4.3)	1.2 (4.7)	1.1 (3.4)	1.4 (4.6)	1.2 (3.0)	0.62
Food Group Intake*						
Added Sugar†	5.1 (3.5)	4.8 (2.7)	4.5 (2.6)	4.3 (2.3)	4.3 (1.8)	<0.0001
Total Dairy‡	1.0 (0.7)	1.0 (0.6)	1.0 (0.6)	1.0 (0.6)	1.0 (0.6)	0.48
Total Fruit‡	0.8 (0.7)	1.0 (0.8)	1.1 (0.8)	1.2 (0.8)	1.2 (0.6)	<0.0001
Total Vegetables‡	0.8 (0.4)	0.9 (0.5)	1.0 (0.5)	1.1 (0.5)	1.2 (0.5)	<0.0001
Starchy Vegetables‡	0.2 (0.1)	0.2 (0.1)	0.2 (0.1)	0.2 (0.1)	0.2 (0.1)	0.68
Dark Green Vegetables‡	0.05 (0.06)	0.05 (0.8)	0.06 (0.08)	0.08 (0.1)	0.08 (0.1)	<0.0001
Total Grains§	2.9 (1.0)	3.1 (1.1)	3.2 (1.1)	3.2 (1.0)	3.3 (1.0)	<0.0001
Whole Grains§	0.5 (0.5)	0.7 (0.6)	0.8 (0.6)	0.9 (0.6)	1.0 (0.6)	<0.0001
Legumes‡	0.04 (0.05)	0.05 (0.07)	0.05 (0.07)	0.06 (0.07)	0.07 (0.07)	<0.0001
Nuts/Seeds‖	0.1 (0.2)	0.2 (0.3)	0.2 (0.4)	0.3 (0.4)	0.4 (0.4)	<0.0001
Meat#	1.3 (0.9)	1.1 (0.8)	1.0 (0.7)	1.0 (0.7)	0.8 (0.6)	<0.0001
Poultry**	0.7 (0.6)	0.7 (0.6)	0.7 (0.6)	0.7 (0.6)	0.7 (0.5)	0.61
Fish††	0.3 (0.3)	0.3 (0.3)	0.4 (0.4)	0.5 (0.4)	0.5 (0.4)	<0.0001

* Estimated daily nutrient and food group intakes reported as quintile mean (SD); values for all nutrients (except Total Energy) and food groups are per 1,000 Calories.

† Teaspoon equivalents

‡ Cup equivalents

§ Ounce equivalents

‖ Ounce equivalents of lean meat

\# Ounces of cooked lean meat from beef, pork, lamb, game and veal

** Ounces of cooked poultry

†† Ounces of cooked fish

Table S5. Nutrient and food group characteristics of the American Diabetes Association (ADA) recommendations dietary pattern score by quintile of WHI participants with type 2 diabetes.

	Quintile of ADA Diet Score					
Nutrient Intake*	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	***P***
Total Energy (Calories)	1190.0 (540.0)	1421.2 (579.7)	1575.0 (558.2)	1839.1 (612.2)	2130.2 (647.6)	<0.0001
Carbohydrate (g)	117.3 (26.9)	118.3 (23.0)	120.9 (22.8)	122.1 (21.8)	126.0 (20.4)	<0.0001
Total Sugar (g)	54.9 (23.4)	52.9 (18.8)	54.3 (18.5)	54.7 (17.0)	57.7 (16.4)	<0.0001
Fiber (g)	9.2 (3.9)	10.1 (3.8)	10.7 (3.7)	11.1 (3.7)	11.6 (3.4)	<0.0001
Protein (g)	42.9 (10.0)	44.2 (8.5)	44.5 (8.5)	45.4 (7.9)	45.7 (7.2)	<0.0001
Total Fat (g)	40.2 (9.9)	39.7 (9.1)	38.9 (9.3)	38.1 (9.0)	36.7 (8.9)	<0.0001
Saturated Fat (g)	13.7 (4.1)	13.0 (3.7)	12.7 (3.5)	12.1 (3.2)	11.2 (3.1)	<0.0001
Monounsaturated Fat (g)	15.2 (4.0)	15.2 (4.0)	14.8 (3.9)	14.6 (3.9)	14.2 (3.8)	<0.0001
Polyunsaturated Fat (g)	7.9 (2.8)	8.2 (2.6)	8.3 (2.7)	8.4 (2.5)	8.5 (2.4)	<0.0001
Dietary Cholesterol (mg)	180.1 (92.3)	162.2 (69.8)	153.0 (63.0)	144.8 (60.2)	131.6 (45.3)	<0.0001
Sodium (mg)	1710 (346.4)	1788.3 (319.0)	1786.2 (304.9)	1803.0 (281.0)	1825.1 (256.3)	<0.0001
Alcohol (g)	1.8 (5.6)	1.4 (4.8)	1.0 (3.4)	1.0 (3.1)	0.7 (2.2)	<0.0001
Food Group Intake*						
Added Sugar†	4.9 (3.5)	4.4 (2.8)	4.5 (2.5)	4.5 (2.0)	4.7 (1.9)	<0.0001
Total Dairy‡	0.8 (0.6)	0.9 (0.6)	1.0 (0.6)	1.1 (0.6)	1.2 (0.6)	<0.0001
Total Fruit‡	1.1 (1.0)	1.0 (0.8)	1.1 (0.7)	1.0 (0.7)	1.0 (0.6)	0.44
Total Vegetables‡	0.9 (0.5)	1.0 (0.6)	1.0 (0.5)	1.1 (0.5)	1.1 (0.5)	<0.0001
Starchy Vegetables‡	0.2 (0.1)	0.2 (0.1)	0.2 (0.1)	0.2 (0.1)	0.2 (0.1)	0.0001
Dark Green Vegetables‡	0.06 (0.07)	0.07 (0.10)	0.06 (0.09)	0.07 (0.09)	0.07 (0.08)	0.0002
Total Grains§	2.9 (1.1)	3.2 (1.1)	3.2 (1.0)	3.2 (1.0)	3.3 (0.9)	<0.0001
Whole Grains§	0.5 (0.5)	0.7 (0.6)	0.8 (0.6)	0.9 (0.6)	1.0 (0.6)	<0.0001
Legumes‡	0.04 (0.06)	0.05 (0.08)	0.06 (0.07)	0.06 (0.08)	0.06 (0.06)	<0.0001
Nuts/Seeds‖	0.1 (0.2)	0.2 (0.3)	0.2 (0.4)	0.3 (0.4)	0.4 (0.4)	<0.0001
Meat#	1.2 (0.9)	1.1 (0.8)	1.1 (0.7)	1.0 (0.7)	0.9 (0.6)	<0.0001
Poultry**	0.7 (0.7)	0.7 (0.6)	0.7 (0.6)	0.7 (0.6)	0.6 (0.5)	0.06
Fish††	0.3 (0.3)	0.3 (0.4)	0.4 (0.4)	0.4 (0.4)	0.5 (0.4)	<0.0001

* Estimated daily nutrient and food group intakes reported as quintile mean (SD); values for all nutrients (except Total Energy) and food groups are per 1,000 Calories.
† Teaspoon equivalents
‡ Cup equivalents
§ Ounce equivalents
‖ Ounce equivalents of lean meat
Ounces of cooked lean meat from beef, pork, lamb, game and veal
** Ounces of cooked poultry
†† Ounces of cooked fish

Table S6. Nutrient and food group characteristics of the Paleolithic (Paleo) dietary pattern score by quintile of WHI participants with type 2 diabetes

	Quintile of Paleo Diet Score					
Nutrient Intake*	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	***P*‡‡**
Total Energy (Calories)	2054.9 (660.0)	1798.6 (667.0)	1578.3 (658.7)	1422.7 (575.0)	1233.6 (469.1)	<0.0001
Carbohydrate (g)	113.5 (19.9)	116.2 (20.8)	118.1 (22.1)	123.8 (23.5)	132.7 (25.6)	<0.0001
Total Sugar (g)	51.4 (18.7)	51.6 (17.7)	52.8 (18.7)	56.0 (18.7)	62.9 (19.6)	<0.0001
Fiber (g)	7.9 (2.3)	9.0 (2.5)	10.0 (2.8)	11.5 (3.3)	14.2 (4.2)	<0.0001
Protein (g)	40.9 (7.4)	44.2 (7.9)	44.7 (8.1)	46.0 (8.5)	47.0 (9.6)	<0.0001
Total Fat (g)	42.8 (8.1)	40.4 (8.9)	39.6 (8.7)	37.2 (9.3)	33. 8 (9.1)	<0.0001
Saturated Fat (g)	14.7 (3.4)	13.4 (3.4)	12.9 (3.3)	11.7 (3.3)	10.2 (3.1)	<0.0001
Monounsaturated Fat (g)	16.2 (3.4)	15.4 (3.7)	15.1 (3.7)	14.2 (3.9)	12.8 (4.1)	<0.0001
Polyunsaturated Fat (g)	8.5 (2.6)	8.4 (2.6)	8.3 (2.6)	8.2 (2.9)	7.9 (2.5)	
Dietary Cholesterol (mg)	157.1 (62.5)	157.8 (67.2)	158.2 (67.4)	154.5 (75.7)	147.4 (78.9)	0.0014
Sodium (mg)	1731.7 (296.3)	1780.0 (274.5)	1777.0 (302.1)	1815.22 (320.6)	1793 .3 (327.9)	<0.0001
Alcohol (g)	1.4 (4.2)	1.3 (3.8)	1.4 (4.6)	1.0 (3.8)	0.9 (3.7)	0.0008
Food Group Intake*						
Added Sugar†	5.8 (3.4)	4.9 (2.6)	4.4 (2.4)	4.1 (2.2)	3.7 (1.8)	<0.0001
Total Dairy‡	1.1 (0.6)	1.1 (0.7)	1.0 (0.6)	1.0 (0.6)	0.9 (0.6)	<0.0001
Total Fruit‡	0.6 (0.4)	0.8 (0.4)	1.0 (0.6)	1.2 (0.7)	1.8 (1.0)	<0.0001
Total Vegetables‡	0.7 (0.3)	0.8 (0.3)	0.9 (0.4)	1.2 (0.4)	1.5 (0.6)	<0.0001
Starchy Vegetables‡	0.2 (0.1)	0.2 (0.1)	0.2 (0.1)	0.2 (0.1)	0.2 (0.1)	<0.0001
Dark Green Vegetables‡	0.02 (0.03)	0.03 (0.03)	0.05 (0.05)	0.08 (0.08)	0.1 (0.1)	<0.0001
Total Grains§	3.3 (1.1)	3.3 (1.0)	3.2 (1.0)	3.1 (1.0)	2.8 (1.0)	<0.0001
Whole Grains§	0.7 (0.6)	0.8 (0.6)	0.8 (0.6)	0.8 (0.6)	0.8 (0.6)	<0.0001
Legumes‡	0.05 (0.07)	0.05 (0.06)	0.06 (0.07)	0.06 (0.07)	0.06 (0.08)	<0.0001
Nuts/Seeds‖	0.2 (0.3)	0.2 (0.3)	0.2 (0.3)	0.3 (0.4)	0.3 (0.5)	<0.0001
Meat#	1.0 (0.7)	1.1 (0.7)	1.1 (0.7)	1.1 (0.8)	1.0 (0.8)	<0.0001
Poultry**	0.5 (0.4)	0.6 (0.5)	0.7 (0.5)	0.7 (0.6)	0.9 (0.8)	<0.0001
Fish††	0.2 (0.2)	0.3 (0.3)	0.4 (0.3)	0.5 (0.4)	0.6 (0.5)	<0.0001

* Estimated daily nutrient and food group intakes reported as quintile mean (SD); values for all nutrients (except Total Energy) and food groups are per 1,000 Calories.

† Teaspoon equivalents

‡ Cup equivalents

§ Ounce equivalents

‖ Ounce equivalents of lean meat

Ounces of cooked lean meat from beef, pork, lamb, game and veal

** Ounces of cooked poultry

†† Ounces of cooked fish

‡‡ *P* value is based on analysis of variance