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Sex differences in sociodemographic and lifestyle factors associated with diet quality in a multiethnic population

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ABSTRACT

Objectives: The purpose of this study was to examine associations of sociodemographic and lifestyle factors with diet quality in a multiethnic population.
Methods: The analysis included 160 353 African American, Native Hawaiian, Japanese American, Latino, and non-Hispanic white participants aged 45 to 75 y who entered the Multiethnic Cohort study by completing a comprehensive questionnaire in 1993 to 1996 and did not report cancer or heart disease. Diet quality was assessed using four diet quality indexes (DQIs): the Healthy Eating Index 2010, the Alternative Healthy Eating Index 2010, the alternate Mediterranean Diet, and the Dietary Approaches to Stop Hypertension.
Results: For three DQIs, the Healthy Eating Index 2010, Alternative Healthy Eating Index 2010, and Dietary Approaches to Stop Hypertension, mean scores were significantly higher in women than men, whereas the mean score of the alternate Mediterranean Diet was significantly higher in men than women. In both men and women, older age, higher education, being physically active, and multivitamin use were associated with scores above the median of DQIs, whereas overweight/obesity, current smoking, and heavy alcohol consumption (≥2 drinks/d) were associated with scores less than the median of DQIs. Race/ethnicity had inconsistent associations according to the DQIs. Being widowed, being a previous smoker, and having a low body mass index (<20 kg/m^2) were associated with scores less than the median of DQIs in men but not in women.
Conclusions: Diet quality was associated with sociodemographic and lifestyle characteristics in men and women. The associations with several factors, such as marital status, body mass index, and smoking status, differed by sex. These findings may help to identify at-risk populations for nutritional screening and to develop nutritional intervention strategies and educational materials.

Introduction

The concepts of a high-quality diet usually address items to limit, such as sodium, solid fats, added sugars, and refined grains [1–5]. Conversely, these high-quality diet recommendations emphasize inclusion of nutrient-dense foods and beverages—vegetables, fruits, whole grains, fat-free or low-fat milk and milk products, seafood, lean meats and poultry, eggs, beans and peas, and nuts and seeds [1–5]. Dietary recommendations, such as the US Dietary Guidelines for Americans, emphasize diet quality as an important factor to maintain a healthy weight, reduce risk of chronic disease, and promote overall health [1]. Results from epidemiological studies in the United States suggest that high-quality diets are associated with lower risk of mortality from all causes, cardiovascular disease, and cancer, and a lower risk of colorectal cancer for men and women [6–10]. Further, an association between high-quality diet and reduced risk of colorectal, esophageal, pancreatic, and prostate cancer was reported from a systematic meta-analysis of cohort studies [10].

Sociodemographic and lifestyle factors are important covariates in diet–disease relationships. Previous studies have reported that diet quality was associated with sociodemographic and lifestyle factors, including age, sex, race/ethnicity, education, and energy intake [11–15]. For instance, a study from the 2003–2004 National Health and Nutrition Examination Survey found that older adults had better-quality diets than younger and middle-aged adults, women had better-quality diets than men, and Hispanic men and

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women had better-quality diets than African American men and women, but not better than their non-Hispanic white counterparts [11]. A study in four European countries reported that education, not living alone, and being a woman were positively associated with diet quality among elderly individuals [12].

Although many studies have been published on the associations between diet quality and sociodemographic characteristics [11–15], they were mostly conducted in racially and ethnically homogeneous populations. The present study aimed to examine the associations of diet quality assessed by four diet quality indexes (DQIs) [16]—the Healthy Eating Index 2010 (HEI-2010) [2], the Alternative Healthy Eating Index 2010 (AHEI-2010) [3], the alternate Mediterranean Diet (aMED) [4], and the Dietary Approaches to Stop Hypertension (DASH) score [5]—with sociodemographic and lifestyle factors in men and women of a multiethnic population.

Methods

Study population

The Multiethnic Cohort Study (MEC) was established between 1993 and 1996 to study diet and cancer in Hawaii and California (primarily Los Angeles County) [17]. Details of the study design and implementation have been described previously [17]. Briefly, the cohort consisted of more than 215 000 men and women (aged 45–75 y at baseline) who were primarily of five major racial or ethnic groups: African American, Native Hawaiian, Japanese American, Latino, and non-Hispanic white [17]. At cohort entry, participants completed a self-administered 26-page questionnaire, including a quantitative food frequency questionnaire (QFFQ), demographic factors, lifestyle factors, history of prior medical conditions, use of medications, reproductive history, use of replacement estrogens or oral contraceptives, and a brief family history of cancer [17]. The study protocol was approved by the institutional review boards at the University of Hawaii and the University of Southern California.

For the present analysis, we excluded participants who did not self-report as a member of one of the five major racial or ethnic groups (n = 13 986), had any previous cancer reported on the baseline questionnaire (n = 17 645) or from tumor registries (n = 2070), had a previous heart attack or angina reported on the baseline questionnaire (n = 14 979), or reported an implausible diet based on total energy or its components intakes (n = 6617). Among records with complete dietary information, dietary extremes were based on energy intakes (kcal) and its components. The ranges for implausible energy intakes were developed using the top and bottom 10% tails of the logged energy distribution, which were excluded, and the variance (V_{Mkcal}) was computed based on the middle 80% of the data. An overall variance was computed as $V_{Akcal} = V_{Mkcal} \times 1.5$. This was based on the variance for the truncated normal distribution from the 10th to the 90th percentile (−1.28 to 1.28 for the standard normal) being 1 to 1.5 times the variance for the untruncated normal distribution. This adjustment allowed the clearly incorrect data (e.g., energy of 100 kcal) in the tails to not contribute to the variance estimate. Then all energy less than [$mean_{kcal} - 3$ standard deviation $(SD)_{Akcal}$] or greater than [$mean_{kcal} + 3SD_{Akcal}$] were excluded, where $SD_{Akcal} = sqrt(V_{Akcal})$. The estimate for average energy ($mean_{kcal}$) was based on all cohort members rather than the middle 80%. These exclusions were made separately by sex and ethnic group. The final sample included 160 353 participants.

Dietary assessment and calculation of dietary indexes

The QFFQ with more than 180 food items was developed using 3-d measured food records from approximately 60 men and women, aged 45 to 75 y, from each of the five main ethnic groups in the study [17]. A substudy with validation and calibration purposes found acceptable correlations ranging from 0.55 to 0.74 between the QFFQ and three 24-h recalls among 1606 cohort members [18]. Daily nutrient and food intakes from the QFFQ were calculated using the MEC food composition tables, including commonly consumed foods in multiethnic populations of Hawaii, California, and the Pacific region [19,20].

Four DQIs (HEI-2010, AHEI-2010, aMED, and DASH score) were calculated for the MEC as part of the Dietary Patterns Method Project [16], which has been described in detail previously [8,9,21]. Briefly, HEI-2010 is a measure of diet quality in terms of conformance to the Dietary Guidelines for Americans 2010 and has 12 components, including 9 adequacy components (total fruit, whole fruit, total vegetables, greens and beans, whole grains, dairy, total protein foods, seafood and plant proteins, and fatty acids) and 3 moderation components (refined grains, sodium, and empty calories) [2,22]. The maximum score for the HEI-2010 is 100, and higher scores indicate closer conformance with dietary guidelines [2,22]. The AHEI-2010 is based on foods and nutrients predictive of chronic disease risk and includes 11 components, which are scored 0 (worst) to 10 (best). The components are vegetables, fruit, whole grains, sugar-sweetened beverages and fruit juice, nuts and legumes, red/processed meat, trans fat, long-chain (ω-3) fats (eicosapentaenoic acid + docosahexaenoic acid), polyunsaturated fatty acids, sodium, and alcohol [3]. The total AHEI-2010 score ranges from 0 (nonadherence) to 110 (perfect adherence) and has been associated inversely with chronic disease risk [3,23–25]. The aMED is a modification of the Mediterranean Diet scale of Trichopoulou et al. [26,27] based on dietary patterns and eating behaviors that have been consistently associated with chronic disease risk [4]. The possible scores on the aMED range from 0 to 9 and include nine components, which are scored 0 (worst) to 1 (best): vegetables, legumes, fruit, nuts, whole grains, red and processed meats, fish, ratio of monounsaturated to saturated fat, and ethanol [4]. The DASH score as constructed by Fung et al. [5] is based on food and nutrients emphasized in the DASH diet designed for hypertension management and includes eight components focusing on higher intakes (fruits, vegetables, nuts and legumes, low-fat dairy products, and whole grains) and lower intakes (sodium, sweetened beverages, and red and processed meats) [5]. The overall DASH score ranges from 8 to 40 and all eight components are scored from 1 (worst) to 5 (best) [5].

Sociodemographic and lifestyle characteristics

For the MEC baseline questionnaire, participants provided comprehensive sociodemographic and lifestyle information, including sex, date of birth, racial or ethnic background, education, marital status, smoking status, weight, height, multivitamin use, menopausal hormone therapy use, and family history of cancer. Body mass index (BMI, kg/m^2) was calculated from self-reported weight and height. Physical activity was calculated as hours spent in vigorous work or sports per day. Selected characteristics for this study represent variables used as adjustment factors in analyzing the relationship between diet and disease in previous studies [6–9].

Statistical analysis

Selected characteristics are presented as means ± SD for quantitative variables and n (%) for categorical variables for men and women separately. Differences of the characteristics between men and women were tested using t test for quantitative variables and χ^2 test for categorical variables. Associations between dietary indexes and selected sociodemographic and lifestyle characteristics were assessed using multivariate logistic regression in men and women separately. The total score of dietary index (HEI-2010, AHEI-2010, aMED, and DASH score) was dichotomized for men and women based on the median value and the odds of being greater than the median scores and were modeled as dependent variables. The multivariate logistic regression was performed with participants who provided information on all covariates (men = 66 940; women = 77 203), including race/ethnicity (non-Hispanic White, African American, Native Hawaiian, Japanese American, Latino), age (45–54, 55–64, 65–75), educational status (≤ 12th grade, post–high school/vocational, college graduate or higher), marital status (married, separated/divorced, widowed, never married), BMI group (<20 kg/m^2, 20 to <25 kg/m^2, 25 to <30 kg/m^2, 30 to <35 kg/m^2, ≥35 kg/m^2), smoking status (never smoking, former smoking, current smoking), physical activity (<0.1 h, 0.1–0.3 h, >0.3 h), multivitamin use (yes/no), family history of cancer (yes/no), menopausal hormone therapy use (yes/no) for women only, energy intake (<1617 kcal, 1617–2381 kcal, >2381 kcal), and alcohol intake (non-drinkers, <1 drink [14 g of ethanol], 1 to <2 drinks, ≥2 drinks). Data were analyzed using SAS Software version 9.4 (SAS Institute Inc., Cary, NC, USA), and differences were considered significant at $P < 0.05$.

Results

Characteristics of the study participants are presented in Table 1. Among the 160 353 participants included in this analysis, 55% were women. The distribution of the study population's race and ethnicity stratified by sex is as follows: for men, 24.6% non-Hispanic white, 13.1% African American, 7.1% Native Hawaiian, 30.4% Japanese American, and 24.9% Latino; and for women, 23.7% non-Hispanic white, 18.8% African American, 7.4% Native Hawaiian, 28.5% Japanese American, and 21.6% Latino. There was no significant difference in age group distribution between men and women. About 76.6% of men and 59.9% of women were married and 33.2% of men and 38.0% of women had a family history of cancer. Among women, 46.1% had used menopausal hormone therapy. Men were more likely to be educated, former or current smokers, and physically active (P <.001). On the other hand, women were more likely to be multivitamin users and non-drinkers of alcohol ($P < 0.001$). Mean BMI of men (26.6 kg/m^2) was significantly higher than that

Table 1
Baseline characteristics of participants in the Multiethnic Cohort Study 1993–1996*

	Men (n = 71 894)	Women (n = 88 459)
Race/ethnicity		
Non-Hispanic white	17663 (24.6)	21009 (23.7)
African American	9384 (13.1)	16663 (18.8)
Native Hawaiian	5096 (7.1)	6514 (7.4)
Japanese American	21840 (30.4)	25182 (28.5)
Latino	17 911 (24.9)	19 091 (21.6)
Age group (y)		
45 to <55	24 556 (34.2)	30 528 (34.5)
55 to <65	24 131 (33.6)	29 649 (33.5)
65–75	23 207 (32.3)	28 282 (32.0)
Educational status		
≤12th grade	28 937 (40.7)	39 942 (45.7)
Vocational school/some college	20 709 (29.1)	25 846 (29.6)
College graduate or higher	21 464 (30.2)	21 569 (24.7)
Marital status		
Married	54 692 (76.6)	52 451 (59.9)
Separated/divorced	8995 (12.6)	16 682 (19.0)
Widowed	2489 (3.5)	12 832 (14.6)
Never married	5218 (7.3)	5672 (6.5)
Body mass index (kg/m^2)	26.6 ± 4.0	26.3 ± 5.4
Body mass index (kg/m^2)		
<20	1468 (2.1)	6875 (7.9)
20 to <25	24 189 (33.9)	34 020 (39.1)
25 to <30	33 649 (47.1)	27727 (31.9)
30 to <35	9443 (13.2)	12 038 (13.8)
≥35	2666 (3.7)	6336 (7.3)
Smoking status		
Never	22 077 (31.1)	49 283 (56.8)
Former	35 627 (50.1)	25 012 (28.8)
Current	13 351 (18.8)	12 472 (14.4)
Physical activity† (h)	0.6 ± 1.1	0.2 ± 0.6
Multivitamin use	33 634 (47.6)	463 554 (54.0)
Family history of cancer	23 884 (33.2)	33 600 (38.0)
MHT ever use among women	–	39 528 (46.1)
Energy intake (kcal)	2444 ± 1134	1979 ± 963
Alcohol non-drinker	26 553 (36.9)	54 369 (61.5)
Alcohol intake among drinkers (g/d)	23.9 ± 39.0	11.1 ± 22.1
Dietary quality indexes		
HEI-2010	64.3 ± 11.0	68.6 ± 10.9
AHEI-2010	64.0 ± 9.8	65.1 ± 9.2
aMED	4.14 ± 1.78	4.08 ± 1.78
DASH	23.9 ± 4.4	24.0 ± 4.4

aMED, alternate Mediterranean Diet; AHEI-2010, Alternative Healthy Eating Index 2010; DASH, Dietary Approaches to Stop Hypertension; HEI-2010, Healthy Eating Index 2010; MHT, menopausal hormone therapy.
*Values are n (%) or mean ± SD. All distributions and means were significantly different between men and women ($P < 0.001$) except for age group ($P = 0.27$).
†Hours spent in vigorous work or sports per day.

of women (26.3 kg/m^2) ($P < 0.001$). Mean energy and alcohol intakes among drinkers were higher in men than in women ($P < 0.001$). For the three DQIs, HEI-2010, AHEI-2010, and DASH, mean scores were significantly higher in women (68.6, 65.1, and 24.0, respectively) than men (64.3, 64.0, and 23.9, respectively), whereas mean score of aMED was significantly higher in men (4.14) than women (4.08) (all $P < 0.001$). Scores of each component for the four DQIs were also calculated (Supplemental Tables 1–4). There were variation in scores of each component for the four DQIs by race and ethnicity because the four DQIs included a unique combination of dietary constituents.

Independent associations between the four DQIs and selected sociodemographic and lifestyle factors are presented in Table 2 for men and women separately. Older age, higher educational status, physical activity, and multivitamin use were associated with scores greater than the median for all four DQIs in both men and women. Ever use of menopausal hormone therapy among women was also associated with scores greater than the median for all four DQIs.

Compared with non-Hispanic white men, African American men were more likely to be in the upper half of HEI-2010 and aMED scores but in the lower half of AHEI-2010 and DASH score. Japanese American men were associated with scores greater than the median for AHEI-2010 and aMED and scores less than the median for HEI-2010 and DASH. Native Hawaiian men were associated with scores less than the median for HEI-2010 and DASH. Latino men were associated with scores less than the median for all four DQIs.

Among women participants, race or ethnic group also had inconsistent associations according to the DQIs. For instance, compared with non-Hispanic white women, African American women were more likely to be in the upper half of HEI-2010, AHEI-2010, and aMED but in the lower half of DASH score. Native Hawaiian ethnicity and Japanese American ethnicity were associated with scores greater than the median for AHEI-2010 and aMED but with scores less than the median for HEI-2010 and DASH scores. Latino ethnicity was associated with scores less than the median for all four DQIs compared with non-Hispanic white women.

For marital status, widowed men tended to be in the lower half of all four DQI scores compared with married men. In contrast, widowed women were in the upper half of DASH score and had no significant associations with HEI-2010, AHEI-2010, and aMED. Compared with a BMI of 20 to <25 kg/m^2, lower BMI (<20 kg/m^2) was associated with scores less than the median for HEI-2010 and aMED in men but with scores greater than the median for AHEI-2010, aMED, and DASH in women. On the other hand, classification as overweight or obese was associated with scores less than the median for all four DQIs in both men and women. In addition, former smokers were more likely to be in the lower half of HEI-2010, aMED, and DASH compared with never smokers in men. While in women, former smokers were more likely to be in the upper half of AHEI-2010 and had no associations with the other three DQIs. Current smokers were more likely to be in the lower half of all four DQIs compared with never smokers in both men and women.

Among both men and women, higher energy intakes (>2381 kcal) were associated with scores greater than the median for AHEI-2010, aMED, and DASH, but with a score less than the median for HEI-2010, in which a density (intake per 1000 kcal) approach was used. The positive associations with energy intake were much stronger for aMED compared with the other three DQIs. Compared with non-drinkers of alcohol, alcohol consumption ≥2 drinks/d (1 drink = 14 g of ethanol) was associated with scores less than the median for all four DQIs in both men and women. On the other hand, alcohol drinkers reporting <2 drinks/d were associated with scores greater than the median for HEI-2010, AHEI-2010, and aMED but with a score less than the median for DASH in both men and women.

Discussion

This study examined the associations between four DQIs and sociodemographic and lifestyle factors in a large multiethnic population. Older age, higher education, physical activity, and multivitamin use were associated with scores greater than the median, and overweight or obesity, current smoking, and heavy alcohol consumption were associated with scores less than the median in both men and women. Being widowed, underweight, and a former smoker were related to be in the lower half of DQI scores in men but not in women. Race or ethnicity was inconsistently associated with diet quality across the DQIs.

In our analysis, women tend to have better diet quality than men. This finding is consistent with other research [11,28]. For instance, in the National Health and Nutrition Examination Survey (NHANES), a nationwide survey, women had significantly higher

Table 2
Odds ratios and 95% confidence intervals from multivariate analyses of sociodemographic and lifestyle factors associated with dietary quality indexes in the Multiethnic Cohort Study 1993–1996*

	Men (n = 66 940)				Women (n = 77 203)			
	HEI-2010	AHEI-2010	aMED	DASH	HEI-2010	AHEI-2010	aMED	DASH
Race/ethnicity								
White	1	1	1	1	1	1	1	1
African American	1.09 (1.02–1.15)	0.90 (0.85–0.95)	1.06 (1.00–1.13)	0.55 (0.52–0.59)	1.27 (1.21–1.34)	1.05 (1.00–1.10)	1.18 (1.12–1.25)	0.57 (0.54–0.60)
Native Hawaiian	0.78 (0.72–0.83)	1.05 (0.98–1.13)	1.02 (0.94–1.10)	0.43 (0.40–0.46)	0.90 (0.85–0.96)	1.06 (1.00–1.13)	1.20 (1.12–1.29)	0.48 (0.45–0.51)
Japanese American	0.59 (0.56–0.62)	1.10 (1.05–1.15)	1.05 (1.00–1.10)	0.33 (0.31–0.34)	0.63 (0.60–0.66)	1.34 (1.28–1.40)	1.19 (1.14–1.25)	0.37 (0.36–0.39)
Latino	0.58 (0.55–0.61)	0.62 (0.59–0.65)	0.71 (0.67–0.75)	0.72 (0.68–0.75)	0.57 (0.54–0.60)	0.62 (0.59–0.66)	0.74 (0.70–0.78)	0.71 (0.68–0.75)
Age group (y)								
45 to <55	1	1	1	1	1	1	1	1
55 to <65	1.56 (1.50–1.63)	1.55 (1.48–1.61)	1.38 (1.32–1.44)	1.70 (1.64–1.77)	1.67 (1.61–1.73)	1.62 (1.56–1.69)	1.58 (1.52–1.65)	1.80 (1.74–1.87)
65–75	2.25 (2.15–2.35)	2.19 (2.10–2.29)	1.93 (1.84–2.02)	2.99 (2.86–3.13)	2.54 (2.44–2.65)	2.21 (2.12–2.30)	2.08 (1.99–2.18)	3.04 (2.91–3.17)
Educational status								
≤12th grade	1	1	1	1	1	1	1	1
Post-high school/vocational	1.27 (1.22–1.32)	1.14 (1.10–1.19)	1.13 (1.08–1.18)	1.21 (1.16–1.26)	1.41 (1.36–1.47)	1.19 (1.14–1.23)	1.16 (1.12–1.21)	1.36 (1.31–1.42)
College graduate or higher	1.61 (1.55–1.68)	1.41 (1.35–1.47)	1.37 (1.31–1.44)	1.62 (1.55–1.70)	1.71 (1.64–1.78)	1.36 (1.31–1.42)	1.37 (1.31–1.44)	1.76 (1.69–1.84)
Marital status								
Married	1	1	1	1	1	1	1	1
Separated/divorced	0.95 (0.90–0.99)	1.01 (0.96–1.06)	1.01 (0.96–1.07)	0.97 (0.92–1.02)	0.99 (0.95–1.03)	0.97 (0.93–1.01)	0.93 (0.89–0.98)	1.05 (1.01–1.10)
Widowed	0.87 (0.80–0.96)	0.91 (0.83–1.00)	0.90 (0.81–0.99)	0.89 (0.81–0.97)	0.99 (0.95–1.04)	0.98 (0.93–1.02)	0.96 (0.91–1.01)	1.06 (1.01–1.11)
Never married	1.14 (1.08–1.22)	1.14 (1.07–1.22)	1.05 (0.99–1.13)	1.15 (1.08–1.23)	1.14 (1.07–1.21)	1.03 (0.97–1.10)	1.03 (0.96–1.10)	1.18 (1.11–1.26)
Body mass index (kg/m^2)								
<20	0.77 (0.69–0.87)	0.91 (0.81–1.02)	0.84 (0.74–0.95)	0.93 (0.83–1.05)	1.04 (0.98–1.10)	1.12 (1.05–1.18)	1.14 (1.07–1.21)	1.22 (1.15–1.29)
20 to <25	1	1	1	1	1	1	1	1
25 to <30	0.90 (0.87–0.93)	0.88 (0.85–0.91)	0.90 (0.86–0.93)	0.84 (0.81–0.88)	0.89 (0.86–0.92)	0.88 (0.85–0.91)	0.88 (0.84–0.91)	0.81 (0.78–0.84)
30 to <35	0.81 (0.77–0.85)	0.82 (0.78–0.87)	0.86 (0.81–0.91)	0.73 (0.69–0.77)	0.75 (0.71–0.78)	0.78 (0.75–0.82)	0.75 (0.71–0.79)	0.68 (0.65–0.72)
≥35	0.75 (0.69–0.82)	0.85 (0.77–0.92)	0.84 (0.76–0.93)	0.73 (0.67–0.80)	0.66 (0.62–0.71)	0.75 (0.71–0.80)	0.71 (0.67–0.76)	0.59 (0.55–0.63)
Smoking status								
Never	1	1	1	1	1	1	1	1
Former	0.87 (0.83–0.90)	0.98 (0.95–1.02)	0.92 (0.88–0.96)	0.88 (0.85–0.91)	0.97 (0.94–1.00)	1.07 (1.04–1.11)	1.01 (0.97–1.05)	0.98 (0.95–1.02)
Current	0.38 (0.36–0.40)	0.52 (0.50–0.55)	0.51 (0.49–0.54)	0.41 (0.39–0.43)	0.48 (0.46–0.50)	0.58 (0.55–0.61)	0.56 (0.53–0.59)	0.44 (0.42–0.47)
Physical activity†								
Tertile 1 (<0.1 h)	1	1	1	1	1	1	1	1
Tertile 2 (0.1–0.3 h)	1.15 (1.10–1.20)	1.15 (1.10–1.20)	1.20 (1.14–1.26)	1.13 (1.08–1.18)	1.16 (1.12–1.21)	1.16 (1.12–1.21)	1.20 (1.15–1.25)	1.16 (1.12–1.21)
Tertile 3 (>0.3 h)	1.42 (1.37–1.48)	1.33 (1.28–1.38)	1.50 (1.44–1.56)	1.42 (1.36–1.47)	1.47 (1.41–1.53)	1.48 (1.42–1.54)	1.52 (1.46–1.59)	1.57 (1.51–1.63)
Multivitamin use	1.42 (1.37–1.47)	1.33 (1.29–1.37)	1.37 (1.32–1.42)	1.47 (1.42–1.52)	1.38 (1.34–1.42)	1.35 (1.31–1.39)	1.37 (1.33–1.42)	1.44 (1.39–1.48)
Family history of cancer	1.06 (1.03–1.10)	1.06 (1.02–1.10)	1.05 (1.01–1.09)	1.03 (1.00–1.07)	1.06 (1.03–1.09)	1.01 (0.98–1.05)	1.02 (0.99–1.05)	1.03 (1.00–1.06)
MHT ever use among women	—	—	—	—	1.24 (1.20–1.28)	1.17 (1.13–1.20)	1.14 (1.11–1.18)	1.24 (1.20–1.28)
Energy intake								
Tertile 1 (<1617 kcal)	1	1	1	1	1	1	1	1
Tertile 2 (1617–2381 kcal)	1.07 (1.03–1.12)	1.64 (1.57–1.72)	3.00 (2.87–3.14)	1.67 (1.60–1.75)	1.03 (1.00–1.07)	1.90 (1.84–1.97)	3.72 (3.59–3.86)	1.80 (1.73–1.86)
Tertile 3 (>2381 kcal)	0.95 (0.91–0.99)	1.88 (1.80–1.97)	10.09 (9.61–10.60)	2.70 (2.59–2.83)	0.89 (0.86–0.93)	2.44 (2.34–2.53)	13.61 (12.93–14.32)	3.40 (3.26–3.54)
Alcohol intake								
Non-drinkers	1	1	1	1	1	1	1	1
<1 drink (14 g of ethanol)	1.08 (1.04–1.12)	1.50 (1.44–1.56)	1.23 (1.18–1.28)	0.89 (0.86–0.93)	1.04 (1.01–1.08)	1.30 (1.26–1.35)	1.35 (1.30–1.40)	0.95 (0.92–0.99)
1 to <2 drinks	1.19 (1.12–1.25)	3.76 (3.54–3.99)	2.23 (2.09–2.38)	0.79 (0.75–0.84)	1.20 (1.12–1.30)	3.14 (2.90–3.41)	1.01 (0.93–1.09)	0.88 (0.82–0.95)
≥2 drinks	0.72 (0.69–0.76)	0.62 (0.59–0.65)	0.65 (0.62–0.68)	0.55 (0.52–0.58)	0.57 (0.53–0.62)	0.41 (0.37–0.44)	0.57 (0.52–0.61)	0.56 (0.52–0.61)

aMED, alternate Mediterranean Diet; AHEI-2010, Alternative Healthy Eating Index 2010; DASH, Dietary Approaches to Stop Hypertension; HEI-2010, Healthy Eating Index 2010; MHT, menopausal hormone therapy.

*Odds ratio of being greater than the median score and 95% confidence interval. Multivariate logistic regression was performed in participants with complete information on covariates (66 940 men and 77 203 women). Therefore, for each factor (e.g., race/ethnicity), all other factors in the table were adjusted for. This was repeated for every factor in the table.

†Hours spent in vigorous work or sports per day.

mean AHEI-2010 score than men in the 1999–2010 NHANES [28]. Also, women had a higher total HEI-2005 score than men in the 2003–2004 NHANES [11]. In our results, only the aMED score was higher in men than women. The aMED was most strongly associated with energy intake among the four DQIs. The aMED does not standardize its components to 2000/1500 kcal before computing a score, so, naturally, higher intake means higher score because there are more adequacy components than moderation components. This coincides with the study by Trichopoulou et al. [26] that assessed diet quality using the original Mediterranean Diet scale (range of scores, 0–9) among adult men and women in Greece.

In previous studies conducted in United States and elsewhere, such as Australia, Brazil, and European countries, that analyzed the association between sociodemographic and lifestyle characteristics and diet quality, diet quality was positively associated with factors including older age, higher education, and not living alone and negatively associated with factors including obesity and smoking [12,13,15,29]. Similarly, we found that older age, higher educational status, engaging in regular physical activity, and multivitamin use were associated with scores greater than the median for all four DQIs in both men and women.

Race and ethnicity differences were inconsistent among the four DQI scores. These may be partly a result of the differences in components and scoring system by each DQIs. For example, Japanese American men and women in the MEC were associated with scores greater than the median for AHEI-2010 and aMED but in the lower half of HEI-2010 and DASH. AHEI-2010 includes the consumption of soy as a part of a component and does not include the consumption of dairy products [3], which represent traditional dietary practices of Japanese Americans. In aMED, legumes are included as a component and dairy products are not included, and a high score (1, between 0 and 1) is obtained when the intake of each component is higher than the median value [4,26,27]. For DASH, legumes and low-fat dairy products are included as components, and the highest value (5, from 1 to 5) is given when classified to the highest quintile of intake [5]. Latino men and women were associated with scores less than the median for all four DQIs compared with non-Hispanic white men and women, respectively. Few other studies have reported the associations between race or ethnicity and diet quality, and those that have studied this have found mixed results. For instance, one study focusing on the diet quality of urban older adults ages 60 to 99 y in the United States using HEI-2005 found that Hispanic participants were more likely to have higher HEI-2005 scores than African American participants, and non-Hispanic white participants had no significant difference compared with African American participants [13]. Another study found that diet quality assessed using the AHEI-2010 differed by Hispanic or Latino background, with higher AHEI-2010 among those with origins associated with Mexico and lower AHEI-2010 among those with origins associated with Puerto Rico [30].

The associations between the DQIs and several factors varied between men and women. Among marital status, widowed men tended to be in the lower half of all four DQI scores compared with those who were married men, but widowed women tended to be in the upper half of DASH and found no associations in three DQIs (HEI-2010, AHEI-2010, and aMED). In a previous study reporting gender differences in bereavement, men believed women were better equipped to deal with widowhood as a result of women's domestic abilities and social skills and men's inability to talk about their emotions [31]. Hughes et al. also described poor cooking skills and low motivation to change eating habits that may constitute barriers to improving healthy eating in older men living alone [32].

Several studies have examined the association between smoking status and diet quality and have reported smoking being inversely associated with overall diet quality [15,33]. In our results, individuals currently smoking were associated with scores less than the median for all four DQIs in both men and women. As with current smoking, previous smoking was associated with scores less than the median for diet quality in men but not in women. In addition, classification as overweight or obese was associated with scores less than the median for all four DQIs in both men and women. However, compared with a BMI of 20 to 25 kg/m^2, lower BMI (<20 kg/m^2) was associated with scores less than the median for HEI-2010 and aMED in men but with scores greater than the median for three DQIs in women. In previous studies reporting about eating differences in men and women, women have a higher awareness and better knowledge of nutrition than men and women usually attach greater importance to healthy eating [34,35]. Also, women are less satisfied with their weight, the motivation of weight control is more prominent in women, and they are more likely to diet or restrain their eating behavior [34,35]. Therefore these differences in men and women may in part explain the variation by sex for the associations with DQIs.

Several limitations should be taken into consideration. For the present analysis, we excluded participants who had any previous cancer and cardiovascular disease to examine the relationship between diet quality and sociodemographic and lifestyle factors of healthy participants, but we could not completely rule out disease-induced dietary changes. Also, dietary data based on a self-administered QFFQ are subject to measurement error inherent in all dietary assessment methods, including QFFQ [18,36]. Lastly, this study was a cross-sectional analysis, so we cannot infer causality from our results. Nevertheless, this study is the first to estimate the associations between sociodemographic and lifestyle characteristics and dietary quality using four indexes among healthy African American, Native Hawaiian, Latino, Japanese American, and non-Hispanic white adults for whom all data were collected in a uniform manner.

Conclusions

In a multiethnic population, we found that older age, higher education, engaging in physical activity, and multivitamin use were positively associated with diet quality in men and women. The relationships among diet quality and several factors, such as race/ethnicity, marital status, BMI status, and smoking status, were found to be different in men and women. These findings are important to both the clinical and research areas in adult populations because they may help to identify at-risk populations for nutritional screening, such as men who live alone, underweight men, overweight or obese men and women, men who are former smokers, and men and women who are current smokers. Furthermore, findings from this study can support targeted effort in developing nutritional intervention strategies and educational materials across ethnic minority groups.

Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.nut.2018.11.022.

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