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The relationship between the healthy eating index and an alternate healthy eating index with the risk factors for cardiovascular disease in a population from northeastern Iran

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ABSTRACT

Background: The Healthy Eating Index (HEI) is used widely to investigate diet quality. It is used for a number of different applications, for example to measure compliance with dietary recommendations and guidelines. The Alternate Healthy Eating Index (AHEI) was created in 2002 and was designed to improve the ability to predict major chronic disease risks.
Objective: The main objective of the present study was to assess the associations between the HEI/AHEI with several cardiovascular disease risk factors (RFs) within a population sample of adults from north-eastern Iran and to compare the predictive values obtained using HEI for these cardiovascular RFs with the values obtained using AHEI.
Material and methods: A total sample of 748 men, were recruited from Sarakhs City, in northeastern Iran. The mean age of study participants was 43.50 ± 8.88 years. Anthropometric indices were measured based on standard methods. Fasting blood samples (12 hrs) were collected from all subjects to determine several biochemical measures. HEI/AHEI were used to assess the quality of diet.
Results: There were no significant differences in diet quality with respect to the presence or absence of obesity, diabetes, metabolic syndrome, hypertension, hypercholesterolemia, and hypertriglyceridemia. AHEI was significantly higher among subjects with a high serum levels of sensitive-C reactive protein (Hs-CRP) ($p = 0.005$), and the HEI was higher in subjects with a high serum copper ($p = 0.01$). There were no significant correlations between HEI/AHEI with CVD risk factors.
Conclusions: The results showed that there were no significant associations between the HEI/AHEI with CVD risk factors in the study population.

1. Introduction

There is an increasing burden of non-communicable diseases worldwide, and a clear and important role of diet in the pathogenesis of these chronic conditions. Dietitians have focused on providing comprehensive yet applicable dietary guidelines to protect societies against this disease burden. Several scoring systems have been developed to assess the adherence to specific guidelines, among these is the healthy eating index (HEI), that was introduced

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by the US Department of Agriculture's Center and was based on the Dietary Guidelines for Americans.[1] A revision of the HEI, led to an alternative healthy eating index (AHEI) that was reported to be associated with an improved ability to predict major chronic disease risks.[2,3] The HEI-2010 is comprised of 12 components. For each component, the HEI–2010 designates a certain amount as the standard optimal value. Maximum scores of 5, 10, or 20 points are allocated, depending upon the component. Amounts that do not meet the standard get fewer points, with zero being the minimum score.[4] The total HEI-2010 score is the sum of the component scores and has a maximum of 100 points. It can also be used in research to better understand relationships between nutrients, foods, and/or dietary patterns and health-related outcomes.[5–7] The AHEI is a particularly relevant target for mortality research because it can support dietary guidelines with the specific intention of combating major chronic diseases.[2]

Cardiovascular disease (CVD) accounts for 32% of the total global mortality, and is the most common cause of non-communicable disease death.[8] Most of the modifiable CVD traditional risk factors (RFs) are directly affected by diet, a fact that emphasizes the importance of having a clear quantitative insight about the effect of dietary pattern on developing CVD. This have been the focus for a number of previous studies that assessed the association between HEI/AHEI score and cardiovascular risk all of which have reported significant levels of correlation especially with the AHEI.[4,9,10]

Higher scores on the AHEI are reported to be strongly associated with lower risk of major chronic disease including: diabetes,[11] heart failure,[12] colorectal[12] and estrogen-receptor-negative breast cancer,[13] and total and cardiovascular mortality.[1,2,11,12,17] Barbara et al, identified abdominal obesity as the most common metabolic syndrome (MetS) risk factor to emerge during long-term follow-up in healthy individuals.[14] Furthermore, NCEP ATP III recognizes abdominal obesity as a key underlying feature of MetS.[15,16] Subjects with a poor HEI score had a high risk of obesity, twice that of subjects with a good HEI score.[14] Desiree et al, indicated that dietary consumption that follows the HEI is associated with a lower risk for abdominal obesity.[9,17–21,24,25] Serum copper has been shown to be associated with CVD risk factors in northeastern Iran so, it has been considered in current study.[22]

Here we aimed to assess the relationship between the HEI/AHEI with major CVD RFs in Iranian adults from northeastern of Iran and to compare the predictive values obtained using HEI for these cardiovascular RFs with the values obtained using AHEI.

2. Material and methods

2.1. Study population

A total sample of 748 men, were recruited from the city of Sarakhs, in northeastern Iran. All demographic and socioeconomic data including age, residual information, educational and marital status, occupational and smoking data were collected using an interviewer-administrated questionnaire. Participants were provided with information about the study both verbally and using written information sheets. Those who had exclusion criteria such as poorly controlled diabetes, severe hypertension, overt signs/symptoms of CVD, endocrine abnormalities, or who preferred not to participate at any point were allowed to withdraw from the study. All participants gave informed, written consent to contribute in the survey, which was approved by the Ethics Committee of Mashhad University of Medical Sciences, Mashhad, Iran. The investigation conformed to the principles outlined in the Declaration of Helsinki.

2.2. Demographic, anthropometric and metabolic data

For all participants, body weight was measured to the nearest 0.1 kg using electronic scales, and height and waist circumference were measured to the nearest millimeter using a tape measure. The largest circumference at the level of the buttocks was used for measuring hip circumference, with a flexible tape.

Fasting blood samples were collected after a 12-hour overnight fast to determine fasting blood glucose (FBG) and a full fasted lipid profile, consist of high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C), total cholesterol (TC), and triglyceride (TG), as described previously.[3,23,24,29] Serum high sensitive-C reactive protein (Hs-CRP) concentration was estimated using an immunoturbidimetry method, with detection limit of 0.06 mg/l (Pars Azmun, Karaj, Iran).[26] The National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP III)[27] criteria for MetS were used in our analysis. According to the ATP III definition, MetS was determined with the presence of 3 or more of the following metabolic abnormalities: (1) waist circumference > 102 cm (40 inches) in men and 88 cm (35 inches) in women, (2) fasting glucose >100 mg/dl, (3) blood pressure (BP) > 130/85 mmHg, (4) TG > 150 mg/dl and (5), HDL-C < 40 in men and <50 mg/dl in women.

2.3. Measurement of diet quality

A diet quality score was derived using a food frequency questionnaire (FFQ), and applying the HEI and AHEI.

The score for the HEI ranges from 0 to 100 and assesses conformance to the US Federal dietary guidelines, with higher scores indicating greater conformance.[28] The HEI was calculated using established methods of assigning scores based on adequacy of consumption of My Pyramid food groups as well as meeting guidelines for sodium, saturated fat, and cholesterol.[1] An HEI score >80 implies a “good” diet, an HEI score between 51 and 80 implies a diet that “needs improvement,” and an HEI score ≤51 implies a “poor” diet.[28] The Alternate Healthy Eating Index (AHEI) was created in 2002 as an alternative to the HEI. All AHEI-2010 components were scored from 0 (worst) to 10 (best), and the total AHEI-2010 score ranged from 0 (nonadherence) to 110 (perfect adherence).[2]

2.4. Statistical analysis

Data analysis was carried out using Statistical Package for Social Sciences-16 software (SPSS Inc., IL, USA) and R software, version 3.0.2. The normality of data was evaluated using Kolmogorov–Smirnov test. Descriptive statistics including mean, frequency, and standard deviation (SD) were determined for all variables and expressed as Mean ± standard deviation (SD) for variables with normally distribution or median ± IQR for non-normally distributed variables. For normally distributed variables, Student's T-test or analysis of variance (ANOVA) was performed. The Mann–Whitney U and Kruskal–Wallis test was used for non-normally distributed data. A p-value <0.05 was considered as significant for all analysis.

3. Results

Table 1 shows the characteristics of the study population. The mean age of study participants was 43.50 ± 8.88 years.

Obese patients were found to have significantly higher levels of FBG, LDL-C, TG, SBP, diastolic blood pressure (DBP), uric acid and Hs-CRP (Table 2). Moreover, HDL-C was significantly lower among obese individuals. As shown in Table 2, individuals with type 2

Table 1
Clinical and biochemical features in subjects.

	N	Mean ± SD
Age (years)	733	43.49 ± 8.88
Weight (kg)	730	79.35 ± 12.01
BMI (kg/m^2)	728	27.16 ± 3.76
FAT%	727	24.57 ± 9.50
WC (cm)	732	95.45 ± 10.30
HC (cm)	731	103.72 ± 20.71
DBP (mmHg)	727	76.77 ± 10.18
SBP (mmHg)	727	115.18 ± 14.62
FBG (mg/dl)	738	101.31 ± 30.16
LDL-C (mg/dl)	738	127.77 ± 34.11
HDL_C (mg/dl)	737	40.6395 ± 12.05
TC (mg/dl)	738	182.79 ± 35.78
Triglycerides (mg/dl)	738	147.05 ± 76.46
Uric acid (mg/dl)	738	5.28 ± 1.833
Zinc (μg/dl)	730	140.75 ± 47.02
Copper (μg/dl)	538	140.22 ± 38.36
Hs-CRP (mg/l)	735	2.71 ± 2.60
HEI	378	51.43 ± 10.07
AHEI	379	62.44 ± 5.90

Values expressed as mean ± SD for normally distributed data, and median and interquartile range for non-normally distributed data. Between groups comparisons were assessed by parametric statistical analysis for normal distributed data and nonparametric test for non-normally distributed data. BMI, body mass index; WC; waist circumference FBG, fasting blood glucose; Hs-CRP; high sensitive C reactive protein, DM, diabetes mellitus, SBP; systolic blood pressure, DBP; diastolic blood pressure, HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; TC; Total cholesterol, TG; triglyceride, HEI; Healthy Eating Index, AHEI; Alternative Healthy Eating Index.

diabetes mellitus had significantly higher levels of TG, SBP, DBP, uric acid and Hs-CRP. In the case of HEI and AHEI, there were no significant differences between the groups.

There was no significant difference in HEI and AHEI between hypertensive and normotensive subjects (Table 3). Moreover, as reported in Table 3, there was no significant difference in HEI and AHEI among patients with MetS and healthy subjects. Subjects with MetS had a significantly higher levels of serum uric acid and Hs-CRP.

High risk individuals, as defined by a Hs-CRP ≥3 mg/L, had significantly higher levels of FBG, LDL-C, TG, and uric acid than low risk and intermediate risk subjects (Table 4). They also had higher scores of AHEI ($p = 0.005$) and were older than low risk and intermediate risk participants. Subjects with high levels of TC, had significantly higher levels of LDL-C, TG, uric acid, and Hs-CRP (Table 4). There was no significant difference in HEI and AHEI in subjects with dyslipidemia with healthy ones.

As presented in Table 5, with regards to HEI and AHEI scores, there were no significant differences between hypertriglyceridemia and the non-hypertriglyceridemic groups. However, individuals with higher levels of serum copper had significantly higher HEI score ($p = 0.01$).

As shown in Table 6, there was a significant association between HEI with serum copper level ($p = 0.01$). None of the demographic and biochemical parameters in Table 6 had significant correlation with AHEI ($p > 0.05$).

4. Discussion

The present study aimed to investigate the association between HEI and AHEI scores and CVD RFs among Iranian men. The results showed that conventional CVD RFs were not significantly related to the HEI or AHEI. AHEI was only significantly higher among subjects with augmented serum levels of Hs-CRP ($p = 0.005$). After adjustment for age, we found an increased Hs-CRP levels were significantly correlated with increased AHEI score ($p = 0.04$). This result was inconsistent with previous reports.[2,29,31] The current study showed that there were increased levels of hs-CRP in subjects with obesity, hypertension, metabolic syndrome, diabetes, hypercholesterolemia and hypertriglyceridemia.

Rashidipour-Fard et al, showed a significant inverse correlation between HEI score with FBG and Hs-CRP.[29] McCullough et al, used the dietary questionnaires in 38615 men and 67271 women from the Health Professional's Follow-up and the Nurses' Health Studies, respectively. Their results also confirmed an inverse association of AHEI with CVD.[2]

Another study investigated associations between diet quality measures, lifestyle parameters, and CVD risk factors in a large cohort of French adults. A total of 5081 French men and women aged 35–61 years old were recruited in a long-term clinical trial. The results demonstrated that there was an association between the higher diet quality assessed by HEI score, with aging, marital status, educational attainment, being physical active and being a non smoker. A high HEI score was weakly associated with lower BMI and blood pressure, but not associated with plasma lipid levels.[30] Haghighatdoost, et al, investigated the associations between the HEI and cardiometabolic risk factors among 9568 Iranians from participated in Isfahan Healthy Heart program (IHHP). Higher HEI scores were

Table 2
Healthy eating index (HEI), alternative healthy eating index (AHEI) and biochemical characteristics of different categories of body mass index (BMI) and diabetes mellitus (DM).

Characteristics	body mass index (BMI)				Diabetes mellitus (DM)			
	Normal weight (BMI≥30)	Overweight (BMI = 25–30)	Obese (BMI = 18.5–25)	P value	Normal (FBG<100)	Pre-DM (FBG = 100–126)	DM (FBG ≥ 126)	P value
HEI score	50.0 ± 9.8	51.6 ± 10.3	53.1 ± 9.6	0.1	51.3 ± 10.0	51.4 ± 10.6	52.1 ± 9.1	0.9
AHEI score	61.9 ± 4.9	62.6 ± 6.0	62.4 ± 6.7	0.6	62.3 ± 5.8	62.6 ± 6.2	62.4 ± 5.4	0.9
Age (year)	41.8 ± 9.1	43.2 ± 8.7	46.1 ± 8.1	<0.001	41.8 ± 8.8	46.8 ± 7.7	49.2 ± 6.4	<0.001
FBG (mg/dl)	97.2 ± 30.4	101.9 ± 30.1	105.5 ± 30.2	0.03	89.4 ± 7.7	108.1 ± 6.7	178.0 ± 45.0	<0.001
LDL-C (mg/dl)	124.2 ± 35.1	127.1 ± 33.2	134.5 ± 33.9	0.01	126.6 ± 35.4	129.8 ± 31.4	132.1 ± 28.4	0.3
HDL-C (mg/dl)	41.6 ± 10.6	40.7 ± 13.7	38.4 ± 7.5	0.04	41.0 ± 12.5	40.2 ± 11.3	38.0 ± 8.8	0.1
TG (mg/dl)	121.5 ± 57.3	150.8 ± 72.4	173.4 ± 97.2	<0.001	139.9 ± 68.9	152.7 ± 68.4	189.7 ± 119.9	<0.001
TC (mg/dl)	177.5 ± 34.1	183.6 ± 35.5	188.3 ± 37.9	0.1	181.7 ± 35	186.4 ± 35	183.6 ± 41	0.4
SBP (mmHg)	110.6 ± 13.2	115.6 ± 14.6	119.9 ± 14.3	<0.001	113.0 ± 13.1	117.7 ± 12.7	126.5 ± 21.3	<0.001
DBP (mmHg)	74.9 ± 10.5	76.1 ± 9.8	80.8 ± 9.1	<0.001	75.4 ± 9.4	79.5 ± 9.5	81.5 ± 14.0	<0.001
Uric acid (mg/dl)	4.7 ± 1.1	5.4 ± 2.1	5.6 ± 1.5	<0.001	5.3 ± 1.4	5.6 ± 2.9	4.5 ± 1.4	<0.001
Hs-CRP (mg/l)	1.43 (0.86–2.43)	1.83 (1.16–3.25)	2.58 (1.49–4.71)	<0.001	1.74 (1.09–3.03)	1.81 (1.04–2.98)	2.97 (1.43–5.04)	<0.001

HEI, healthy eating index; AHEI, healthy eating index; FBG, fasting blood glucose; LDL-C, Low density lipoprotein; HDL-C, High density lipoprotein; TG, Triglyceride; TC, Total cholesterol; SBP, Systolic blood pressure; DBP, Diastolic blood pressure; Hs-CRP, high sensitivity C-reactive protein.

Table 3
Healthy eating index (HEI), alternative healthy eating index (AHEI) and biochemical characteristics for different categories of hypertension and metabolic syndrome (MetS).

Characteristics	Hypertension			Metabolic syndrome (MetS)		
	Hypertensive subjects (SBP > 135; DBP > 80)	Normotensive subjects	P value	MetS (+)	MetS (−)	P value
HEI score	53.55 ± 8.63	51.06 ± 10.20	0.11	51.0 ± 10.1	52.1 ± 9.8	0.32
AHEI score	62.97 ± 5.10	62.26 ± 6.01	0.36	62.1 ± 5.8	62.7 ± 5.9	0.31
Age (year)	42.5 ± 8.7	47.9 ± 7.7	<0.001	42.1 ± 8.9	45.6 ± 8.3	<0.001
FBG (mg/dl)	97.8 ± 24.7	121.2 ± 47.0	<0.001	94.4 ± 19.7	112.0 ± 39.1	<0.001
LDL-C (mg/dl)	126.5 ± 34.2	129.7 ± 34.1	0.06	127.0 ± 35	128.9 ± 32	0.4
HDL-C (mg/dl)	40.7 ± 11.8	39.1 ± 7.9	0.6	44.0 ± 13.7	35.3 ± 5.3	<0.001
TG (mg/dl)	144.1 ± 76	158.8 ± 92	0.1	113.6 ± 49	198.9 ± 82	<0.001
TC (mg/dl)	181.9 ± 35	181.0 ± 43	0.1	180.0 ± 35	187.0 ± 36	0.009
SBP (mmHg)	110.3 ± 8.6	147.8 ± 24.9	<0.001	111.9 ± 12.2	120.1 ± 16.5	<0.001
DBP (mmHg)	74.3 ± 7.7	95.5 ± 14.8	<0.001	74.5 ± 9.7	80.2 ± 9.9	<0.001
Uric acid (mg/dl)	5.2 ± 1.7	5.5 ± 1.9	0.3	5.0 ± 1.3	5.6 ± 2.3	<0.001
Hs-CRP (mg/l)	2.05 (1.30–3.63)	1.73 (1.07 to −2.99)	0.6	2.24 (1.43–4.05)	1.63 (0.96–2.73)	<0.001

HEI, healthy eating index; AHEI, healthy eating index; FBG, fasting blood glucose; LDL-C, Low density lipoprotein; HDL-C, High density lipoprotein; TG, Triglyceride; TC, Total cholesterol; SBP, Systolic blood pressure; DBP, Diastolic blood pressure; Hs-CRP, high sensitivity C-reactive protein.

Table 4
Healthy eating index (HEI), alternative healthy eating index (AHEI) and biochemical characteristics between different categories of high-sensitivity C-Reactive Protein (Hs-CRP) and Total Cholesterol (TC).

Characteristics	High sensitive C-Reactive Protein (Hs-CRP)			Total Cholesterol (TC)			
	low risk (Hs-CRP < 3)	High risk (Hs-CRP ≥ 3)	P value	Desirable (TC < 200)	Borderline high (TC = 200–239)	High (TC ≥ 240)	P value
HEI score	51.04 ± 9.89	53.0 ± 10.19	0.13	51.1 ± 10.3	52.3 ± 9.2	51.2 ± 10.3	0.6
AHEI score	61.84 ± 5.75	64.11 ± 6.16	0.005	62.2 ± 6.0	62.3 ± 5.1	64.6 ± 7.5	0.3
Age (year)	41.6 ± 9.0	45.5 ± 8.8	<0.001	42.7 ± 9.2	45.0 ± 8.0	45.6 ± 6.4	0.004
FBG (mg/dl)	98.6 ± 25.7	107.5 ± 38.1	0.002	100.5 ± 28.8	103.0 ± 34.0	105.2 ± 30.0	0.4
LDL-C (mg/dl)	122.7 ± 35.1	131.7 ± 34.4	0.04	113.7 ± 25.6	153.9 ± 23.1	191.0 ± 36.7	<0.001
HDL-C (mg/dl)	42.8 ± 13.1	38.9 ± 11.8	0.01	39.4 ± 10.0	43.2 ± 15.4	44.1 ± 15.9	<0.001
TG (mg/dl)	124.6 ± 64	162.3 ± 88	<0.001	135.4 ± 71.8	169.4 ± 74.8	195.4 ± 103.6	<0.001
TC (mg/dl)	179.4 ± 35	185.3 ± 37	0.3	165.1 ± 24.5	215.1 ± 10.4	265.0 ± 23.5	<0.001
SBP (mmHg)	112.9 ± 13.9	116.0 ± 12.6	0.1	114.9 ± 15.6	115.7 ± 12.1	116.2 ± 11.3	0.7
DBP (mmHg)	76.5 ± 11.5	77.5 ± 9.5	0.5	76.2 ± 10.3	77.7 ± 9.9	79.6 ± 8.5	0.06
Uric acid (mg/dl)	4.9 ± 1.2	5.5 ± 1.8	0.004	5.1 ± 1.4	5.3 ± 1.6	6.7 ± 4.9	<0.001
–	–	–	–	1.73 (1.06–3.18)	1.96 (1.26–3.43)	2.25 (1.23–3.63)	<0.001

HEI, healthy eating index; AHEI, healthy eating index; FBG, fasting blood glucose; LDL-C, Low density lipoprotein; HDL-C, High density lipoprotein; TG, Triglyceride; TC, Total cholesterol; SBP, Systolic blood pressure; DBP, Diastolic blood pressure; Hs-CRP, high sensitivity C-reactive protein.

Table 5
Healthy eating index (HEI), alternative healthy eating index (AHEI) and biochemical characteristics between different categories of Triglyceride (TG) and serum copper.

Characteristics	Triglyceride (TG)				Serum Copper		
	Normal (TG < 150)	Borderline high (TG = 150–200)	High (TG ≥ 200)	P value	Normal (70–140)	High (≥140)	P value
HEI score	51.7 ± 10.4	49.9 ± 9.5	51.9 ± 9.2	0.4	50.0 ± 9.8	52.7 ± 10.2	0.01
AHEI score	62.2 ± 6.1	62.1 ± 5.6	62.9 ± 5.2	0.6	62.1 ± 5.5	62.4 ± 6.1	0.7
Age (year)	42.9 ± 9.1	43.6 ± 8.3	45.0 ± 8.4	0.03	44.1 ± 8.4	43.2 ± 9.2	0.2
FBG (mg/dl)	98.0 ± 25.7	103.5 ± 32.0	108.9 ± 38.0	<0.001	100.9 ± 29.0	101.7 ± 29.6	0.7
LDL-C (mg/dl)	126.1 ± 33.3	135.2 ± 35.3	125.2 ± 34.2	0.01	125.8 ± 34.2	129.3 ± 34.9	0.2
HDL-C (mg/dl)	42.7 ± 11.9	37.1 ± 6.5	37.6 ± 14.8	<0.001	40.9 ± 10.8	41.2 ± 15.9	0.7
TG (mg/dl)	99.2 ± 29.3	173.5 ± 14.1	262.2 ± 73.1	<0.001	141.8 ± 75.0	153.9 ± 76.0	0.05
TC (mg/dl)	176.6 ± 33.4	188.5 ± 37.2	195.2 ± 37.0	<0.001	182.4 ± 35.5	184.1 ± 35.0	0.5
SBP (mmHg)	114.1 ± 14.6	116.9 ± 15.0	116.6 ± 13.8	0.06	115.7 ± 14.9	116.1 ± 14.8	0.7
DBP (mmHg)	76.0 ± 10.1	78.3 ± 9.7	77.4 ± 10.4	0.04	77.2 ± 10.2	76.8 ± 10.2	0.6
Uric acid (mg/dl)	5.0 ± 1.3	5.5 ± 1.6	5.8 ± 2.8	<0.001	5.2 ± 1.5	5.5 ± 2.4	0.05
Hs-CRP (mg/l)	1.67 (1.02–2.99)	2.15 (1.33–3.90)	2.12 (1.29–3.79)	<0.001	1.67 (1.00–2.93)	2.17 (1.31–3.85)	<0.001

HEI, healthy eating index; AHEI, healthy eating index; FBG, fasting blood glucose; LDL-C, Low density lipoprotein; HDL-C, High density lipoprotein; TG, Triglyceride; TC, Total cholesterol; SBP, Systolic blood pressure; DBP, Diastolic blood pressure; Hs-CRP, high sensitivity C-reactive protein.

associated with healthier dietary habits and a weak inverse association was found between HEI scores and serum levels of CRP, apolipoprotein B, and SBP.[31]

It has been shown that in the United States, cancer, type 2 diabetes, CVD, and hypertension are related to poor diet quality such as diet high in fats and added sugars and low in micronutrients and fiber.[32–34]

The contrasting results for the present study suggest that HEI and AHEI may not be valid in all cultures, perhaps because of the differences in dietary habits, that may greatly vary.[35]

We also observed a novel association; individuals with a high serum copper were found to have higher HEI as well as Hs-CRP levels. It has been previously proposed that copper can induce inflammation.[36] Moreover, there is an association between the

Table 6
Correlations between healthy eating index (HEI) and alternative healthy eating index (AHEI) with demographic and biochemical Characteristics.

Characteristics	HEI score	P-value	AHEI score	P-value
Age (year)	0.05	0.3	0.05	0.3
FBG (mg/dl)	0.03	0.5	−0.006	0.9
LDL-C (mg/dl)	0.09	0.08	−0.006	0.9
HDL-C (mg/dl)	−0.03	0.6	−0.03	0.5
TG (mg/dl)	−0.03	0.5	−0.004	0.9
TC (mg/dl)	0.07	0.1	0.01	0.7
BMI (kg/m^2)	0.1	0.05	0.07	0.1
PAB	0.01	0.7	0.04	0.4
SBP (mmHg)	0.01	0.7	−0.03	0.6
DBP (mmHg)	0.01	0.7	0.03	0.6
Serum Uric acid (mg/dl)	0.004	0.9	0.02	0.7
Serum Zinc (μg/dl)	0.02	0.7	0.016	0.7
Serum Copper (μg/dl)	0.1	0.01	−0.01	0.8
Serum Hs-CRP (mg/l)	0.08	0.1	0.1	0.06

Pearson's correlation was used in case of normally distributed data, Spearman's correlation otherwise. HEI, Healthy eating index; AHEI, Alternative Healthy eating index; FBG, Fasting blood glucose; LDL-C, Low density lipoprotein; HDL-C, High density lipoprotein; TG, Triglyceride; TC, Total cholesterol; BMI, Body mass index; PAB, pro oxidant anti-oxidant balance; SBP, Systolic blood pressure; DBP, Diastolic blood pressure; Hs-CRP, high sensitivity C-reactive protein.

inflammation-sensitive plasma proteins (ISPs) and CRP.[37] Because the current study was performed only on male employees, it may not be entirely representative of the Iranian population.

Conclusions

The results showed that there were no significant association between the HEI/AHEI with classical CVD risk factors in Iranian adult men.

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Conflict of interest

The authors declare no conflict of interest.

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