Association Between Dietary Quality Indices and Atherosclerosis Risk: A Case-Control Study

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ABSTRACT

BACKGROUND: Several diet quality scores have been developed to evaluate the health benefits of individual diets such as Healthy Eating Index (HEI), Dietary Approach to Stop Hypertension (DASH), and Mediterranean diet score (Med). This study aims to determine the relationship between dominant dietary health scores with the risk of atherosclerosis in Iranian adults.

METHODS: This case-control study was conducted on 323 patients with atherosclerosis and 334 individuals without atherosclerosis as control group. Food Frequency Questionnaire was used for obtaining dietary intakes; then HEI, DASH score, and Med score was calculated. Logistic regression models were used to calculate Odds Ratios (OR) and 95% Confidence intervals (CI) between quartiles of the HEI, DASH and Med and atherosclerosis risk.

RESULTS: The results showed that total scores for HEI, DASH, and Med in control group was higher than the atherosclerosis group. The results also indicated that higher adherence to HEI (OR: 0.43; CI: [0.24, 0.76], *P*-trend = .006), DASH (OR: 0.48; CI: [0.3, 0.78], *P*-trend = .003), and Mediterranean pattern (OR: 0.4; CI: [0.21, 0.76]) decreased odds ratio of atherosclerosis.

CONCLUSION: Our findings suggest that adherence to HEI, DASH, and Mediterranean diet might be associated with a lower risk of Atherosclerosis and can have a positive effect on general health and prevention of chronic diseases in people.

KEYWORDS: Healthy Eating Index, DASH, Mediterranean diet, atherosclerosis

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Introduction

Advances in urbanization and facilities have led to an increase in the age of the population. Aging of the population may result in the development of chronic diseases such as cardiovascular diseases.[1] The leading cause of death worldwide are cardiovascular diseases (CVDs) that account for almost 38 million deaths during 2012.[2] The most common underlying pathology of coronary artery disease is atherosclerosis, peripheral artery disease (PAD), and cerebrovascular disease.[1]

The characteristic of the main lesions in atherosclerosis is lipid deposition in parts of the artery accompanied by smooth muscle cell and fibrous matrix proliferation. This gradually leads to the plaque formation.[3] Atherosclerosis can start early in life and remain asymptomatic for long periods before progressing to advanced stages.[4]

Diet is an important modifiable cardiovascular risk factor.[5] It is widely known that the combination of foods consumed, known as dietary patterns, and their potential synergistic effects are important in the prevention of chronic diseases (such as type 2 diabetes and cardiovascular disease) rather than the impact of individual nutrients.[6-8] This has led to the development of methods that can be used to describe these dietary patterns.

Several diet quality indices based on established nutrient requirements and dietary guidelines, have been developed to evaluate the health benefits of individual diets such as Healthy Eating Index (HEI), Dietary Approach to Stop Hypertension (DASH), and Mediterranean diet (MED). These scores reflect overall diet quality and can help researchers to provide a measure of diet that incorporates nutrient and food interactions of likely biological importance.[8]

Following healthy eating patterns such as DASH and MED have been shown to reduce the risk of metabolic syndrome, diabetes, CVD, and cancer.[9,10]

HEI, which measures adherence to the US Dietary Guidelines have been demonstrated to be associated with reduced risk of chronic diseases and all-cause mortality.[11] Recent studies on dietary patterns and cardiovascular disease have shown that adherence to patterns such as DASH, MED, HEI, and patterns with high intake of vegetables, fruits, and nuts can reduce the risk of cardiovascular disease. In contrast, following food patterns with low intake of fruits and vegetables and high intake of red and processed meat increases the risk of cardiovascular disease.[12-14]

In many studies, the relationship between dietary patterns and atherosclerosis risk factors have been performed on healthy individuals and very few studies have been performed on patients with atherosclerosis.

On the other hand, data for whole dietary patterns and their relationship to disease within populations are scarce. In addition, most of these studies have been done in Western populations and conducted as cross- sectional studies. Therefore, the purpose of this study was to assess the relationship between dominant dietary health scores with the risk of atherosclerosis in Iranian adults.

Materials and Methods

Study population

This descriptive-analytical study was performed as a case-control study. In the case group, 323 patients with atherosclerosis were selected from Ahvaz public hospitals including Imam Khomeini, Golestan, and Razi Hospitals by random sampling. In the control group, 334 people who met the inclusion criteria were selected from those who went to sections other than the heart section for outpatient visits. Inclusion criteria included ages over 20 years and absence of infectious or inflammatory disease or cancer.

Exclusion criteria included pregnancy and lactation, energy intake of less than 800 and more than 4200 kcal, weight loss surgery in the past year, following certain diets in the past 6 months, taking certain medications and consuming alcohol.

Demographic and anthropometric assessment

Preliminary and demographic information of the participants including age, education level, marital status, and use of a particular drug was collected by an initial questionnaire.

A digital scale was used to measure patients' weight with an accuracy of 100 g and with minimal clothing and no shoes. Patients' height was measured using an inelastic tape meter with an accuracy of 0.5 cm. Then, Body mass index (BMI) was calculated by dividing weight by height squared.

Physical activity assessment

A shortened version of the International Physical Activity Questionnaire (IPAQ) was used for the assessments of the amount of physical activity and the activity was self-reported. The questionnaire consisted of 7 questions assessing the level of physical activity of a person in the past week. In this questionnaire, MET values for walking, average physical activity, and intense physical activity were computed as 3.3, 4, and 8, respectively. To calculate the total amount of physical activity per week, the amount of walking (day × minute × MET) or moderate physical activity (day × minute × MET) and intense physical activity (day × minute × MET) were aggregated in the past week. The IPAQ questionnaire is standard and its validity and reliability has been confirmed by Vasheghani-Farahani et al.[15]

Diet assessment and computation of diet scores

Participants' Food intake was acquired by professional nutritionists through interview. A valid and reliable 147-item semi quantitative FFQ with standard serving sizes was used to determine usual food intakes.[16] The consumption of any food during the past year was asked on daily, weekly or monthly basis and converted to gram scale. Then, the intake of total energy and nutrients were calculated using the Nutritionist IV software that has been modified for Iranian food.

HEI calculation

HEI-2015 includes 13 components as follows: total fruits (whole fruits and fruit juice), whole fruits, total vegetables (legumes [beans and peas], dark-green vegetables, and other vegetables), greens and beans, total protein foods (meat, poultry, eggs, seafood, nuts, seeds), legumes (beans and peas, and soy products), seafood and plant proteins (seafood, nuts, seeds, legumes [beans and peas], and soy products), whole grains (legumes [beans and peas] and dark-green vegetables), dairy, fatty acids, refined grains, sodium, added sugars, and saturated fats (ratio of polyunsaturated and monounsaturated fatty acids to saturated fatty acids). For each of the following items 5 points were considered: total fruits, whole fruits, total vegetables, greens and beans, total protein foods, and seafood and plant proteins, and 10 points is given to other items. Each food group in FFQ is translated into equivalents of cups and ounces.[17]

DASH score calculation

For estimating DASH score, 8 food-derived components were considered including higher intakes of fruits, vegetables, nuts, legumes, low-fat dairy, whole grains, and lower intakes of sodium, sweetened beverages, and processed and red meats. For each of the 8 components, all participants were categorized into fifths according to their intakes ranking. Individuals received the maximum score of 4 if their intakes were in the highest quartile for components in which higher consumptions are desirable like fruits, vegetables, nuts, legumes, low-fat dairy, and whole grains. The other components such as sodium, sweetened beverages, and red and processed meats were reversely coded. Component's intake was scored proportionally between minimum and maximum values. Finally, the scores were added to a total DASH score ranging from a minimum of 8º to a maximum of 32 points.[18]

Calculation of modified Mediterranean diet score

An index variable was used that consisted of 8 Mediterranean food groups to estimate Mediterranean dietary pattern scores. In brief, consumption of food groups (vegetables, legumes, nuts and fruits, whole grains, dairy, fish, and MUFA/SAFA) were scored based on the average values received by the study population (ie, scores of 0 and 1 for the following and above the middle). For the total red meat score, a score of 0 was given if participants consumed more than average and a score of 1 if they ate less than average. Finally, after summing the scores of the individual components, the overall score of the Mediterranean diet pattern ranged from 0 to 8.[19]

The Mediterranean diet is based on 8 items: vegetables, legumes, fruits and nuts, dairy products, cereals, red meat and its products, fish, the ratio of unsaturated fatty acids with a double bond to saturated fatty acids. The median intakes of these foods were calculated for each sex. For items of meat and its products, less than average consumption values are given one point and for consumption values above average, zero points are given. For vegetables, legumes, fruits and nuts, cereals, fish, and the ratio of unsaturated fatty acids with a double bond to saturated fatty acids less than average consumption values are given zero point and for consumption values above average, one points are given. The range of scores given to all individuals ranged from 0 to 8. In the present study, due to ethical criteria, the adherence to the modified Mediterranean diet was measured and no score was considered for ethanol consumption.[20]

Ethics approval and consent to participate

All study protocols were explained to the participants. The study protocols were approved by the ethics committee of AJUMS (IR.AJUMS.REC.1400.119). An informed consent was given to each participant to sign.

Statistical analysis

Chi-square tests or independent sample *t*-tests were applied for comparison of categorical and continuous variables, respectively. Where the distribution of continuous variables was not normal, Mann–Whitney test was used. HEI, DASH, and Mediterranean Diet scores were categorized into quartile for analyses. The composition of each index according to HEI, DASH and Mediterranean Diet scores quartile was analyzed using one-way analysis of variance (ANOVA) to compare continuous variables. In case of non-normal distribution, the Kruskal–Wallis test was used. Linear regression test was used to examine the relationship between different indicators with quantitative variables in both healthy and patient groups. Also, logistic regression statistical test was used to calculate the odds ratio (OR) and 95% confidence interval. If there were confounding variables, we used analysis of covariance (ANCOVA). All data were expressed as Mean ± standard deviation and SPSS software version 18 was used to analyze the data. *P*-value less than .05 was considered as significant.

Results

General characteristics of the participants in 2 groups are displayed in Table 1. Mean age of the atherosclerosis and the control group was 54.73 ± 1.33 and 55.75 ± 12.00, respectively. No statistically significant differences were observed for the demographic variables. The results showed that the control group had significantly more physical activity than the Atherosclerosis group.

Comparison of Healthy Eating Index (HEI) scores and its component between the control and atherosclerosis groups has been presented in Table 2. The results showed that total HEI score was higher in the control group but the difference was not statistically significant.

Comparison of control and atherosclerosis group demonstrated that controls had higher intakes of fruits and total fruits, greens and beans, whole grains, seafood and plant protein ($P < .05$). The consumption of vegetables was also higher in control group, but it was not statically significant. Also, the atherosclerosis group had significantly higher intakes of refined grains, dairy and added sugars ($P < .05$). The atherosclerosis group also had higher intakes of saturated fats and sodium, but it was not statically significant.

Table 3 presents the comparison of scores of Dietary Approaches to Stop Hypertension (DASH) and its components between the control and atherosclerosis groups. The results indicated that there is a statistically significant difference between total DASH scores in control and atherosclerosis groups as the control group had higher DASH scores ($P < .001$). The control group had higher intakes of whole grains, nuts and legumes, low-fat dairy, vegetables, fruits, and lower intakes for sweetened beverages and salt ($P < .05$).

The comparison of the Mediterranean pattern scores and its components between the control, and atherosclerosis groups has been presented in Table 4. The results showed that the control group had significant higher Mediterranean score ($P = .01$). Also, the control group had higher intakes of whole grains, legumes, sea foods, fruits and nuts, MUFA/SFA, and vegetables ($P < .05$).

Table 5 indicates the association between Dietary health indexes and Atherosclerosis. The index scores were divided into quartiles and the correlation between diet quality indexes and atherosclerosis were evaluated in 3 models. The first model was crude, Model-1 was adjusted for calorie intake and BMI, and Model-2 was further adjusted for sex, age, race, marriage

Table 1. General characteristics of the participants in 2 groups.

	CONTROL (N=334)	ATHEROSCLEROSIS (N=323)	*P*-VALUE[A]
Age (y)	55.75 ± 12.00	54.73 ± 11.33	0.26
Sex [n (%)]			
Male	178 (52.3%)	171 (52.9%)	0.92
Female	156 (46.7%)	152 (47.1%)	
BMI (kg/m²)	28.84 ± 8.62	29.83 ± 5.14	0.07
Ethnicity [n (%)]			
Fars	86 (25.7%)	78 (24.1%)	
Arab	149 (44.2%)	146 (45.2%)	0.65
Lor	99 (29.6%)	99 (30.7%)	
Marriage status [n (%)]			
Married	50 (15%)	51 (15.8%)	0.77
Single	284 (85%)	272 (84.3%)	
Education [n (%)]			
Illiterate	32 (9.6)	30 (9.3)	
Primary	114 (34.1)	97 (30.00)	
Diploma	53 (15.9)	72 (22.3)	0.91
Bachelor	55 (16.5)	68 (21.1)	
MS	76 (22.8)	43 (12.3)	
higher	4 (1.2)	13 (4)	
Physical activity (MET-min/day)	758.9 ± 258.29	550.25 ± 105.19	0.04

Abbreviations: BMI, body mass index; MS, Master of Science.
Data are presented as mean ± SD or n (%).
[a]Independent samples *t*-test was used for continuous variables and Chi-square test was used for categorical variables.

status, physical activity. The results showed that the association between HEI and atherosclerosis was not significant in non-adjusted model and Model-1. But after all the adjustment, the relationship was negative and strongly significant in the third (OR: 0.49; CI [0.28, 0.88]) and fourth quartile (OR: 0.43; CI: [0.24, 0.76], *P*-trend = .006).

Our results indicated that the relationships for DASH scores were only significant in the fourth quartile of crude model (OR:0.48; CI: [0.3, 0.78], *P*-trend = .003). The Odds Ratio of atherosclerosis was decreased in the last quartile against the first quartile, however, there was not any significancy in adjusted models.

Considering the relationship between Mediterranean pattern and atherosclerosis, a strong negative correlation was found in the fourth quartile of crude model (OR: 0.24; CI: [0.24, 0.67], *P*-trend = .01) and the fourth quartile of Model-1 (OR: 0.5; CI: [0.29, 0.87]) and Model-2 (OR: 0.4; CI: [0.21, 0.76]) but *P*-trend for the adjusted models was not significant.

Discussion

The results of our study demonstrated that the participants without subclinical atherosclerosis had higher adherence to healthy patterns such as HEI, DASH, and Mediterranean pattern.

Considering the HEI score and its components, it was found that the control group followed the pattern more than the atherosclerosis group. Also, the control group had higher intakes of fruits, greens and beans, whole grains than the atherosclerosis group. In contrast, the atherosclerosis group had higher intakes of refined grains and added sugars. In examining the relationships between the odds ratio of atherosclerosis with dietary health indexes, the results showed that further adherence to the HEI pattern, in Model-2 in the third and fourth quartile, reduced the odds ratios by 51% and 57%, respectively.

Our results, were aligned to Phillips et al,[21] which showed that lower adherence to healthy patterns was associated with presence of subclinical atherosclerotic disease. The results also consistent with previous large prospective follow-up studies which showed

Table 2. Comparison of Healthy Eating Index (HEI) scores and its component between the control and atherosclerosis groups.

	UNIT	CONTROL (N = 334)	ATHEROSCLEROSIS (N = 323)	*P*-VALUE
HEI score	–	62.46	62.32	.82[a]
Total fruits	cup/1000 kcal	0.68 ± 0.34	0.59 ± 0.55	.01[b]
Fruits	cup/1000 kcal	0.67 ± 0.55	0.57 ± 0.95	.03[b]
Total vegetables	cup/1000 kcal	1.15 ± 0.5	1.10 ± 0.23	.11[b]
Greens and beans	cup/1000 kcal	0.48 ± 0.5	0.34 ± 0.23	.05[b]
Whole grains	oz/1000 kcal	3.41 ± 2.22	3.13 ± 2.56	.001[b]
Dairy	cup/1000 kcal	0.5 ± 0.42	0.65 ± 0.31	< .001[b]
Total protein	oz/1000 kcal	2.30 ± 1.57	1.93 ± 0.3	.04[b]
Seafood and plant proteins	oz/1000 kcal	1.11 ± 0.90	0.83 ± 0.45	.001[b]
Fatty acids	Ratio*	1.71 ± 0.60	1.90 ± 0.69	< .001[b]
Refined grains	oz/1000 kcal	5.63 ± 2.44	6.10 ± 2.1	.001[b]
Sodium	gr/1000 kcal	0.94 ± 0.59	1.17 ± 0.47	< .001[b]
Added sugar	%/1000 kcal	19.69 ± 18.31	20.10 ± 14.41	.05[b]
SFA	%/1000 kcal	6.59 ± 3.65	7.76 ± 2.65	< .001[b]

Abbreviations: gr, gram; HEI, healthy eating index; kcal, kilo calorie; SFA, saturated fatty acids.
Data are presented as mean ± SD.
[a]Independent *t*-test.
[b]Mann-Whitney.
*Polyunsaturated fatty acids + monounsaturated fatty acids)/saturated fatty acids.

Table 3. Comparison of scores of Dietary Approaches to Stop Hypertension (DASH) and its components between the control and atherosclerosis groups.

	UNIT	CONTROL (N = 334)	ATHEROSCLEROSIS (N = 323)	*P*-VALUE
DASH score	–	20.75 ± 3.13	19.80 ± 3.37	.001[a]
Whole grains	gr	571.38 ± 722.76	330.62 ± 52.80	.002[b]
Nuts and legumes	gr	87.46 ± 76.32	43.66 ± 33.21	< .001[b]
Meats	gr	21.83 ± 19.95	23.68 ± 14.55	.17[b]
Low-fat dairy	gr	12.78 ± 7.87	11.04 ± 10.46	.31[b]
Vegetables	gr	536.61 ± 247.65	486.49 ± 285.57	.01[b]
Fruits	gr	371.26 ± 159.63	316.83 ± 200.73	< .001[b]
Sweetened beverages	gr	29.54 ± 32.48	45.47 ± 61.84	< .001[b]
Salt	gr	3.42 ± 2.97	4.33 ± 2.11	< .001[b]

Abbreviations: DASH, Dietary Approaches to Stop Hypertension diet; gr, gram.
Data are presented as mean ± SD.
[a]Independent *t*-test.
[b]Mann-Whitney.

Table 4. Comparison of the Mediterranean pattern scores and its components between the control and atherosclerosis groups.

	UNIT	CONTROL (N=334)	ATHEROSCLEROSIS (N=323)	*P*-VALUE
MED score	–	4.12 ± 1.50	3.84 ± 1.25	.01[a]
Whole grains	gr	571.38 ± 722.76	330.63 ± 521.80	<.001[b]
Legumes	gr	67.49 ± 55.82	35.78 ± 20.94	<.001[b]
Meats	gr	21.82 ± 19.95	22.68 ± 14.55	.17[a]
Seafoods	gr	21.37 ± 15.01	16.56 ± 17.64	<.001[b]
Fruits and nuts	gr	378.85 ± 156.51	336.8 ± 211.12	.01[a]
Dairy	gr	130.64 ± 139.57	83.74 ± 82.31	<.001[b]
MUFA/SFA	gr	1.03 ± 0.28	0.93 ± 0.46	<.001[b]
Vegetables	gr	526.61 ± 241.69	486.49 ± 285.57	.01[a]

Abbreviations: gr, gram; MED, Mediterranean diet.
Data are presented as mean ± SD.
[a]Independent *t*-test.
[b]Mann-Whitney.

Table 5. Association between dietary health indexes and atherosclerosis.

		HEI			DASH			MED		
		OR	CI	*P*-TREND	OR	CI	*P*-TREND	OR	CI	*P*-TREND
Crude[a]	Q1	–	–	.87	–	–	.003	–	–	.01
	Q2	1.11	(0.72, 1.71)		0.77	(0.50, 1.19)		0.85	(0.58, 1.25)	
	Q3	1.03	(0.67, 1.59)		0.68	(0.46, 1.02)		1.07	(0.70, 1.62)	
	Q4	0.56	(0.68, 1.63)		0.48	(0.30, 0.78)		0.24	(0.24, 0.67)	
Model- I[b]	Q1	–	–	.43	–	–	.058	–	–	.2
	Q2	1.04	(0.67, 1.63)		0.84	(0.54, 1.30)		0.96	(0.65, 1.43)	
	Q3	0.86	(0.55, 1.35)		0.78	(0.51, 1.18)		1.31	(0.85, 2.04)	
	Q4	0.88	(0.56, 1.37)		0.61	(0.37, 1.01)		0.50	(0.29, 0.87)	
Model-II[c]	Q1	–	–	.006	–	–	.08	–	–	.06
	Q2	0.68	(0.39, 1.2)		0.83	(0.48, 1.42)		0.84	(0.52, 1.37)	
	Q3	0.49	(0.28, 0.88)		0.83	(0.50, 1.37)		0.98	(0.63, 1.79)	
	Q4	0.43	(0.24, 0.76)		0.57	(0.31, 1.03)		0.40	(0.21, 0.76)	

Abbreviations: CI, confidence interval; DASH, Dietary Approaches to Stop Hypertension diet; HEI, healthy eating index; MED, Mediterranean Diet; OR: odds ratio.
[a]Model Crude, linear regression analysis without adjustment.
[b]Model I, linear regression analysis with adjustment for energy intake and MBI.
[c]Model II, linear regression analysis with correction for energy intake, BMI, age, sex, physical activity, race, marital status, and education.

that there was a negative association between AHEI-2010 scores and cardiovascular diseases mortality independent of BMI.[22] The HEI-2015 supports a diet high in vegetables, fruit, whole grains, seafood, and legumes. This dietary pattern would contain carotenoids, ascorbic acids, phytochemicals, dietary fibers, omega-3 fatty acids, and other nutrients that are well-known to have cardioprotective effects.[23,24]

The results of the present study also demonstrated that control group had higher scores for DASH score. Considering the components of this pattern, higher intakes of nuts and legumes, whole grains and low-fat dairy, fruits and vegetables were observed in control group compared to the patients group. But the patients had higher intakes for salt and high sugar drinks. Moreover, the results showed that high adherence to DASH diet, in crude model, reduced the odd of atherosclerosis by 52%. Hummel et al[25] found that the DASH diet was associated with reduced blood pressure, oxidative stress, and arterial stiffness as well as improved diastolic function, arterial elastance, and systolic performance. Previous studies have indicated a beneficial effect of the DASH diet on lowering blood pressure because of the lower sodium contents,[26] and lowering high sensitivity C-reactive protein concentration (hs-CRP).[27,28] Moreover, Phillips et al[21] conducted a study that indicated a correlation between high DASH score diet and decreased concentrations of IL-6, TNF-a, as well as increased adiponectin concentrations. Moreover, Magdalena et.al showed a decrease in hs-CRP levels, with concomitant reduction in CXCL4 concentration, which most probably was a result of a significant increase in the consumption of vegetables, indicated in the analysis results of correlation with DASH index for vegetable consumption.[29] Studies show that CXCL4 chemokine could induce differentiation of macrophages which constitute main cellular components of atherosclerotic plaque during its formation and progression.[30]

The present study demonstrated that the control group had a higher score of the Mediterranean pattern. Regarding the components of the Mediterranean pattern, we found that the control group had higher intakes of whole grains, sea-foods, fruits and vegetables, nuts and higher ratio of MUFA/SFA. Considering the relationships between Mediterranean pattern scores, the results showed a 76% decrease in odds of the disease, by higher adherence to the crude model. Furthermore, the odds in the last quartile in Model-2 of Mediterranean pattern (after full adjustments) indicated a 60% decrease of atherosclerosis. The Mediterranean diet pattern, as described by Martínez-González,[31] emphasizes increasing intakes of fish and unsaturated fat intakes and reducing intake of poultry and high-fat dairy. High consumption of seafood leads to high omega-3 intake, which is effective in modulating the lipid profile and reducing the risk of atherosclerosis.[32]

It appears that Mediterranean diet is high in antioxidants, micronutrients, dietary nitrate, and fiber but low in saturated/trans fats and sodium which is associated with decreased cardiovascular risk. Moreover, the Mediterranean diet and its components have been found to reduce cardiovascular disease risk factors including blood pressure, lipid profile, endothelial dysfunction, glucose, BMI, and waist circumference. This effect is due to the increased NO bioavailability, antioxidant properties and anti-inflammatory effects of this pattern.[33] This pattern also contains high contents of nuts. Studies also have shown a reduced risk of coronary heart disease for individuals who consumed nuts more than 5 times/week compared with no consumption.[34] It is likely that these dietary features contribute to decreased oxidative stress and lower inflammatory factors as well as to higher antioxidant defense, nitric oxide bioavailability and gut microbiome modulation.[35,36]

The present study had some limitations that must be mentioned. First of all, although the case-control design of the study is useful for verifying the prognosis of the disease, it does not allow inferring causation or recommendation. Secondly, taking into consideration an epidemiological basis, the sample size was limited to only one population (Ahvaz, Iran) and, therefore, may not be representative of other populations and countries. Also, recall bias among the participants may be a major limitation because the study was retrospective. Ultimately, the biomarkers of oxidative stress and antioxidant status were not measured due to obstacles caused by the COVID-19 pandemic. However, to the best of our knowledge, this is the first work that investigated the association between HEI-2015, DASH score and Mediterranean pattern and atherosclerosis.

Conclusion

The present study showed that adherence to healthy dietary patterns such as DASH diet, HEI, and Mediterranean pattern is associated with lower atherosclerosis risk. Future studies are warranted to determine the ability of the dietary score to predict the incidence of CVD end-points in longer-term follow-up.

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Author Contributions

MM designed the original intervention. MS and HH collected the data. All authors contributed in the analyzes design. MS, AM, and FH analyzed and interpreted the data and were the major contributors in writing the manuscript. All authors reviewed and confirmed the final manuscript. The author(s) read and approved the final manuscript.

Availability of Data and Materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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