Relationship between dietary approaches to stop hypertension score and presence or absence of coronary heart diseases in patients referring to Imam Hossein Hospital, Tehran, Iran

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Original Article

Abstract

BACKGROUND: The dietary approaches to stop hypertension (DASH) dietary pattern reduces blood pressure. However, there is little information about the relationship between DASH and coronary heart diseases. This study aimed to assess the relationship between a DASH-style diet adherence score and coronary heart diseases (CHD) in patients referring for coronary angiography.

METHODS: In this study, 201 adults (102 males, 99 females) within the age range of 40-80 years who referred for coronary angiography were selected. Diet was evaluated using a validated food frequency questionnaire. DASH score was calculated based on 8 food components (fruits, vegetables, whole grains, nuts and legumes, low fat dairy, red/processed meats, soft drinks/sweets, and sodium). The relationship between DASH score and CHD was assessed using logistic regression analysis.

RESULTS: Mean of DASH score was 23.99 ± 4.41. Individuals in the highest quartile of DASH score were less likely to have CHD [odds ratio (OR) = 0.38, 95% confidence interval (CI): 0.16-0.86]. However, after adjustment for gender or smoking, there was little evidence that coronary heart disease was associated with DASH diet score. There was a significant negative correlation between DASH score and diastolic blood pressure ($P \leq 0.05$).

CONCLUSION: In conclusion, having a diet similar to DASH plan was not independently related to CHD in this study. This might indicate that having a healthy dietary pattern, such as DASH pattern, is highly related to gender (dietary pattern is healthier in women than men) or smoking habit (non-smokers have healthier dietary pattern compared to smokers).

Keywords: Coronary Heart Disease, Dietary Approach to Stop Hypertension, Blood Pressure

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Introduction

Coronary heart diseases (CHD) are the main cause of disability and mortality in Iran, since half of annual mortality is due to CHD.[1] The etiology of coronary diseases is largely known and hypertension is its main and independent risk factor.[2] Lifestyle modification is the primary approach to treatment of hypertension and includes dietary changes, weight loss, and physical activity.[2]

Diet plays an important role in hypertension.[3] Previous studies have shown the importance of nutrients such as potassium, calcium, and magnesium in blood pressure regulation.[4] However, compared to micronutrient supplementation, changing dietary pattern appears to be more effective in controlling hypertension.[5] Dietary approach to stop hypertension (DASH) is one of the strategies that have been effective in controlling hypertension.[6] In DASH diet,

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increased consumption of vegetables, fruits, whole grains, nuts, and low-fat dairy and decreased intake of saturated fatty acids and sugar are encouraged.[7] Several studies have suggested that DASH diet decreases blood pressure, low-density lipoprotein cholesterol (LDL-C), and fasting blood glucose.[6,8,9]

Since studying the effect of DASH on cardiovascular events is costly and time consuming, instead of clinical outcomes such as CHD events, most DASH studies have focused on risk factors.[10] However, the relationship between DASH dietary pattern and outcomes of heart diseases could also be investigated through observational studies. Constructing a score which indicates how well an individual follows a diet similar to the DASH plan could be helpful in assessing the relationship between a DASH-style diet and CHD.[11] A study showed that risk of CHD decreased in women, the dietary pattern of whom was similar to DASH pattern.[12] In addition, another study reported that greater concordance with DASH diet guidelines was associated with a somewhat lower incidence of hypertension and mortality due to coronary heart diseases, stroke, or total cardiovascular diseases. However, these relationships were eliminated after adjustment for other risk factors.[6]

The DASH dietary pattern is recommended by the American Heart Association[13] and is included as an example of healthy eating in the 2005 Dietary Guidelines for people.[14] Moreover, no studies have previously investigated the relationship between DASH dietary pattern and coronary artery stenosis in Iran. Therefore, the present work aimed to assess the association between a DASH-style diet adherence score and coronary artery stenosis in patients referring for coronary angiography.

Materials and Methods

Participants

This cross-sectional study was conducted on individuals who referred for coronary angiography to Imam Hossein Hospital in Tehran, Iran, from May 2011 to March 2012. The initial criteria for eligible subjects were age of 40–80 years, no change in diet in the past year, and no history of cancer, kidney, or liver disease. Out of the 215 potential participants, 201 (93.4%) agreed to participate in this study. Moreover, the subjects who reported extremely low or high energy intakes (< 500 or > 5000 kcal/d) were excluded.[15] The final sample consisted of 201 subjects, for whom complete data were available. The ethical committee of Shahid Beheshti University of Medical Sciences approved this study (no: 043426) and an informed written consent was obtained from all the participants.

Assessment of clinical measures

Angiography results were determined and recorded by a cardiologist. The criterion for CHD was 50% stenosis in coronary arteries.[16] History of diabetes mellitus, hypertension, and hyperlipidemia was obtained from the patients' medical records. Seated blood pressure after 5 min of resting was measured using a random zero sphygmomanometer.

Assessment of anthropometric measures

Weight was measured and rounded to the nearest 100 g by digital scales while the subjects were minimally clothed and not wearing shoes. Height was measured while the subjects were standing, not wearing shoes, and the shoulders were in a normal position using a tape measure. Body mass index (BMI) was calculated and expressed in kg/m^2.

Assessment of dietary intake

The patients' dietary intake was assessed through a valid and reliable semi-quantitative food frequency questionnaire (FFQ), which included 168 items of food with standard serving sizes, as commonly consumed by Iranians.[17] Consumption frequency of each food item was questioned on a daily, weekly, or monthly basis and converted to daily intakes; portion sizes were then converted to gram using household measures.[18]

The collected data were analyzed using Nutritionist V (First Databank, Hearst Corp., San Bruno, CA, USA). The patients who had incomplete dietary questionnaires were excluded from the study. A DASH score was calculated for each FFQ. DASH score was constructed based on the food and nutrients emphasized or minimized in DASH diet, focusing on 8 components: 1. High intake of fruits (all fruits and fruit juice), 2. Vegetables (all vegetables except potatoes), 3. Low fat dairy products (skimmed milk, yogurt, doogh/yogurt drink, cheese, and kashk (a traditional high protein dairy product)), 4. Whole grains (all whole and dark breads, popcorn, cooked barley, bulgur, and corn), 5. Nuts/legumes (nuts, dried beans, and pear), 6. Low intake of soft drinks and sweets (all soft and sweet drinks, non-alcoholic beer, syrup sugar, cube sugar, noghl (a traditional small white candy), candy, honey, and jams), 7. Red/processed meats (tuna, egg, hamburger, sausage, organ meat, poultry, fish, red meats (beef, and lamb) and 8. Sodium (sum of sodium content of all foods in FFQ).

For calculation, the intake of fruit, vegetable, dairy, bean and nuts, whole grains, red and processed meat, and soft drinks and sweets was transformed to the servings. Due to the lack of data on the salt intake, only the data on the sodium in foods were used to estimate sodium intake (without considering the received salt). For each 8 components, intake (in serving) was ranked to quintiles.[12]

For each food group, a maximum score of 5 points could be achieved when the intake met the recommendation, whereas lower intakes were scored proportionately. For the 5 groups of fruit, vegetable, dairy, and beans/nuts minimum intake of quintile received a score of 1 point and maximum intake received a score of 5 points. For the remaining components (red/processed meat, soft drinks/sweets, and sodium) low intake was desirable. Therefore, the lowest quintile received 5 points and the highest was given 1 point. The resulting 8 component scores were summed to create the overall DASH score which could range from 8 to 40.

Assessment of other variables

Data on physical activity were obtained using a validated questionnaire and expressed as metabolic equivalents hour/day (METs-h/day), in which 9 different MET levels were ranged on a scale from sleep/rest (0.9 METs) to high-intensity physical activities (> 6 METs).[19,20] The MET-time was calculated by multiplying time spent on each activity level by the MET value of each level. Additional covariate information regarding age, smoking habits, medical history, and current use of medications was obtained by questionnaires.

Statistical analysis

To determine normality of data distribution, Kolmogorov-Smirnov test was used. Systolic blood pressure and diastolic blood pressure were not normally distributed. Therefore, log transformation was used in statistical tests. Baseline characteristics and components of DASH score were compared between those with and without CHD using t-test for continuous variables and chi-square for dichotomous and categorical variables. DASH score was divided into four ascending categories on an ordinal scale. Mean or prevalence of baseline characteristics was computed for each category. Baseline characteristics were also compared between quartiles of DASH score using ANOVA for continuous variables and chi-square for dichotomous and categorical variables. Dietary intakes of the participants by quartiles of DASH score were analyzed using analysis of covariance (ANCOVA) after being adjusted for age and total energy intake. The relationship between CHD variable and adherence to DASH diet was assessed using multiple regression analysis in different models; controlling for age and energy intake (kcal/day) in model I, for BMI, multivitamin intake, physical activity (METh/day), aspirin use, history of diabetes, hypertension, and hyperlipidemia in model II, and for gender and smoking in model III. Partial correlation was used to assess the relationship between DASH score and blood pressure while controlling for the effects of age and energy intake, BMI, multivitamin use, physical activity, aspirin use, gender, history of diabetes, hypertension, and hyperlipidemia. All the statistical analyses were done in SPSS for Windows (version 19; SPSS Inc., Chicago, IL, USA). Values of $P \leq 0.05$ were considered significant.

Results

In this study, 102 men and 99 women with the mean age of 59.72 ± 10.43 years participated. Characteristics of the participants by status of CHD are summarized in table 1. Patients with CHD were slightly older, smoked more, and were more likely to have a history of hypertension.

Components of DASH score were not different with or without CHD (Table 2).

Basic characteristics and dietary intakes of the studied participants by quartiles of DASH score are shown in table 3. In the higher quartiles of DASH score, there were more women than men, and more non-smokers than smokers. Furthermore, the subjects in the top quartile of DASH score were less likely to have CHD. The calculated DASH scores for all FFQs ranged from 13 to 34 and the mean DASH score of all the participants was 23.99 ± 4.41. The subjects with higher DASH scores tended to consume more protein, potassium, calcium, and magnesium, but less total energy.

In table 4, odds ratio (OR) is presented for CHD across quartile of DASH score. After adjusting for age, energy intake, BMI, multivitamin use, physical activity, aspirin use, history of diabetes, hypertension, and hyperlipidemia, individuals in the highest quartile of the DASH score were less likely to have CHD [OR = 0.38, 95% Confidence interval (CI): 0.15-0.93; P = 0.05 for trend]. However, when analysis was further adjusted for gender and/or smoking, the trend was not significant.

There was a significant negative correlation ($r = -0.13$, $P = 0.05$) between DASH score and diastolic blood pressure, but no such relationship was observed for systolic blood pressure ($r = -0.09$, $P = 0.09$). The association was still held even after controlling effect of age, energy intake, BMI, aspirin use, multivitamin use, physical activity, and gender, history of diabetes, hypertension, and hyperlipidemia.

Table 1. Coronary heart disease (CHD) Risk Factors of study participants according to the status of CHD†

Variables	Without CHD (n = 99)	With CHD (n = 102)	P††
Age (year)	58.00 ± 9.80	61.39 ± 10.88	0.012
BMI (kg/m^2)	28.71 ± 5.07	27.48 ± 4.33	0.062
Systolic blood pressure (mmHg)	122.71 ± 15.65	127.61 ± 20.35	0.074
Diastolic blood pressure (mmHg)	76.56 ± 10.89	78.42 ± 11.26	0.203
Female	67 (68.3)	29 (28.7)	0.001
Current smokers	10 (10.9)	25 (24.3)	0.015
History of hypertension	58 (57.4)	83 (81.5)	0.001
History of hyperlipidemia	39 (39.6)	52 (50.9)	0.124
History of diabetes	21 (20.8)	30 (29.6)	0.147

† Data are presented as mean ± standard deviation or number (%); †† Independent t-test for quantitative variables and chi-square test for qualitative variables; CHD: Coronary heart disease; BMI: Body mass index

Table 2. Components of dietary approach to stop hypertension (DASH) score according to the status of coronary heart disease (CHD)†

Variables	Without CHD (n = 99)	With CHD (n = 102)	P††
Fruit (servings/d)	2.28 ± 0.09	2.28 ± 0.11	0.960
Vegetables (servings/d)	2.25 ± 0.10	2.23 ± 0.11	0.932
Whole grain (servings/d)	1.94 ± 0.25	1.57 ± 0.20	0.265
Nuts and legumes (servings/d)	1.54 ± 0.08	1.42 ± 0.08	0.344
Low-fat dairy (servings/d)	1.94 ± 0.08	1.80 ± 0.08	0.248
Red/processed meats (servings/d)	0.85 ± 0.04	0.95 ± 0.06	0.152
Soft drinks/sweets (servings/d)	2.60 ± 0.23	2.77 ± 0.27	0.613
Sodium (mg/d)	2174.91 ± 101.42	2308.92 ± 113.18	0.381

† Mean ± SEM (all such values); †† Independent t-test; CHD: Coronary heart disease

Table 3. Basic characteristics and dietary intakes of study participants by quartiles of dietary approach to stop hypertension (DASH) score†

Dietary intake	Quartiles of DASH score				P for trend††
	Q1 (n = 50)	Q2 (n = 60)	Q3 (n = 44)	Q4 (n = 47)	
Female/male	14/36 (28/7)	33/27 (55/4)	23/21 (52.3/47.7)	29/18 (61.7/38.3)	0.005
Current smokers	22 (44.0)	15 (25.0)	9 (20.5)	6 (12.8)	0.004
Coronary heart disease	32 (64.0)	29 (48.3)	22 (50.0)	19 (40.4)	0.051
Multivitamin use	7 (14.0)	6 (10.3)	9 (20.9)	14 (29.8)	0.053
BMI (kg/m^2)	28.31 ± 4.51	28.32 ± 4.81	28.27 ± 4.52	27.41 ± 5.12	0.731
Physical activity††† (MET)	29.87 ± 7.98	30.01 ± 7.89	30.25 ± 7.89	30.35 ± 7.25	0.932
Nutrients‡					
Total energy (kcal/d)	2333.90 ± 98.27	2041.04 ± 89.23	2195.74 ± 104.86	1999.50 ± 103.17	< 0.001
Carbohydrate (% of total energy)	56.00 ± 0.90	55.00 ± 0.87	53.74 ± 1.00	56.81 ± 0.98	0.061
Protein (% of total energy)	13.10 ± 0.34	14.05 ± 0.30	14.51 ± 0.36	14.71 ± 0.33	< 0.001
Fat (% of total energy)	32.20 ± 0.91	33.01 ± 0.82	33.81 ± 1.01	31.48 ± 1.00	0.263
Potassium (mg/d)	2533.14 ± 72.12	2955.12 ± 65.72	3196.22 ± 76.12	3551 ± 75.34	< 0.001
Calcium (mg/d)	951.26 ± 38.36	1043.64 ± 34.13	1064.09 ± 40.44	1191.48 ± 39.63	< 0.001
Magnesium (mg/d)	321.11 ± 10.84	349.27 ± 9.80	367.54 ± 11.42	414.58 ± 11.27	< 0.001
Components of DASH score					
Fruit (servings/d)	1.50 ± 0.12	2.13 ± 0.10	2.57 ± 0.13	3.03 ± 0.13	< 0.001
Vegetables (servings/d)	1.36 ± 0.12	1.92 ± 0.10	2.70 ± 0.12	3.11 ± 0.12	< 0.001
Whole grain (servings/d)	0.80 ± 0.30	1.29 ± 0.27	1.51 ± 0.32	3.67 ± 0.31	<0.001
Nuts and legumes (servings/d)	0.84 ± 0.09	1.40 ± 0.08	1.78 ± 0.10	2.01 ± 0.09	< 0.001
Low-fat dairy (servings/d)	1.40 ± 0.11	1.85 ± 0.10	1.96 ± 0.11	2.29 ± 0.11	< 0.001
Red/processed meats (servings/d)	0.90 ± 0.06	0.90 ± 0.05	0.85 ± 0.06	0.80 ± 0.07	< 0.001
Soft drinks/sweets (servings/d)	3.21 ± 0.30	3.01 ± 0.27	2.26 ± 0.31	2.15 ± 0.31	< 0.001
Sodium (mg/d)	2468.39 ± 85.69	2132.82 ± 78.09	2221.12 ± 90.19	2170.69 ± 88.96	<0.001

† Data are presented as mean ± SEM or number (%); †† ANCOVA for quantitative variables and chi-square test for qualitative variables; ††† MET: metabolic equivalent task; 1 MET: Energy expenditure of sitting quietly or approximately 1 kcal per kg body weight per hour; ‡ Nutrients (except total energy) food intakes were adjusted for age and total energy intake
DASH: Dietary approaches to stop hypertension; BMI: Body mass index

Table 4. Multivariate adjusted odds for coronary heart disease (CHD) across quartiles of dietary approaches to stop hypertension (DASH) score†

CHD	Quartiles of DASH score				P for trend
	Q1 (n = 50)	Q2 (n = 60)	Q3 (n = 44)	Q4 (n = 47)	
Crude	1.00	0.52 (0.24-1.13)	0.56 (0.24-1.18)	0.38 (0.16-0.86)	0.032
Model I††	1.00	0.52 (0.23-1.11)	0.54 (0.23-1.27)	0.36 (0.15-0.86)	0.036
Model II‡	1.00	0.51 (0.22-1.12)	0.55 (0.23-1.13)	0.38 (0.15-0.93)	0.051
Model III‡‡	1.00	0.54 (0.21-1.39)	0.66 (0.24-1.70)	0.42 (0.15-1.20)	0.085

DASH: Dietary approaches to stop hypertension; BMI: Body mass index; † Values are odds ratio (OR) with 95% of confidence interval (CI);
†† Model I: Adjusted for age and energy intake
‡ Model II: Additionally adjusted for BMI, multivitamin use, physical activity and aspirin use, history of diabetes, hypertension and hyperlipidemia
‡‡ Model III: Further adjusted for gender and smoking

Discussion

This study showed that a diet that was more similar to the DASH diet was associated with lower CHD. The rate of coronary heart diseases (CHD) was lower in patients who were at the highest quartile of DASH score (those with a diet most similar to DASH pattern) compared to patients with the lowest quintile score (those with a diet less similar to DASH pattern). However, these relationships were eliminated after adjustment for gender and smoking. Furthermore, DASH score had a reverse correlation with diastolic blood pressure, while no correlation was observed with systolic blood pressure.

A clinical trial showed that DASH diet could reduce systolic blood pressure by 7.7 and diastolic blood pressure by 3.6 mmHg.[21] Furthermore, DASH plan might influence other cardiovascular risk factors such as high LDL cholesterol, metabolic syndrome, and inflammation, which could reduce atherosclerosis and CHD.[7,12,22] Several studies have shown that having a diet similar to DASH diet in which higher intake of whole grains, vegetables, and fruits are emphasized is associated with lower risk of cardiovascular diseases and stroke.[23-25] This decrease in the risk of heart diseases may be related to the micronutrient content of the food recommended in DASH; since higher intake of magnesium, potassium, calcium, and other nutrients like dietary fiber may have a favorable effect on blood pressure, insulin sensitivity, satiety, and BMI.[26,27] However, red meat and processed products, which are not recommended in the DASH diet, contain high sodium and saturated fats and could have adverse effects on blood pressure.[26,28] In addition, the DASH diet may increase intake of antioxidant and plant compounds with estrogenic activity which could play a role in reduction of cardiovascular diseases.[29-32]

In this study, when regression analysis was adjusted for gender or smoking, there no longer was a significant relationship between diet and CHD. This might indicate that a healthy diet is highly related to gender or smoking habit. Generally, adherence to the DASH diet in men was significantly lower than that of women in the current study and frequency of CHD was higher in men compared to women. A similar conclusion could also be made in the case of smoking habit. One clear and potentially important difference between this study and some previous studies was that they have examined DASH scores separately in men or women, but this study was conducted on both genders.[11,12,33] A similar study showed no correlation between DASH diet and incidence of hypertension and CHD mortality after adjustment for risk factors of CHD.[6] However, the results were inconsistent with the study of Fung et al. that observed a significant negative correlation between DASH diet score and incidence of CHD and stroke.[12]

In this study, adherence to DASH diet in men was significantly less than of women. This difference may be related to the fact that women, compared to men, tend to have a healthier diet. In men, intake of vegetables, fruits, low-fat dairy products, beans, and nuts that increase the DASH diet score was lower, while the intake of red meat/processed products, and sweet drinks which decrease the DASH diet score was higher. Another study reported that, even in similar DASH diet scores, men received more sweet drinks and red meat/processed products than women.[33] Another finding was that non-smokers had higher DASH diet scores than smokers. One possible explanation for the low score of smokers might be related to higher consumption of sweets and sweet drinks, since smokers generally consume more sweets than nonsmokers.[34,35] DASH score in diabetics was higher than that of non-diabetics, which was consistent with a national study conducted in the United States of America, showing that, the diet of diabetics had more similarities to the DASH plan than that of non-diabetics.[36] One limitation of this study was that the present study's FFQ was not designed to precisely estimate sodium intake. Given that the amount of sodium intake cannot be accurately estimated through FFQs, by using the quintile approach the probability of misclassifying the participants' DASH score would decrease.[12] Another limitation of this study was its cross-sectional design, since a cohort design was more appropriate.

In conclusion, following a diet similar to the DASH plan was not independently associated with coronary heart diseases in this study. This might indicate that having a healthy dietary pattern such as DASH pattern is highly related to gender (dietary pattern is healthier in women than men) or smoking habit (non-smokers have healthier dietary pattern compared to smokers). With respect to the role of DASH diet in reducing cardiovascular risk factors and events, it is appropriate to provide approaches for encouraging people with high risk of CHD to take this diet.

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Conflict of Interests

Authors have no conflict of interests.

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