Impact of the components of Mediterranean nutrition regimen on long-term prognosis of diabetic patients with coronary artery disease

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Original Article

Abstract

BACKGROUND: The impact of different nutritional regimens on long-term prognosis and outcome in diabetic patients with coronary artery disease (CAD) has been questioned. Therefore, the objective of the present study was to determine the effects of different nutritional components of Mediterranean regimen on long-term cardiovascular events in diabetic patients with CAD in the Iranian population.

METHODS: In a prospective cohort study, we recruited 233 consecutive patients with the diagnosis of type 2 diabetes mellitus and with at least 6 months of documented CAD. Nutritional assessment was obtained by a validated semi-quantitative food frequency questionnaire (FFQ) and the diet score was calculated on the basis of the Mediterranean diet quality index (Med-DQI). For Assessing long-term CAD prognosis, the patients were followed by telephone for one year. The study endpoint was long-term major adverse cardiac and cerebrovascular event (MACCE).

RESULTS: Death was observed in 19 patients (8.2%) during the one-year follow-up. Two patients (0.9%) suffered non-fatal myocardial infarction and 14 (6.0%) needed revascularization within 1 year after discharge from hospital. Overall MACCE within one year in the study population was 12.4%. There were significant differences between number of deaths and dietary scores of saturated fatty acid, cholesterol, meats, fish, and fruit and vegetables (P < 0.05). Moreover, significant differences were found between MACCE rate and dietary scores of saturated fatty acid, cholesterol, and fruit and vegetables (P < 0.05). Using multivariate logistic regression models, Mediterranean dietary regimen could effectively predict long-term death as well as MACCE adjusted for gender and age variables.

CONCLUSION: Mediterranean dietary regimens, including low level of cholesterol and saturated fatty acid, can effectively improve long-term outcome including death and MACCE in diabetic patients with CAD.

Keywords: Diabetes Mellitus, Coronary Artery Disease, Nutrition

Introduction

According to the results of recent epidemiological surveys, diabetes mellitus confers an increased risk for coronary artery disease (CAD) and leads to cardiac mortality and morbidity that accounts currently for almost 32% of all deaths among diabetic patients.[1,2] The largest increase in mortality and morbidity due to CAD in diabetic patients is expected to occur in developing countries. In Iran, as a developing country, the prevalence of CAD among diabetic patients was estimated to be 28.0%, and among patients with CAD who died in hospital 75.6% were diabetics.[3,4]

Previous studies have emphasized the role of some risk factors, such as advanced age, fasting glucose levels, smoking, hypertension, and triglyceride levels, as independent risk factors for development of CAD events in diabetic patients.[5,6] However, the role of different nutritional regimens on severity of CAD in these patients is questioned. It has been shown that the optimal nutrition therapy is associated with a 2.0% decrease in glycated

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haemoglobin (HbA$_1$C) in patients with newly diagnosed type 2 diabetes mellitus.[7]

Some studies showed the possibility of comprehensive lifestyle changes, and improvements in coronary risk factors and quality of life by an optimal nutritional program in patients with concomitant CAD and diabetes mellitus in comparison to those without diabetes.[8-9] Furthermore, some others suggested that the combination of dietary change and physical conditioning is associated with improved glucose tolerance for diabetics and can improve patients' quality of life.[10] However, fewer evidences are available regarding the role of nutritional habits, especially Mediterranean regimen, as a predictor of CAD prognosis among diabetic patients. In the present study, we planned to determine the effects of different nutritional components of Mediterranean regimen on long-term cardiovascular events in Iranian diabetic patients with CAD.

Materials and Methods

In a prospective cohort study, we recruited 233 consecutive patients with the diagnosis of type 2 diabetes mellitus for at least 6 months with documented CAD; they were diagnosed and hospitalized at the Tehran Heart Center, Tehran, Iran, in 2012. In this study, CAD was considered significant if there was a 75% or greater stenosis in the cross-sectional diameter and 50% or greater stenosis in the luminal view.[11] The data included for analysis were demographic characteristics, preoperative risk factors, paraclinical data, and cardiac status.[12]

Diabetes mellitus was defined on the basis of the American Diabetes Association (ADA) criteria as the presence of diabetes symptoms plus plasma glucose concentration $\geq$ 11.1 mmol/l or fasting plasma glucose $\geq$ 5.6 mmol/l or 2-hp $\geq$ 11.1 mmol/l or using anti-diabetic drugs.[13] Studied patients were also interviewed on admission and asked to report how often they consumed each of the food items listed as the number of times per day, per month, or per year during the previous year. Nutritional assessment was obtained by a validated semi-quantitative food frequency questionnaire (FFQ), with 48 items which was previously validated in Iran, and a 24-hour dietary recall questionnaire to record the types, amounts, and frequencies of foods consumed.[14] We used the sum of the consumption of each of several food items to estimate the overall consumption of the food group to which each item belonged.[15,16]

The Mediterranean diet is define as a dietary

pattern usually used among the populations around the Mediterranean Sea, and it is reported as a model for healthy eating and better quality of life. The diet score was calculated on the basis of the Mediterranean diet quality index (Med-DQI); the construction of the score for this index is mentioned in table 1.[17] To calculate the dietary intake we divided the consumption amount by the frequency of consumption. The index assigns a score of 0, 1, or 2 according to the daily intake of each of the seven components and then final score is reported as a summation of all nutrient (saturated fatty acids, cholesterol, meats, olive oil, fish, cereals, and vegetable and fruits) scores ranging between 0 and 14. A lower score on this index indicates a better nutrition quality.

For Assessing long-term CAD prognosis, the patients were followed by telephone for one year. The study endpoint was long-term major adverse cardiac and cerebrovascular event (MACCE) (defined as occurrence of one of these morbidities including death, non-fatal myocardial infarction, or need to revascularization).

Statistical analysis

Results were reported as mean $\pm$ standard deviation (SD) for quantitative variables, and number (percentages) for categorical variables. Categorical variables were compared using chi-square test or Fisher's exact test if required. P-values of 0.05 or less were considered statistically significant. All the statistical analyses were performed using SPSS for Windows (version 16.0; SPSS Inc., Chicago, IL, USA).

Results

Demographic characteristics and clinical data of studied patients are summarized in table 2. Mean age of studied patients was 59.00 ± 8.39 (ranging from 38 to 75 years) and almost two thirds of them were male. The most common general risk factors for CAD included hypercholesterolemia (76.4%), hypertension (58.4%), and family history of CAD (50.2%). Mean left ventricular ejection fraction was 49.37 ± 10.05, and 82.4% of cases had functional class I-II. In the review of angiographic reports, it was found that the majority of patients (79.0%) suffered from three coronary vessels disease.

One-year death was revealed in 19 (8.2%). Two patients (0.9%) suffered non-fatal myocardial infarction and 14 (6.0%) needed to revascularization within 1 year after discharge from hospital. Overall, one-year MACCE in the study population was 12.4%. One year death and MCCE rates in different dietary groups in men and women are shown in tables 3. There were significant relationships

between death rate and dietary scores of saturated fatty acid, cholesterol, meats, fish, and fruit and vegetables. Moreover, significant relationships were found between MACCE rate and dietary scores of saturated fatty acid, cholesterol, and fruit and vegetables. These differences were independent to gender variable for both one-year mortality and MACCE rates. Using multivariate logistic regression models, Mediterranean dietary regimen could effectively predict long-term mortality and MACCE adjusted for gender and age variables (Tables 4 and 5). A significant relationship was found between total score of Mediterranean regimen and MACCE after adjustment by sex and age ($P = 0.039$).

Table 1. Construction of the score for the Mediterranean Dietary Quality Index

Scoring	0	1	2
Saturated fatty acids (% energy)	< 10	10-13	> 13
Cholesterol (mg)	< 300	300-400	> 400
Meats (g)	< 25	25-125	> 125
Olive oil (ml)	> 15	5-15	< 5
Fish (g)	> 60	30-60	< 30
Cereals (g)	> 300	100-300	< 100
Vegetables + fruits (g)	> 700	400-700	< 400

Table 2. Demographic characteristics and clinical data of studied patients (n = 233)

Characteristic	Mean ± SD	n (%)
Age (year)	59.00 ± 8.39	
Body mass index (kg/m^2)	28.31 ± 4.19	
NYHA score	2.11 ± 0.78	
Ejection fraction (%)	49.37 ± 10.05	
Euroscore	2.46 ± 2.27	
Laboratory indices		
Fasting blood sugar (mg/dl)	126.14 ± 45.97	
Creatinine (mg/dl)	1.26 ± 0.30	
Triglyceride (mg/dl)	175.40 ± 79.21	
Cholesterol (mg/dl)	158.55 ± 47.66	
High density lipoprotein (mg/dl)	40.04 ± 8.57	
Low density lipoprotein (mg/dl)	83.52 ± 34.82	
Hemoglobin A_1C (%)	6.90 ± 1.59	
Albumin (g/dl)	4.64 ± 3.34	
Men		146 (62.7)
Family history of CAD		117 (50.2)
Current cigarette smoking		69 (29.6)
Opium addiction		26 (11.2)
Hypercholesterolemia		178 (76.4)
Hypertension		136 (58.4)
Cerebrovascular disease		14 (6.0)
Peripheral vascular disease		88 (37.8)
Recent myocardial infarction		107 (45.9)
Congestive heart failure		33 (14.2)
Functional class		
I		78 (33.5)
II		114 (48.9)
III		41 (17.6)
Education level		
Primary		137 (58.8)
Secondary		62 (26.6)
Higher		34 (14.6)
Coronary vessels involvement		
Single-vessel disease		6 (2.6)
Two-vessel disease		43 (18.5)
Three-vessel disease		184 (79.0)

CAD: Coronary artery disease; NYHA: New York Heart Association

Table 3. The number of death and major adverse cardiac and cerebrovascular event (MACCE) according to the nutrition components

Dietary group	Death	MACCE
Saturated fatty acid		
0 (n = 85)	0 (0.0)	1 (1.1)
1 (n = 64)	4 (6.3)	8 (12.5)
2 (n = 33)	15 (45.6)	20 (60.6)
P	< 0.001	< 0.001
Cholesterol		
0 (n = 134)	1 (7.5)	5 (3.7)
1 (n = 24)	5 (20.8)	8 (33.3)
2 (n = 24)	13 (54.2)	16 (66.7)
P	< 0.001	< 0.001
Meats		
0 (n = 66)	2 (3.0)	7 (10.6)
1 (n = 108)	14 (13.0)	19 (9.2)
2 (n = 8)	3 (37.5)	3 (37.5)
P	0.006	0.106
Olive		
0 (n = 19)	1 (4.5)	2 (9.9)
1 (n = 52)	6 (11.5)	9 (17.3)
2 (n = 111)	12 (10.8)	18 (16.2)
P	0.650	0.731
Fish		
0 (n = 24)	0 (0.0)	2 (8.3)
1 (n = 45)	3 (6.7)	7 (15.6)
2 (n = 113)	16 (14.2)	20 (17.7)
P	0.037	0.351
Cereal		
0 (n = 121)	11 (9.1)	13 (10.7)
1 (n = 57)	7 (12.3)	15 (26.3)
2 (n = 4)	1 (25.0)	1 (25.0)
P	0.364	0.079
Fruits and vegetables		
0 (n = 147)	11 (7.5)	10 (6.8)
1 (n = 28)	4 (14.3)	15 (53.6)
2 (n = 7)	4 (57.1)	4 (57.1)
P	0.003	< 0.001

MACCE: Major adverse cardiac and cerebrovascular event

Table 4. Multivariate analysis of the effects of nutrition components on death adjusted for sex and age

Variables	Univariate analysis				Multivariate analysis			
	Odds ratio	95% Confidence interval		P	Odds ratio	95% Confidence interval		P
		Lower	Upper			Lower	Upper	
Age	1.031	1.009	1.053	0.005	1.021	0.999	1.044	0.067
Male gender	1.650	1.105	2.463	0.014	1.534	1.019	2.309	0.040
Total score of Mediterranean regimen	2.411	1.102	2.998	0.037	1.990	1.091	2.022	0.042

Hosmer-Lemeshow goodness of fit test; χ^2 = 8.190; Degree of freedom = 8; P = 0.415

Table 5. Multivariate analysis of the effects of nutrition components on major adverse cardiac and cerebrovascular event (MACCE) adjusted for sex and age

Variables	Univariate analysis				Multivariate analysis			
	Odds ratio	95% Confidence interval		P	Odds ratio	95% Confidence interval		P
		Lower	Upper			Lower	Upper	
Age	1.142	1.021	1.191	0.021	1.110	1.099	1.104	0.041
Male gender	1.424	1.078	2.217	0.042	1.987	1.178	2.190	0.034
Total score of Mediterranean regimen	1.664	1.148	2.098	0.021	1.987	1.056	2.088	0.039

Hosmer-Lemeshow goodness of fit test; χ^2 = 7.655; Degree of freedom = 8, P = 0.428; MACCE: Major adverse cardiac and cerebrovascular event

Discussion

Improving the contents of nutrients for diabetic patients facilitates health care in these patients, and this critical issue can influence medical and clinical outcomes and patient quality of life. It has been confirmed that promoting healthy food choices can lead to decrease in the risk of diabetes and cardiovascular complications.[18]

In the present study, we tried to consider the impact of different Mediterranean dietary components on long-term outcome of diabetes in patients suffering from CAD. We found that one-year death in these patients was dependent on the consumption of some nutrient components such as saturated fatty acids and cholesterol. Epidemiological studies strongly support the suggestion that low intakes of cholesterol and free fatty acids prevent the development of type II diabetes mellitus and people who consume foods with the lowest levels of these nutritional agents are less likely to develop diabetes and its-related complications than higher level consumers.[19,20] The effect of low-fat diets in the prevention of CAD has also been demonstrated. It has been concluded that a relationship between cereal intake and CAD was seen with considerable reduction in risk for those who eat this food habitually versus those who eat them rarely.[21-23] Some studies also showed that the consumption of rich-cholesterol foods increases the effect of plasma lipoprotein risk factors in cardiovascular disease. Total plasma and low density lipoprotein cholesterol concentrations were significantly lowered, and the ratios of plasma high-density-lipoprotein cholesterol to total cholesterol and of apolipoprotein A-I to B were significantly increased with the consumption of this dietary group.[24] Therefore, it seems that low consumption of Mediterranean diet, including low consumption of saturated fatty acids and cholesterol, can improve one-year survival in diabetic patients with CAD via regulation of lipids metabolism and loss of body weight.

Our study also showed a relationship between the consumption of saturated fatty acids and cholesterol, and mid-term MACCE rate. It has been confirmed that the consumption of saturated fatty acids induces hyperlipidemia and obesity, causing progression of atherosclerosis especially in diabetic patients.[25] Furthermore, the increase of adipose tissue stores can disturb insulin-mediated regulation of lipolysis and increase circulating fatty acid concentrations which may promote insulin resistance and cardiovascular complications; therefore, these pathways can predispose diabetic CAD patients to poor prognosis.[26,27]

In the present study, we finally showed that the Mediterranean diet in diabetic patients with CAD, including low cholesterol, and high cereal, fruits and vegetables, and olive and fish intake, can be an acceptable regimen for these patients leading to favorable outcome. Besides, it seems that overall dietary patterns in various populations are dependent upon socioeconomic status, demographic characteristics, and patients' lifestyle.[28] It is recommended that the impact of these factors on dietary patterns be investigated in different populations, especially diabetic patients.

Limitation

A limitation of this study was the relatively small sample size. For this reason, these findings cannot be generalized to the broader community based on this study alone.

Conclusion

It can be concluded that nutritional pattern of Mediterranean regimen, particularly consumption of lower level of cholesterol and saturated fatty acids, can effectively improve one-year death and MACCE in diabetic patients with CAD.

Conflict of Interests

Authors have no conflict of interests.

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