

## Original Article

# Adherence to Mediterranean diet and its relation with cardiovascular diseases in Turkish population

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**Abstract:** Mediterranean diet (MD) is considered a model for healthy eating. However, prospective evidence in Turkey evaluating the relationship between MD and cardiovascular events is scarce. We surveyed the adherence of Alanya population to MD and its association with coronary heart diseases (CHD). The study population consisted of participants in Alanya, a region placed southern Turkey. Followed-up 900 participants (52 percent women) initially free of CHD during 5.1 years. The general dietary habits of study population were detected with a food frequency questionnaire. Data obtained from that questionnaire were tested with Mediterranean diet score in order to find out the relevance to Mediterranean diet. A MD score (scale 0-8) was computed reflecting high ratio of monounsaturated to saturated fat; high intake of legumes, cereals, vegetables, and fruits; low intakes of meat and its products, milk and dairy products. Scoring < 5 was defined as Low-MD consuming, while 5+ as High-MD consuming. We observed 25 incident cases of CHD. Consumption of High-MD was 21% in men and 19% in women. The risk for myocardial infarction, coronary bypass, coronary angioplasty, and any cardiovascular disease in men increased by 1.3 ( $P = 0.02$ ), 1.4 ( $P = 0.03$ ), 1.5 ( $P = 0.01$ ), and 1.3 ( $P = 0.02$ ), respectively, for each MD score decrease. In women, the risk for myocardial infarction and angioplasty increased by 1.3 ( $P = 0.02$ ) and 1.5 ( $P = 0.01$ ), respectively, for each MD score decrease. The risk for coronary bypass, and any cardiovascular disease in women, crude odds ratios ranged from 1.1 to 1.3 but were not statistically significant. The current rate of MD in Alanya is fairly low. There is an inverse association between adherence to MD and the incidence of fatal and non-fatal CHD in initially healthy adults.

**Keywords:** Cardiovascular disease, mediterranean diet, Turkish population

## Introduction

The Mediterranean diet which is one of the best known dietary patterns was first identified by Ancel Keys in the 1960s [1]. This kind of dietary pattern consists of daily consumption of fruits, vegetables and olive oil, nonrefined grains and dairy products, weekly consumption of fish and poultry, potatoes, olives, tree nuts and legumes, monthly consumption of red meat, and also a moderate consumption of wine [1-4].

Adhering to the Mediterranean dietary pattern has been proposed to have a positive effect on mortality from all reasons, primary and also secondary prevention of chronic diseases, especially cardiovascular disease (CHD) and cancer [5, 6], and also obesity and type 2 diabetes [7, 8]. In addition, adherence to the Mediter-

anean dietary pattern may result in beneficial effects on human health and coronary heart disease in particular because of its antioxidant and anti-inflammatory effects [7, 9-12]. Results of previous prospective cohort, cross-sectional studies and clinical trials demonstrate that the Mediterranean diet has positive effects in regards to coronary heart disease. This protective role has been underlined by the results from the 25-year follow up of the Seven Countries Study [13], and also from the Nurses' Health Study [14], the HALE project [15] and the Greek arm of the EPIC study [16]. Besides, dietary pattern adhered to the Mediterranean diet has also protective effect in patients with hypertension [17], hypercholesterolemia [18], metabolic syndrome [19], the stroke and pulmonary embolism [20] against the development of coronary heart disease. Finally, clinical

trials underline the important contribution of the Mediterranean diet to a lowered risk of coronary heart disease [5, 21].

General dietary habits and the frequency of Mediterranean diet application yet remain unclear in Turkey which has a coast to Mediterranean Sea. In this study, we aimed to assess the frequency of Mediterranean diet application and its association with cardiovascular disease.

### Materials and methods

The study was approved by Baskent University Ethical Committee and supported by Baskent University Research Fund. The study included 900 volunteers (468 women) aged between 25-70 years. Hospital staff and relatives of the patients were included in the study. The exclusion criteria have the story of cardiovascular disease (angina, myocardial infarction, heart failure, revascularization procedures). Participants who had not spent enough time in the study to complete and those with missing values for any of the covariates of interest were also excluded. The study was conducted in accordance with the Declaration of Helsinki on the human trial performance and informed consent was provided by participants.

Dietary intake was assessed by a validated [22, 23] food frequency questionnaire (FFQ) which contained questions on the habitual frequency of consumption of 156 food items. Additional information was obtained on consumption frequency for different sub-items, and preparation methods. Colored photographs were used to estimate portion sizes of 25 food items [22, 23]. For each of the components, the percentage contribution to total energy was computed. The median sex-specific values of the percent of the total energy contribution were then used as cutoff points for intake of cereals, fruits, vegetables, meat, milk and their products. The possible range of scores was from 0 to 8. We proposed that the higher the score, the more beneficial the diet. Persons scoring 4 or less were defined as low-MD consumers while a score of 5 or higher defined participants as high-MD consumers.

Regarding ethanol, one point was scored if consumption was 10-50 g/day for men or 5-25 g/day for women.

The baseline questionnaire requested information about anthropometric characteristics (weight, height), health related habits (smoking status, physical activity, sedentary lifestyle), and clinical variables (use of medication, personal and family history of coronary heart disease, and other CHD). Physical activity was expressed in metabolic equivalent tasks (METs Z time spent at each activity [hours/week] multiplied by its typical energy expenditure) [24].

The primary end point for the present analysis was the combined outcome measure of incident cardiovascular death, acute coronary syndromes (myocardial infarction with or without ST elevation). An expert panel of physicians, blinded to the information on diet and risk factors, adjudicated the events by reviewing medical records applying the universal criteria for myocardial infarction [25] or clinical criteria for the other outcomes. Morbidity was assessed with standard questions such as, "Has a doctor ever told you that you have myocardial infarction (MI)"? "Have you undergone coronary artery bypass grafting (CABG)"? "Have you undergone percutaneous transluminal coronary angioplasty (PTCA)"? The presence of CHD was coded positive if participants answered "yes" to at least to one of these three questions.

Statistical analyses were performed using SAS 9.2 software (SAS Institute, INC., Cary, NC). Participants' characteristics were calculated by sex and cohort as means (standard deviation) or medians (inter-quartile range) for continuous variables, and as percentages for categorical variables.

Odds ratio (OR) with 95% confidence intervals (95% CI) were computed for association between MD consumption (Low/High) and MI, CABG, PTCA, and CHD (yes/no). The association between MI, CABG, PTCA, CHD, and MD as a continuous variable, adjusting for age, reported hypertension, hypercholesterolemia, and diabetes mellitus was performed using multi-variable logistic regression.

### Results

During the period March 2007 to April 2012, 900 participants were enrolled in the study and 25 cases of incident CHD (acute coronary acute syndromes and revascularization procedures) were observed. Only 5 events were fatal. Ba-

## Mediterranean diet and cardiovascular diseases

**Table 1.** Participants' characteristics at baseline and CHD incidence, by sex and cohort

	Men	Women
N	432	468
Age (years) <sup>a</sup>	43	42
Smoking (%) <sup>b</sup>	30	21
Physically active (%)	22	15
Alcohol consumption (% , ≥ 1 glass per month)	42	10
Alcohol (gram/day) <sup>a</sup>	18 (3-29)	1 (0-4)
Energy intake (kcal/day) <sup>a</sup>	1770 (1127-2399)	1550 (925-2264)
Vegetables (gram/day) <sup>a</sup>	210 (151-258)	198 (126-247)
Fruit (gram/day) <sup>a</sup>	187 (92-223)	154 (86-218)
Legumes (gram/day) <sup>a</sup>	20 (12-27)	17 (9-25)
Nuts (gram/day) <sup>a</sup>	4 (0-11)	2 (0-8)
Grains (gram/day) <sup>a</sup>	180 (126-338)	174 (132-294)
Fish and seafood (gram/day) <sup>a</sup>	3 (0-10)	2 (0-8)
Unsaturated fatty acids (gram/day) <sup>a</sup>	39 (27-51)	34 (26-44)
Saturated fatty acids (gram/day) <sup>a</sup>	62 (46-81)	55 (38-69)
Dairy and dairy products (gram/day) <sup>a</sup>	321 (193-524)	314 (190-488)
Meat products (gram/day) <sup>a</sup>	124 (108-155)	93 (61-112)
Fatal CHD (n)	3	2
Incident CHD (n)	15	10

<sup>a</sup>Numbers are given as mean (sd) or as median (interquartile range); <sup>b</sup>Cigarette, cigar or hookah; CHD = cardiovascular diseases, MI = myocardial infarction.

seline characteristics of the study participants according to their adherence to the Mediterranean diet are presented in **Table 1**.

We examined the associations between reported cardiovascular conditions (MI, CABG, PTCA, and CHD-at least one of the above) and MD (**Table 2**).

The average daily energy intake was 1770 in men and 1550 kcal/day in women. When the distribution according to different food groups examined, 38% grains, 11% fat, 18% milk products, 12% fruits, 8% red meat and poultry, 8% vegetables make up of dietary energy groups. Although it was a coastal region, fish consumption was lower (2%). The most consumed among cereals was bread (95%). After cereals, fruits, jam, honey, molasses, sugary foods and drinks, chocolate and cake consumed.

The frequency and amount of fruits and vegetables consumed was in recommended (~400 g/day) amounts but the amount of consumption of whole grains and legumes were not in desired amounts.

We found relatively low mean consumption of olive oil of 0.9 g per day per person in our study.

The major contributors to monounsaturated fatty acids in our study were cooking oil (Corn, Sunflower). Consumption of butter and vegetable oil was equal.

Those of medium and high level of physical activity was 22% in males and females 15%. The study population was divided into high-MD consumers (score of 5+ points) and low-MD consumers (score 0-4 points) using the score as described in methods. Twenty percent of males and 19% of female were High-MD consumers. The risk for myocardial infarction, coronary bypass, angioplasty, and any cardiovascular disease in men increased by 1.3 ( $P = 0.02$ ), 1.4 ( $P = 0.03$ ), 1.5 ( $P = 0.01$ ), and 1.3 ( $P = 0.02$ ), respectively, for each MD score decrease. In women, the risk for myocardial infarction and angioplasty increased by 1.3 ( $P = 0.02$ ) and 1.5 ( $P = 0.01$ ), respectively, for each MD score decrease. The risk for coronary bypass, and any cardiovascular disease in women, crude odds ratios ranged from 1.1 to 1.3 but were not statistically significant.

### Discussion

This study is the first study showing the relationship between coronary artery disease and

**Table 2.** Odds Ratios (OR) and 95% confidence intervals (95% CI) of the association between Mediterranean diet and reported MI, CABG, PTCA and CHD by sex<sup>a</sup>

Morbidity		Males			Females		
		N cases (%)	OR (95% CI)	P	N cases (%)	OR (95% CI)	P
MI	High-consumers <sup>b,c</sup>	2 (3.0)	1.0	0.03	1 (7.1)	1.0	0.03
	Low-consumers <sup>d</sup>	10 (23.0)	4.3 (3.03-6.8)		8 (15)	3.3 (1.7-4.9)	
CABG	High-consumers	1 (1.5)	1.0	0.01	2 (2.9)	1.0	0.59
	Low-consumers	4 (8.3)	4.4 (1.9-11.7)		3 (2.9)	1.0 (0.7-3.3)	
PTCA	High-consumers	3 (6.2)	1.0	0.01	4 (4.3)	1.0	0.01
	Low-consumers	11 (18.0)	3.0 (1.05-10.7)		6 (14.5)	2.2 (0.7-4.1)	
CHD	High-consumers	5 (12.5)	1.0	0.03	5 (10)	1.0	0.10
	Low-consumers	10 (27.0)	2.2 (1.03-3.9)		5 (10)	1.08 (0.7-2.7)	

<sup>a</sup>MI-myocardial infarction; CABG-coronary artery bypass grafting; PTCA-percutaneous transluminal coronary angioplasty; CHD-cardiovascular disease (at least one of the above). <sup>b</sup>Reference group. <sup>c</sup>High-consumers-persons with a Mediterranean diet score of 5+. <sup>d</sup>Low-consumers-persons with score 0-4.

Mediterranean-type diet in Turkish society. Turkey's overall dietary habits and the rate of adaptation to the Mediterranean diet has not been determined clearly yet. The study by Şahingöz et al. [26] has investigated Mediterranean Diet Quality Index (KIDMED) of Turkish adolescents and results showed that the subjects' diet quality was low. Results indicated that 17.9% of the participants had a low quality diet ( $\leq 3$  points), 59.2% had a mid-quality/needs-improvement diet (4-7 points) and 22.9% had an optimal quality diet ( $\geq 8$  points).

In our study, despite being a country that is bordering the Mediterranean Sea, we have determined that compliance to the Mediterranean diet compliance is quite low (21% in men and 19% in women).

In the present study, we found an inverse relationship between Mediterranean diet adaptation and fatal and nonfatal coronary artery disease in healthy adults.

Mediterranean diet, especially all-cause mortality, reducing the risk of cardiovascular disease and cancer which has been shown to be related to human health, is the best known and most researched dietary pattern [27].

This dietary pattern have been reported to reduce the incidence of cardiovascular and neoplastic diseases in many epidemiological, community-based and randomized clinical investigating the effects of diet on human health [28, 29].

In PREDIMED study, of which the results reported past year, Estruch et al. have been shown that in high-risk patients without cardiovascular disease Mediterranean-type diet reduces major cardiovascular events [30]. This was a multicenter, randomized controlled, primary prevention study. In this study, 7447 participants with initially elevated cardiovascular risk but without cardiovascular disease were randomized into one of three diet types: Mediterranean diet supplemented with virgin olive oil, Mediterranean diet supplemented with mixed nuts or a low fat diet. The primary end point was the rate of major cardiovascular events (myocardial infarction, stroke or death from cardiovascular causes occurred). After the average follow-up of 4.8 years, the study was stopped prematurely based on the results of the interim analysis. The primary end point occurred in 288 participants. 96 events occurred in Mediterranean diet with extra virgin olive oil group, 83 events occurred in Mediterranean diet with mixed nuts group and 109 events occurred in the control group. No diet-related side effects were reported. Among high cardiovascular risk people, Mediterranean diet supplemented with extra virgin olive oil or nuts reduced major cardiovascular events. The Mediterranean diet provided 3 per 1000 person-years absolute risk reduction of major cardiovascular events and approximately 30% relative risk reduction in high-risk patients who is initially free of cardiovascular disease.

Although our study is not an interventional study, it was shown a significant reduction in

cardiovascular rates after 5.1-year follow-up in patients initially without heart disease and adaption to the Mediterranean diet is high as Estruch et al [30].

In our study, in men with higher adherence to the Mediterranean diet, myocardial infarction, coronary bypass graft, percutaneous coronary intervention and coronary artery disease rates were significantly lower according to the men with lower adherence to this diet. In women with higher adherence to the Mediterranean diet, myocardial infarction and percutaneous coronary intervention was significantly lower while coronary artery bypass surgery and the rate of coronary artery disease had a non-significant decrease.

ATTICA which was a cross-sectional study designed similar to our study, was containing 2282 Greeks without any cardiovascular disease or diabetes mellitus. Participants were followed up for 5 years. At the end of the five-year period, it was concluded that the absence of adaptation to the Mediterranean diet was a determinant of cardiovascular disease events. In people with high adherence to Mediterranean diet (as determined by Mediterranean diet score-MedDietScore-) determined by A-) the chance of having metabolic syndrome was 19% lower [31-36].

A meta-analysis of 12 studies, analyzing prospectively the relation between adaptation to the Mediterranean diet, mortality and disease incidence have been made [6]. In these studies, a total of 1,574,299 people were followed for 3-18 years. The higher adherence to Mediterranean diet was associated with significant reduction in overall mortality (9%), in CVD caused mortality (9%), the incidence of cancer or cancer related mortality (6%) and Parkinson's disease and Alzheimer's disease incidence (13%) and a significant improvement in health status. This dietary pattern described as Cultural Intangible Heritage of Humanity by UNESCO in 2010 [37].

Our study has some limitations. Firstly study was conducted in a single center, so it is not correct to generalize the results to all of Turkey. In addition, study population in the beginning was low risk in terms of cardiovascular disease; therefore to answer whether generalizations for patients with higher risk or other situations can be made requires further research.

As in most clinical trials, the rate of cardiovascular events observed was lower than expected and this has reduced the statistical power of the primary endpoint.

Mediterranean diet is not a uniform eating pattern and there is heterogeneity in score substances. How will legumes, nuts, foods such as milk and dairy products be grouped into categories, the real significance of different types of meat and assessing moderate amounts of alcohol consumption are still controversial among researchers and can be different between selected studies. In addition, score usage in determining the dietary pattern is a limitation due to the use of subjectivity and thus can cause a huge variation in the interpretation of results.

One of the basic methodological problems in assessing the effect of the dietary habits on human health is how to measure the level of compliance of the participants to specific dietary patterns. In studies on the Mediterranean diet, to evaluate the compliance of this dietary pattern, six different Mediterranean diet score was used. Among them, there are similarities as well as differences. In all, seven nutrients and food groups (i.e. vegetables, fruits, legumes, fish, red meat, alcohol and olive oil or monosaturated or unsaturated fat ratio) was scored. Other dietary variables evaluated by some of the scores are grains (i.e., total, complete and refined), potatoes, nuts, poultry, dairy products, eggs, oil, sugar, sugary drinks and sofrito (a sauce prepared by cooking garlic, onions, leeks and tomatoes in olive oil). Differences were in associated with number of the components (i.e. the different food groups or 9-14 components showing substances), scoring system (i.e., the number of partitions for each component, some scores use binary scoring while some of them uses larger scales), and finally with the total theoretical score range (0-9 or 0-100).

In our study, frequency of consumption of 156 nutrients were asked with a questionnaire and scored to calculate their adaptation to the Mediterranean diet.

As a result, the compliance to the Mediterranean diet is low in Turkey which is a country on the coast of the Mediterranean Sea. The rate of major cardiovascular events was lower in peo-



ple with high compliance rate to the Mediterranean diet.

Mediterranean diet features not only food consumption but also entertainment, socialization, biological diversity and seasonality, kitchen activities, sufficient rest and also emphasis on cultural backgrounds.

Even in the Mediterranean basin, oil, meat, eggs and dairy consumption has increased grains, legumes, vegetables and seafood consumption has reduced. This dietary pattern is often characterized by the consumption of olive oil, fruits, vegetables, whole grains and fish. One of the important things about this dietary pattern is the applicability in different cultures with minor modifications. It is important to highlight that the Mediterranean diet is not only consists of set of dietary recommendations but also a healthier and more sustainable way of life.

## Disclosure of conflict of interest

None.

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