Research Article / Araştırma Makalesi

Ege Journal of Medicine / *Ege Tıp Dergisi* 2024; 63 (3): 466-473

Dietary interventions for reducing atherosclerosis and heart attack risk: a cross-sectional study of coronary artery disease patients

Ateroskleroz ve kalp krizi riskini azaltmaya yönelik diyet müdahaleleri: koroner arter hastalığı hastalarının kesitsel bir çalışması

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ABSTRACT

Aim: Cardiovascular diseases, particularly atherosclerosis and heart attacks, pose significant health threats worldwide. We aimed to examine the complex relationship between dietary habits and cardiovascular health, in the context of the role of various dietary components.

Materials and Methods: This descriptive cross-sectional study consists of coronary artery patients who applied to the cardiology outpatient clinic of the hospital between June 14 and August 30, 2022. The sample of the study consists of 116 participants diagnosed with coronary artery disease (CAD). The food consumption frequency data were calculated using the BeBiS (Nutrition Information System) computer program. The nutrient values calculated by BeBis were evaluated according to the "Dietary Reference Intake" (DRI). A Mediterranean Diet Index score of ≤7 indicates a low level of adherence to the Mediterranean diet, while scores of 8-9 or ≥10 indicate higher adherence levels.

Results: The average age of the participants in the study is 57.84±13.38 years (range 31-80 years). 46.5% of the participants are in the 51-70 age group, 25.7% are over 70 years old, and 27.7% are in the 31-50 age group. The participants were divided into two groups based on whether they have a diagnosis of type 2 diabetes mellitus. In terms of the Mediterranean Diet Scale classification, 56% of the patients scored ≤7 points, 33% scored 8-9 points, and 11% scored ≥10 points.

Conclusion: Reducing saturated fats, trans fats, and excess sodium intake plays an important role in maintaining optimal heart health. We think it is important to include omega-3 fatty acids, antioxidants and fiber-rich foods in one's diet. By promoting a better understanding of the Mediterranean diet and its potential health benefits, health professionals can contribute to improving dietary behaviors and overall health outcomes, especially in societies with a high prevalence of overweight and obesity.

Keywords: Atherosclerosis, heart attack, cardiovascular health, dietary strategies, nutrition.

ÖZ

Amaç: *Kardiyovasküler hastalıklar, özellikle ateroskleroz ve kalp krizleri, dünya çapında önemli sağlık tehditleri oluşturmaktadır. Bu çalışmanın amacı, bu hastalıklarla ilişkili risk faktörlerini azaltmak için beslenme stratejilerini araştırmaktır.*

Gereç ve Yöntem: *Bu tanımlayıcı kesitsel çalışma, 14 Haziran- 30 Ağustos 2022 tarihleri arasında hastanenin kardiyoloji polikliniğine başvuran koroner arter hastalardan oluşturmaktadır. Çalışmanın örneklemini koroner arter hastalığı (KAH) tanısı almış 116 katılımcı oluşturmaktadır. Besin tüketim sıklığı BeBiS (Beslenme Bilgi Sistemi) bilgisayar programı kullanılarak değerlendirilmiştir. BeBis tarafından hesaplanan besin değerleri "Diyet Referans Alımı"na (DRI) göre derecelendirilmiştir. Akdeniz Diyeti İndeksi puanı ≤7, Akdeniz diyetine düşük düzeyde uyumu gösterirken, 8-9 veya ≥10 puanları daha yüksek düzeyde uyumu göstermektedir.*

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Application date: 15.08.2024 Accepted: 21.08.2024

Bulgular: *Çalışmaya katılanların yaş ortalaması 57,84±13,38 yıldır (aralığı 31-80 yıl). Katılımcıların %46,5'i 51-70 yaş grubunda, %25,7'si 70 yaş üstü ve %27,7'si 31-50 yaş grubundadır. Katılımcılar tip 2 diabetes mellitus tanısı olup olmadıklarına göre iki gruba ayrıldı. Akdeniz Diyeti Ölçeği sınıflamasına göre hastaların %56'sı ≤7 puan, %33'ü 8-9 puan, %11'i ise ≥10 puan aldı.*

Sonuç: *Doymuş yağları, trans yağları ve aşırı sodyum alımını azaltmak, optimum kalp sağlığını korumada önemli bir rol oynar. Kişinin diyetine omega-3 yağ asitleri, antioksidanlar ve lif açısından zengin yiyecekleri dahil etmenin önemli olduğunu düşünüyoruz. Akdeniz diyeti ve potansiyel sağlık yararları hakkında daha iyi bir anlayış teşvik ederek, sağlık profesyonelleri özellikle aşırı kilo ve obezitenin yaygın olduğu toplumlarda diyet davranışlarını ve genel sağlık sonuçlarını iyileştirmeye katkıda bulunabilirler.*

Anahtar Sözcükler: *Ateroskleroz, kalp krizi, kardiyovasküler sağlık, diyet stratejileri, beslenme*

INTRODUCTION

Cardiovascular diseases, foremost among them atherosclerosis and heart attacks, represent enduring challenges to global public health, exerting a substantial toll on individuals and healthcare systems. Atherosclerosis, the progressive buildup of plaque within arterial walls, serves as a pivotal precursor to various cardiovascular complications, with heart attacks emerging as critical and potentially life-threatening events. Against this backdrop, the intricate interplay between dietary patterns and cardiovascular health has gained increasing recognition. This article embarks on a comprehensive exploration of the multifaceted relationship between nutrition and the prevention of atherosclerosis and heart attacks (1).

The escalating prevalence of cardiovascular diseases underscores the urgency of developing effective preventive strategies, and dietary interventions have emerged as a promising avenue. Scientific literature consistently underscores the profound impact of dietary choices on cardiovascular outcomes, emphasizing the need for informed nutritional strategies to curb risk factors associated with atherosclerosis and heart attacks (2).

In our study, we aimed to examine the complex relationship between dietary habits and cardiovascular health, in the context of the role of various dietary components, such as fruits, vegetables, whole grains, healthy fats, adequate water intake, low glycemic index foods, and sodium, in atherosclerosis and heart attack risk. We also evaluated the potential protective effects of certain nutrients, such as omega-3 fatty acids and antioxidants, and the benefits of a fiber-rich diet.

MATERIALS AND METHODS

Study design

This descriptive cross-sectional study consists of coronary artery patients who applied to the cardiology outpatient clinic of the hospital between June 14 and August 30, 2022.

The sample was determined through simple random sampling. All selected samples from the universe were reached. The sample of the study consists of 116 participants diagnosed with coronary artery disease (CAD). The study included individuals who volunteered to participate and were communicative. Individuals with communication difficulties, pregnant women, and those diagnosed with cancer were excluded from the study.

Data Collection

Information regarding the socio-demographic characteristics of the participants was obtained through the Introduction Information Form, while data determining their dietary habits were assessed using the Mediterranean Diet Scale based on the frequency of food consumption. The data for the study were collected through face-to-face interviews. The Introduction Information Form includes general characteristics of individuals, such as age, gender, body weight, height, Body Mass Index (BMI), waist circumference, marital status, education level, presence of chronic diseases, and information on smoking and alcohol consumption.

Data related to the participants' height, weight, and waist circumference were collected by a single researcher. Height was measured using a height gauge with 1 mm intervals, and weights were measured with a precise electronic scale with 0.1 kg accuracy. Body Mass Index (BMI) was calculated using the formula "BMI (kg/m2) = Body Weight (kg) / Height2 (m)" based on the participants' height and weight.

Participants' BMIs were classified according to the World Health Organization (WHO) BMI classification. BMI values of 18.5-24.9 are classified as normal, 25.00-29.99 as pre-obese, and ≥30.00 as obese.

Biochemical data were obtained from participants' medical records and recorded in the general survey form. The biochemical parameters included in the study are fasting blood glucose, Hemoglobin A1C (HbA1C), total cholesterol (T-Chol), triglycerides (TG), high-density lipoprotein cholesterol (HDL-Chol), low-density lipoprotein cholesterol (LDL-Chol), aspartate aminotransferase (AST), alanine aminotransferase (ALT), red blood cell (RBC), Hemoglobin (HGB), and Hematocrit (Hct) serum levels.

To determine individuals' food consumption, the food frequency questionnaire form includes categories such as dairy and products, meat and products, grains, fruits and vegetables, fats, and other foods. Food consumption frequency questionnaire included the consumption frequencies and quantities of foods within the basic food groups recorded over the past month, and daily food consumption amounts were calculated. The data on food consumption frequency were obtained through face-to-face interviews. The food consumption frequency data were calculated using the BeBiS (Nutrition Information System) computer program, which indicates the macro and micronutrient quantities of foods (3). The nutrient values calculated by BeBis were evaluated according to the "Dietary Reference Intake" (DRI). Age groups were categorized into four categories according to the DRI: 19-30, 31-50, 51-70, and >70 years. To assess adherence to the Mediterranean diet, the 14-item Mediterranean Diet Scale used by Martinez-Gonzales et al. in the PREDIMED study was employed (4). The scale consists of 14 questions aimed at evaluating diet quality and, particularly, adherence to the Mediterranean diet. The questions are answered with "yes" or "no," with "yes" being scored as one point and "no" as zero points. The total score obtained from the scale is examined in three categories. A Mediterranean Diet Index score of ≤7 indicates a low level of adherence to the Mediterranean diet, while scores of 8-9 or ≥10 indicate higher adherence levels.

Statistical Analysis

The data of the study were analyzed using IBM SPSS Statistics 20.0. Descriptive statistics, including mean, standard deviation, maximum, minimum, and percentage values, were utilized to assess the distribution of the data. The Kolmogorov-Smirnov test was employed to check the normality of the data, and since the significance values were greater than 0.05, parametric tests were used for advanced analyses. The Chi-square test was applied to evaluate the relationship between two categorical variables. For detecting relationships among three or more variables, the One-Way Analysis of Variance (ANOVA) test was used, and the homogeneity of variances was assessed using the Levene test. In post-hoc analysis, the Tukey Honestly Significant Difference (HSD) test was utilized. The statistical significance level in the study was considered as $p<0.05$.

The study was approved by the Ethics Committee of Gaziantep City Hospital (2024/65, 15/05/2024). The Declaration of Helsinki protocol was followed in the research protocol Written informed consent was obtained from each patient prior to their inclusion in the study.

RESULTS

Table-1 provides the mean and standard deviations along with the lower and upper values of age, BMI, and waist circumference measurements according to individuals' genders. The average age of the participants in the study is 57.84±13.38 years (range 31-80 years). 46.5% of the participants are in the 51-70 age group, 25.7% are over 70 years old, and 27.7% are in the 31-50 age group. According to the World Health Organization's BMI classification, 47.5% of the participants are overweight, 34.7% are obese, and 17.8% have normal body weight. According to the World Health Organization's waist circumference cutoff points, 68.3% of the participants have a high waist circumference. Regarding education levels, 65.3% of the participants completed primary education, 18.8% completed high school, and 15.8% graduated from university/postgraduate studies. The rate of non-smokers is 76.2%, and the rate of non-alcohol consumers is 93.1% (Table-1).

All participants in the study have been diagnosed with coronary artery disease (CAD). The participants were divided into two groups based on whether they have a diagnosis of type 2 diabetes mellitus, and the mean, standard deviation, and lower-upper values of their biochemical findings are shown in Table 2. It was determined that 26.7% of the participants have type 2 diabetes mellitus. Fasting blood glucose and HbA1C levels are higher in individuals with type 2 diabetes mellitus ($p<0.05$) (Table-2).

In Table 3, participants were categorized based on gender, age, BMI, the presence or absence of Type 2 Diabetes Mellitus (DM), and whether they had high or normal waist circumference. In terms of the Mediterranean Diet Scale classification, there was no statistically significant differences were observed. The participants were further subgrouped based on the medical diagnosis of Type 2 Diabetes Mellitus and Coronary Artery Disease (CAD), and their Mediterranean Diet Scale classifications were compared. No statistically significant differences were found in these comparisons either. In terms of the Mediterranean Diet Scale classification, 56% of the patients scored ≤7 points, 33% scored 8-9 points, and 11% scored ≥10 points (Table-3).

In Table 4, there was no statistically significant difference between the Mediterranean Diet Scale score classification and biochemical findings ($p>0.05$) (Table-4).

Table-1. Mean values of age, body mass index, and waist circumference measurements of individuals.

	Female (n=47)	Male (n=54)	P value	Total (n=101)
Age, years	56.47±12.44	61.72±13.77	0.448	57.84±13.38
BMI, kg/m2	26.73±5.11	27.55±5.13	0.696	26.48±4.35
Waist circumference, cm	96.88±13.71	99.49±12.56	0.611	97.33±12.86

Table-2. Comparison of biochemical findings

	CAD (n=74)	CAD+DM (n=27)	P-value	Total (n=101)
Glucose, mg/dL	105.2±17.86	144.67±62.78	0.021*	114.48±38.23
HbA1C	5.869±0.61	7.098±1.66	0.017*	6.216±1.16
Total Cholesterol, mg/dL	198.47±45.76	182.94±42.41	0.377	193.02±44.62
LDL-C, mg/dL	137.94±39.18	118.75±38.64	0.363	131.68±40.36
HDL-C, mg/dL	45.69±12.86	45.78±10.02	0.731	45.71±12.09
Triglycerides, mg/dL	155.17±85.69	147.63±70.23	0.575	152.47±80.49
ALT, U/L	21.48±11.41	22.18±17.42	0.278	21.68±13.87
AST, U/L	20.04±6.76	21.58±21.58	0.146	20.36±9.76
RBC	4.67±0.51	4.50±0.61	0.331	4.62±0.55
HGB	13.89±1.39	13.64±1.81	0.219	13.79±1.53
HCT	41.92±9.75	39.33±5.38	0.461	41.24±8.95

Chi-square/Independent t-tests, *$p<0.05$, CAD: Coronary Artery Disease, DM: Diabetes Mellitus, HbA1C: Hemoglobin A1C, LDL-C: Low-Density Lipoprotein Cholesterol, HDL-C: High-Density Lipoprotein Cholesterol, ALT: Alanine Aminotransferase, AST: Aspartate Aminotransferase, RBC: Red Blood Cell, HGB: Hemoglobin, HCT: Hematocrit

Table-3. Comparison of Mediterranean Diet Scale Classification by Participants' Demographic Characteristics and Anthropometric Measurements

Mediterranean Diet Scale Classification	<=7		8-9		>=10			
Characteristics								
	Num	Per	Num	Perc	Num	Perc	P.val	Mean±SD P.va
Gender								
Female (n=47)	31	56.0	18	33.5	7	9.7	0.897	7.20 ±1.812 (4-10) 0.474*
Male (n=54)	35	55.9	21	34.7	8	11.0		7.41 ±1.699 (3-11)
Age, years								
31-50 (n=26)	15	60.0	8	33.3	6	8.3	0.948	7.30±1.941(3-11) 0.972**
51-70 (n=57)	32	54.2	21	36.3	6	8.5		7.24±1.791(3-11)
>70 (n=25)	13	49.6	11	38.4	5	12.0		7.29±1.971 (3-11)
BMI, kg/m2								
18.5-24.9 (n=21)	11	44.3	11	30.7	5	11.4	0.412	7.19 ±2.061 (3-11) 0.593**
25-29.9 (n=51)	28	52.8	17	32.5	8	13.6		7.36±1.594 (3-11)
>=30 (n=39)	25	68.4	10	26.8	3	5.6		7.05±1.821 (3-11)
Waist circumference								
Normal (n=37)	16	49.2	17	35.2	5	12.0	0.762	7.30±1.945 (3-11) 0.993*
High (n=70)	42	71.1	20	28.9	8	11.0		7.28±1.874 (3-11)
Diagnosis								
CAD (n=78)	46	51.7	31	38.5	10	13.0	0.041	7.33±1.942 (3-11) 0.048**
CAD+DM (n=22)	19	57.4	10	42.6	6	11.1		7.18±1.902 (4-10)
Education Level								
Primary School (n=58)	48	62.4	24	30.9	7	6.7	0.527	7.28±1.887 (3-11) 0.695**
High School (n=34)	11	50.0	9	45.0	6	14.3		7.39±1.958 (3-11)
University/Postgraduate (n=16)	9	45.0	7	35.3	4	10.3		7.82±1.819 (3-11)

*Chi-square test, **ANOVA, BMI: Body Mass Index

Table-4. Comparison of individuals' biochemical findings based on the Mediterranean Diet Scale classification.

Biochemical Parameters	Mediterranean Diet Scale Classification	<8 (n=45)	8-9 (n=28)	>9 (n=30)	P-value
Glucose, mg/dL	115.20±10.112	101.45±24.081	119.76±44.292	118.46±0.284	0.349
HbA1C	6.32±1.0823	6.174±0.9172	6.482±1.1311	6.77±.426	0.387
Total Cholesterol, mg/dL	198.37±53.486	185.42±41.958	190.79±38.375	193.53±0.528	0.298
LDL-C, mg/dL	141.98±45.827	132.40±37.552	130.91±38.365	137.43±0.737	0.361
HDL-C, mg/dL	44.61±13.702	46.48±14.991	43.14±11.896	45.53±0.614	0.346
Triglycerides, mg/dL	147.76±85.239	128.12±58.677	139.59±54.904	136.55±0.416	0.271
ALT, U/L	22.03±13.260	19.67±8.243	24.94±21.802	23.56±0.247	0.319
AST, U/L	19.12±7.406	20.01±6.847	27.92±23.122	27.44±0.042*	0.389
RBC	4.66±0.602	4.54±0.624	4.59±0.541	4.48±0.715	0.259
HGB	13.79±1.682	13.37±1.207	13.94±1.468	13.69±0.592	0.318
HCT	40.82±10.036	38.51±4.418	39.61±4.765	41.53±0.626	0.334

ANOVA, *p<0.05, HbA1C: Hemoglobin A1C, Total Cholesterol (T-Kol), LDL-C: Low-density lipoprotein cholesterol, HDL-C: High-density lipoprotein cholesterol, TG: Triglycerides, ALT: Alanine aminotransferase, AST: Aspartate aminotransferase, RBC: Red blood cell, HGB: Hemoglobin, HCT: Hematocrit

DISCUSSION

The findings of this study underscore a significant concern regarding the dietary habits of patients diagnosed with coronary artery disease (CAD). The notably low adherence to the Mediterranean diet, observed in the majority of participants, highlights a critical gap in dietary practices that are essential for managing and potentially reducing the risk of further cardiovascular events. With 56% of the patients classified as having low adherence to the Mediterranean diet and only 11% demonstrating high adherence, these results reflect a pressing need for more effective dietary interventions and education. Higher adherence to the Mediterranean diet has been associated with lower mortality, cardiovascular disease, metabolic disease, and cancer risks. Mechanisms underlying the beneficial effects of the Mediterranean diet include reductions in blood lipid levels, inflammatory and oxidative stress markers, improvement in insulin sensitivity, endothelial function, and anti-thrombotic effects, possibly attributed to bioactive components such as polyphenols, monounsaturated, and polyunsaturated fatty acids, or dietary fiber (5-8).

Adherence to the Mediterranean diet may have positive effects on disease-related issues and mortality in CAD patients (9, 10). A meta-analysis has shown a 29% reduction in major cardiovascular events (myocardial infarction, stroke, or cardiovascular death) associated with adherence to the Mediterranean diet (11). Another meta-analysis suggests an average 40% decreased risk associated with the incidence of CAD and mortality. The protective effects of the diet are particularly associated with olive oil, fruits, vegetables, and legumes. Similarly, a meta-analysis examining three randomized clinical controlled trials reported that adherence to the Mediterranean diet has a beneficial impact on the overall incidence of CAD and total myocardial infarction (12). Another meta-analysis, examining six randomized clinical controlled trials, indicated that the Mediterranean diet provides protection against major vascular events, coronary events, stroke, and heart failure, but it does not affect all-cause mortality or cardiovascular mortality (13). Similarly, another meta-analysis of 14 randomized clinical controlled trials reported beneficial effects of the Mediterranean diet on endothelial function (14).

It has been determined that approximately 80% of the participants in this study are overweight or obese. When participants are grouped according to their BMI and compared based on the classification of the Mediterranean Diet, there was no statistically significant difference among the groups (15). In a study examining the relationship between obesity and CAD through meta-analyses, it was observed that mortality in individuals with diabetes, hypertension, or coronary artery disease exhibited a U-shaped relationship with BMI. While a slight excess weight in elderly patients may initially show a protective effect against mortality due to sarcopenia, ongoing weight gain increases the risk of mortality. Therefore, it is crucial to prevent obesity in these patients. Meta-analyses have demonstrated that adherence to the Mediterranean diet has positive effects on reducing body weight and BMI or preventing weight gain. This effect is expected to increase further with energy restriction, increased physical activity, and adherence to the Mediterranean diet for more than six months (16).

Among the participants in this study, 25.7% have been diagnosed with Type 2 diabetes mellitus. When comparing groups with and without a diagnosis of Type 2 diabetes mellitus based on the classification of the Mediterranean Diet, there was no statistically significant difference. However, it was observed that the group with Type 2 diabetes mellitus had higher levels of fasting blood glucose and HbA1c. Therefore, increasing adherence to the Mediterranean diet is particularly important in patients with both diabetes and CAD. Although diabetes poses a risk for CAD, studies have shown no significant difference in the severity of CAD between individuals with and without diabetes. Additionally, it has been reported that an increase of 1 mmol/L in serum glucose independently increases the risk of CAD by 43%. A meta-analysis of eight randomized controlled trials demonstrated that the Mediterranean diet significantly reduces HbA1c but is not effective in reducing glucose parameters (17, 18). Another study evaluating nine randomized controlled trials indicated that adherence to the Mediterranean diet reduces HbA1c, fasting plasma glucose, and fasting insulin. In a different meta-analysis, adherence to the Mediterranean diet for more than six months was reported to have more favorable effects on glycemic control compared to low-fat diets (19).

In this study, no statistically significant differences were found in the mean values of Total Cholesterol (T-Col), LDL-Cholesterol (LDL-Col), HDL-Cholesterol (HDL-Col), and Triglycerides (TG) among the participants classified according to the Mediterranean Diet Scale. The Mediterranean diet's positive effects on endothelial dysfunction are attributed to its low cholesterol content. A meta-analysis of eleven randomized controlled trials provided strong evidence that the Mediterranean diet has a positive effect on TG, T-Col, and HDL-Col (20).

Approximately one-fourth of the participants in our study smoke. Smoking is an independent risk factor for CAD, particularly contributing to the formation and spreading of coronary artery plaques. Studies have shown that smokers develop 4% more plaques than non-smokers. Additionally, smoking increases oxidative stress, endothelial dysfunction, and atherosclerosis, thereby raising the risk of CAD and adversely affecting the prognosis in CAD patients (21). Adherence to the Mediterranean diet can counteract the damaging effects of smoking and potentially prevent its harms (22). In a study examining various education methods related to the Mediterranean diet, including individual counseling, computer-based personalized counseling, group education, internet-based training, cooking classes, and printed materials, participants who received education demonstrated statistically significant increases in the intake of vegetables, legumes, nuts, fruits, whole grains, seeds, olive oil, polyunsaturated fatty acids, and monounsaturated fatty acids. Moreover, improvements were observed in Total Cholesterol, LDL-Cholesterol, Total Cholesterol/HDL-Cholesterol ratio, insulin resistance, BMI, body weight, and waist circumference measurements. Another study reported that including cooking applications in educational programs tripled adherence to the Mediterranean diet (23).

This study has certain limitations. The data is limited to a single center, and the cross-sectional design prevents making causal inferences.

CONCLUSION

Our study reveals a concerningly low adherence to the Mediterranean diet among participants, which aligns with the high prevalence of overweight and obesity in the study population. These findings emphasize the critical need for targeted, continuous, and effective nutritional education programs. By focusing on improving dietary habits and promoting the Mediterranean diet, healthcare professionals can play a pivotal role in addressing these health issues.

The implementation of personalized counseling, group education sessions, and interactive approaches like cooking classes can significantly enhance participants' understanding and adoption of healthier eating patterns. Such initiatives are not only essential for raising awareness but also for empowering individuals to make sustainable dietary changes that improve long-term health outcomes.

In conclusion, enhancing adherence to the Mediterranean diet through well-structured and consistent nutritional education efforts is vital for improving overall health, particularly in populations at risk due to overweight and obesity. Continued efforts in this direction will be crucial for fostering healthier communities and reducing the burden of diet-related chronic diseases.

Conflict of interest: The authors declare no competing interests.

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