Progress in Nutrition 2021; Vol. 23, N. 3: e2021086 DOI: 10.23751/pn.v23i3.10828

Original Article

Mediterranean Type Diet Protects Adult Individuals From Diabetes[1]

Zeliha UÇAR[1], Mehmet AKMAN[2]

[1]Stanbul Okan University, Institute of Health Sciences, Nutrition and Dietetics Department, Mecidiyeköy / İstanbul
zelihaguvenc@hotmail.com
[2]Beykent University, School of Health Sciences, Nutrition and Dietetics Department, Büyülçekmece / İstanbul
mehmetakman35@gmail.com

Abstract

Objective: As one of the sustainable diets, the Mediterranean Diet (MD) is one of the healthiest diets in the world. The aim of this study is to determine the effect of MD, which is one of the dietary models supporting healthy nutrition, on biochemical parameters in adult individuals. MD supports healthy life and is important in preventing chronic diseases. *Methods:* study was conducted with a total of 122 individuals between the ages of 18-64 who applied to Sakarya University Healthy Nutrition / Obesity Counseling Unit between September 2019 and February 2020. The data were collected by face-to-face interview technique. Collected data are; demographic information, Mediterranean diet compliance scale survey, and biochemical parameters. *Results:* According to the results obtained, the erythrocyte and fasting insulin in individuals were found to be significant with the Mediterranean diet compliance ($p < 0.05$). Homeostatic Model Assessment-Insulin Resistance (HOMA-IR) and fasting insulin were found to be significant with Mediterranean diet compliance in the analyzes performed for women ($p < 0.05$). *Conclusion:* As a result; The findings obtained from this study showed that the Mediterranean diet reduced the risk of macro and micro complications caused by Diabetes Mellitus.

Keywords: Mediterranean Diet, Healthy Lifestyle, Chronic Diseases

Introduction

With the opportunities provided by technological developments in the field of medicine and health, the control of infectious diseases has been achieved and as a result, the life expectancy of the human being has been extended. Extension of life expectancy, on the other hand, caused an increase in the incidence of non-communicable metabolic and systemic diseases associated with poor lifestyle and unhealthy eating habits, apart from natural aging (1,2). According to the World Health Organization (WHO), health is defined as not only the absence of illness or disability, but also the complete physical, mental and social well-being of the individual (3). Nutrition, which is essential for the maintenance of life, starts from the mother's womb and continues until death, therefore it has a direct effect on health (4). Nutrition is expressed as the intake and use of the energy and nutrients required by the organism, not only for the treatment of diseases, but also primarily for the protection and improvement of health, and for increasing productivity and quality of life (4,5,6). It is thought that 60% of deaths in the world are caused by non-communicable diseases associated

1 This research was produced from the master thesis "Evaluation Of The Relationship Between Mediterranean Diet Score and Nutritional Status and Body Composition in Adult Individuals" under the consultancy of the author (Mehmet Akman).
2 Corresponding author

with lifestyle. It has been reported as a result of many studies that there is a strong relationship between food selection, nutritional pattern (diet) and these diseases. In the results of these studies, it has been shown that imbalances in energy and nutrient intake lead to four basic metabolic or physiological changes such as high blood pressure, overweight or obesity, hyperglycemia, and hyperlipidemia, which increase the risk of chronic disease by disrupting macro and / or micronutrient intake (1,2). It has also been reported that optimal nutrition may be sufficient for maintaining health, and the Mediterranean Nutrition (AD) Model has the potential to meet optimal nutrition due to its nutrient composition and variety (1,2,5). Feeding the MD style has been accepted as a life style that is passed down from generation to generation and recreated according to the changing living conditions, and it was determined as an intangible cultural heritage of humanity by the United Nations Educational, Scientific and Cultural Organization (UNESCO) in 2010 (5,7,8).

The Mediterranean Nutrition Model Pyramid, which includes lifestyle habits and consumption recommendations from food groups, has been updated especially according to the needs of healthy adults between the ages of 18-65 in order to gain healthy eating habits and to increase their applicability (8). In general, this model is rich in vegetables, fruits, whole grain products, legumes and nuts, and olive oil is used as the main oil source. In addition, consumption of fish, milk and dairy products (mainly yoghurt, cheese), eggs, poultry is recommended at moderate levels and red meat consumption is recommended at low levels. On the other hand, the Mediterranean Nutrition Model, which includes moderate alcohol and packaged foods, contains 30-40% fat (5,9,10). It is recommended to consume vegetables and fruits rich in polyphenols and antioxidants every day, which is considered a great feature for MD (1). In other words, it is thought that it is protective against chronic diseases by increasing the consumption of plant-based food rather than a single nutrient in MD type nutrition, but when a holistic adaptation is achieved. This effect is thought to be due to the high amounts of beneficial components found in phytonutrients such as dietary fiber, folate, antioxidants, vitamins, polyphenols, and potassium (11).

In different studies examining the interaction of foods that form the basis of the Mediterranean diet with chronic diseases and biochemical parameters, it has been reported that statistically significant reductions have been achieved in cardiovascular disease (CVD) mortality risk, blood pressure and HbA1c levels of diabetic patients and have a protective effect (1,5, 9,12-18). In Turkey, which is one of the Mediterranean countries, due to differences in people's income levels and geographic regions, although generally observed that sustainable diet that is compatible with AD; It is also seen that large amounts of sugar, saturated fat and foods with high energy density are preferred (19). Limited parameters have been evaluated in many comprehensive studies covering this subject in the literature (6-,9).

This study was planned and conducted in order to determine the effect of the Mediterranean Diet, which is a healthy eating model, on biochemical parameters.

Materials and Methods

The study was carried out according to the flow chart in Figure 2. Accordingly, after the preliminary assessment of the people applying to the counseling unit, the individuals who meet the conditions were determined. Then, biochemical parameters and demographic information were recorded using face-to-face interview technique. The interview was concluded by giving healthy nutrition training to the individuals. Then the collected data were analyzed.

Data Collection

In the study, the records of individuals between the ages of 18-64 who applied to Sakarya University Healthy Nutrition / Obesity Counseling Unit between September 2019 and February 2020 (retrospectively for 6 months) were used. Individuals using electronic (pacemaker) or non-electronic (leg prosthesis, etc.) medical implants and pregnant women were excluded in the study. The minimum sample size was calculated according to the Sample Calculation Formula Method and 122 individuals were included in the study. The Mediterranean Diet Scoring Scale was administered

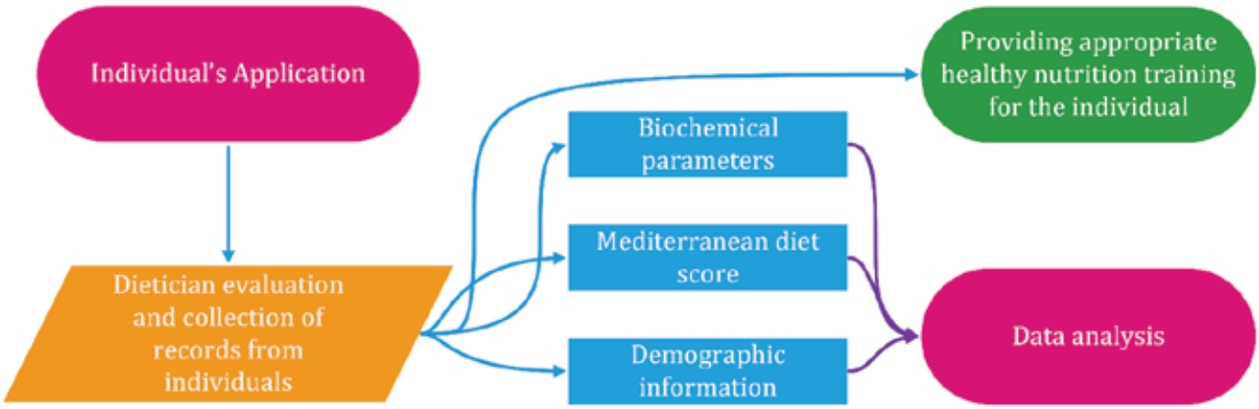

Figure 1. Flow diagram

to the participants who met the criteria and signed a voluntary consent form using face-to-face interview technique, and biochemical parameters were collected.

The Mediterranean Diet Compliance Scoring (MDS) was taken from the Turkish Adaptation Validity and Reliability of the Mediterranean Diet Commitment Scale (20). With MDS, consumption habits of the foods characteristic of MD were questioned in 2 questions, and the frequency of food consumption in 12 questions. For each question, 0 or 1 point can be obtained. Those who consume foods with high consumption such as olive oil, vegetables, fruits, legumes, oil seeds, fish and wine above the values specified in Mediterranean countries are given 1 point, and those who consume less are given 0 points. In addition, those who consume low consumption foods (such as red meat, butter, margarine, cream, sugary / carbonated beverages) traditionally in Mediterranean countries receive 1 points, while those who consume more receive 0 points. The total score obtained varies between MDS 0-14. Scores are classified as MDS≤5 low compatibility, MDS 6-9 medium compatibility, and MDS≥10 high compatibility.

Within the scope of biochemical parameters, Alanine Aminotransferase (ALT), Aspartate Aminotransferase (AST), lipid profiles (HDL-cholesterol, LDL-cholesterol, Total-cholesterol, triglyceride), fasting blood glucose, fasting insulin, fasting blood sugar, uric acid, creatinine, erythrocyte, hemoglobin, hematocrit, HOMA-IR, Thyroid Stimulating Hormone (TSH), Triiodothyronine (T3), Thyroxine (T4), bilirubin total, bilirubin direct, ferritin, iron, B12, vitamin D, albumin, calcium, total protein, Hemoglobin A1c (%) (HbA1c) results were recorded. HOMA-IR value of individuals was calculated with the formula in equation 1. HOMA-IR value of individuals was calculated with the formula in equation 1and HOMA-IR cut-off value was accepted as 2.7.

$$HOMA-IR = \frac{Fasting\ Blood\ Sugar\ (mg/dl) \times Fasting\ Insulin\ Level\ (\mu U/ml)}{405}$$

Biochemical findings of individuals were obtained from different laboratories. Therefore, the blood values were evaluated according to the reference range of each laboratory (3) below the reference value, (4) within the reference value range, and (1) above the reference value.

Statistical analysis

Statistical Package for the Social Sciences (SPSS) was used for statistical analysis. For statistical analysis, firstly, the normality of the data was determined by applying Levene's test to the data. Parametric or nonparametric tests were preferred in accordance with the hypotheses and whether the data were normally distributed. The mean, standard deviation, percentage, chi-square and two independent samples t test were used to determine whether there was a significant difference between the means according to the analysis

made in the presentation of the data. Results were considered significant at p <0.05.

Results

The demographic information of the individuals whose data was collected are given in Table 1. Age, marital status, and education status are given in the table. Gender and age were found to be significant.

Analysis results of the distribution of biochemical parameters of individuals according to MDS groups are given in Table 2 for all individuals, Table 3 for male individuals, and Table 4 for female individuals. All of the individuals are in the erythrocyte reference value range and 87% are in the low MDS group and 96.3% are in the middle MDS group. While 7.4% of the individuals above the reference value are in the low MDS group, there is no individual in the middle ADS group. According to the analyzes performed, a significant difference was found between the erythrocyte and fasting insulin and MDS groups in all individuals (p <0.05). In the analyzes performed for men, no significance was found between biochemical parameters and MDS groups (p> 0.05). In the analyzes performed for women, a significant difference was found between the HOMA-IR and fasting insulin and MDS groups (p <0.05).

Discussion

In this study, the investigation of the relationship between MDS groups and biochemical parameters was carried out in two ways, gender-based and all individuals (Table 2-4). For the evaluation of biochemical parameters, they are grouped in 3; under the reference value, within the reference value range, and above the reference value. After this grouping, an examination was made among the MDS groups. When the MDS groups and biochemical parameters were examined for all individuals, a significant difference was found in terms of erythrocytes (p <0.05) (Table 2). No significant difference was found for other parameters. A significant difference was found in HOMA-IR and fasting insulin (μIU / ml) values in women (p <0.05). When the analysis was made for men, no significant difference was found in any parameter (p> 0.05).

In studies in the literature, mean and standard deviation information were shared when examining

Table 1. Demographic Characteristics of Individuals

	Male		Female		Total		*p*
Age (year) ($\bar{x}$ ± SD)	**(n=49) $\bar{x}$ ± SD** 30±12		**(n=73) $\bar{x}$± SD** 26±9		**(n=122) $\bar{x}$ ± SD** 27,62±10,406		**0,009**[a]
Marital status	**S**	**%**	**S**	**%**	**S**	**%**	
Married	18	36,73	15	20,55	33	27,05	
Single	31	63,27	58	79,45	89	72,95	
	X^2=3,503[b] p>0,05						
Education Level	**S**	**%**	**S**	**%**	**S**	**%**	
Secondary school graduate	0	0	1	2,04	1	2,04	
High school graduate	28	57,14	53	108,16	81	165,31	
Associate Degree	2	4,08	5	10,20	7	14,29	
Bachelor's Degree	12	24,49	11	22,45	23	46,94	
Master's Degree	5	10,20	3	6,12	8	16,33	
PhD graduate	2	4,08	0	0	2	4,08	
	X^2=7,753[b] p>0,05						

[a] Two independent samples t test, b Chi-square test

Table 2. Evaluation of the distribution of biochemical parameters of all individuals according to Mediterranean diet score groups

	MDS≤5 (Low)						6≤MDS<10 (Medium)						10≤MDS (High)						X2	pa
	RDAl		RDAr		RDU		RDAl		RDAr		RDU		RDAl		RDAr		RDU			
Biochemical Parameters	**S**	**%**	**S**	**%**	**S**	**%**	**S**	**%**	**S**	**%**	**S**	**%**	**S**	**%**	**S**	**%**	**S**	**%**		
25-OH vitamin D3 (µg/L)	25	89,3	3	10,7	0	0,0	29	82,9	6	17,1	0	0,0	2	100	0	0	0	0	0,857	0,651
B12 vitamin (pg/mL)	5	10,4	42	87,5	1	2,1	6	12,8	41	87,2	0	0,0	1	50	1	50	0	0	2,878	0,237
Ferritin (ng/mL)	8	19,5	33	80,5	0	0,0	13	37,1	22	62,9	0	0,0	0	0	1	100	0	0	3,296	0,192
Total cholesterol (mg/dL)	0	0,0	24	64,9	13	35,1	0	0,0	30	63,8	17	36,2	0	0	1	100	0	0	0,555	0,758
Albumin (g/dL)	0	0,0	12	100,0	0	0,0	0	0,0	13	100,0	0	0,0	0	0	2	100	0	0	0,000	1,000
Total protein (g/dL)	0	0,0	5	83,3	1	16,7	0	0,0	9	100,0	0	0,0	0	0	1	100	0	0	1,667	0,435
Calcium (mg/dL)	0	0,0	26	96,3	1	3,7	0	0,0	26	100,0	0	0,0	0	0	2	100	0	0	1,037	0,595
Iron level (µg/dL)	9	26,5	24	70,6	1	2,9	11	39,3	17	60,7	0	0,0	0	0	1	100	0	0	1,849	0,397
HDL-Cholesterol (mg/dL)	3	8,1	32	86,5	2	5,4	4	8,9	39	86,7	2	4,4	0	0	1	100	0	0	0,057	0,972
Thyroxine (Free T4) (pg/mL)	0	0,0	40	100,0	0	0,0	0	0,0	30	100,0	0	0,0	0	0	1	100	0	0	0,000	1,000
Triiodothyronine (Free T3) (pg/mL)	0	0,0	22	95,7	1	4,3	0	0,0	18	94,7	1	5,3	0	0	0	0	0	0	0,019	0,891
TSH (µIU/mL)	0	0,0	48	98,0	1	2,0	1	2,1	43	89,6	4	8,3	0	0	1	100	0	0	0,783	0,676
Erythrocyte (x106)	3	5,6	47	87,0	4	7,4	2	3,7	52	96,3	0	0,0	1	50	1	50	0	0	6,119	**0,047**
Hemoglobin (g/dL)	9	16,7	42	77,8	3	5,6	7	12,5	49	87,5	0	0,0	1	50	1	50	0	0	1,798	0,407
Hematocrit (%)	8	14,8	43	79,6	3	5,6	8	14,5	46	83,6	1	1,8	1	50	1	50	0	0	1,887	0,389
LDL-Cholesterol (mg/dL)	0	0,0	27	61,4	17	38,6	0	0,0	28	65,1	15	34,9	0	0	1	100	0	0	0,702	0,704
AST (U/L)	1	2,0	46	93,9	2	4,1	0	0,0	51	96,2	2	3,8	0	0	2	100	0	0	0,188	0,910
ALT (U/L)	1	2,0	44	86,3	6	11,8	0	0,0	49	94,2	3	5,8	0	0	2	100	0	0	0,644	0,725
Triglyceride (mg/dL)	0	0,0	37	88,1	5	11,9	0	0,0	35	81,4	8	18,6	0	0	1	100	0	0	0,913	0,634
Creatinine (mg/dl)	2	5,0	38	95,0	0	0,0	5	10,0	43	86,0	2	4,0	0	0	2	100	0	0	0,103	0,950
Blood glucose (mg/dL)	2	3,8	48	92,3	2	3,8	2	3,7	47	87,0	5	9,3	0	0	2	100	0	0	0,835	0,659
HOMA-IR	0	0,0	18	75,0	6	25,0	0	0,0	15	71,4	6	28,6	0	0	0	0	1	100	2,607	0,272
Direct bilirubin (mg/dL)	0	0,0	21	95,5	1	4,5	0	0,0	11	84,6	2	15,4	0	0	2	100	0	0	1,435	0,488
Total bilirubin (mg/dL)	2	7,7	24	92,3	0	0,0	1	7,1	12	85,7	1	7,1	0	0	2	100	0	0	0,583	0,747
Uric acid (mg/dl)	0	0,0	23	92,0	2	8,0	0	0,0	26	92,9	2	7,1	0	0	2	100	0	0	0,174	0,917
Fasting insulin (µIU/ml)	0	0,0	25	92,6	2	7,4	0	0,0	21	100,0	0	0,0	0	0	0	0	1	100	16,438	**0,000**
HbA1C (%)	1	5,6	17	94,4	0	0,0	0	0,0	12	85,7	2	14,3	0	0	1	100	0	0	3,365	0,186

RDAl Below Reference Value, RDAr Within Reference Value Range, RDU Above Reference Value

a Kruskal-Wallis

Table 3. Evaluation of the distribution of biochemical parameters of male individuals according to Mediterranean diet score groups

	MDS≤5 (Low)						6≤MDS<10 (Medium)						10≤MDS (High)						X2	pa
	RDAl		RDAr		RDÜ		RDAl		RDAr		RDÜ		RDAl		RDAr		RDÜ			
Biochemical Parameters	S	%	S	%	S	%	S	%	S	%	S	%	S	%	S	%	S	%		
25-OH vitamin D3 (µg/L)	13	92,9	1	7,1	0	0,0	9	90,0	1	10,0	0	0,0	0	0	0	0	0	0	0,060	0,807
Vitamin B12 (pg/mL)	3	13,0	20	87,0	0	0,0	3	16,7	15	83,3	0	0,0	0	0	0	0	0	0	0,104	0,748
Ferritin (ng/mL)	2	11,1	16	88,9	0	0,0	4	33,3	8	66,7	0	0,0	0	0	0	0	0	0	2,148	0,143
Total cholesterol (mg/dL)	0	0,0	11	61,1	7	38,9	0	0,0	12	66,7	6	33,3	0	0	0	0	0	0	0,117	0,732
Albumin (g/dL)	0	0,0	5	100,0	0	0,0	0	0,0	4	100,0	0	0,0	0	0	0	0	0	0	0,000	1,000
Total protein (g/dL)	0	0,0	1	50,0	1	50,0	0	0,0	3	100,0	0	0,0	0	0	0	0	0	0	1,500	0,221
Calcium (mg/dL)	0	0,0	11	91,7	1	8,3	0	0,0	9	100,0	0	0,0	0	0	0	0	0	0	0,750	0,386
Iron level (µg/dL)	1	6,7	13	86,7	1	6,7	2	33,3	4	66,7	0	0,0	0	0	0	0	0	0	2,541	0,111
HDL-Cholesterol (mg/dL)	2	11,1	16	88,9	0	0,0	2	11,1	16	88,9	0	0,0	0	0	0	0	0	0	0,000	1,000
Thyroxine (Free T4) (pg/mL)	0	0,0	21	100,0	0	0,0	0	0,0	7	100,0	0	0,0	0	0	0	0	0	0	0,000	1,000
Triiodothyronine (Free T3) (pg/mL)	0	0,0	12	100,0	0	0,0	0	0,0	4	100,0	0	0,0	0	0	0	0	0	0	0,000	1,000
TSH (µIU/mL)	0	0,0	24	100,0	0	0,0	1	6,3	15	93,8	0	0,0	0	0	0	0	0	0	1,500	0,221
Eritrosit (x106)	1	4,2	20	83,3	3	12,5	0	0,0	21	100,0	0	0,0	0	0	0	0	0	0	0,938	0,333
Hemoglobin (g/dL)	0	0,0	22	91,7	2	8,3	0	0,0	22	100,0	0	0,0	0	0	0	0	0	0	1,875	0,171
Hematokrit (%)	0	0,0	21	87,5	3	12,5	0	0,0	21	95,5	1	4,5	0	0	0	0	0	0	0,895	0,344
LDL-Cholesterol (mg/dL)	0	0,0	13	59,1	9	40,9	0	0,0	12	70,6	5	29,4	0	0	0	0	0	0	0,537	0,464
AST (U/L)	1	4,0	23	92,0	1	4,0	0	0,0	19	90,5	2	9,5	0	0	0	0	0	0	1,174	0,279
ALT (U/L)	1	4,0	21	84,0	3	12,0	0	0,0	18	85,7	3	14,3	0	0	0	0	0	0	0,282	0,596
Triglyceride (mg/dL)	0	0,0	16	84,2	3	15,8	0	0,0	9	64,3	5	35,7	0	0	0	0	0	0	1,690	0,194
Creatinine (mg/dl)	1	5,3	18	94,7	0	0,0	1	5,0	18	90,0	1	5,0	0	0	0	0	0	0	0,334	0,563
Blood glucose (mg/dL)	0	0,0	23	95,8	1	4,2	1	4,8	17	81,0	3	14,3	0	0	0	0	0	0	0,341	0,559
HOMA-IR	0	0,0	4	44,4	5	55,6	0	0,0	6	60,0	4	40,0	0	0	0	0	0	0	0,436	0,509
Direct bilirubin (mg/dL)	0	0,0	10	90,9	1	9,1	0	0,0	3	75,0	1	25,0	0	0	0	0	0	0	0,600	0,439
Total bilirubin (mg/dL)	0	0,0	11	100,0	0	0,0	1	25,0	3	75,0	0	0,0	0	0	0	0	0	0	2,750	0,097
Uric acid (mg/dl)	0	0,0	12	92,3	1	7,7	0	0,0	13	92,9	1	7,1	0	0	0	0	0	0	0,003	0,957
Fasting insulin (µIU/ml)	0	0,0	11	91,7	1	8,3	0	0,0	10	100,0	0	0,0	0	0	0	0	0	0	0,833	0,361
HbA1C (%)	0	0,0	9	100,0	0	0,0	0	0,0	4	66,7	2	33,3	0	0	0	0	0	0	3,231	0,072

RDAl Below Reference Value, RDAr Within Reference Value Range, RDU Above Reference Value
a Kruskal-Wallis

Tablo 4. Evaluation of the distribution of biochemical parameters of female according to Mediterranean diet score groups

	MDS≤5 (Low)						6≤MDS<10 (Medium)						10≤MDS (High)						X2	pa
	RDAl		RDAr		RDÜ		RDAl		RDAr		RDÜ		RDAl		RDAr		RDÜ			
Biochemical Parameters	**S**	**%**	**S**	**%**	**S**	**%**	**S**	**%**	**S**	**%**	**S**	**%**	**S**	**%**	**S**	**%**	**S**	**%**		
25-OH vitamin D3 (µg/L)	12	85,7	2	14,3	0	0,0	20	80,0	5	20,0	0	0,0	2	100,0	0	0	0	0	0,624	0,732
Vitamin B12 (pg/mL)	2	8,0	22	88,0	1	4,0	3	10,3	26	89,7	0	0,0	1	50,0	1	50	0	0	3,415	0,181
Ferritin (ng/mL)	6	26,1	17	73,9	0	0,0	9	39,1	14	60,9	0	0,0	0	0,0	1	100	0	0	1,350	0,509
Total cholesterol (mg/dL)	0	0,0	13	68,4	6	31,6	0	0,0	18	62,1	11	37,9	0	0,0	1	100	0	0	0,732	0,694
Albumin (g/dL)	0	0,0	7	100,0	0	0,0	0	0,0	9	100,0	0	0,0	0	0,0	2	100	0	0	0,000	1,000
Total protein (g/dL)	0	0,0	4	100,0	0	0,0	0	0,0	6	100,0	0	0,0	0	0,0	1	100	0	0	0,000	1,000
Calcium (mg/dL)	0	0,0	15	100,0	0	0,0	0	0,0	17	100,0	0	0,0	0	0,0	2	100	0	0	0,000	1,000
Iron level (µg/dL)	8	42,1	11	57,9	0	0,0	9	40,9	13	59,1	0	0,0	0	0,0	1	100	0	0	0,686	0,710
HDL-Cholesterol (mg/dL)	1	5,3	16	84,2	2	10,5	2	7,4	23	85,2	2	7,4	0	0,0	1	100	0	0	0,207	0,901
Thyroxine (Free T4) (pg/mL)	0	0,0	19	100,0	0	0,0	0	0,0	23	100,0	0	0,0	0	0,0	1	100	0	0	0,000	1,000
Triiodothyronine (Free T3) (pg/mL)	0	0,0	10	90,9	1	9,1	0	0,0	14	93,3	1	6,7	0	0,0	0	0	0	0	0,051	0,822
TSH (µIU/mL)	0	0,0	24	96,0	1	4,0	0	0,0	28	87,5	4	12,5	0	0,0	1	100	0	0	1,359	0,507
Eritrosit (x106)	2	6,7	27	90,0	1	3,3	2	6,1	31	93,9	0	0,0	1	50,0	1	50	0	0	4,607	0,100
Hemoglobin (g/dL)	9	30,0	20	66,7	1	3,3	7	20,6	27	79,4	0	0,0	1	50,0	1	50	0	0	1,000	0,607
Hematocrit (%)	8	26,7	22	73,3	0	0,0	8	24,2	25	75,8	0	0,0	1	50,0	1	50	0	0	0,645	0,724
LDL-Cholesterol (mg/dL)	0	0,0	14	63,6	8	36,4	0	0,0	16	61,5	10	38,5	0	0,0	1	100	0	0	0,603	0,740
AST (U/L)	0	0,0	23	95,8	1	4,2	0	0,0	32	100,0	0	0,0	0	0,0	2	100	0	0	1,417	0,492
ALT (U/L)	0	0,0	23	88,5	3	11,5	0	0,0	31	100,0	0	0,0	0	0,0	2	100	0	0	3,944	0,139
Triglyceride (mg/dL)	0	0,0	21	91,3	2	8,7	0	0,0	26	89,7	3	10,3	0	0,0	1	100	0	0	0,144	0,930
Creatinine (mg/dl)	1	4,8	20	95,2	0	0,0	4	13,3	25	83,3	1	3,3	0	0,0	2	100	0	0	0,466	0,792
Blood glucose (mg/dL)	2	7,1	25	89,3	1	3,6	1	3,0	30	90,9	2	6,1	0	0,0	2	100	0	0	0,682	0,711
HOMA-IR	0	0,0	14	93,3	1	6,7	0	0,0	9	81,8	2	18,2	0	0,0	0	0	1	100	6,392	**0,041**
Direct bilirubin (mg/dL)	0	0,0	11	100,0	0	0,0	0	0,0	8	88,9	1	11,1	0	0,0	2	100	0	0	1,444	0,486
Total bilirubin (mg/dL)	2	13,3	13	86,7	0	0,0	0	0,0	9	90,0	1	10,0	0	0,0	2	100	0	0	2,877	0,237
Uric acid (mg/dl)	0	0,0	11	91,7	1	8,3	0	0,0	13	92,9	1	7,1	0	0,0	2	100	0	0	0,173	0,917
Fasting insulin (µIU/ml)	0	0,0	14	93,3	1	6,7	0	0,0	11	100,0	0	0,0	0	0,0	0	0	1	100	12,896	**0,002**
HbA1C (%)	1	11,1	8	88,9	0	0,0	0	0,0	8	100,0	0	0,0	0	0,0	1	100	0	0	1,000	0,607

RDAl Below Reference Value, RDAr Within Reference Value Range, RDU Above Reference Value
a Kruskal-Wallis

the relationship between biochemical parameters and MDS groups (21, 22). In this study, the biochemical parameters collected were obtained from many different laboratories. For this reason, the parameters had to be grouped. The explanation of the data after grouping is given in the form of data number and percentage. Although the study differs from the literature in terms of processing data, it offers a different approach.

In a study in the literature, biochemical parameters for all individuals were examined among ADS groups. According to the analysis results, HbA1c%, fasting insulin, HOMA-IR and leukocyte (WBC) values were found to be significant (21). In another study, Total Cholesterol, HDL-Cholesterol, LDL-Cholesterol and Triglyceride were found to be significant (22). According to the MDS groups obtained in this study; The erythrocyte, HOMA-IR and fasting insulin significance values are consistent with the literature.

In the study performed by Azzini et al., no relationship was found between MDS and LDL-cholesterol, HDL-cholesterol, total cholesterol, and triglyceride values (23). On the other hand, Beunza et al. found a significant relationship between total cholesterol and HDL-cholesterol and MDS. However, contrary to expectations, individuals in the group with high MDS had higher total cholesterol values compared to the other groups (24). In another study, it was found that increased compliance with MD had a positive effect on blood HDL-cholesterol, LDL-cholesterol, and total cholesterol (17). In another study, LDL-cholesterol was found to be significant with MDS, but no relationship was found between other blood fats and MDS (10). There are significant differences in studies in the literature (10, 17, 23). These differences may be due to sample size, sample distribution, and the distribution of individuals; answers to the questionnaires. The relationship was examined in the articles selected from the literature, but only distributions were shown in this article. The reason for this may be our sample and the low number of people in the 3rd group belonging to MDS. In addition, the average age of individuals in this study is closer to the study conducted by Azzini et al. It is similar to Azzini and the age difference may be the reason for the difference seen with other studies.

Park et al. found that leukocyte, HOMA-IR, fasting insulin, and HbA1c% values were significant with MDS in their study. Fasting insulin and HOMA-IR decrease as MDS increases (25). In this study, HOMA-IR, fasting insulin values were found to be significant with MDS. This result is consistent with the literature. MD may be effective in preventing diabetes since HOMA-IR and fasting insulin values are parameters associated with diabetes.

Erythrocyte is a biochemical parameter sensitive to iron, B12, and folate values due to nutritional deficiency (26). When nutritional deficiency occurs, erythrocyte values may be observed as low. MD is one of the diet models that provide optimal nutrition. Individuals with high MDS compliance are less likely to have nutritional deficiencies such as iron, folic acid, and vitamin B12. Erythrocyte may vary as sensitive to this vitamin and mineral consumption. In one study, no relationship was found between vitamin B12 and MDS in parallel with this study (10).

It is thought that there is a significant relationship between compliance with the Mediterranean diet and reduced insulin resistance, erythrocyte, which is one of the nutritional parameters in the blood, and blood insulin level.

Nowadays, the number of chronic diseases is increasing day by day due to many factors such as the widespread use of the western type of diet, sedentary life, and the existence of an obesogenic environment. Western type of nutrition model is also becoming widespread in Mediterranean countries. This situation is common especially at young ages. The Mediterranean type diet, which has been the nutrition model of Mediterranean countries for many years, has been replaced by the western type diet. For this reason, the importance of the Mediterranean type diet model has been emphasized more in recent years. Especially after being modeled in accordance with today's lifestyle, the number of researches has increased. In addition, although the Mediterranean diet model is a healthy diet type, its mechanism of action in protecting against chronic diseases is still being studied.

In the literature review, the efficacy of the Mediterranean diet on individuals with chronic diseases and its effect on impaired biochemical parameters were determined among the studies conducted so far. In this

study, without observing the presence of chronic disease, the adaptation of individuals to the Mediterranean diet was evaluated and the relationship between biochemical parameters was evaluated. Mostly, Biochemical parameters obtained from a single laboratory are used in the literature. The most important feature of this study is that biochemical parameters were used without making laboratory distinction. Instead of giving the mean standard deviation, it is evaluated as above, between, and below the reference value range. Thus, more individuals have been reached. In addition, considering the studies that calculate the mean without giving reference value ranges, in this study interpretation was made without allowing the reader to interpret it according to incorrect reference intervals. In addition, according to the literature, more biomarkers were determined and used for each individual. In this respect, it is one step ahead of the studies in the literature.

Conclusion

In the studies conducted in the literature, mostly, male / female distinction has not been made. In this study, separate statistical evaluations were made in terms of all individuals / men / women. As a result of the analysis, fasting insulin and erythrocyte are compatible with MDS in all individuals and women. MDS is also compatible with HOMA-IR in women. Although meaningful results are not obtained in the analyzes made for men, the results obtained for all individuals can enable us to generalize in men. The best result obtained at the end of the study can be thought to be able to improve the fasting insulin and HOMA-IR with Mediterranean type nutrition model. In this case, it can be used as an important nutritional model in preventing diabetes. When the relationship of MD with fasting insulin and decreased insulin resistance is evaluated, it can be said that it will have an important effect on protection from diabetes.

Conflict of Interests: The author declares that there is no conflict of interests regarding the publication of this paper.

Acknowledgment

Financial Support: No financial support has been received from any institution or organization for this study.

Ethics Committee Approval: Ethics committee approval was obtained from Sakarya University Faculty of Medicine to carry out this study. Approval date and number 03/05/2019 - 71522473/050.01.04/112.

Data Use Permission: The data collection and usage permission of Sakarya University Rectorate was obtained to carry out this study. Permission date and number 27/08/2019 - 35955870/604.02.

References

1. Galbete C., Schwingshackl L., Schwedhelm C., Boeing H., Schulze MB. "Evaluating Mediterranean diet and risk of chronic disease in cohort studies: an umbrella review of meta-analyses". *Eur J Epidemiol*. 2018, 33(10): 909–31.
2. Aktaş N., Özdoğan Y., University S., Faculty SB., And B., Department D., et al. " Food and Nutrition Literacy ". *Harran Journal of Agriculture and Food Science*. 2016, 20(2): 146–53.
3. WHO DSÖ. "Frequently asked questions" [Internet]. 2020 [2020 Apr 14]. Access: https://www.who.int/about/who-we-are/frequently-asked-questions
4. T.R. Ministry of Health Public Health Agency of Turkey. " Turkey Nutrition Guide "TÜBER 2015"" [Internet]. 2015 [2020 Apr 14]. 30 p. Access: www.albantanitim.com.tr
5. Barbaros B. " Determination of Oxidative Stress and Total Antioxidant Capacity in Individuals with High, Medium and Low Mediterranean Diet Compliance Burcu Barbaros". 2015.
6. Yurtseven E., Eren F., Vehid S., Köksal S., Erginöz E., Sarper M., et al. " Evaluation of White Collar Workers' Eating Habits ". *Kocatepe Tıp Derg*. 2014, 15(1): 20–6.
7. Aşit M. " Evaluation of the Relationship between the Adult's Mediterranean Diet Score and Nutrition Habits and Anthropometric Measurements in Individuals ". 2018, .
8. Madencioğlu S. "A Study on Determining the Adaptation of the Students of the Department of Nutrition and Dietetics to the Mediterranean Diet at Near East University". 2015.
9. Dalgıç GS. "Assessment of Health Sciences Faculty Students' Compliance with the Mediterranean Diet". 2018.
10. Boru B. "The Relationship of Nutritional Status and Diabetes to the Level of Depression, Anxiety and Stress in Obese Adults". 2018.
11. Aguilera Y., Martin-Cabrejas MA., González de Mejia E. "Phenolic compounds in fruits and beverages consumed as

part of the mediterranean diet: their role in prevention of chronic diseases". *Phytochem Rev*. 2016, 15(3): 405–23.
12. Cin P., Gezer C. " Relationship between Citrus fruits as a Functional Food and Metabolic Syndrome ". *J Food Heal Sci*. 2017, 3(2): 49–58.
13. Asgary S., Keshvari M. "Effects of citrus sinensis juice on blood pressure". *ARYA Atheroscler*. 2013, 9(1): 98–101.
14. (14) Pan B., Wu Y., Yang Q., Ge L., Gao C., Xun Y., et al. "The impact of major dietary patterns on glycemic control, cardiovascular risk factors, and weight loss in patients with type 2 diabetes: A network meta-analysis". *J Evid Based Med*. 2019, 12(1): 29–39.
15. Guasch-Ferre M., Merino J., Sun Q., Fito M., Salas-Salvado J. "Dietary Polyphenols, Mediterranean Diet, Prediabetes, and Type 2 Diabetes: A Narrative Review of the Evidence". *Oxid Med Cell Longev*. 2017, 2017.
16. Kılıç FN. " Dietary fiber and health ". In: Nutrition and dietetics current issues -2. 1st ed. Ankara: Hatiboğlu Publisher; 2015. p. 81–107.
17. Muscogiuri G., Barrea L., Somma C Di., Altieri B., Vecchiarini M., Orio F., et al. "Patient empowerment and the Mediterranean diet as a possible tool to tackle prediabetes associated with overweight or obesity : a pilot study". *Hell Endocr Soc*. 2019, 75–84.
18. Malakou E., Linardakis M., Elaine M., Armstrong G., Zannidi D., Foster C., et al. "The Combined Effect of Promoting the Mediterranean Diet and Physical Activity on Metabolic Risk Factors in Adults : A Systematic Review and Meta-Analysis of Randomised Controlled Trials". *Nutrients*. 2016, .
19. Alphan EM. " Healthy Eating Healthy Tastes ". Nobel Yayın Dağıtım Ltd.; 2005. 78–80 p.
20. Fatma E., Pehlivanoğlu Ö., Balcıoğlu H., Ünlüoğlu İ., İl B., Müdürlüğü S., et al. "Turkish validation and reliability of mediterranean diet adherence screener", Pehlivanoglu Ozkan EF Balcioglu H Unluoglu I. 2019, 42(2): 160–4.
21. Park Y-M., Zhang J., Steck SE., Fung TT., Hazlett LJ., Han K., et al. "Obesity Mediates the Association between Mediterranean Diet Consumption and Insulin Resistance and Inflammation in US Adults". *J Nutr*. 2017 Apr, 147(4): 563–71.
22. E.Koloverou., Panagiotakos DB., C.Pitsavos., Chrysohoou C., Georgousopoulou EN., Grekas A., et al. "Adherence to Mediterranean diet and 10-year incidence (2002–2012) of diabetes: correlations with inflammatory and oxidative stress biomarkers in the ATTICA cohort study". *Diabetes Metab Res Rev*. 2016, 32(30): 13–23. Access: http://libweb.anglia.ac.uk/
23. Azzini E., Polito A., Fumagalli A., Intorre F., Venneria E., Durazzo A., et al. "Mediterranean Diet Effect: An Italian picture". *Nutr J*. 2011, 10(1): .
24. Beunza JJ., Toledo E., Hu FB., Bes-Rastrollo M., Serrano-Martínez M., Sánchez-Villegas A., et al. "Adherence to the Mediterranean diet, long-term weight change, and incident overweight or obesity: The Seguimiento Universidad de Navarra (SUN) cohort". *Am J Clin Nutr*. 2010 Dec 1, 92(6): 1484–93.
25. Oude Griep LM., Geleijnse JM., Kromhout D., Ocké MC., Monique Verschuren WM. "Raw and processed fruit and vegetable consumption and 10-year coronary heart disease incidence in a population-based cohort study in the Netherlands". *PLoS One*. 2010, 5(10): .
26. Mahan LK., Raymond JL. "Krause's food and autrition care process". 14th ed. Saunders, Philadelphia; 2017.