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EVALUATION OF ADHERENCE LEVELS TO THE MEDITERRANEAN DIET IN PATIENTS WITH CHOLELITHIASIS

KOLELİTİAZİSLİ HASTALARINDA AKDENİZ DİYETİNE UYUMUN DEĞERLENDİRİLMESİ

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ABSTRACT

Objective: The Mediterranean diet is associated with preventing and treating diseases with the consumption of beneficial nutrients in its composition and the intake of nutrients. It is a sustainable diet model with a protective feature on health. The beneficial health effects of the daily dietary pattern and adherence level to the Mediterranean diet in forming gallstones are well recognized. This study aimed to investigate the effect of the Mediterranean diet on individuals with cholelithiasis.

Methods: The study included a total of one hundred people, fifty of whom had cholelithiasis, and fifty healthy controls who were in the same age group as the patient group. Participants were questioned about their food frequency by surveys. Adherence level to the Mediterranean diet was evaluated with the Mediterranean Diet Adherence Screener (MEDAS).

Results: When the patients were compared with the healthy controls, the patient group had a lower Mediterranean diet adherence ($p<0.01$). According to the statistics, there was a negative correlation between body mass index (r: -0.486), waist circumference (r: -0.407), body fat ratio (r: -0.521), and adherence levels to the Mediterranean diet in the males of the patient group. The total daily energy, total fat, carbohydrates, n-6 fatty acid, and saturated fatty acid intake levels of females in the patient group were higher than those in the control group ($p<0.05$). The total daily energy, fat, saturated fatty acids, and cholesterol intake levels of the males in the patient group were higher than those in the control group ($p<0.05$).

Conclusion: The study found that adherence level to the Mediterranean diet model and weight control significantly affect the formation of gallstones. Keywords: Anxiety, Blood Draw, Child, Nursing, Pain, Virtual Reality.

Keywords: Anthropometric Measurements, Cholelithiasis, Diet, Gallstones, Mediterranean Diet.

ÖZET

Amaç: Akdeniz diyeti, sağlığın korunması ve geliştirilmesinde önemli role sahip, sürdürülebilir bir diyet modelidir. Safra kesesi taşı oluşumunda günlük diyetle alınan besin öğeleri ve Akdeniz diyetine uyumun yüksek olmasının sağlık üzerine olumlu etkileri bilinmektedir. Bu çalışma, kolelitiazisli bireylerin Akdeniz diyetine olan uyumlarını belirlemek amacıyla planlanmıştır.

Gereç ve Yöntem: Çalışmaya kolelitiazis tanılı 50 vaka ve yaş grubu vaka grubuna benzer 50 sağlıklı kontrol olmak üzere 100 birey dahil edilmiştir. Çalışmaya katılan bireylerin beslenme durumları besin tüketim sıklık anketiyle sorgulanırken; Akdeniz diyet uyumları, Akdeniz Diyeti Bağlılık Ölçeği (MEDAS) ile değerlendirilmiştir. Antropometrik ölçümler araştırmacı tarafından uygulanmıştır. Verilerin değerlendirilmesinde NCSS-2007 programı kullanılmıştır.

Bulgular: Çalışmaya katılan vaka grubundaki bireylerin Akdeniz diyet uyumlarının kontrol grubundan düşük olduğu saptanırken ($p<0.01$); vaka grubundaki erkek bireylerin beden kütle indeksi (BKİ) (r: -0.486), bel çevresi (r: -0.407) ve vücut yağ oranlarıyla (r: -0.521) Akdeniz diyet uyumu arasında negatif yönde istatistiksel olarak anlamlı ilişki bulunmuştur ($p<0.05$). Vaka grubundaki kadınların günlük yiyecek ve içeceklerden alınan toplam enerjilerinin, yiyeceklerden alınan toplam yağ, karbonhidrat, n-6 yağ ve doymuş yağ asit miktarlarının kontrol grubundan yüksek olduğu belirlenmiştir ($p<0.05$). Vaka grubundaki erkeklerin günlük yiyecek ve içeceklerden alınan toplam enerjileri, yiyeceklerden alınan toplam yağ, doymuş yağ asit ve kolesterol miktarları kontrol grubundan yüksek saptanmıştır ($p<0.05$).

Sonuç: Çalışma sonunda, safra taşı oluşumunda Akdeniz diyet modeline uyumun ve ağırlık kontrolünün olumlu etkisinin olduğu bulunmuştur.

Anahtar Kelimeler: Akdeniz Diyeti, Antropometrik Ölçümler, Beslenme, Kolelitiazis, Safra Taşı.

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INTRODUCTION

It has been shown that the majority of gallbladder diseases are associated with cholecystitis caused by gallstones (cholelithiasis) (Jessri and Rashidkhani, 2015). The incidence rate of gallstones has rapidly increased by changes in diet and prolongation of life expectations (Gu et al.,2020). In epidemiological studies, the prevalence rate of gallstones differs between the societies (European Association for the Study of the Liver,2016; Everhart et al. 1999; Stinton and Schafer, 2012). There are a limited number of prevalence studies in our country and the incidence rate of the formation of gallstones in the general population was seen to be between 5.25% and 7.79% (Koşar et al.,2019).

Diet is an important modifiable risk factor in the formation of gallstones. Although there are some contradictions in the studies; it has been shown that diets containing high cholesterol, saturated fatty acids and high carbohydrates increase the risk of gallbladder disease, while a diet rich in unsaturated fatty acids, fiber and vitamins and minerals reduces this risks. While high intake of saturated and trans fatty acids is associated with an increased risk of gallstone formation; intake of mono and polyunsaturated fatty acids has been associated with a lower risk of gallstone formation (Jessri and Rashidkhani, 2015). It has been shown that a healthy diet, especially including the consumption of energy-balanced oilseeds, is protective against gallstone formation (Attili et al.,1998; Méndez-Sánchez et al., 2007; Thornton et al.,1983). At the same time, it is thought that increasing the amount of carbohydrates taken in the diet may increase the risk of gallstone formation by causing a decrease in total fat consumption (Thornton et al.,1983). Due to the relationship between high energy intake and obesity which is an important risk factor for the formation of gallstones, it is considered that high energy intake increases the risk of gallstone formation (Méndez-Sánchez et al., 2007). Although the studies performed cannot clearly state the relationship between the formation of gallstones and dietary patterns; the risk of gallstone formation has been reported to be higher in Western-style diet models rich in refined carbohydrates, saturated, and trans fatty acids and poor in fiber, and less in diet models rich in unsaturated fatty acids, vitamin C, fiber, vegetable oils, consumption of vegetable and fruits (Attili et al.,1998; Méndez-Sánchez et al., 2007; Park et al.,2017; Shaffer, 2006; Thornton et al.,1983).

The Mediterranean diet consists of higher consumption levels of olive oil, fruit and vegetables, whole grain products, oil seeds, and legume, intermediate consumption levels of egg, milk, and dairy products, and lower consumption levels of red meat, wine, pre-prepared, processed high energy density foods and sugary beverages and known to have favorable effects on chronic diseases such as obesity, diabetes, cardiovascular diseases, metabolic syndrome, cancer, and neurodegenerative diseases (Bach-Faig et al., 2011; Sofi et al., 2010). There is a limited number of studies assessing the relationship between the Mediterranean diet and the formation of gallstones in the literature. Due to containing foods rich in fiber (fruits, vegetables, legumes, and whole grain products) and olive oil as a basic fat resource, the Mediterranean diet has been reported to be protective against the formation of gallstones (Barré et al., 2017; Şahin et al., 2020; Wirth et al., 2018).

This study aimed to evaluate the adherence levels of individuals with cholelithiasis to the Mediterranean diet.

MATERIALS AND METHODS

Voluntary acceptance to participate in the research, being between the ages of 18-65 and being diagnosed with cholelithiasis were determined as the inclusion criteria for the study; being younger than 18 years of age and older than 65 years of age and not being diagnosed with cholelithiasis were determined as exclusion criteria from study. Adult volunteer individuals who met the eligibility criteria and agreed to participate in the study among eighty patients hospitalized in the general surgery department of the Acıbadem Kozyatağı Hospital with a diagnosis of cholelithiasis within the study period were included in the study population for the patient group. Fifty female and male individuals between 18 to 65 years of age diagnosed with cholelithiasis constituted the patient group, and fifty female and male individuals between 18 to 65 years of age not diagnosed with cholelithiasis constituted the control group. This study was conducted by applying a face-to-face questionnaire form by the researcher. In the questionnaire form used, demographic characteristics and dietary habits of individuals were questioned, and a food-frequency questionnaire (FFQ) determining the consumption frequencies and daily consumption quantities of forty-seven foods and beverages determined was applied. Anthropometric measurements of the individuals participating in the study were performed by the researcher. The waist circumference was measured with a non-elastic measuring tape, the body weight (kg) was measured with a precision scale with an accuracy of 0.5 g, and the height (cm) was measured with a vertical Stadiometer while the participant standing in the Frankfort horizontal plane without shoes. Following the body weight and height measurements, body mass index (BMI) was calculated, and body fat ratio (%) was assessed with a bioelectrical impedance analysis (BIA) device. Mediterranean Diet Adherence Screener (MEDAS) was used to evaluate adherence levels to the Mediterranean diet. MEDAS was developed for the first time by Martínez-González MA et al. (2012), its validity was constructed by Schröder H et al. (2011), and Turkish Validation and Reliability of the scale was performed by Pehlivanoglu Ozkan EF (2020). NCSS (Number Cruncher Statistical System) 2007 (Kaysville, Utah, USA) program was used for statistical analysis. During the evaluation of the study data, descriptive statistical methods (Mean, Standard Deviation, Median, Frequency, Ratio, Minimum, and Maximum) were used. The conformity of the qualitative data to the normal distribution was evaluated with the Shapiro-Wilk test and graphical investigations. The Student t-test was used for the intergroup comparisons of the variables with normal distribution. The Mann-Whitney U test was used for the intergroup comparisons of the qualitative variables without normal distribution. The Pearson Chi-Square test, Fisher's Exact, test, and Fisher-Freeman-Halton test were used for the comparison of qualitative data. The statistical significance was evaluated at the level of p<0.01. The conditions with a p-value of <0.05 were considered to be statistically significant in all assessments.

Ethics Committee Approval

The study was found to be suitable according to medical ethics with the decision number of 2019-18 at the meeting of the Ethics Committee of 2019-18/32 numbered and received "the Ethics Committee approval" dated 21.11.2019. The participants were given verbal and written information and an informed volunteer consent form was signed by them.

RESULTS

Twenty-three of the individuals in the patient group participating in the study were females and 27 of them were males. Twenty-five of the individuals in the control group were females and 25 of them were males. While the mean age of the individuals diagnosed with cholelithiasis was 45.22±10.85 years; the mean age of the individuals without a diagnosis of cholelithiasis was 40.84±12.51 years. Twenty-two percent of the individuals in the patient group graduated from high school, 64% of them graduated from university, and 14% of them had a post-graduate degree. Eight percent of the individuals in the control group graduated from high school, 64% of them graduated from university and 28% of them had a post-graduate degree. Eighty-four percent of the individuals in the patient group were married, and 16% were single. Seventy percent of the individuals in the control group were married, and 30% were single. Ninety-four percent and 98% of the individuals in the patient and control groups were determined to live with their parents; respectively (Table 1).

Table 1. Sociodemographic characteristics of the study population

		Total (n=100)	Patient Group (n=50)	Control Group (n=50)	p
		n (100%)	n (100%)	n (100%)	
Age (year)	Min – Max (Median)	22-64 (41)	28-64 (45.5)	22-63 (38.5)	[a]**0.064**
	Mean±SD	43.03±11.86	45.22±10.85	40.85±12.51	
Sex	Female	48 (48)	23 (46)	25 (50	[b]**0.689**
	Male	52 (52)	27 (54)	25 (50)	
Education Level	High School	15 (15)	11 (22)	4 (8)	[b]**0.062**
	University	64 (64)	32 (64)	32 (64)	
	Post-graduate	21 (21)	7 (14)	14 (28)	
Marital status	Married	77 (77)	42 (84)	35 (70)	[b]**0.096**
	Single	23 (23)	8 (16)	15 (30)	
The way of life	At home, alone	4 (4)	3 (6)	1 (2)	[c]**0.617**
	With parents	96 (96)	47 (94)	49 (98)	

[a]*Student t Test* [b]*Pearson Chi-Square Test* [c]*Fisher's Exact Test*

While the mean body weight of the females in the patient group was 69.20±11.19 kg, the mean body weight of those in the control group was 60.71±8.72 kg. It was determined that 39.1% of the individuals in the patient group were normal weight, 47.8% of them were overweight, and 13% of them were obese. Four t of the individuals in the control group were thin, 84% of them were normal weight, 8% of them were mildly obese, and 4% of them were obese ($p<0.05$). While the mean waist circumference measurements of the patient group were 87.26±7.72 cm; the mean waist circumference measurements of the control group were 79.72±7.61 cm. While 47.8% of the patient group had a normal body fat ratio, and 52.2% of them had a higher body fat ratio; 84% of the control group had a normal body fat ratio, and 16% of them had a higher body fat ratio. Differences between the groups regarding anthropometric measurements were found to be statistically significant ($p<0.05$). When the anthropometric measurements of male individuals participating in the study were evaluated, body weights, BMI assessments, and waist circumference measurements were not found to be statistically significant between the groups ($p>0.05$). Fourteen-point-eight percent of the individuals in the patient group had a normal body fat ratio, and 85.2% of them had a higher body fat ratio. The body fat ratio of the patient group was found to be statistically significantly higher than the control group ($p<0.05$) (Table 2).

Table 2. Distribution of anthropometric measurements of the individuals

		Patient Group (Female) (n=23)	**Control Group (Female) (n=25)**	^{a}**p**	**Patient Group (Male) (n=27)**	**Control Group (Male) (n=25)**	^{a}**p**
		n (%)	**n (%)**		**n (%)**	**n (%)**	
Body weight (kg)	**Mean±SD**	69.20±11.19	60.71±8.72	**0.005****	83.04±10.43	81.82±8.86	**0.652**
BMI (kg/m²)	**Mean±SD**	26.29±4.38	22.74±3.51	**0.003****	26.19±2.04	25.33±1.95	**0.127**
	Thin (<18.5 kg/m²)	0 (0)	1 (4)		-	-	
	Normal weight (18.5-24.9 kg/m²)	9 (39.1)	21 (84)		8 (29.6)	11 (44)	
	Mildly obese (25.0 – 29.9 kg/m²)	11 (47.8)	2 (8)		19 (70.4)	14 (56)	
	Obese (≥30 kg/m²)	3 (13)	1 (4)		-	-	
Waist circumference (cm)	**Mean±SD**	87.26±7.72	79.72±7.61	**0.001****	95.07±7.85	92.52±7.60	**0.240**
Body fat ratio (%)	**Mean±SD**	31.07±5.23	26.32±4.83	**0.002****	26.87±4.18	24.44±3.03	**0.021***
	Normal (%6-24)	11 (47.8)	21 (84)		4 (14.8)	8 (32)	
	High (≥%25)	12 (52.2)	4 (16)		23 (85.2)	17 (68)	

^{a}*Student t Test* ***p<0.01 *p<0.05*

According to the evaluation of the averages of daily dietary energy and macronutrient intakes of the individuals participating in the study obtained from the food-frequency questionnaire, the following was determined: the total intake of energy, total fat quantity, and the ratio of fat, carbohydrate, polyunsaturated fat, n-6 fatty acid, and saturated fatty acid amounts taken from daily food by the females in the patient group was higher than those in the control group; the fiber and protein quantities consumed per kilogram of females in the patient group were determined to be statistically significantly less than those in the control group ($p<0.05$). The total intake of energy, total fat quantity, and the ratio of fat, the ratio of n-6 fatty acid, saturated fatty acids, and cholesterol amounts taken from daily food by the males in the patient group were determined to be higher than those in the control group; the fiber amounts and the ratio of carbohydrate consumed per kilogram of the males in the patient group were determined to be statistically significantly less than those in the control group (p<0.05) (Table 3).

Table 3. Evaluation of the average dietary intakes of the female and male individuals

		Female			**Male**		
		Patient Group (n=23)	**Control Group (n=25)**	**p**	**Patient Group (n=23)**	**Control Group (n=25)**	**p**
Energy (Kcal)	*Min-Max (Median)*	1372-2329.2 (1786.6)	1173-1912.7 (1561.6)	[a]0.001**	1378.8-2506 (1978.8)	1594.7-2297 (1945.2)	[a]0.265
	Mean±SD	1807.46±257.50	1567.53±179.28		1989.84±236.90	1925.28±166.90	
Protein (g)	*Min-Max (Median)*	46.6-99.2 (69.1)	51.6-88.2 (70.6)	[a]0.866	62.2-121.8 (89.7)	56.2-105.1 (88.2)	[a]0.236
	Mean±SD	70.43±14.12	69.83±10.38		91.34±13.26	87.26±11.04	
Protein (%)	*Min-Max (Median)*	12-19 (16)	13-22 (19)	[a]0.001**	16-25 (18)	14-21 (19)	[a]0.626
	Mean±SD	15.78±1.88	18.20±2.24		18.74±2.10	18.48±1.69	
Protein (g/kg)	*Min-Max (Median)*	0.8-1.7 (1)	0.9-1.5 (1.2)	[a]0.017*	0.8-1.6 (1.1)	0.7-1.4 (1.1)	[a]0.428
	Mean±SD	1.03±0.21	1.16±0.16		1.11±0.18	1.07±0.15	
	< 0.83	2 (8.7)	0 (0)		1 (3.7)	1 (4)	
	≥ 0.83	21 (91.3)	25 (100)		26 (96.3)	24 (96)	
Carbohydrate (g)	*Min-Max (Median)*	86.5-189.6 (132.2)	54-176.6 (120.3)	[a]0.012*	81-183.6 (134.3)	116-185.4 (147.2)	[a]0.291
	Mean±SD	136.83±25.70	118.72±21.99		138.90±26.07	145.27±16.06	
Carbohydrate (%)	*Min-Max (Median)*	24-38 (31)	19-41 (30)	[a]0.987	18-35 (28)	27-36 (31)	[a]0.021*
	Mean±SD	30.74±3.17	30.72±4.51		28.41±4.39	30.72±2.19	
Fiber (g)	*Min-Max (Median)*	12.8-29.3 (18.1)	12.4-37.4 (24.5)	[a]0.001**	10.5-31.2 (18.9)	15.5-39.9 (24.9)	[a]0.001**
	Mean±SD	18.26±4.22	25.61±5.50		20.27±6.00	26.25±6.4	
Fat (g)	*Min-Max (Median)*	82.4-140.1 (111.4)	60.1-119 (89.1)	[a]0.001**	71.9-168.3 (120	93-136.4 (109.4)	[a]0.045*
	Mean±SD	108.90±14.87	90.41±12.63		119.08±18.19	110.58±10.22	
Fat (%)	*Min-Max (Median)*	46-59 (53)	41-63 (51)	[a]0.036*	46-61 (52)	47-55 (52)	[a]0.026*
	Mean±SD	53.52±3.15	51.12±4.41		52.74±3.60	50.92±1.87	
Monounsaturated fatty acids (g)	*Min-Max (Median)*	28.3-64.1 (45.6)	30.6-58.7 (44.8)	[a]0.969	35.6-76.4 (57.8)	45.9-63.7 (52.3)	[a]0.651
	Mean±SD	45.50±11.29	45.39±6.82		55.02±9.56	54.05±4.82	
Polyunsaturated fatty acids (g)	*Min-Max (Median)*	7.3-38.6 (12.4)	7.1-12.9 (10.7)	[d]0.040*	7.6-37.1 (12)	10.6-15.4 (12.8)	[d]0.621
	Mean±SD	19.39±11.46	10.71±1.25		13.88±6.41	12.76±1.40	
(n-6) fatty acid (g)	*Min-Max (Median)*	6.1-36.7 (10.9)	5.8-11.1 (9.3)	[d]0.036*	6.4-35.8 (10.1)	8.9-14.1 (11)	[d]0.309
	Mean±SD	17.74±11.32	9.18±1.10		11.95±6.45	10.97±1.37	
(n-6) fatty acid (%)	*Min-Max (Median)*	3.8-18.3 (5.7)	4-6.6 (5.3)	[d]0.342	4-17.4 (4.6)	4.2-8 (5.1)	[d]0.011*
	Mean±SD	8.72±5.37	5.30±0.64		5.42±3.01	5.16±0.77	
(n-3) fatty acid (g)	*Min-Max (Median)*	0.9-2 (1.3)	0.8-1.6 (1.2)	[a]0.072	0.9-2.2 (1.5)	1.1-1.8 (1.5)	[a]0.142
	Mean±SD	1.37±0.26	1.24±0.22		1.54±0.30	1.43±0.19	
(n-3) fatty acid (%)	*Min-Max (Median)*	0.6-1 (0.7	0.6-0.9 (0.7)	[d]0.246	0.6-1 (0.7)	0.5-0.8 (0.7)	[d]0.6536
	Mean±SD	0.68±0.10	0.71±0.10		0.70±0.11	0.66±0.07	
Saturated fatty acids (g)	*Min-Max (Median)*	26.9-48.8 (36.8)	18-39.5 (27.3)	[a]0.001**	21.9-65 (41.2)	25.4-47.5 (36.9)	[a]0.008**
	Mean±SD	36.74±5.97	28.18±5.59		41.66±8.28	36.37±5.05	
Cholesterol (mg)	*Min-Max (Median)*	171.5-484.5 (346.1)	182.8-432 (298.6	[a]0.096	285.8-653.9 (431.3)	155.2-486.2 (398.8)	[a]0.030*
	Mean±SD	336.05±80.24	296.26±81.87		430.14±97.30	376.54±72.89	

[a]Student t Test *[d]Mann Whitney U Test* **p<0.05* **p<0.01*

According to the evaluation of the adherence levels of the individuals to the Mediterranean diet, the MEDAS scores of the females participating in the study were 4.91±0.67 and 8.44±1.00 in the patient and the control groups, respectively; the MEDAS scores of the males participating in the study were 4.37±0.74 and 8.48±1.00 in the patient and the control groups; respectively. All of the individuals in the patient group were seen to be nonadherent to the Mediterranean diet ($p<0.05$) (Table 4).

Table 4. Distribution of adherence levels to the Mediterranean diet according to gender

Female Individuals		Total	Patient Group	Control Group	ᵃp
		n (%) n=48	n (%) n=23	n (%) n=25	
MEDAS score	Min-Max (Median)	4-11 (7)	4-6 (5)	7-11 (8)	**0.001****
	Mean±SD	6.75±1.97	4.91±0.67	8.44±1.00	
	Nonadherent to the Mediterranean diet (0-7 points)	23 (47.9)	23 (100)	0 (0)	
	Acceptable adherence level to the Mediterranean diet (7-9 points)	14 (29.2)	0 (0)	14 (56)	
	Strict adherence level to the Mediterranean diet (≥9 points)	11 (22.9)	0 (0)	11 (44)	
Male Individuals		**n=52**	**n=27**	**n=25**	
MEDAS score	Min-Max (Median)	3-11 (6)	3-6 (4)	7-11 (8)	**0.001****
	Mean±SD	6.35±2.25	4.37±0.74	8.48±1.00	
	Nonadherent to the Mediterranean diet (0-7 points)	27 (51.9)	27 (100)	0 (0)	
	Acceptable adherence level to the Mediterranean diet	13 (25)	0 (0)	13 (52)	
	Strict adherence level to the Mediterranean diet (≥9 points)	12 (23.1)	0 (0)	12 (48)	

[a]*Student t Test* ***p<0.01*

According to the evaluation of anthropometric measurements and adherence levels to the Mediterranean diet of the individuals participating in the study; a negative statistically significant relationship was determined between BMI, waist circumference, body fat ratios, and adherence levels of the males to the Mediterranean diet in the patient group ($p<0.05$) (Table 5).

Table 5. Relationship between anthropometric measurements and adherence levels to the Mediterranean diet

	Adherence levels to the Mediterranean diet				Adherence levels to the Mediterranean diet			
	Female Individuals Patient Group (n=23)		Female Individuals Control Group (n=25)		Male Individuals Patient Group (n=23)		Male Individuals Control Group (n=25)	
	r	p	r	p	r	p	r	p
Body weight (kg)	0.039	**0.861**	-0.172	**0.411**	-0.333	**0.090**	-0.005	**0.979**
BMI (kg/m²)	-0.091	**0.679**	-0.028	**0.896**	-0.486	**0.010***	0.076	**0.717**
Waist circumference (cm)	0.099	**0.653**	-0.323	**0.115**	-0.407	**0.035***	0.054	**0.797**
Body fat ratio (%)	-0.050	**0.822**	-0.283	**0.170**	-0.521	**0.005****	-0.119	**0.570**

r: Pearson correlation coefficient **p<0.01* ***p<0.01*

DISCUSSION

The research is a descriptive, cross-sectional study conducted on 100 individuals between the ages of 18-65. There are two groups in the research. Case group of 50 male and female individuals between the ages of 18-65 diagnosed with cholelithiasis; 50 male and female individuals between the ages of 18-65 who were not diagnosed with cholelithiasis constituted the control group. The incidence of gallstones changes based on many factors such as gender, age, ethnicity, chronic diseases, and dietary habits. It is known that the formation of gallstones increases with advancing age and is more commonly seen in females compared to males (Figueiredo et al., 2017). In this study, no statistically significant difference was determined between the distributions of gender and age in the groups. Being overweight and obese are considered to be important risk factors increasing the risk of cholecystectomy by predisposing to gallstone formation. Additionally, higher BMI values and waist circumference measurements are also described as important risk factors for gallstone formation, especially in females (European Association for the Study of the Liver, 2016). In a case-control study investigating the association between anthropometric measurements and gallstone formation, it has been reported that the mean body weight, BMI, and waist circumference values of individuals in the patient group were higher than the values of those in the control group (Dhamnetiya et al., 2018). It is considered that this condition results from increased cholesterol synthesis, increased biliary cholesterol secretion and cholesterol supersaturation of the bile through the liver, and dysmotility of the gallbladder caused by obesity (Tseng et al.,1999). In this study, it was observed that body weights, BMI values, waist circumference measurements, and body fat ratios of female individuals and only body fat ratios of male individuals in the patient group were determinative factors for the risk of gallstone formation.

High energy intake among modifiable risk factors is shown as a risk factor in gallstone formation due to its association with obesity (Méndez-Sánchez et al., 2007). Studies performed confirm high energy intake in the Western-style diet model as an increased risk factor in gallstone formation (Cuevas, 2004; Jessri and Rashidkhani, 2015; Kwon et al., 2020; Misciagna et al., 1999). Generalization of the Western style diets consist of high energy, refined carbohydrates, animal protein, saturated fatty acids, cholesterol, salt, and trans fatty acids content, and poor fiber is especially shown to be associated with the increasing prevalence of gallstones (European Association for the Study of the Liver, 2016). In a prospective cohort study performed, the total energy intakes of individuals with high adherence levels to the Western-style diet from food and beverages except alcohol were reported to be higher than those with high adherence levels to the Mediterranean diet. The risk of cholecystectomy in individuals with high adherence levels to the Mediterranean diet was found to be lower (Barré et al, 2017). Similar to the results of the studies performed, the total energy intakes of the individuals in the patient group were determined to be statistically significantly higher than those in the control group in this study.

Western-style diets high in energy, refined carbohydrates, animal protein, saturated fats, cholesterol, salt, and trans fatty acids, and low in fiber are linked to an increased prevalence of gallstones (European Association for the Study of the Liver, 2016). It has been reported that the consumption of a high intake of carbohydrates with a high glycemic load, and glycemic index, and a diet rich in food and beverages consisting of refined sugar and sucrose as the type of carbohydrates increases the risk of gallstone formation (Attili et al., 1998; Cuevas et al.,2004; Tsai et al.,2005). While consumption of highly refined carbohydrates is associated with an increased risk of the formation of gallstones in the gallbladder, consumption of high fiber is associated with a decreased risk of the formation of gallstones. It is considered that insoluble fiber is protective against gallstone formation by speeding intestinal transit and reducing the generation of secondary bile acids associated with increased biliary cholesterol saturation index (Misciagna et al., 1999; Tseng et al., 1999). In this study, while the daily dietary carbohydrate intake of female individuals in the patient group was observed to be higher than those in the control group, the difference between male individuals in the groups was not found to be significant. The average daily fiber consumption of individuals in the patient group was determined to be less than those in the control group, and lower fiber consumption was observed to be an effective factor in gallstone formation, similar to the studies performed.

In a cohort study investigating the relationship between dietary protein consumption and gallstone formation, it was reported that high vegetable protein consumption had a protective effect against the risk of gallstone formation, and increased red meat consumption was associated with a low but statistically insignificant level of risk of gallstone formation; total daily protein consumption was not found to be associated with gallstone formation (McConnell et al., 2017). In this study, quantities of total daily dietary protein intake were not significantly different between the groups. It is emphasized that the type of fat preferred in addition to total dietary fat intake is a risk factor for increasing gallstone formation (Yago et al., 2005). In this respect, while an increase in dietary high cholesterol, saturated and trans fatty acids intakes are associated with the formation of gallstones in the gallbladder; monounsaturated and polyunsaturated fatty acids consumption is associated with a reduction in the risk of gallstone formation (Misciagna et al., 1999). When intakes of total fat, cholesterol, and saturated fatty acids shown to be among the dietary nutrients increasing the risk of gallstone formation were evaluated in this study, total daily dietary fat and saturated fatty acids intakes of individuals in the patient group were determined to be statistically significantly higher than those in the control group. While daily dietary cholesterol intakes of individuals in the patient group were determined to be statistically significantly higher than those in the control group; this difference was found to be statistically significant between male individuals in the groups and not statistically significant between female individuals in the groups.

In the case-control study investigating the effect of polyunsaturated fatty acids on gallstone formation, n-6/n-3 fatty acids ratios of the individuals with a gallstone in the patient group were reported to be higher than those without gallstone in the control group (Pasternak et al., 2017). According to the report of the American Dietetic Association (ADA), it has been reported that an increase in dietary intake of n-6 fatty acids increased chronic diseases as well as the risk of gallstone formation (Kris-Etherton and Innis, 2007). It is considered that n-3 fatty acids are protective against cholesterol stone formation by inhibiting cholesterol saturation and cholesterol precipitation in supersaturated bile through their EPA and DHA compositions among its components (Méndez-Sánchez et al., 2007). In this study, while daily dietary intake of n-6 fatty acids was determined to be statistically significantly higher in females of the patient group compared to those in the control group; the difference between male individuals in the groups was not found to be statistically significant. The quantities of daily dietary intake of n-3 fatty acids and monounsaturated fatty acids were not statistically significant between the groups. Studies examining the association between dietary vitamin and mineral intake and gallstone formation are extremely limited (Tseng et al., 1999).

Folate found profoundly in fruits and vegetables has been linked to a lower risk of gallstone formation (Novacek, 2006). Lower dietary intake of vitamin C has been linked to gallstone formation (Jessri and Rashidkhani, 2015; European Association for the Study of the Liver, 2016). In a cohort study investigating the association between diet and gallstone formation, it has been reported that the risk of cholecystectomy of individuals with high adherence levels to the Mediterranean diet model decreased with a rate of 11% and the content of nutrients rich in vitamin C was also linked to a lower risk of gallstone formation (Barré et al., 2017). Although it is known that individuals with higher vitamin E levels are better protected from oxidative stress and, therefore, their risks of developing gallstones are lower, it is reported that further studies are needed (Waniek et al., 2018). In a pilot study investigating micronutrient intake of individuals with cholesterol stones, while thiamine, riboflavin, folate, B12, and vitamin C intakes of individuals in the patient group did not show a significant difference compared to those in the control group; niacin, vitamin B6, vitamin A and vitamin E intakes of individuals in the control group were observed to be significantly higher compared to those in the patient group (Worthington et al., 1997). In this study, thiamine, riboflavin, folate, vitamin B6, vitamin A, and vitamin C intakes of female individuals in the control group, and thiamine, folate, vitamin B6, vitamin E and vitamin C intakes of male individuals in the control group were found to be significantly higher compared to corresponding individuals in the patient group. The risk of gallstone formation of individuals with higher dietary magnesium intake was found to be lower with a rate of 28% and dietary magnesium consumption was reported to be protective against gallstone formation (Tsai et al., 2008). A higher dietary heme iron intake was associated with an increased risk of gallstone formation (Tsai et al., 2007). It is considered that higher dietary animal iron intakes affect the blood lipid levels and cause cholesterol stone formation by increasing the saturated fat/polyunsaturated fatty acids ratio as well the consumption of a diet rich in iron can cause gallstone formation by increasing the plasma levels of triacylglycerol (Fields and Lewis, 1999). It is considered that iron deficiency also plays a role in the pathogenesis of gallstones (Jessri and Rashidkhani, 2015). It is known that dietary calcium intake decreases the risk of gallstone formation by preventing the reabsorption of secondary bile acids in the colon and by altering the composition of bile, and secondary bile acids are more effective in the formation of cholesterol stones (Tseng et al., 1999). As a consequence of a prospective cohort study performed with male individuals, it has been reported that individuals with higher dietary calcium intake had a lower risk of gallstone formation (Moerman et al., 1994). In this study, while the mean dietary potassium and iron intake quantities of females in the patient group were determined to be less than those in the control group, mean dietary potassium and calcium intake quantities of males in the patient group were determined to be less than males in the control group.

In our study, the Mediterranean Diet adherence screener (MEDAS) consisting of 14 questions with a scoring range of 0-14 points developed by Martínez- González MA et al. was used to appraise the adherence levels of individuals to the Mediterranean diet (2012). In the cohort study performed in France, 1033955 female individuals were included in the study and the Mediterranean Diet adherence screener (MEDAS) was used. The outcome of the study was similar to the outcome of this study. It has been reported that the individuals with high adherence levels to the Mediterranean diet (6–9 score) had a lower risk of cholecystectomy with a rate of 11% compared to the individuals with low adherence levels to the Mediterranean diet (0–3 score), and BMI values of the control group were lower than BMI values of the patient group (Barré et al., 2017). In a prospective cohort study performed with 43635 male healthcare professionals investigating the association between gallstone formation and the Mediterranean diet and the other models, the risk of gallstone formation of the individuals with higher adherence levels to the Mediterranean diet (6–9 score) and the other diet models was found to be 35% less than those with lower adherence levels to the Mediterranean diet (0–2 score) and the other diet models. BMI and waist circumference measurements of the individuals with lower adherence levels to the Mediterranean diet were reported to be higher than the BMI and waist circumference measurements of the individuals with higher adherence levels to the Mediterranean diet (Wirth et al., 2018). Due to being a diet model especially rich in vegetables, fruits, legumes, olive oil, and whole grain products, the Mediterranean diet has been reported to be protective against the formation of gallstones.

Also, the results of this study were similar to the results of the aforementioned study, adherence levels of the individuals in the patient group to the Mediterranean diet were determined to be lower than those in the control group. It was determined that as BMI, waist circumference measurements, and body fat ratios of the male individuals in the patient group participating in the study increased their adherence levels to the Mediterranean diet decreased. A negative statistically significant relationship was observed between anthropometric measurements and adherence levels to the Mediterranean diet in gallstone formation. No significant relationship was determined between BMI, waist circumference, body fat ratios, and adherence levels to the Mediterranean diet of the female individuals in the groups.

CONCLUSION

It has been shown in patients with gallstones that adherence levels to the Mediterranean diet which was accepted to be a sustainable and healthy diet model in the literature were lower, and energy and macro and micronutrients and anthropometric measurements had an important effect on gallstone formation. Since most individuals with gallstones are overweight or obese, weight loss should be ensured in these individuals. A diet model can be constituted by abstaining from rapid weight loss and low-calorie diets and considering energy, macro, and micronutrient content, glycemic index, and glycemic load of diet and the Mediterranean diet model can be gotten individuals adopted as a healthy dietary habit.

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Author Contributions
Plan, design: ASB, GAÇ**; Materials, methods, and data collection:** ASB, GAÇ**; Analysis and interpretation:** ASB, GAÇ**; Writing and critical assessment:** ASB, GAÇ

Conflict of interest
There is no conflict of interest to declare in this study.

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