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Gestasyonel Diabetes Mellitus Tanısı Almış Gebelerde Akdeniz Diyetine Bağlılık ve Fiziksel Aktivite Durumunun Değerlendirilmesi

Evaluation of Adherence to the Mediterranean Diet and Physical Activity Status in Pregnant Women Diagnosed with Gestational Diabetes Mellitus

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ÖZ

Giriş: Gestasyonel diabetes mellitus (GDM), bir karbonhidrat intoleransıdır ve hem anne hem de bebek için olumsuz sonuçlar doğurabilir. Sağlıklı beslenme ve fiziksel aktivite, GDM'nin önlenmesi ve tedavisinde temel taşlardır. Bu araştırmada GDM tanısı almış olan gebelerde Akdeniz diyetine bağlılık, beslenme ve fiziksel aktivite durumunun değerlendirilmesi amaçlanmıştır.

Yöntem: 18 yaş ve üzeri, ≥24–≤29 gestasyonel hafta arasındaki 51 GDM'li ve 51 sağlıklı (kontrol grubu) gebenin demografik, obstetrik özellikleri ve antropometrik ölçümleri değerlendirilmiştir. Akdeniz Diyetine Uyum Ölçeği (MEDAS), Birinci Basamak İçin Fiziksel Aktivite Anketi (GPPAQ) uygulanmış ve üç günlük besin tüketim kayıtları alınmıştır.

Bulgular: GDM'li gebelerin günlük enerji ve protein gereksinimlerini karşılama oranı ve karbonhidrat alımı daha yüksektir (p<0,05). GDM'li gebelerin MEDAS puan ortalaması (5,71±1,51) kontrol grubundan (8,02±2,15) düşük bulunmuştur (p=0,001). GDM'li kadınlarda Akdeniz diyetine zayıf uyum gösterenlerin ve fiziksel olarak inaktif olan kadınların oranı kontrol grubundan fazladır (p=0,001).

Sonuç: Bulgular, GDM'li gebelerin sağlıklı gebelere kıyasla daha inaktif olduklarına, Akdeniz diyetine daha zayıf uyum gösterdiklerine, daha fazla beslenme ile ilişkili risk faktörlerine sahip olabileceklerine işaret etmektedir. Gebelik döneminde beslenme ve fiziksel aktivite alışkanlıklarının fetal, neonatal ve maternal sağlık üzerindeki etkileri göz önüne alındığında, özellikle risk altındaki gebelerin sağlıklı davranışlar açısından teşvik edilmesi önemlidir.

Anahtar Kelimeler: gebelik, gestasyonel diabetes mellitus, Akdeniz diyeti, beslenme durumu, fiziksel aktivite

ABSTRACT

Objective: Gestational diabetes mellitus (GDM) is a carbohydrate intolerance and can have negative consequences for both mother and infant. Healthy nutrition and physical activity are the cornerstones for the prevention and treatment of GDM. This study is aimed to evaluate the adherence to the Mediterranean diet, nutrition, and physical activity status in pregnant women diagnosed with GDM.

Method: This study was carried out with 51 pregnant women with GDM and 51 pregnant women without GDM (control group) aged ≥18 years, between ≥24–≤29 gestational weeks. Demographic, obstetric, and health status of individuals were questioned, and anthropometric measurements were evaluated. In addition, the Mediterranean Diet Adherence Screener (MEDAS) and the General Practice Physical Activity Questionnaire (GPPAQ) were applied, and three-day diet records were collected.

Results: Pregnant women with GDM have a higher rate of meeting their daily energy and protein requirements and higher carbohydrate intake (p<0.05). The MEDAS scores of pregnant women diagnosed with GDM (5.71±1.51) were found to be lower than the control group (8.02±2.15) (p=0.001). The rate of poor adherence to the Mediterranean diet and physical inactivity are higher in women with GDM (p=0.001 for all).

Conclusion: The findings suggest that pregnant women with GDM are more inactive, have poorer adherence to the Mediterranean diet, and may have more diet-related risk factors compared to healthy pregnant women. Considering the effects of nutritional and physical activity habits during pregnancy on fetal, neonatal and maternal health, it is important to encourage healthy behaviors, especially in pregnant women at risk.

Keywords: pregnancy, gestational diabetes mellitus, Mediterranean diet, nutritional status, physical activity

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INTRODUCTION

Gestational diabetes (GDM) is carbohydrate intolerance that occurs with insulin resistance response to placental hormone secretion during pregnancy. It is caused by pancreatic beta-cell failure as well as insulin resistance. The main hormone associated with insulin resistance is placental lactogen, but growth hormone, corticotropin-releasing hormone, prolactin, and progesterone also direct this disease (1). Its global prevalence is 14.0%, and this rate is highest in high-income countries (2). Obesity and a sedentary lifestyle cause this prevalence to increase (3). Both the mother and the child may experience numerous short- and long-term complications as a result of GDM. Long-term glucose intolerance and obesity may result from GDM, which is linked to an increase in infants that are large for gestational age, with respiratory distress syndrome, neonatal jaundice, and the need for admission to the neonatal intensive care unit (4, 5). Also, it has been linked to a higher risk of cardiovascular disease and type 2 diabetes in mothers. Therefore, the treatment and management of gestational diabetes is crucial for both mother and infant (5).

GDM can be controlled with medical nutrition therapy and lifestyle changes, although medication is required in some cases (3). Individualized medical nutrition therapies should be implemented to prevent both short and long-term complications (6). There is no data that pregnant women with gestational diabetes have a different energy expenditure than healthy pregnant women (7). Therefore, Dietary Reference Intakes (DRI) recommendations must be met to support maternal and fetal health (8). As the amount and type of carbohydrates can affect blood glucose levels, attention should be paid to the amount of consumption. In this respect, it is emphasized that 175 g carbohydrate intake and simple sugar consumption should be considered. In addition, it is recommended that the intake of saturated and trans fats should be limited, and the consumption of mono- and poly-unsaturated fats should be preferred (7).

Recent studies have drawn attention to the role of the Mediterranean diet in the prevention and treatment of gestational diabetes. Mediterranean diet is a pattern that includes moderate to low levels of dairy products, eggs, fish, poultry, fruits, vegetables, and olive oil as a primary source of fat (9). In view of this, following a Mediterranean diet can help prevent and treat non-communicable diseases like cancer, depression, heart disease, respiratory conditions, and neurological illnesses (10, 11). Therefore, the role of the Mediterranean diet on GDM is examined. The Mediterranean diet was linked to a lower incidence of GDM, according to a meta-analysis study (12). In addition to preventing GDM, it has been reported that adherence to or following the Mediterranean diet during pregnancy may reduce risks of diabetes and adverse maternal-fetal complications (13-15).

In light of these results, our objectives were to evaluate the Mediterranean diet adherence of gestational diabetes cases and healthy pregnancies, as well as to uncover nutritional risk factors. We also hypothesized that pregnant women with GDM may be less adherent to the Mediterranean diet and have more nutrition-related risk factors.

MATERIALS AND METHODS

Participants

In this cross-sectional study, pregnant women between ≥24 and ≤29 weeks of gestation who were followed up in a private hospital in Diyarbakır, Turkey between March and May 2020 were included. Pregnant women under the age of 18, diagnosed with hyperemesis gravidarum, type 1 and type 2 diabetes, hypothyroidism, and hyperthyroidism, and multiple pregnancies were excluded from the study. Power analysis was performed with G*Power for the sample size, and 51 pregnant women were calculated for each group at d=0.50 effect size, 80% test power, and 95% confidence interval. Accordingly, the study was conducted with 51 pregnant women diagnosed with GDM (GDM group) and 51 pregnant women (control group) who did not meet the inclusion criteria.

The oral glucose tolerance test (OGTT), which was conducted at weeks 24 and 28 of gestation in compliance with the International Association of Diabetes and Pregnancy Study Group (IADPSG) standards, was used by the physician to diagnose GDM (7). The data collection form was applied to pregnant women who were referred to a dietitian after being diagnosed with GDM by their physician, before medical nutrition treatment was administered.

The research was approved in terms of medical ethics by the Acıbadem Mehmet Ali Aydınlar University Medical Research Ethics Committee with the decision dated 27.02.2020 and numbered 2020-03/50. The research was approved in terms of medical ethics by the same ethics committee with the decision dated 08.07.2021 and numbered 2021-13/06 due to the revision in the title, provided that the methodology remained the same, and the research was conducted in accordance with the Declaration of Helsinki. All participants voluntarily participated in the study and their written consent was acquired.

Data Collection Tool

The data collection tool including questions about the demographic, anthropometric, and obstetric characteristics of women was administered face-to-face. To determine the obstetric characteristics, information about the number of pregnancies, the first gestational age, the number of live stillbirths, the number of abortions, the number of vaginal-cesarean deliveries, the time between the last pregnancy and the pregnancy at the time of the interview, the history of macrosomia in previous pregnancies, and the disease information were recorded in the data collection form. Height and weight were questioned during the visit and before pregnancy. Body mass index (BMI) was calculated and classified according to the recommendations of the World Health Organization (16). Adequacy of weight gain by week of gestation was assessed using Institute of Medicine (IOM) recommendations (17).

The Mediterranean Diet Adherence Screener (MEDAS) was applied to evaluate the participants' adherence to the Mediterranean diet. The 14-item MEDAS was developed by Martinez-Gonzalez et al. (18) in 2012 in the PREDIMED study and validated by Schröder et al. (19). Turkish validation of MEDAS was done by Özkan Pehlivanoglu et al. (20). In MEDAS, the basic oil type, the daily consumption of olive oil, fruit and vegetable portions, margarine-butter, red meat consumption, and weekly consumption of wine, pulses, fish, seafood, and nut consumption is questioned. The total score ranges from 0 to 14, and a total score of ≤6 indicates low adherence to the Mediterranean diet, and a score ≥9 indicates high adherence (20).

The General Practice Physical Activity Questionnaire (GPPAQ) is used to evaluate the physical activity levels of adults in primary care and was developed by The London School of Hygiene and Tropical Medicine within the scope of the National Health Service in 2002 (21). Nogay et al. (22) translated the GPPAQ into Turkish and found it to be a useful tool for finding the degree of physical activity in primary care that can be applied swiftly and securely. The results of this questionnaire are categorized into two groups as 'active' and 'not active'.

In addition, 3-day diet records were taken prospectively to determine the nutritional status. The foods they consumed were recorded in detail with their contents and amounts. The 'Food and Food Photo Catalogue' was used to accurately record the amount of food consumed. According to the food records, daily energy and nutrient intakes were analyzed with Beslenme Bilgi Sistemi (BeBiS) v.8.2 program and were compared with the DRI values, and the adequacy of the consumption conditions was evaluated (8).

Statistical Analysis

For statistical analysis, the Number Cruncher Statistical System (NCCS) (Kaysville, Utah, USA) was utilized. While assessing the study data, descriptive statistical methods (mean, standard deviation, median, frequency, rate, minimum, and maximum) were used. Through the use of the Shapiro-Wilk test, graphical analyses, and Kolmogorov-Smirnov, quantitative data was assessed for conformance to normal distribution. When comparing two groups of quantitative data that were regularly distributed, the Student's t-test was utilized, and when comparing two groups of non-normally distributed data, the Mann-Whitney U test was employed. Chi-Square test by Pearson, Fisher Freeman the Kruskal Wallis test was utilized to compare three or more groups that did not exhibit a normal distribution, the Pearson correlation analysis was employed to assess the associations between variables, and the Halton and Fisher's exact tests were utilized to analyze qualitative data. All variable's significance was assessed at the p<0.05 level.

RESULTS

Demographic and obstetric characteristics of pregnant women are shown in Table 1. The mean age of pregnant women with GDM (30.69±4.15 years) was higher than the control group (28.54±4.80 years) (p=0.018). In addition, the educational level of pregnant women with GDM was lower (p=0.021). The count of pregnancies of those with GDM was higher than control group (p<0.05). While a history of macrosomia was found in 19.4% of pregnant women with multiparous GDM, there was no history of macrosomia in the control group (p=0.032).

Table 2 shows the anthropometric measurements of women. There was no difference between the groups in terms of the mean pre-pregnancy weight, pre-pregnancy BMI, weight gain during pregnancy, and the distribution of pre-pregnancy BMI classification and weight gain recommendations during pregnancy (p>0.05, for all). According to the gestational week, it was determined that 13.7% of the women with GDM and 23.5% of the women in the control group had a weight gain below the IOM recommendations (p>0.05).

It was shown that pregnant women with GDM consumed more protein and carbohydrates and met their daily calorie and protein requirements at a higher rate than the women in the control group (p<0.05). The rate of daily energy intake from lipids was higher in control group (p<0.05). There was no significant difference between dietary intake of polyunsaturated, monounsaturated, saturated fatty acids, cholesterol, and fiber in pregnant women (p>0.05) (Table 3).

The evaluation of MEDAS and GPPAQ scores is shown in Table 4. The mean MEDAS score of women with GDM (5.71±1.51) was lower than the control group (8.02±2.15) (p=0.001). Also, 74.5% of pregnant women with GDM and 29.4% of the control group had poor adherence to the Mediterranean diet (p=0.001). According to GPPAQ results, it was determined that 41.2% of pregnant women with GDM and 96.1% of the control group were active (p=0.001).

There was no significant difference between MEDAS scores in pregnant women with GDM and the control group according to BMI classification before pregnancy, weight gain status in accordance with the recommendations, and GPPAQ classification (p>0.05, for all) (Table 5).

In pregnant women with GDM, negative, weak correlations were found between daily carbohydrate intake and MEDAS score, and between the ratio of energy from carbohydrates and MEDAS score (respectively r=-0.280 and r=-0.283; p<0.05). In the control group, a positive moderate correlation was detected between the MEDAS score and daily protein intake (r=0.359; p=0.010), and a weak positive correlation was found between the MEDAS score and daily MUFA intake (r=0.295; r=0.036) (Table 6).

DISCUSSION

The Mediterranean diet has a protective and therapeutic role on health. The nutrition of the mother during pregnancy, which constitutes an important period in the life cycle, has a great role in terms of the mother's and the infant's health. This study revealed that pregnant women diagnosed with gestational diabetes were different from healthy pregnant women in terms of adherence to the Mediterranean diet and nutritional risk factors.

Given the increasing prevalence of GDM, it is vital to identify risk factors and develop prevention strategies accordingly (2). Advanced maternal age, low physical activity before pregnancy, pre-pregnancy BMI ≥ 30 kg/m2, and family history of diabetes are defined as the most important risk factors (23,24). In our study, we did not discover significant differences between the groups when we inquired about the first gestational age. Besides, we determined that women with GDM were more inactive according to their physical activity status during pregnancy. This finding suggests that being physically inactive during pregnancy may also be a risk for GDM. In addition, according to research, increasing insulin resistance in GDM increases the quantity of blood glucose that enters the fetal circulation. This extra glucose is then deposited as body fat and resulting in macrosomia (25). Similarly, the history of macrosomia was higher in pregnant women with GDM in our study. There fore, it has been supported that macrosomia is a condition that may be associated with GDM.

Table 1. Demographic and Obstetric Characteristics of Women

	GDM (+) (n=51)		GDM (-) (n=51)		
	x̄±SD	Median (min-max)	x̄±SD	Median (min-max)	p
Age (years)	30.69±4.15	30.0 (23.0-41)	28.54±4.80	28 (20-42)	**[a]0.018**
Gestation week (weeks)	27.10±1.79	28 (24-29)	26.96±1.81	28 (24-29)	[a]0.701
First gestational age (years)	25.76±4.86	26 (15-39)	25.57±4.21	26 (17-34)	[a]0.828
Count of pregnancy	2.47±1.65	2 (1-8)	1.75±1.09	1 (1-6)	**[c]0.021***
Count of live birth** (n=54)	1.84±1.37	2 (0-6)	1.26±0.92	1 (0-4)	[c]0.093
Count of vaginal delivery** (n=54)	1.00±1.48	0 (0-6)	0.35±0.78	0 (0-3)	[c]0.060
Count of cesarean delivery** (n=54)	1.10±1.19	1 (0-5)	1.00±0.90	1 (0-4)	[c]0.963
Time between pregnancies** (year) (n=54)	3.20±1.88	3.5 (0.3-9.7)	3.85±1.83	4.3 (0.3-6.6)	[c]0.077
	n	**%**	**S**	**%**	**p**
Education level					
Primary/secondary school	22	43.1	3	5.9	**[b]0.001***
High school	7	13.7	14	27.4	
Bachelor's degree and postgraduate	22	43.1	34	66.7	
Parity					
Primiparity	20	39.2	28	54.9	[b]0.113
Multiparity	31	60.8	23	45.1	
Stillbirth (n=54)**					
Yes	3	9.7	0	0	[d]0.253
No	28	90.3	23	100.0	
Abortus (n=54)**					
Yes	15	48.4	7	30.4	[b]0.184
No	16	51.6	16	69.6	
History of macrosomia (n=54)**					
Yes	6	19.4	0	0	**[d]0.032***
No	25	80.6	23	100.0	

*[a]Student t Test, [b]Pearson Chi-Square Test, [c]Mann Whitney U Test, [d]Fisher's Exact Test, *p<0.05*
*** For multiparous women*

Table 2. Anthropometric Measurements of Women

	GDM (+) (n=51)		GDM (-) (n=51)		
	x̄±SD	Median (min-max)	x̄±SD	Median (min-max)	p
Height (cm)	162.61±4.88	162 (153-175)	163.76±5.55	164 (154-174)	[a]0.266
Pre-pregnancy weight (kg)	69.90±13.10	69 (51-122)	68.56±13.72	66 (46-107)	[a]0.614
Pre-pregnancy BMI (kg/m^2)	26.35±4.44	25.9 (19.1-42.7)	25.54±4.78	24.8 (18.5-40.6)	[a]0.381
Current body weight (kg)	78.71±12.45	78 (60-129)	76.57±13.05	75.3 (55.5-113)	[a]0.400
Weight gain during pregnancy (kg)	8.81±5.39	8.5 [(-8)-22]	8.01±4.88	8 [(-6)-19]	[c]0.441
	n	**%**	**n**	**%**	**p**
Pre-pregnancy BMI classification					
Normal	19	37.3	26	51.0	[b]0.176
Overweight	23	45.1	14	27.5	
Obese	9	17.6	11	21.5	
Weight gain status during pregnancy					
Below recommendations	7	13.7	12	23.5	[b]0.185
Adequate	13	25.5	17	33.3	
Above Recommendations	31	60.8	22	43.2	

BMI: Body mass index, SD: standard deviation [a]Student t Test, [b]Pearson Chi-Square Test, [c]Mann Whitney U Test

Table 3. Daily Energy and Macronutrient Intakes of Women

	GDM (+) (n=51)		GDM (-) (n=51)		p
	x̄±SD	Median (min-max)	x̄±SD	Median (min-max)	
Energy (Kcal)	2268.50±517.55	2245.7 (1509.2-3397.7)	1995.79±539.12	1912.1 (1034.8-3749.3)	**[a]0.011***
Energy DRI (%)	80.03±20.58	88.48 (49.35-137.96)	79.87±23.00	75.02 (42.09-154.64)	**0.042***
Protein (g)	90.79±24.67	88.8 (53.6-157)	75.71±30.16	71.2 (38.6-171.9)	**[b]0.001***
Protein DRI (%)	126.47±35.06	124.9 (75.5-221.2)	108.04±42.89	102.5 (54.3-242.1)	**[b]0.004***
Protein % of total energy intake	16.80±4.40	16 (12-36)	15.61±4.13	16 (8-36)	[b]0.254
Lipid (g)	101.88±29.21	94.9 (65.6-203)	96.95±31.15	94.3 (29.2-185.4)	[b]0.545
Lipid (%) of total energy intake	40.55±6.95	41 (22-54)	43.67±8.71	41 (24-61)	**[a]0.048***
PUFA (g)	21.10±8.19	20.5 (4.7-38.6)	20.51±11.24	18.4 (2.8-65.3)	[b]0.373
MUFA (g)	32.06±10.35	29.5 (17.8-70)	35.28±15.69	32.2 (7.9-88.2)	[b]0.401
SFA (g)	36.02±15.4	32.7 (14.6-87.9)	30.97±11.44	29.3 (7.9-68.7)	[b]0.123
Cholesterol (mg)	386.59±180.07	348.5 (48-770.1)	356.29±159.52	318.4 (50.6-803)	[a]0.370
CHO (g)	237.41±80.61	240.8 (47.5-412.6)	197.46±69.13	194.1 (68.4-372.5)	**[a]0.008***
CHO % of total energy	42.59±9.15	43 (11-65)	40.63±9.22	40 (21-60)	[a]0.284
Fiber (g)	32.07±9.81	31.8 (7-54)	29.21±11.37	29 (11.1-54.5)	[a]0.178

*DRI: Dietary Recommended Intake, PUFA: Polyunsaturated fatty acids, MUFA: Monounsaturated fatty acids, SFA: Saturated fatty acids, CHO: Carbohydrate, SD: Standard deviation , [a]Student t Test, [b]Mann Whitney U Test, *p<0.05*

Table 4. The MEDAS and GPPAQ Scores of Women

	GDM (+) (n=51)		GDM (-) (n=51)		p
	x̄±SD	Median (min-max)	x̄±SD	Median (min-max)	
MEDAS score	5.71±1.51	6 (2-10)	8.02±2.15	8 (3-12)	**[a]0.001***
	n	**%**	**S**	**%**	**p**
Classification of MEDAS					
Poor adherence (≤6 point)	38	74.5	15	29.4	**[b]0.001***
Acceptable adherence (7-9 points)	12	23.5	14	27.5	
Good adherence (≥9 points)	1	2.0	22	43.1	
Classification of GPPAQ					
Inactive	30	58.8	2	3.9	**[b]0.001***
Active	21	41.2	49	96.1	

*MEDAS: The Mediterranean Diet Adherence Screener, GPPAQ: The General Practice Physical Activity Questionnaire, SD: standard deviation [a]Student t Test, [b]Pearson Chi-Square Test, *p<0.05*

Table 5. MEDAS Scores According to BMI Before Pregnancy, Weight Gain During Pregnancy, GPPAQ Groups

MEDAS scores	GDM (+) (n=51)				GDM (-) (n=51)			
	n	$\bar{x}$ ±SD	Median (Min-Max)	p	n	$\bar{x}$ ±SD	Median (Min-Max)	p
Pre-pregnancy BMI								
Normal	19	5.95±1.72	6 (3-10)		26	8.27±2.03	8 (5-12)	
Pre-obesity	23	5.61±1.50	6 (2-8)	b0.744	14	7.36±2.02	7 (4-11)	[b]0.372
Obesity	9	5.44±1.13	5 (4-7)		11	8.27±2.57	9 (3-12)	
Weight gain during pregnancy								
Below recommendations	7	6.71±1.89	6 (4-10)		12	7.75±2.09	7 (5-12)	
Adequate	13	6.08±1.50	6 (3-8)	b0.089	17	7.88±2.15	8 (5-12)	[b]0.586
Above recommendations	31	5.32±1.33	5 (2-8)		22	8.27±2.25	9 (3-11)	
GPPAQ								
Inactive	30	5.70±1.76	6 (2-10)	a0.974	2•	7.00±0.00	7 (7-7)	-
Active	21	5.71±1.10	6 (4-8)		49	8.06±2.18	8 (3-12)	

*BMI: Body mass index, MEDAS: The Mediterranean Diet Adherence Screener, GPPAQ: The General Practice Physical Activity Questionnaire, SD: standard deviation , [a]Student t Test, [b]Kruskal Wallis Test, **p<0.01*
•Since the number of people in the group was small, it could not be evaluated statistically

Table 6. The Relationship Between Age, BMI Before Pregnancy, Energy and Nutrient Intakes, and MEDAS Score of Pregnant Women

	MEDAS Score			
	GDM (+) (n=51)		GDM (-) (n=51)	
Age (year)	0.116	0.419	0.082	0.568
BMI before pregnancy (kg/m^2)	-0.182	0.202	-0.015	0.914
Energy (kcal)	-0.177	0.214	0.110	0.440
CHO (g)	-0.280	**0.047***	-0.031	0.829
CHO (%)	-0.283	**0.044***	-0.131	0.359
Fiber (g)	0.054	0.706	0.200	0.160
Protein (g)	0.023	0.874	0.359	**0.010***
Protein % of total energy intake	0.172	0.227	0.272	0.053
Lipid (g)	-0.053	0.714	0.103	0.470
Lipid % of total energy intake	0.207	0.504	-0.041	0.773
PUFA (g)	0.096	0.745	-0.154	0.280
MUFA (g)	-0.045	0.756	0.295	**0.036***
SFA (g)	-0.058	0.685	0.123	0.389
Cholesterol (mg)	-0.042	0.769	0.236	0.096
Age (year)	0.116	0.419	0.082	0.568

*PUFA: Polyunsaturated fatty acids, MUFA: Monounsaturated fatty acids, SFA: Saturated fatty acids, CHO: Carbohydrate, SD: Standard deviation, [a]Spearman Correlation Test, *p<0.05*

Another risk factor for GDM is obesity. It is stated that GDM risk can increase with pre-obesity and obesity (26-28). In addition, obesity is associated with high fasting plasma glucose, high HbA1c, and insulin resistance and is therefore defined as a risk factor for GDM. However, we found pre-pregnancy BMI similar for GDM and healthy pregnant women. Furthermore, both GDM (60.8%) and healthy pregnant women (43.2%) gained weight over the recommendations during pregnancy. However, the difference is not significant ($p>0.05$). Although these findings were not significant, they pointed out that, similar to the literature, pregnant women with GDM had higher pre-pregnancy BMIs and gained weight over the recommendations during pregnancy.

Exercise can improve blood glucose levels by increasing insulin sensitivity and using glucose as energy when muscles contract (29). While a sedentary lifestyle is a risk factor for GDM, regular physical activity can be effective in reducing the occurrence of GDM (30,31). We also found that the rate of physical inactivity was higher in pregnant women with GDM, and this risk factor was also observed in our study group. In this respect, it is important to encourage pregnant women with this diagnosis to do moderate-intensity exercise at least three times a week, for 30-60 minutes each time (32).

Nutrition is the cornerstone of both the prevention and treatment of GDM. Pregnant women with GDM consume higher carbohydrate and saturated fat than the current recommendation level, their consumption of vegetables and fruits is insufficient. Moreover, a decrease in fiber intake and an increase in the glycemic index and glycemic load are also linked to GDM risk (33). In a study conducted in Ordu, it was reported that the energy intake of pregnant women with and without GDM was in accordance with the DRI recommendations, and that 45.7% of those with GDM and the entire control group had protein intakes higher than the DRI recommendations (34). In this study, we determined the rate of meeting the daily energy requirement and amount of protein and carbohydrate intake higher in pregnant women with GDM. It is obvious that especially high carbohydrate intake is common in these pregnant women, and they cannot meet optimal targets in terms of other nutrients. Therefore, it is crucial to develop strategies to enhance the nutritional status of these pregnant women.

The role of the Mediterranean diet as one of the effective strategies is discussed. Mediterranean diet is a predominantly plant-based diet model that emphasizes the consumption of seasonal vegetables, fruits, nuts, legumes, extra virgin olive oil, fermented dairy products, fish, and lean meats (35). Tsarna et al. (36) reported that the consumption of cereals, fruits, and vegetables in pregnant women is protective for GDM. These food groups are both good sources of fiber and one of the main components of the Mediterranean diet. Conversely, Tranidou et al. (37), who reported that the risk of GDM lowers as adherence to the Mediterranean diet increases before pregnancy, highlighted its importance in prevention. Moreover, studies evaluating the adherence of pregnant women to the Mediterranean diet during pregnancy emphasized that the risk of GDM decreases as adherence increases (38, 39). In a study conducted in Izmir, similar to this study, it was found that the MEDAS score was lower in pregnant women with GDM than in the control group, and the rate of those with low compliance to the Mediterranean diet was higher ($p<0.001$). In addition, it was found that moderate adherence to the Mediterranean diet increased the risk of GDM by 8.0 times compared to good adherence (40). In another study conducted in Çankırı, the MEDAS score of women with GDM was lower than the control group, and the relationship between GDM risk and adherence with the Mediterranean diet was found to be significant (95% CI, 0.28-0.87) (41). We also determined that the MEDAS scores of pregnant women with GDM were lower ($p<0.05$) and poor adherence was higher in pregnant women with GDM, while good adherence was higher in healthy pregnant women ($p<0.05$). These findings suggest that pregnant women with GDM have poor adherence to the Mediterranean diet and this may increase the risk of GDM. In addition, we determined that pregnant women with GDM had higher carbohydrate intakes and that there was an inverse relationship between carbohydrate intake and MEDAS scores ($p<0.05$). In this respect, attention should be paid to carbohydrate consumption, as fluctuations in blood glucose levels and hyperglycemia are related to the amount and type of carbohydrate (42). Moreover, considering that it reduces MEDAS scores, improving carbohydrate consumption may be one of the primary goals.

In this study, although the nutritional status of pregnant women was evaluated with a 3-day food consumption record, the fact that this evaluation was made only in the 24-29th weeks of gestation provides cross-sectional data and this is thought to be the limitation of the study. In addition, although micronutrient intakes of pregnant women were not evaluated, the results obtained by evaluating the correlation of energy and macronutrient intakes with MEDAS draw attention to the importance of nutritional monitoring in pregnancy follow-up. It is thought that the use of practical measurement tools that can reflect nutritional status such as MEDAS in routine pregnancy follow-up in the clinic may point out the nutrition of pregnant women.

CONCLUSION

GDM has consequences that can affect the health of both the mother and infant for life in the post-pregnancy period. Therefore, it is important to prevent GDM and ensure normoglycemia in pregnant women with GDM. Among the causes of GDM are modifiable risk factors. The incidence of GDM and unfavorable pregnancy outcomes in pregnant women with GDM may be decreased with healthy eating habits and lifestyle modifications both before and throughout pregnancy. Especially the Mediterranean diet is thought to play a role in this regard. In this study, we determined that the adherence of pregnant women with GDM to the Mediterranean diet was poor, their energy, protein, and carbohydrate intakes were higher, and their adherence decreased as carbohydrate consumption increased. These findings suggest that adherence to the Mediterranean diet and other nutritional risk factors may increase the risk of GDM. In this respect, it is important to encourage pregnant women at risk to adhere to this diet in the pre-pregnancy period and to maintain it throughout pregnancy.

Ethics Committee Approval: The research was approved in terms of medical ethics by the Acıbadem Mehmet Ali Aydınlar University and Acıbadem Healthcare Institutions Medical Research Ethics Committee (ATADEK) with the decision dated 27.02.2020 and numbered 2020-03/50. The research was approved in terms of medical ethics by the same ethics committee with the decision dated 08.07.2021 and numbered 2021-13/ 06 due to the revision in the title, provided that the methodology

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