

DETERMINANTS OF ADHERENCE TO THE MEDITERRANEAN DIET AND DEPRESSIVE SYMPTOMS IN TURKISH YOUNG ADULTS

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ABSTRACT

Purpose: This research aimed to investigate the effects of adherence to the Mediterranean diet (MD) on depression risk in young adults and to understand potential associations.

Material and Methods: An online survey form was sent to university students in Türkiye, and 479 participated in this cross-sectional study. Data was collected based on students' declarations. Adherence to the MD was decided using the Mediterranean Diet Adherence Screener (MEDAS). Beck Depression Inventory (BDI) was applied to measure the presence of manifestations of depression. Multivariate linear regression models were used for the determinants of MEDAS and BDI scores.

Results: 73 males and 406 females with a mean age of 21.6±2.3 years and a mean Body Mass Index (BMI) of 22.0±3.5 kg/m² participated in the study. While 61.8% had a moderate adherence to the MD, 54.9% had a mild or moderate BDI level. According to models, regular exercise, presence of NCD(s), and adherence to an adequate/balanced diet were MEDAS score's determinants, and adherence to an adequate/balanced diet and BMI were for BDI score (p<0.05). No statistically significant effect of MEDAS and BDI scores on each other was found (p>0.05).

Conclusion: The relationship between the MD and depression is complex and encompasses several dimensions. More comprehensive and long-term studies, considering the influence of individual differences and other factors such as genetics, environment, and lifestyle, may help to reveal this effect more clearly.

Keywords: Body mass index, depression, Mediterranean diet, multivariate linear regression

INTRODUCTION

The Mediterranean diet (MD), originating from the Mediterranean region, is characterized by fruits, vegetables, fish, whole grains, and olive oil consumption (1). Current research indicates that following the Mediterranean diet could potentially reduce the risk of various non-communicable diseases (NCDs) such as obesity, diabetes, hypertension, heart disease, and metabolic syndrome, as well as enhance overall well-being (2, 3). Furthermore, recent studies suggest that adherence to the MD may also be an important factor

in reducing the risk of depression (4, 5). Depression is a prevalent mental health issue worldwide and can significantly impact individuals' quality of life and functionality (6). Therefore, understanding the effects of the MD on depressive symptoms is important both to improve the mental health of individuals and to promote the overall well-being of society (7, 8). Scientific evidence shows that following a Mediterranean diet provides a diet rich in omega-3 fatty acids, antioxidants, and other nutrients that support brain health (9, 10). Omega-3 fatty acids are well-known for enhancing brain functions and mental

health (11). In addition, compliance with the Mediterranean diet has also been shown to reduce inflammation. Nutrients in the Mediterranean diet can reduce the inflammatory process in the body, which in turn can decrease the risk of mental health problems, such as depression (12). Chronic inflammation is one of the important factors in depression and other mental health problems development (13). Moreover, it should be noted that adherence to the Mediterranean diet is also associated with social and psychological factors. The Mediterranean diet generally promotes social interactions and encourages the sharing of eating habits and eating together. This could potentially play a positive role in reducing social isolation and loneliness and decreasing the risk of depression (14). The impact of university students' adaptation to the Mediterranean diet on the risk of depression is one of the focal points of recent research. University students are young adults who face a range of stressors, such as academic expectations, social pressures, and lifestyle changes (15). The intense pressures during this period can increase the risk of depression and negatively affect the mental health of young adults (16). Eating habits are also often associated with these stressors, and a healthy diet has been shown to have positive effects on mental health (17). In this context, this research aims to investigate the effects of adherence to the Mediterranean diet on depression risk in university students and to understand potential associations. This research endeavor has the potential to enhance our comprehension of the impacts of the Mediterranean diet on mental well-being, thereby facilitating the development of more efficacious intervention approaches.

MATERIALS AND METHODS

Study Design: The study was planned as self-reported, online, and cross-sectional. The study was conducted with university students studying in Türkiye and the random and snowball sampling methods was used. Participants were reached via social media platforms (Facebook, Instagram, WhatsApp) using snowball methods to guarantee a large-scale distribution and recruitment of participants.

Participants: Sample size calculation was made based on the Multivariate Linear Regression Analysis to be conducted in the study with a 5% margin of

error, 95% power level, 0.15 effect size, and 12 possible determinants (age, gender, smoking, alcohol intake, regular exercise, presence of NCD(s), sufficient nutritional knowledge, adherence to an adequate and balanced diet, main meals/day, snacks/day, BMI, and BDI score) of the dependent variable (Mediterranean diet compliance score). The minimum sample size was calculated as 184 on the Free Statistics Calculators website (<https://www.danielsoper.com/statcalc/default.aspx>). The data collection period was aimed to reach the maximum sample size. The study was conducted with 479 participants aged between 18 and 35, and data were collected through an online survey prepared in Google Forms between November 2023-March 2024. Among the criteria for inclusion in the study; being a volunteer, studying at a university in Türkiye, living in Türkiye, having a device such as a computer, tablet, or phone, having internet access, having enough time to fill out the online survey form. The exclusion criteria of the study were not willing to participate, not living or studying in Türkiye, not being university students, and not having the opportunity to fill out the online survey form. While the universe of the study consisted of all university students studying in Turkey, the sample comprised students who met the study inclusion criteria and were reached during the data collection process of the study. Before participating in the online survey, students were given information related to the study, and their consent was provided by clicking the box in the online survey.

There are reasons for collecting data using the online survey method in this study. Firstly, university students spend long hours a day using the Internet, and paper survey forms might not have interested them. In this study, the online survey form presents time and cost savings (18). In addition, some studies' results indicate that web-based surveys may be more reliable or advantageous than face-to-face surveys and other survey methods (19).

Data collection instruments: An online survey form used in the study was created by researchers after a literature review. The form consists of three sections: i) baseline characteristics (gender, age, living place etc.), ii) health and nutrition status information (presence of diseases, physical activity level, meal consumption), iii) "Mediterranean Diet Adherence Screener (MEDAS)" and "Beck Depression Inventory (BDI)".

Mediterranean Diet Adherence Screener (MEDAS): MEDAS was created by Martínez-González et al. (20)

and Pehlivanoğlu et al. conducted its validity and reliability study in Turkish. As a result of this study, the Cronbach alpha coefficient of the scale was determined as 0.829, and it was concluded that it is a valid and reliable tool for assessing compliance with MD. It consists of two questions on habits of consuming foods and 12 questions on food consumption frequency, 14 items in total. MEDAS items are scored between 0-1 points, and the cutoffs ≤ 5 , 6-9, and ≥ 10 indicate low, moderate, and high adherence, respectively (20, 21).

Beck Depression Inventory (BDI): BDI was developed by Beck et al. (22) to evaluate the existence and severity of depression's affective, cognitive, motivational, psychomotor, and vegetative manifestations. The tool was adapted into Turkish with university students by Hisli (23). The Cronbach alpha coefficient of the valid and reliable tool's Turkish version is 0.80. BDI consists of 21 items, and each item determines a behavioral pattern specific to depression. It contains 21 self-evaluation sentences with four options ranging from least to most (0-3). The score obtained from the scale is evaluated as 0-9 points (minimal), 10-16 points (mild), 17-29 points (moderate), 30-63 points (severe) (22, 23).

Body mass index (BMI) by using participants' reported body weight (kg) and height (cm) information with the formula $\text{body weight}/\text{height}^2$ (kg/m^2) was calculated. The BMI was divided into four groups underweight (<18.5 kg/m^2), normal weight (18.5-24.9 kg/m^2), overweight (25.0-29.9 kg/m^2), and obese (≥ 30.0 kg/m^2) according to the WHO reference classifications (24).

Statistical Analysis: The study's data were processed in the SPSS (Statistical Package for the Social Sciences) package program (IBM SPSS Statistics 23.0. Armonk, NY, USA: IBM Corp; 2013). In the descriptive analyses, categorical data were used as number and frequency (%). The mean, standard deviation (SD) and minimum-maximum (min-max) values were calculated for quantitative data of the participants. To compare two groups and more than two groups, showing normal distribution, were conducted with the Independent Samples T test and One-Way ANOVA test, respectively. The chi-square test (Pearson chi-square) was used to determine significant differences between the frequencies. Multivariate linear regression models were conducted to identify independent predictors of

the MD. $p < 0.05$ was taken as the reliability coefficient.

Ethical Approval: The study was carried out with the permission of Mardin Artuklu University Non-Interventional Research Ethics Committee (Date:14.12.2022, Decision no:2022/14-16). The study was carried out following the Declaration of Helsinki principles. Students ticked an informed consent form in the online survey form and could withdraw from participation at any time without providing a reason. Permission was obtained from the authors who performed the validity and reliability study of the scale to administer the MEDAS in this study.

RESULTS

73 males and 406 females, in total 479, young adults from 64 different universities and 23 faculties or vocational schools participated in this study, and general characteristics are presented in Table 1.

Mean age and distributions of living place, habits (smoking, alcohol intake, regular exercise), and presence of NCDs were statistically different in males and females ($p < 0.05$).

In terms of self-nutritional assessment, 40.5% of participants, with 38.4% of males and 40.9% of females, have declared having sufficient nutrition knowledge. While the distribution of female students who confidante dietitian on nutrition information was higher than male students. The distribution of female students who confident dietitians on nutrition information was higher than that of male students (80.8% vs 54.3%, $p < 0.05$). The distribution of main meals, meal skipping, and snacks were different in genders ($p < 0.05$). The mean BMI was 22.0 ± 3.5 kg/m^2 and 68.3% of students had a normal BMI with differences between genders ($p < 0.05$) (as shown in Table 2).

When examining the distribution of students' adherence levels to the MD, it was determined that 5.0% had high, 61.8% had moderate, and 33.2% had low MD adherence levels. The mean MEDAS score was 6.4 ± 1.9 (in the moderate category), 6.2 ± 2.0 for males vs 6.4 ± 1.9 for females, with no difference between genders. While 33.6% of students had a minimal BDI level, 11.5% of them had a severe BDI level, the distribution in gender groups differed and the mean BDI was 15.3 ± 10.4 (in the mild category), with higher mean BDI score in females (15.7 ± 10.2) than males (13.0 ± 11.4) ($p < 0.05$) (Table 3).

Table 1. Characteristics of study participants

Characteristics	Male (n=73, 15.2%)		Female (n=406, 84.8%)		Total (n=479)		p*
Age (years) mean ± SD (min-max)	22.2±2.6 (18-35)		21.5±2.2 (18-35)		21.6±2.3 (18-35)		0.028
	n	%	n	%	n	%	
Marital status							
Single	73	100.0	395	97.3	468	97.7	0.155
Married	-	-	11	2.7	11	2.3	
Living place							
Dormitory	33	45.2	218	53.7	251	52.4	0.006
Home	35	47.9	183	45.1	218	45.5	
Other	5	6.9	5	1.2	10	2.1	
Habits							
Smoking	29	39.7	85	20.9	114	23.8	0.001
Alcohol intake	18	24.7	41	10.1	59	12.3	<0.001
Regular exercise	36	49.3	106	26.1	142	29.6	<0.001
Presence of NCDs	5	6.8	75	18.5	80	16.7	0.014

NCDs: Non-communicable diseases. The bold values indicate statistically significant results (p<0.05). *Chi-Square test and t-test were used.

Table 2. Self-nutritional assessment and BMI of the participants

Nutritional assessment	Male (n=73, 15.2%)		Female (n=406,84.8%)		Total (n=479)		p*
	n	%	n	%	n	%	
Sufficient nutrition knowledge **							
Yes	28	38.4	166	40.9	194	40.5	0.456
No	9	12.3	32	7.9	41	8.6	
Partially	36	49.3	208	51.2	244	50.9	
Confidence in nutrition information							
Dietitians	39	54.3	328	80.8	367	76.6	<0.001
Other HP(s) ^a	17	23.3	41	10.1	58	12.1	
Organization(s) ^b	8	11.1	22	5.4	30	6.3	
Other(s) ^c	9	12.3	15	3.7	24	5.0	
Adherence to an adequate balanced diet**							
Yes	16	21.9	64	15.8	80	16.7	0.404
No	28	38.4	159	39.2	187	39.0	
Sometimes	29	39.7	183	45.0	212	44.3	
Main meal(s)/day							
1	2	2.8	11	2.7	13	2.7	0.002
2	30	41.7	257	63.5	287	60.2	
≥3	40	55.5	137	33.8	177	37.1	
Main meal skip							
Yes	18	24.7	142	35.0	160	33.4	0.018
Sometimes	39	53.4	220	54.2	259	54.1	
No	16	21.9	44	10.8	60	12.5	
Snacks/day							
No	11	15.1	31	7.7	42	8.8	0.091
1	28	38.3	137	33.7	165	34.4	
2	26	35.6	165	40.6	191	39.9	
≥3	8	11.0	73	18.0	81	16.9	
BMI (kg/m²)^d							
<18.5 kg/m ²	5	6.8	65	16.0	70	14.6	0.181
18.5-24.9 kg/m ²	53	72.6	274	67.5	327	68.3	
25.0-29.9 kg/m ²	12	16.4	58	14.3	70	14.6	
≥30.0 kg/m ²	3	4.2	9	2.2	12	2.5	
BMI (kg/m²) mean ± SD (min-max)	23.1±3.2 (16.2-32.3)		21.8±3.5 (15.0-38.8)		22.0±3.5 (15.0-38.8)		0.004

^aHP(s): health professions (physician, nurse, psychologist=). ^bHealth organizations(s) (WHO, Ministry of health). ^cSocial environment, media. ^d<18.5 kg/m² underweight, 18.5-24.9 kg/m² normal weight, 25.0-29.9 kg/m² overweight, ≥30.0 kg/m² obese. *Chi-Square test and t-test were used. ** The answers to the questions 'Do you think you have sufficient nutritional knowledge?' and 'Do you think you have adequate and balanced nutrition?' reflect the statements of the participants, respectively.

Table 4 shows the analysis of determinants of BDI score using multivariate linear regression models. The regression model incorporates variables such as age, gender, smoking, alcohol intake, regular exercise, presence of NCD(s), nutritional parameters (sufficient nutritional knowledge, adherence to an adequate and balanced diet, main meals/day, snacks/day), BMI, and MEDAS score. The variables that were found to be statistically significant ($p < 0.05$) in the regression model were regular exercise, presence of NCD(s), and adherence to an adequate and balanced diet.

Table 5 shows the analysis of determinants of MEDAS score using multivariate linear regression models. The regression model incorporates variables such as age, gender, smoking, alcohol intake, regular exercise, presence of NCD(s), nutritional parameters (sufficient nutritional knowledge, adherence to an adequate and balanced diet, main meals/day, snacks/day), BMI, and BDI score. The variables that were found to be statistically significant ($p < 0.05$) in the regression model were adherence to an adequate and balanced diet and BMI. A negative effect was found between adherence to the Mediterranean diet and depression, but this effect was not statistically significant in regression analyses ($p > 0.05$).

DISCUSSION

University years are an important period in which individuals shape their pre- and post-adult lifestyle habits. Adopting healthy eating patterns, such as the Mediterranean diet, during this period contributes to the formation of sustainable health habits in later

ages (25). Particular attention is paid to the Mediterranean diet due to its protective effects against type 2 diabetes, metabolic syndrome, inflammatory diseases, liver diseases, cancer or cardiovascular diseases (26). In addition to these effects on health, the relationship between this eating pattern and depression is also an important issue. The relationship between the Mediterranean diet and depression has been examined by many studies and various findings have been revealed (27-29). This study found a negative effect between compliance with the Mediterranean diet and depression, but this effect was not statistically significant in regression analyses. In a study examining the level of students' commitment to MD and its impact on depression during the COVID-19 epidemic, a negative significant relationship was found between MEDAS scores and depression and anxiety (30). Similarly, among Korean adults, adherence to the Mediterranean diet has been suggested to be inversely associated with depression in both females and males (31). In a systematic review, analyzes of cohort studies revealed that there was no significant relationship between adherence to the Mediterranean diet and the risk of depression (32). Similarly, other studies did not find a relationship between adherence to the Mediterranean diet and depression (33, 34).

Understanding the level of compliance with MD and the factors influencing it is crucial for public health initiatives. A superabundance of studies conducted in the European Mediterranean region assessed the adherence levels to this dietary pattern and identified the associated sociodemographic and lifestyle

Table 3. Mediterranean Diet Adherence Screener and Beck Depression Inventory scores of the participants

Scores	Male (n=73)		Female (n=406)		Total (n=479)		p*
	n	%	n	%	n	%	
Adherence level to the MD							
Low	29	39.7	130	32.0	159	33.2	0.430
Moderate	41	56.2	255	62.8	296	61.8	
High	3	4.1	21	5.2	24	5.0	
MEDAS Score mean ± SD (min-max)	6.2±2.0 (2-11)		6.4±1.9 (1-12)		6.4±1.9 (1-12)		0.405
BDI Level							
Minimal	37	50.7	124	30.5	161	33.6	0.002
Mild	17	23.3	120	29.6	137	28.6	
Moderate	9	12.3	117	28.8	126	26.3	
Severe	10	13.7	45	11.1	55	11.5	
BDI Score mean ± SD (min-max)	13.0±11.4 (0-40)		15.7±10.2 (0-52)		15.3±10.4 (0-52)		0.046

determinants (35-37). In this study, it was found that the proportion of students with high commitment to MD was low (5.0%), while 61.8% had a medium level of commitment. The mean MEDAS score was 6.4±1.9 (medium category) and there was no difference between genders. Similarly, while a moderate level of adherence was found in many studies examining compliance with the Mediterranean diet (38, 39), this

compliance did not differ according to gender was detected (40, 41). In another study, it was determined that the average MEDAS score was 5.6±1.82 and the majority (69.4%) had a low level of adherence to the Mediterranean diet (42). There may be various reasons behind the low Mediterranean diet scores in university students, such as eating habits and preferences, economic factors and accessibility, time

Table 4. Potential factors affecting depression risk via multivariate linear regression models

Factors	Unstandardized Coefficients		Standardized Coefficients	t	P*
	β1 (%95 CI)	Std. Error	Beta		
(Constant)	31.754	8.639	-	3.676	<0.001
Age	-0.127	0.209	-0.028	-0.611	0.542
Gender	2.143	1.394	0.073	1.537	0.125
Smoking	-2.199	1.206	-0.090	-1.823	0.069
Alcohol intake	1.896	1.557	0.060	1.218	0.224
Regular exercise	-2.180	1.054	-0.095	-2.069	0.039
Presence of NCD(s)	-5.019	1.259	-0.179	-3.987	<0.001
Sufficient NK *	0.716	0.521	0.065	1.374	0.170
Adherence to an ABD*	-1.513	0.666	-0.106	-2.270	0.024
Main meal(s)/day	-1.372	0.774	-0.082	-1.773	0.077
Snacks/day	-0.129	0.500	-0.012	-0.257	0.797
BMI	0.110	0.137	0.036	0.800	0.424
MEDAS score	-0.148	0.247	-0.027	-0.600	0.549
Adjusted R ²	0.071				

NK: nutrition knowledge, ABD: adequate and balanced diet, BMI: body mass index, CI: Confidence interval, MEDAS: Mediterranean Diet Adherence Screener. Multivariate linear regression models were used. The bold values indicate statistically significant results (p<0.05). *The answers to the questions 'Do you think you have sufficient nutritional knowledge?' and 'Do you think you have adequate and balanced nutrition?' reflect the statements of the participants, respectively.

Table 5. Potential factors affecting adherence to the Mediterranean diet via multivariate linear regression models

Factors	Unstandardized Coefficients		Standardized Coefficients	t	p*
	β1 (%95 CI)	Std. Error	Beta		
(Constant)	4.644	1.634	-	2.842	0.005
Age	0.028	0.039	0.034	0.713	0.476
Gender	0.252	0.263	0.047	0.958	0.338
Smoking	0.045	0.228	0.010	0.197	0.844
Alcohol intake	-0.493	0.292	-0.085	-1.688	0.092
Regular exercise	0.130	0.199	0.031	0.653	0.514
Presence of NCD(s)	-0.027	0.241	-0.005	-0.111	0.912
Sufficient NK*	-0.033	0.098	-0.016	-0.333	0.739
Adherence to an ABD*	-0.292	0.125	-0.112	-2.331	0.020
Main meal(s)/day	0.146	0.146	0.048	1.001	0.318
Snacks/day	0.133	0.094	0.067	1.418	0.157
BMI	0.059	0.026	0.106	2.295	0.022
BDI score	-0.005	0.009	-0.029	-0.600	0.549
Adjusted R ²	0.019				

NK: nutrition knowledge, ABD: adequate and balanced diet, BMI: body mass index, CI: Confidence interval, BDI: Beck Depression Inventory. Multivariate linear regression models were used. The bold values indicate statistically significant results (p<0.05). *The answers to the questions 'Do you think you have sufficient nutritional knowledge?' and 'Do you think you have adequate and balanced nutrition?' reflect the statements of the participants, respectively.

management and busy schedules, cultural and social factors, and knowledge and awareness levels.

Adherence to an adequate and balanced diet is an important component of a healthy lifestyle, and dietary patterns such as the Mediterranean diet encourage the consumption of foods with high nutritional value (43). In this study, according to the multivariate linear regression model, the factors affecting the MEDAS score were found to be adherence to adequate and balanced nutrition and BMI ($p < 0.05$). In one study, it was found that age and knowledge of sustainable nutrition affected compliance with the Mediterranean diet (41). Hashim et al. (2024) found an effect between MD adherence and physical activity and nutritional information from dietitians (44). Vera Ponce et al. reported that the relevant factors were gender, smoking, physical activity level and BMI (45). The findings of our study indicate that high BMI may negatively affect compliance with the Mediterranean diet and therefore MEDAS scores in young people. This dietary pattern generally supports a healthy lifestyle, and as a result, body weight is likely to be under control and a healthy BMI maintained. However, more research is needed to understand this relationship, and it is important to also consider individual factors.

Although no significant effect was found between the Mediterranean diet and depression in this study, determining the prevalence of depression and the effective factors in university students is important to protect students' academic success, social relationships, physical health and general well-being (46). In this study, 26.3% of the students had a moderate BDI level and 11.5% had a severe BDI level, while the average BDI score in females was higher than in males ($p < 0.05$). Similarly, in a study conducted on university students, it was found that the depression, anxiety, and stress scores of female participants were higher than male participants (47). In particular, the fact that female students have higher BDI scores than male students indicate the effect of gender on depressive symptoms. This finding suggests that gender differences and mental health status in young females should be considered. According to the results of the multivariate linear regression models of the study, regular exercise, the presence of NCDs, and adherence to adequate and balanced nutrition were found to have significant effects on depression. Although these findings may suggest that both physical activity and dietary habits could be important potential factors in mental health,

it should be noted that they are based on student self-reports. The positive effects of regular exercise on depression are widely supported in the literature (48-50). Exercise can improve mood and reduce depressive symptoms by increasing the release of endorphins. The presence of NCDs may negatively affect the quality of life, which may increase the risk of depression. For example, factors such as persistent pain, fatigue, physical limitations, stress and anxiety, social isolation, and treatment compliance problems may contribute to the development of depression. Healthy eating habits can have positive effects on depression; for example, consumption of foods with high nutritional value can have positive effects on brain function and mood.

The study has some strengths and limitations. The study drew attention to the role of the Mediterranean diet, which is accepted worldwide, in improving mental health and alleviating symptoms of depression in young adults. On the other hand, the study was conducted using the snowball sampling method. To generalize the results to all university studies, data was collected from as many universities as possible by using the communication power of technology. The second limitation of the study is that students with psychological problems or diagnosed psychological disorders/diseases were not excluded from the study. It is recommended that this criterion be taken into consideration in future studies on this subject. Finally, participants' nutritional knowledge and adherence to healthy nutrition were obtained based on their statements. It is recommended that valid and reliable measurement tools be used in future studies.

CONCLUSION

In conclusion, it was determined that there was no significant effect between the Mediterranean diet and depression. However, the study identified several factors affecting both the level of adherence to the Mediterranean diet and the prevalence of depression. This may offer perspectives to be considered in the establishing and maintaining healthy eating habits, improving mental health in university students. As the relationship between the Mediterranean diet and depression is complex and multifaceted, more comprehensive, and long-term studies may help to provide a clearer picture of the effects of the Mediterranean diet on health and mental health in young people.

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