



SAĞLIK BİLİMLERİNDE GÜNCEL YAKLAŞIMLAR

CURRENT PERSPECTIVES ON
HEALTH SCIENCES

Research Article

The relationship between adherence to the mediterranean diet, coronavirus anxiety, and cognitive status in university students

Üniversite öğrencilerinde akdeniz diyetine uyum, koronavirüs kaygısı ve bilişsel durum arasındaki ilişki

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Received 09.08.2022

Accepted 28.09.2022

Published Online 30.09.2022

Article Code CPHS2022-3(2)-2

Keywords

Mediterranean diet score
anxiety score
general well-being

Anahtar kelimeler

Akdeniz diyeti skoru
anksiyete skoru
genel iyi oluş

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Abstract

Objective: To determine the relationship between adherence to the Mediterranean Diet, Coronavirus Anxiety, and Cognitive Status in University Students. **Methods:** This cross-sectional study was conducted on 385 university students. A sociodemographic form, Mediterranean Diet Adherence Screener (MEDAS), Coronavirus Anxiety Scale Short Form (CAS), and Warwick Edinburgh Mental Well-Being Scale (WEMWBS) were used. Statistical analysis was performed to investigate potential predictors of adherence to Mediterranean Diet (MD) and coronavirus anxiety and psychological well-being. **Results:** The 19.5% of the sample resulted at high risk of depression (WEMWBS score<40) and the 14.0% at high risk of psychological distress (WEMWBS score 41-45). The median MEDAS score was 6 for men (IQR = 4) and 7 for female (IQR=2) in a range between 0 and 14 (the higher score, the higher is the adhesion) (p = 0.001). The MEDAS score of 7-9 points was associated with a lower risk of depression (p=0.027). Only 12.2% of sample had coronavirus anxiety. The main variable that had a positive correlation with WEMWBS was CAS (r=-0.132; p=0.001). **Conclusions:** Coronavirus anxiety was not common among students. Adherence to the MD and good mental health seem to be related among university students, those with the lowest risk of depression. The potential MD'S protective role in terms of mental health among university students could be used to help developing more comprehensive intervention strategies of health promotion among young people.

Öz

Amaç: Üniversite öğrencilerinde Akdeniz Diyetine uyum, Koronavirüs Kaygısı ve Bilişsel Durum arasındaki ilişkinin belirlenmesidir. **Metot:** Bu kesitsel araştırma 385 üniversite öğrencisi üzerinde yapılmıştır. Sosyodemografik form, Akdeniz Diyetine Uyum Ölçeği (ADUÖ), Koronavirüs Anksiyete Ölçeği (KAÖ) kısa formu ve Warwick Edinburgh Mental İyi Oluş Ölçeği (WEMİÖÖ) kullanılmıştır. İstatistiksel analiz, Akdeniz Diyetine (AD) bağlılığın, Koronavirüs ve psikolojik iyi oluşa potansiyel etkisini belirlemek için uygulanmıştır. **Bulgular:** Örneklem %19,5'inde yüksek depresyon riski (WEMİÖÖ skoru <40) ve %14,0'ı yüksek psikolojik sıkıntı riski (WEMİÖÖ skoru 41-45) belirlendi. MEDAS (0 -14 puan) medyan değeri erkekler için 6 (IQR = 4), kadınlar için ise 7 puandır (IQR=2) (puan ne kadar yüksekse bağlılık o kadar yüksek) (p = 0,001). ADUÖ medyan skorunun 7-9 puan olması, daha düşük depresyon riski ile ilişkilidir (p=0,027). Örneklem sadece %12,2'sinde koronavirüs kaygısı belirlendi. WEMİÖÖ ile KAÖ arasında pozitif korelasyon saptandı (r= 0.132; p=0.001). **Sonuç:** Öğrenciler arasında koronavirüs kaygısı yaygın bulunmamıştır. AD'ye bağlılık ve iyi ruh sağlığı ile en düşük depresyon riski arasında ilişki belirlenmiştir. AD'nin üniversite öğrencileri arasında ruh sağlığı açısından potansiyel koruyucu rolü, gençler arasında sağlığın teşviki ve geliştirilmesine yönelik daha kapsamlı müdahale stratejilerinin geliştirilmesine yardımcı olmak için kullanılabilir.

To cite this article:

Çiftçi S, Çolak B, Sezgi Poyraz S. The relationship between adherence to the mediterranean diet, coronavirus anxiety, and cognitive status in university students. Curr Perspect Health Sci, 2022;3(2): 59-67.

INTRODUCTION

Nutrition has a major impact on general health. Nutrients also affect the function of our immune system, especially in terms of flu and diseases caused by viruses (1). Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) may bring about mild to moderate upper respiratory tract illnesses (2). Coronavirus disease (COVID-19) has had a huge and widespread effect on the welfare of people, economic stability and normal daily life, and threatens psychological and social well-being (3). In the latest pandemic, isolation and quarantine have accelerated depression and anxiety (4); in this process, Wang et al. (2020) showed that participants stated significant anxiety symptoms or moderate to severe depressive symptoms in pandemic (5). As a healthy lifestyle, it is recommended to adhere to Mediterranean diet (MD). Studies have indicated that various advantages of the MD, such as a decrease in ischemic cardio pathology, enhanced lipid profile, decrease blood pressure, insulin resistance, and a lower cancer and stroke risk (6-8). The MD was first described by Ancel Keys in the Seven Countries study and is characterized by high consumption of fruits, vegetables, unprocessed cereals, olive oil, nuts, and seafood, moderate consumption of poultry, dairy products, and red wine, and low consumption of red meat. In 2012, Food and Agriculture Organization of the United Nations (FAO) announced that MD was at the top of the world's most sustainable diets (9). Strict adherence to MD dietary pattern is linked with a decreased risk of numerous chronic diseases (10-13) from cardiovascular disease (14) to cancer (15) and diabetes (16). High adherence to MD leads to improved quality of life and cognitive function both in the elderly and in adults and young people (17). The anti-inflammatory components in fruits and vegetables, vitamin C and polyphenols, the effects of folate content on methylation, the effect of rich dietary fibre on brain-derived neurotrophic factor and essential omega-3 fatty acids taken with fish consumption; it is believed to explain the MD adherence and the improvement in cognitive status (18, 19). In young adults, even 10 days of adherence to MD has been described to improve cognitive status in several ways (17). The MEDIS (Mediterranean Islands Study) study demonstrated that elevated and long-standing consumption of vegetables and unprocessed grains, which are the main characteristics of MD, is associated with a lower depression score (20). In cross-sectional research that assessed young people's adherence to MD, it was shown that high adherence was associated with academic achievement (21). This study aimed to determine the adherence to MD and

the relationship between mental well-being and the COVID-19 pandemic among university students.

METHODS

Participants took part in this study voluntarily following all ethical procedures and standards and the Helsinki Declaration. The study was approved by the Ministry of Health of Turkey (approval 2022-12-24T22_17_01) and the Ethics Committee of the University of Izmir Democracy (approval 2021/02-7). We collected the study data between 15 March to 29 June 2021 by using a web based online questionnaire. We included 385 university students. We excluded the subjects from the study who did not fulfil the questionnaire, under 18 and over 40 years old, has chronic illness. Demographic properties (such as gender, age, height, weight, BMI, educational status, marital status, working status, chronic diseases and smoking), the Mediterranean Diet Adherence Scale (MEDAS), the Coronavirus Anxiety Scale Short Form (CAS) and the Warwick-Edinburgh Mental Well-Being Scale (WEMWBS) and questionnaire was organised by researchers. Moreover, in this process, the changes in eating habits of participants were questioned (such as the number of meals, snacks, food preferences and supplements). During the COVID-19 pandemic, questionnaire with 35 questions and a three-scale questionnaire were created, asking questions about food choice and habits. Participants were questioned about food preparation, different cleaning procedures after purchasing food, skipping meals and food preferences.

Mediterranean Diet Adherence Scale (MEDAS)

Mediterranean diet conformity screening tool is aimed at rapidly controlling the intake of food interventions from the PREvención con DIeta MEDiterránea (PREDIMED) study (22, 23). In this scale, there are a total of fourteen questions, two of which are about food intake habits and twelve of them about food consumption frequency, and the score range varies between zero and 14 points with a higher score indicating better accordance with the MD. Each question has a score of zero or one point. MEDAS questions and getting point principles are given in Supplementary Table 1 (23). A total score of seven and higher up shows that the person has an appropriate level of adherence with the MD, and a score of nine and above suggests that the individual has strict adherence with the MD (24). In Türkiye, Pehlivanoglu, Balcoglu and Unluoglu conducted the validity and reliability of the scale (25).

Table 1. Sociodemographic and health-related variables: descriptive analyses and associations with outcomes.

Characteristics	Total	MEDAS	MEDAS	p value	WEMWBS	WEMWBS	p value	CAS	CAS	p value
	(n=385)	score	score		score	score		score	score	
	n (%)	Mean (SD)	Median [IQR]		Mean (SD)	Median [IQR]		Mean (SD)	Median [IQR]	
Gender										
Male	31 (8.1)	5.61±2.53	6 [4]	0.001*	49.06±8.72	49.0 [16]	0.837*	2.03±4.57	0.0 [2]	0.010*
Female	354 (91.9)	7.23±1.84	7 [2]		48.920±10.68	50.0 [13]		3.14±4.41	1.0 [5]	
BMI (kg/m²)										
Underweight (<18.5)	91 (23.6)	7.12±1.95	7 [2]	0.050**	48.11±10.18	49.0 [14]	0.072**	2.86±4.19	1.0 [4]	0.642**
Normal (18.5-24.9)	252 (65.5)	7.22±1.92	7 [2]		50.53±11.14	53.0 [12]		3.39±5.62	0.0 [5.2]	
Overweight (25-29.9)	38 (9.9)	6.31±2.04	6 [4]		50.55±11.38	50.5 [13]		5.50±9.03	1.5	
Obese (≥ 30)	4 (1.0)	6.50±1.73	6.5 [3]		49.00±18.00	50.5 [8]			[14.5]	
Education Class										
Freshman	98 (25.5)	6.88±2.17	7 [3]	0.337**	50.00±10.43	50.0 [11]	0.001**	2.38±3.72	1.0 [3]	0.064**
Sophomore	180 (46.8)	7.07±1.88	7 [2]		50.30±10.19	51.0 [13]		2.92±4.18	1.0 [5]	
Junior	64 (16.6)	7.81±1.55	8 [2]		47.72±9.76	49.0 [14]		3.07±4.20	1.5 [5]	
Senior	43 (11.1)	6.62±2.04	7 [3]		42.56±11.00	43.0 [11]		5.11±6.40	2.0 [10]	
Body Weight Change										
Increased	138 (35.8)	7.08±1.94	8 [2]	0.066**	48.31±10.17	49.0 [12]	0.066**	3.02±4.45	1.0 [5]	0.988**
Decreased	112 (29.1)	7.33±1.80	7 [1.75]		47.72±10.45	49.0 [13]		3.02±4.76	1.0 [4]	
No changed	135 (35.1)	6.91±2.08	7 [3]		50.56±10.81	52.0 [14]		3.11±4.76	1.0 [4]	
Coronavirus										
Positive	51 (13.2)	7.11±2.09	7 [2]	0.899*	51.55±10.78	51.0 [12]	0.121*	2.37±3.48	1.0 [4]	0.411*
Negative	334 (86.8)	7.09±1.93	7 [1.9]		48.53±10.44	49.0 [14]		3.16±4.55	1.0 [5]	
Main Meal										
No	170 (44.2)	7.25±3.22	8.0 [2.25]	0.150*	50.06±10.69	51.5 [13]	0.080*	2.72±4.54	1.0 [3]	0.047*
Yes	215 (55.8)	6.98±2.07	7 [3]		48.04±10.33	49.0 [13]		3.31±4.33	2.0 [5]	
Breakfast	54 (14)	6.59±2.37	7 [3]	0.210**	47.89±11.74	48.0 [17]	0.207**	2.37±3.40	1.0 [3.2]	0.080**
Lunch	152 (39.5)	7.11±1.91	7 [2]		48.43±9.48	49.0 [12]		3.62±4.58	2.0 [6]	
Dinner	9 (2.3)	7.00±2.69	8 [4.5]		42.22±14.36	45.0 [20]		3.77±4.49	2.0 [9.5]	

*Mann-Whitney U Analysis (p<0.05) **Kruskal-Wallis Analysis (p<0.05), MEDAS: Mediterranean Diet Adherence Screener, CAS: Coronavirus Anxiety Scale Short Form and WEMWBS: Warwick Edinburgh Mental Well-Being Scale.

Coronavirus Anxiety Scale Short Form (CAS)

Lee (2020) (Supplementary Table 2) developed the original Coronavirus Anxiety Scale Short Form (CAS) which Lee (2020) (26) (Supplementary Table 2) has developed to detect potential reasons of dysfunctional anxiety linked with the pandemic and CAS validated in Turkish by Biçer et al. (27). Thus, it is a valid and reliable scale in determining anxiety triggered by a coronavirus and enhancing public mental health. The CAS consists of five questions and all answers have five answers which of these points ranking 0 to 4. Coronavirus Anxiety Scale Short Form also successfully distinguishes between people who have anxiety disorders and people who do not have anxiety disorders using a nine-point optimized cut-off score (26).

SCORES	CAS				p* value	WEMWBS				p* value		
	<9 points No		>9 points Yes			<40 points High risk of depression		41-45 points High risk of psychological distress			>45 points Normal	
MEDAS	n	%	n	%	n	%	n	%	n	%		
<7 points (weak)	107	27.8	18	4.7	35	9.1	15	3.9	75	19.5		
7-9 points (good)	198	51.4	22	5.7	34	8.8	36	9.4	150	39.0		
9 points< (best)	33	8.6	7	1.8	6	1.6	3	0.8	31	8.1		
Total	338	87.8	47	12.2	0.001	75	19.5	54	14.0	256	66.5	0.001

*Chi-Square Analysis (p<0.05), MEDAS: Mediterranean Diet Adherence Screener, CAS: Coronavirus Anxiety Scale Short Form and WEMWBS: Warwick Edinburgh Mental Well-Being

Warwick-Edinburgh Mental Well-Being Scale (WEMWBS)

Warwick-Edinburgh Mental Well-Being Scale (WEMWBS) is a measure of mental well-being focusing on positive aspects of mental health. Tennant et al. (28) developed and validated the scale for students in United Kingdom. The validity and reliability of the scale was carried out by Keldal (29) in Türkiye (Supplementary Table 3). As a short, psychologically robust scale, it is not a threshold

effect on the population sample, and it is promising as a tool to monitor mental well-being at the population level. The scale consists of some statements about emotions and thoughts. Participants tick the box which one describes the best of their experience of each over the last two weeks. The scale consists of fourteen positive items and has a 5-point Likert-type answer and 14-70 points can be obtained from the scale. High-level scores on the scale show high mental (psychological) well-being (29).

Table 3. The correlation between MEDAS, WEMWBS, and CAS scores

	MEDAS		WEMWBS		CAS	
	r	p	r	p	r	p
MEDAS	1	-				
WEMWBS	0.050	0.178	1	-		
CAS	0.047	0.238	-0.132	0.001	1	-
BMI (kg/m ²)	-0.112	0.002	-0.087	0.012	-0.041	0.265

Kendall's tau b analysis (p<0.05); BMI: Body mass index, MEDAS: Mediterranean Diet Adherence Screener, CAS: Coronavirus Anxiety Scale Short Form and WEMWBS: Warwick Edinburgh Mental Well-Being Scale.

Dietary Intake

Instead of a food frequency questionnaire and 24-hour recall dietary intake, we used our self-created questionnaire, as well as the MEDAS questionnaire, to assess general daily food consumption. We evaluated the nutritional habits of the participants.

Statistical analysis

We assessed the data with descriptive statistics, as well as frequencies and percentages for categorical variables and mean, standard deviation (SD) for quantitative variables, and used Shapiro-Wilk test to analyse the normal distribution by using SPSS for Windows, version 25. For comparison of groups, the Mann-Whitney U test and the Kruskal-Wallis analysis with a p value <0.05. Cronbach's alpha coefficients were computed to determine the reliability and homogeneity of global score of the CAS, MEDAS, and WEMWBS. The Cronbach's alpha of CAS, MEDAS and WEMWBS were 0.89, 0.82 and 0.93, respectively.

RESULTS

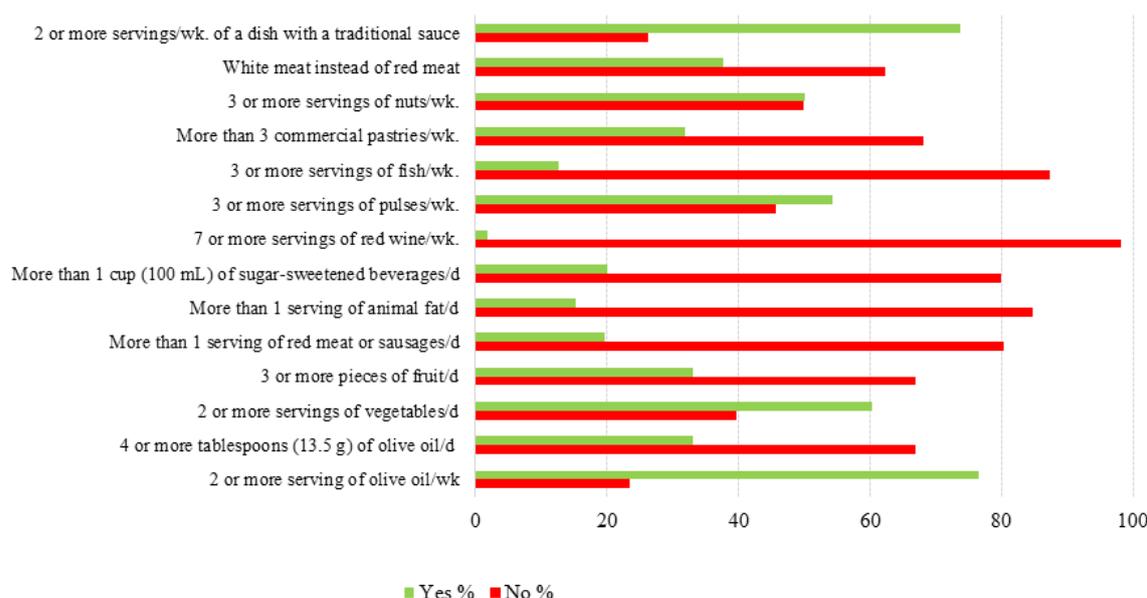
In our study, the consequences of anxiety on eating habits were assessed during the pandemic of COVID-19 among 385 individuals (n=354 women, n=31 men) living in Türkiye. The median of age was 20-year-old, and 46.8% of whom were in sophomore degree education level at university. The mean BMI, the CAS scores, the MEDAS test

scores and the WEMWBS scores were 20.8±3.1 kg/m², 3.05±0.22, 7.10±1.95 and 48.9±10.52, respectively (Data not shown). Table 1 shows characteristics of the sample. There was a greater contribution of female than male (91.1%).

While MEDAS (p=0.001) and CAS (p=0.010) scores were different between sexes, WEMWBS score were not (p=0.837). The MEDAS (p=0.337) and CAS (p=0.064) scores were not statistically different among the education classes, but the WEMWBS score was different (p = 0.001). According to the BMI classification, the MEDAS scores were only different among "normal" and "overweight" group (p=0.039). The 19.5% of the participants developed at considerable risk of depression (WEMWBS<40) and the 14% at high risk of psychological distress (WEMWBS=41-45). The median MEDAS was 7 point (IQR = 2) in a range of 0-14 and the CAS score was 1 point (IQR=5). Under 7-point MEDAS score was related to a lower risk of depression (p=0.027) but did not lead to a lower CAS (p=0.272) (Table 2). In this study, MEDAS scores indicated that 57.1% of the samples had good adherence to MD. Furthermore, 12.2% of the sample had coronavirus anxiety (CAS<9). The association between the MEDAS score and the CAS, WEMWBS scores is shown in Table 2. There was a significant relationship between MEDAS and WEMWBS score (p=0.027), but not with CAS score (p=0.272). We did not find correlation between MEDAS and WEMWBS, CAS score.

However, we only found weak negative correlation between CAS and WEMWBS scores ($r=-0.132$, $p=0.001$). BMI had a weak negative correlation between the MEDAS ($r=-0.112$, $p=0.002$) and WEMWBS scores ($r=-0.087$, $p=0.012$) (Table 3). In this study, we took a general daily food consumption record. In addition, the dietary pattern linked with MD is considered by the intake of fruits and vegetables, whole grains, olive oil, and weekly consumption of legumes, nuts, fish and wine in

moderation, as the well as mild intake of lean meat and milk and milk products. During COVID-19 pandemic daily various food consumption is seen. The foods that were the most preferred were vegetables (67.5%), fruits (53.2%), and fast foods (51.9%) (data not shown). Following this, of the MEDAS daily food consumption percentages alcohol, fish, and animal fat consumption percentage is minimum. Findings demonstrated a high-level intake of olive oil, vegetables and pulses (Figure 3).



DISCUSSIONS

All questionnaires (CAS, MEDAS and WEMWBS) measuring and scoring adherence to the MD, coronavirus anxiety and depression situation are considered suitable tools for finding the potential status of participants. MD diet is a culturally rooted diet transmitted by food habits from early generations. However, new generation including university students may have not followed these customs throughout teenaged years and influenced Western type diet (30). We did not find difference between adherent and non-adherent to MD in subjects among their education class, the same as for the number of main meals per day, body weight changed and diagnosed coronavirus positive or not. Besides MEDAS, we asked a brief dietary questionnaire for last 6 months, which are helpful and often utilized for finding the whole eating patterns and for underlining questions with participants' eating behaviors simply and rapidly. The pandemic is a certain barrier between casual daily life and the life we have lived during COVID-19. We observed post COVID-19 conditions were not changed dramatically. Antioxidant defence systems involved in mental illness work with the support of nutritional cofactors and phytochemicals.

Neurotrophic factors that contribute to neuronal plasticity and repair mechanisms throughout life are also affected by dietary factors (31). Therefore, diet and dietary bioactive components are considered modifiable risk factors affecting the ethology of mental illnesses (32). Current evidence suggests that healthy diet models that meet energy and nutritional needs can help prevent and treat depression and anxiety (33, 34). For example, healthy eating habits with antioxidant and anti-inflammatory effects, for example the Mediterranean and Norwegian diets typified by consumption of high fruit and vegetable intake and whole grains, fish, and meat, consumption have been related with the decreased risk of depressive symptoms (35, 36). Shatwan et al. found an opposite relationship between adherence to MD and BMI (37). By literature, we found a weak negative correlation between BMI and MEDAS, WEMWBS scores. Furthermore, European cohort studies have demonstrated that individuals with a higher adherence to MD are related with decrease weight increase, compared to individuals with a lower adherence (38, 39). A sub analysis of the EPIC study ($n=497.308$; 25-70 years) revealed that, higher adherence to Mediterranean diet is associated with significantly lower BMI (40).

The high-level of dietary fibre represents the MD that caused the better satiety and the low energy density and glycaemic load of MD, are probably to supply a improved metabolic control simultaneously with decreased total calorie intake than previous dietary patterns (41). Some health benefits of MD is caused by olive oil intake. Olive oil phenolics have possible to lessen the beginning and development of a wide of chronic diseases, and are attributed to hypoglycaemic, anti-obesity, cardioprotective, neuroprotective (42). In a cohort, a important linear relationship trend was found between general quality of life and adherence to the Mediterranean diet score. Antioxidant micronutrients and phytochemicals, such as polyphenols, which are high in the Mediterranean diet, are reported to show possible favourable impacts on physical and mental well-being, providing a better overall quality of life (43). These molecules also may work synergistically to prevent and protect inflammatory manifestations and related complications associated with thrombotic and reactive oxygen species (ROS). Therefore, the MD may be beneficial for noncommunicable diseases, it may also be beneficial for infectious diseases such as COVID-19, as it affects immune health (44).

The university students are a unique groups who comes from a critical period of their life and has experienced many stressful events (45). According to a study by Australian university students, 53 per cent of students suffered from mental illnesses (46). Angst is the most common problem among university students, with a higher percentage of 84.4 percent (47). While MEDAS and CAS scores were higher in women than man, WEMWBS score was not different. However, coronavirus anxiety was not high in this population only 12.2 % had coronavirus anxiety positive. It is thought to be full, or semi quarantines and on-line education may be valuable reasons to describe the low CAS score percentage among university students. According to WEMWBS, 66.5% of all have a normal psychological status and only 19.5% of these had a weak adherence to MD. There was no significant correlation between MEDAS and WEMWBS ($r=0.050$; $p=0.178$). However, there was a significant negative correlation between CAS and WEMWBS ($r=-0.138$; $p=0.001$). Because coronavirus anxiety negatively affected the WEMWBS score, the risks of depression increased. Using a healthy diet such as MD can have a beneficial effect on university students by

encouraging academic performance, quality of life, mental health and health status. (17). Dietary habits and behaviours are linked to physical and mental health. Young adults are an important group of people for nutrition interventions aimed at promoting healthy behaviours such as health and healthy eating. To alleviate the health outcomes of mental problems, MD takes into account day by day (48). In our study, the percentage of MD adherence (MEDAS score ≥ 7 points) was higher in participants who did not coronavirus anxiety. Research has highlighted the relationship between healthy habits and mental health, particularly in university students, and has examined the relationship between MD participation and mental health. (49, 50). In our study, a good MEDAS score could be associated with normal WEMWBS scores. The main strength of this study is that this is the first time that MEDAS, CAS, and WEMWBS have been used in university students in the COVID-19 pandemic. Furthermore, our samples consist of students from health sciences faculty who aware the importance of nutritional knowledge and fulfilled the survey in detail. However, our study has some limitations, that is, the participation of more women volunteers was greater. Second, during pandemics, students living with their family at home thus they might have to eat healthy foods because of restrictions.

CONCLUSION

Adherence to MD rich in vegetables, fruits, legumes, whole grains, and healthy fats, brings along healthy lifestyle habits. Students who are inclined to follow MDs were those with lower BMI and lower risk of depression also those who experience the lowest levels of coronavirus anxiety. The potential protection role of MD on the behalf of mental health among university students can be used to develop a more comprehensive intervention strategy for the promotion of health among students.

Acknowledgement: -

Funding Sources: There is no funding source.

Conflict of interest/Çıkar çatışması: Yazarlar ya da yazı ile ilgili bildirilen herhangi bir çıkar çatışması yoktur.

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