



The Impact of Adhering to a Mediterranean Diet on the Severity of Overuse Tendinopathy Symptoms

Akdeniz Diyetine Bağlılığın Aşırı Kullanıma Bağlı Tendinopati Yakınmalarının Ciddiyetine Etkisi


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ABSTRACT

Aim: The Mediterranean diet's high carbohydrate content and antioxidant and anti-inflammatory properties make it appealing to athletes. Tendinopathy etiology is influenced by nutrition. Athletes with high adherence to the Mediterranean diet may have a lower severity of tendinopathy. This study aimed to investigate the effect of adherence to the Mediterranean diet on tendinopathy severity.

Material and Methods: Exercise habits, physical activity level, body region, stage of the injury, age, body mass index, gender, smoking status, and presence of chronic diseases of individuals older than 18 years of age and who were diagnosed with tendinopathy in the sports medicine clinic were recorded in this cross-sectional study. The Revised Oslo Sports Trauma Research Centre Overuse Injury and Health Problems Questionnaires and the Mediterranean diet adherence screener were applied to participants.

Results: A total of 152 participants, 52% (n=79) of whom were female, with lateral epicondylopathy (n=71), Achilles tendinopathy (n=25), plantar fasciitis (n=23), patellar tendinopathy (n=13), and other tendinopathies were included in the study. Upon examination of the relationship between the level of adherence to the Mediterranean diet and the severity of complaints due to overuse, no significant differences were found between groups (p=0.935, and p=0.927, respectively). A weak negative correlation was found between weekly exercise duration and adherence to the Mediterranean diet ($r_s=-0.237$; p=0.016).

Conclusion: No evidence was found that adherence to the Mediterranean diet was associated with differences in the severity of tendinopathy complaints. Athletes with high weekly exercise durations do not adopt the Mediterranean diet as an optimal dietary approach.

Keywords: Mediterranean diet; athletes; tendinopathy; diet patterns.

ÖZ

Amaç: Akdeniz diyetinin yüksek karbonhidrat içeriği ve antioksidan ve anti-inflamatuvar özellikleri bu diyeti sporcular için cazip kılmaktadır. Tendinopati etiyolojisi beslenmeden etkilenmektedir. Akdeniz diyetine bağlılığı yüksek olan sporcularda tendinopati şiddeti daha düşük olabilir. Bu çalışmanın amacı Akdeniz diyetine bağlılığın tendinopati şiddeti üzerindeki etkisini araştırmaktır.

Gereç ve Yöntemler: Bu kesitsel çalışmada spor hekimliği kliniğinde tendinopati tanısı almış olan 18 yaş üstü bireylerin egzersiz alışkanlıkları, fiziksel aktivite düzeyi, vücut bölgesi, yaralanma evresi, yaş, vücut kitle indeksi, cinsiyet, sigara içme durumu ve kronik hastalık varlık durumları kayıt edildi. Katılımcılara Revize Edilmiş Oslo Spor Travması Araştırma Merkezi Aşırı Kullanım Yaralanması ve Sağlık Sorunları Anketleri yanı sıra Akdeniz diyetine uyum tarama aracı uygulandı.

Bulgular: Lateral epikondilopati (n=71), Aşil tendinopatisi (n=25), plantar fasiit (n=23), patellar tendinopati (n=13) ve diğer tendinopatileri olan, %52'si (n=79) kadın olmak üzere toplam 152 katılımcı bu çalışmaya dahil edildi. Akdeniz diyetine uyum düzeyi ile şikâyetlerin şiddeti arasında ilişki olup olmadığı incelendiğinde, gruplar arasında anlamlı bir fark olmadığı bulundu (sırasıyla p=0,935 ve p=0,927). Haftalık egzersiz süresi ile Akdeniz diyetine bağlılık düzeyi arasında zayıf düzeyde negatif bir korelasyon olduğu bulundu ($r_s=-0,237$; p=0,016).

Sonuç: Akdeniz diyetine uyumun tendinopati şikâyetlerinin şiddetindeki farklılıklarla ilişkili olduğuna dair bir kanıt bulunamadı. Haftalık egzersiz süreleri yüksek olan sporcular, Akdeniz diyetini en uygun bir beslenme yaklaşımı olarak benimsememektedir.

Anahtar kelimeler: Akdeniz diyeti; sporcular; tendinopati; diyet kalıpları.

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INTRODUCTION

The Mediterranean diet is a dietary pattern that promotes good health. It is characterized by a high intake of olive oil and low intake of saturated fats and includes plenty of fruits, vegetables, cereals, legumes, nuts, a moderate amount of fish and chicken (2-4 times per week), and low levels of red meat (1-2 times per month). Additionally, it is common to consume small amounts of red wine (1 glass per day for females, two glasses per day for males) with meals (1). The Mediterranean diet's high carbohydrate content and antioxidant and anti-inflammatory properties make it appealing to athletes. Numerous studies have demonstrated that the Mediterranean diet possesses anti-inflammatory properties, resulting in a reduction of tumor necrosis factor-alpha (TNF- α), interleukin 6 (IL-6), and c-reactive protein (CRP) levels (2,3).

Tendinopathy refers to pain and loss of function in tendons caused by mechanical loading (4). It is a prevalent injury among athletes and the general population. Treatment can be challenging, whether the condition is acute or chronic, and it may become a persistent injury that is unresponsive to treatment (5,6). Tendon overload is linked to markers of inflammation and matrix degradation, which can lead to tendinopathy. This condition is characterized by matrix remodeling due to inflammation and damage caused by cytokines and inflammatory cells. The presence of increased macrophage numbers in tendinopathy also indicates inflammation (6,7). Studies on mixed inflammatory processes suggest that inflammation may persist in tendinopathy (5).

The easy adoption of the Mediterranean diet by athletes may be attributed to its richness in carbohydrates and possession of antioxidant and anti-inflammatory properties (8). A review of the effects of nutrition on tendon health indicates that a variety of nutrients, including amino acids, vitamins, and trace minerals, may be beneficial in improving tendon growth and healing. It has been proposed that nutritional interventions comprising multiple nutrients may be more efficacious in tendon and collagen metabolism (9).

Tendinopathy etiology is known to be influenced by various habits, including nutrition (10,11). The hypothesis is that individuals with high adherence to the Mediterranean diet will have a lower severity of tendinopathy. This study aimed to investigate the effect of adherence to the Mediterranean diet on tendinopathy severity.

MATERIAL AND METHODS

The study received ethical approval from the Süleyman Demirel University Health Sciences Ethics Committee on 24.10.2022 (number: 61/4). Participants over 18 years of age diagnosed with tendinopathy due to overuse injury, as determined by sports medicine examination between November 2022 and April 2024, were included in this cross-sectional study. Healthy individuals were not included in the study. Participants were included in the study after signing the informed consent.

Descriptive Information Form

The descriptive characteristics, such as age, body mass index, gender, smoking status, presence of chronic diseases, exercise habits, physical activity level (12), body region, and stage of injury by self-answering (12),

of the participants included in the study were recorded. Additionally, the diagnosis made by the sports medicine after the examination was also documented.

The Revised Oslo Sports Trauma Research Centre Overuse Injury Questionnaire (OSTRC-O) and Questionnaire on Health Problems (OSTRC-H)

The questionnaires aim to evaluate athletes' health concerning their sports involvement, training adjustments, performance, and any pain or symptoms they may experience (13). The questionnaire was converted into two separate measurement tools evaluating overuse injuries and general health, and adjustments had to be made in the answer options to the questions over time. The score of the questionnaire, whose Turkish validity and reliability was conducted by Özal, Kafa, and Güzel following a thesis study in 2023, ranges from 0 to 100, with a higher score indicating more severe health problems (14).

The Mediterranean Diet Adherence Screener (MEDAS)

It is a 14-item scale developed to examine the adherence levels of individuals to the Mediterranean diet (15). Depending on the answer given to the questions related to nutrition, a score of 1 or 0 is obtained, and the total score is obtained by summing the answers given to all questions. The score that can be obtained from the scale is in the range of 0-14. A total score of 7 and above indicates that the individual has an acceptable degree of compliance with the Mediterranean diet (Group acceptable), and a score of 9 and above indicates that the individual has strict compliance with the Mediterranean diet (Group compatible). Turkish validity and reliability of the scale were performed by Pehlivanoglu et al. (16).

Statistical Analysis

IBM SPSS v.23 package was used for the analyses. Since the data were not normally distributed, the Kruskal-Wallis test with Dunn's test and the chi-square test with Monte Carlo simulation were used to analyze the difference between the groups formed according to the level of adherence to the Mediterranean diet. Spearman correlation analysis was used to analyze the relationship between adherence to the Mediterranean diet and other variables. Data were presented as n (%), and median (interquartile range, IQR) [minimum-maximum]. A p-value of <0.05 was accepted as the statistical significance level.

RESULTS

A total of 152 participants, 52% (n=79) of whom were female, were included in the study. The injured body regions were elbow (50%, n=76), ankle (16.4%, n=25), foot (15.1%, n=23), knee (8.6%, n=13), thigh (2.6%, n=4), and other regions, respectively.

The diagnoses made by the sports medicine included lateral epicondylopathy (46.7%, n=71), Achilles tendinopathy (16.4%, n=25), plantar fasciitis (15.1%, n=23), patellar tendinopathy (8.6%, n=13), medial epicondylopathy (2.6%, n=4), and other tendinopathies.

When the participants were grouped according to their MEDAS score, it was determined that females had a higher level of adherence to the Mediterranean diet (p=0.049). However, age, body mass index, smoking, presence of chronic disease, physical activity level, and stage of injury did not make a difference in terms of adherence to the Mediterranean diet (Table 1).

When it was examined whether the level of adherence to the Mediterranean diet caused a difference in the severity level of complaints, no significant difference was found between the groups (Table 2).

It was found that weekly exercise duration was negatively correlated with adherence to the Mediterranean diet at a low level ($r_s=-0.237$; $p=0.016$), while there was no other significant correlation (Table 3).

DISCUSSION

This study of 152 patients with tendinopathy found no difference in Mediterranean diet adherence on tendinopathy severity. Females demonstrated a higher level of adherence to the Mediterranean diet. Age, body mass index, smoking, presence of chronic disease, physical activity level, and

stage of injury did not influence adherence to the Mediterranean diet. Furthermore, the adherence of athletes with more weekly exercise time did not correlate with higher adherence to the Mediterranean diet.

Numerous studies have investigated the relationship between chronic diseases and dietary patterns (17-22). It has been suggested that various dietary patterns may exhibit anti-inflammatory or pro-inflammatory properties (23). The Western diet is generally considered pro-inflammatory, whereas the Mediterranean diet is generally considered anti-inflammatory (24).

The Mediterranean diet is a traditional eating style that is specific to the Mediterranean region. It emphasizes a high proportion of fruits, vegetables, whole grains, olive oil, legumes, nuts, and seeds while limiting the consumption

Table 1. Descriptive characteristics of participants

	Adherence Level to the Mediterranean Diet			P
	Incompatible (n=63)	Acceptable (n=66)	Compatible (n=23)	
MEDAS (score)	5 (4-6) [2-6]	7 (7-8) [7-8]	9 (9-10) [9-12]	<0.001
Age (year)	42 (31-49) [18-64]	46 (31-53) [18-61]	48 (35-53) [18-69]	0.267
Body mass index (kg/m²)	26.8 (24.2-30.1) [17.8-42.4]	25.6 (22.9-28.3) [18.4-44.4]	26.9 (23.1-28.9) [20-34.2]	0.516
Gender, n (%)				
Female	28 (44.4) ^a	34 (51.5) ^{a,b}	17 (73.9) ^b	0.049
Male	35 (55.6) ^a	32 (48.5) ^{a,b}	6 (26.1) ^b	
Smoking status, n (%)				
Smoking	15 (23.8)	13 (19.7)	5 (21.7)	0.900
Quit	15 (23.8)	15 (22.7)	7 (30.4)	
Never smoked	33 (52.4)	38 (57.6)	11 (47.8)	
Chronic disease, n (%)	16 (25.4)	22 (33.3)	10 (43.5)	0.281
Duration of regular sport (year)	10 (5-15) [1-40]	10 (2-15) [0.5-45]	6 (3-12.5) [0.5-46]	0.457
Weekly exercise duration (min)	285 (180-480) [60-3000]	180 (131.25-360) [60-720]	300 (75-600) [30-720]	0.229
Physical activity level, n (%)				
Professional	14 (22.2)	12 (18.2)	4 (17.4)	0.719
Semi-professional	15 (23.8)	16 (24.2)	4 (17.4)	
Recreational	21 (33.3)	30 (45.5)	10 (43.5)	
Sedentary	13 (20.6)	8 (12.1)	5 (21.7)	
Stage of injury, n (%)				
Acute	1 (1.6)	1 (1.6)	1 (4.3)	0.925
Subacute	6 (9.5)	4 (6.3)	2 (8.7)	
Persistent	31 (49.2)	32 (47.6)	10 (43.5)	
Chronic	25 (39.7)	29 (44.4)	10 (43.5)	

MEDAS: Mediterranean diet adherence screener, a,b: denotes a significant difference between groups with different exponential letters, descriptive statistics were presented as n (%) for categorical variables and median (interquartile range, IQR) [minimum-maximum] for numerical variables

Table 2. The level of complaints developing due to overuse according to the level of adherence to the Mediterranean diet

	Adherence Level to the Mediterranean Diet			P
	Incompatible (n=63)	Acceptable (n=66)	Compatible (n=23)	
OSTRC-O (score)	68 (42-84) [0-100]	68 (50.75-92) [16-100]	76 (50-84) [24-100]	0.935
OSTRC-O, n (%)				
0-25 score	5.1 (3)	4.5 (3)	4.8 (1)	0.744
26-50 score	25.4 (16)	19.7 (13)	23.8 (6)	
51-75 score	28.8 (18)	37.9 (25)	19.0 (4)	
76-100 score	40.7 (26)	37.9 (25)	52.4 (12)	
OSTRC-H (score)	68 (45.5-80) [0-100]	68 (41.25-90) [0-100]	75.5 (47-84) [24-100]	0.927
OSTRC-H, n (%)				
0-25 score	10.5 (7)	6.7 (4)	9.1 (2)	0.902
26-50 score	21.1 (13)	23.3 (16)	22.7 (5)	
51-75 score	28.1 (18)	31.7 (21)	18.2 (4)	
76-100 score	40.3 (25)	38.3 (25)	50.0 (12)	

OSTRC-O: The Oslo Sports Trauma Research Center Overuse Injury Questionnaire, OSTRC-H: The Oslo Sports Trauma Research Center Questionnaire on Health Problems, descriptive statistics were presented as n (%) for categorical variables and median (interquartile range, IQR) [minimum-maximum] for numerical variables

Table 3. Correlation of demographic characteristics with MEDAS, OSTRC-O, and OSTRC-H scores

		MEDAS	OSTRC-O	OSTRC-H
Age	r _s	0.158	-0.058	-0.068
	p	0.052	0.484	0.424
Body mass index	r _s	-0.061	-0.095	-0.057
	p	0.456	0.253	0.503
Duration of regular sport	r _s	-0.164	0.017	0.044
	p	0.102	0.868	0.669
Weekly exercise duration	r _s	-0.237	-0.119	-0.120
	p	0.016	0.232	0.235
MEDAS	r _s		0.054	0.056
	p		0.521	0.515
OSTRC-O	r _s	0.054		0.965
	p	0.521		<0.001
OSTRC-H	r _s	0.056	0.965	
	p	0.515	<0.001	

MEDAS: Mediterranean diet adherence screener, OSTRC-O: The Oslo Sports Trauma Research Center Overuse Injury Questionnaire, OSTRC-H: The Oslo Sports Trauma Research Center Questionnaire on Health Problems, r_s: Spearman's rho

of unhealthy foods such as red meat, processed foods, sugary sweets, and saturated fats. Additionally, fish consumption is encouraged several times a week, while red meat consumption is reduced. The Mediterranean diet is a dietary pattern that is high in fiber, antioxidants, omega-3 fatty acids, and other nutrients. It is associated with numerous health benefits, including heart health, weight control, and the prevention of cancer and chronic diseases (18). The Mediterranean diet is a leading healthy dietary recommendation worldwide. However, it may not provide sufficient calories for individuals who engage in sports. Therefore, it is recommended that a modified Mediterranean diet should be prepared specifically for athletes (2).

Additionally, this study found that compliance with the Mediterranean diet decreased as sports participation levels increased. A study conducted on female futsal athletes found low compliance with the Mediterranean diet. This lack of compliance was found to be unrelated to body composition and performance (25). It is important to note that this study was conducted on female futsal athletes only. Additionally, no relationship was found between the Mediterranean diet and body mass index and performance in this study.

A study conducted in Spain analyzed the compliance of cycling and triathlon athletes with the Mediterranean diet. The results showed that male athletes were less compliant than their female counterparts (26). This could be a result of a calorie deficit. This is consistent with the findings of Griffiths et al. (2), who reported that females were more compliant with the Mediterranean diet. Therefore, it can be concluded that gender may play a role in compliance with the Mediterranean diet.

Despite the ability of tendons to adapt to loading, repetitive use can lead to injuries such as tendinopathy. Tendinopathy is characterized by pain during activity, local tenderness to palpation, swelling, and decreased performance. This may prevent sports participation or lead to decreased performance (27). Tendinopathy is an inflammatory process (6). Increased inflammation may prolong the healing process, but since it is an indispensable

part of the healing process, dramatic reduction of inflammation may also have a negative effect on healing. This negative effect may prolong the return to sport, particularly in athletes, and may result in time, training/match, and financial losses. Therefore, it would be incorrect to support the use of an unmodified Mediterranean diet in athletes even though the Mediterranean diet did not seem to affect the severity of tendinopathy in this study.

A systematic review was conducted to evaluate 19 trials about the effects of habitual diet, alcohol exposure, and the use of dietary supplements. The review included four studies investigating the effects of alcohol exposure and 14 studies investigating the use of dietary supplements. The results demonstrated that the number of high-quality studies was limited, and there was significant heterogeneity in methodology across studies (diet, tendon region, outcome measure, population, etc.). Despite these limitations, the findings suggest that providing precise dietary recommendations for the prevention and treatment of tendinopathy remains challenging (28).

Limitations and Strengths

It would have been beneficial to recruit a bigger number of participants and analyze them using the sports discipline. However, adherence to the Mediterranean diet decreased as the sport intensity increased. It would have been advantageous to classify the severity of tendinopathy using a radiological measurement method. A questionnaire was preferred because tendinopathies from different body regions were included. It would be possible to examine the effect of the Mediterranean diet by selecting tendinopathy belonging to a single body region. This may be the subject of further investigation. While there are studies investigating the relationship between chronic diseases and a Mediterranean diet in the literature, no study on this specific subject was identified. Consequently, the results presented in this study are considered valuable contributions to knowledge in this area.

CONCLUSION

The findings of this study indicate that the Mediterranean diet has not much effect on the severity of tendinopathy. Furthermore, the results suggest that athletes with high weekly exercise durations do not adopt the Mediterranean diet as an optimal dietary approach. Further research is needed to gain a more comprehensive understanding of the effects of the Mediterranean diet on sports and athletes.

Ethics Committee Approval: The study was approved by the Health Sciences Ethics Committee of Süleyman Demirel University (24.10.2022, 61/4).

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