SPORMETRE
The Journal of Physical Education and Sport Sciences
Beden Eğitimi ve Spor Bilimleri Dergisi

DOI: 10.33689/spormetre.1624462
Research Article

Geliş Tarihi (Received): 21.01.2025 Kabul Tarihi (Accepted): 30.07.2025 Online Yayın Tarihi (Published): 30.09.2025

THE RELATIONSHIP BETWEEN MUSCULARITY-ORIENTED EATING ATTITUDES AND PROTEIN QUALITY IN STUDENTS WITH AND WITHOUT REGULAR EXERCISE

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Abstract: In recent years, body image concerns, the influence of social media, and societal beauty standards have become significant issues affecting the mental and physical health of many individuals. The aim of this study is to examine the relationship between muscularity-oriented eating behaviors and protein quality among university students who engage in regular exercise and those who do not. The study included 149 university students who exercise regularly and 301 who do not. Participants were assessed using a demographic questionnaire, the Muscularity-Oriented Eating Test (MOET), the International Physical Activity Questionnaire (IPAQ), and a Food Frequency Questionnaire. Protein quality was evaluated considering dietary patterns and categorized into five quartiles. The participants' mean age was 21.95 ± 1.91 years. The MOET score of those who exercised (19.1 ± 11.06) was significantly higher than those who did not (13.22 ± 9.11) ($p < 0.05$). Among exercisers, individuals in the Q2 group had significantly higher MOET scores compared to other groups ($p < 0.05$). The total protein quality score was significantly higher among those who exercised compared to non-exercisers ($p < 0.05$). According to regression analysis, a one-unit increase in the MOET score was associated with a 0.045-fold increase in protein quality. Individuals who exercised regularly were found to have higher protein quality and a greater tendency toward muscularity-oriented eating behaviors. Additionally, it was shown that those consuming higher-quality protein diets might also have a greater inclination toward muscularity-oriented eating.

Keywords: Exercise, protein quality, muscularity-focused eating

DÜZENLİ EGZERSİZ YAPAN VE YAPMAYAN ÖĞRENCİLERİN KASLILIK ODAKLI YEME TUTUMLARI İLE PROTEİN KALİTELERİ ARASINDAKİ İLİŞKİNİN İNCELENMESİ

Öz: Son yıllarda beden kaygısı, sosyal medya etkisi ve toplumsal güzellik standartları nedeniyle birçok kişinin zihinsel ve fiziksel sağlığını etkileyen önemli bir sorun haline gelmiştir. Bu çalışmanın amacı, düzenli egzersiz yapan ve yapmayan üniversite öğrencilerinin kaslılık odaklı beslenme alışkanlıkları ile protein kaliteleri arasındaki ilişkiyi incelemektir. Araştırmaya, 149 düzenli egzersiz yapan ve 301 egzersiz yapmayan üniversite öğrencileri dahil edilmiştir. Katılımcılara, demografik yapı anketi, Kaslılık Odaklı Yeme Testi (MOET), Uluslararası Fiziksel Aktivite Anketi (IPAQ) ve Besin Tüketim Sıklığı Anketi uygulanmıştır. Protein kalitesi, diyet örüntüsündeki besin grupları göz önünde bulundurularak değerlendirilmiştir ve beş çeyreğe ayrılmıştır. Çalışmaya katılına bireylerin yaş ortalaması 21,95±1,91 yıl olarak bulunmuştur. Egzersiz yapanların MOET değeri (19,1±11,06) yapmayanlardan (13,22±9,11) daha yüksek saptanmıştır ($p<0.05$). Egzersiz yapan bireylerden Q2 grubunda bulunanların MOET değeri diğer gruplardan istatistiki olarak yüksek saptanmıştır ($p<0.05$). Düzenli egzersiz yapan bireylerin protein kalitesi toplam puanı, egzersiz yapmayan bireylere göre anlamlı derecede daha yüksek olduğunu göstermiştir ($p<0.05$). Protein kalitesini etkilen faktörlerin regresyon analizi sonucuna göre MOET bir birim artırılması protein kalitesini 0,045 kat artırdığı saptanmıştır. Egzersiz yapan bireylerin protein kalitesinin daha yüksek olduğu ve kaslılık odaklı yemeye daha yatkın olduğu saptanmıştır. Ayrıca daha yüksek protein kalitesinde besin tüketenlerin kaslılık odaklı beslenme eğiliminin de daha fazla olabileceği gösterilmiştir.

Anahtar Kelimeler: Egzersiz, protein kalitesi, kaslılık odaklı yeme

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INTRODUCTION

Physical activity positively impacts both individual and community health (Ergün, M., 2013). Individuals who engage in regular physical activity are better protected from the harmful effects of stressors and experience an improved quality of life (Kaya, 2023). Regular exercise enhances the functioning of the muscular, skeletal, joint, and cardiovascular systems. Moreover, individuals who exercise regularly tend to have higher physical fitness levels compared to those who do not (Demir & Filiz, 2004).

Regular physical activity also contributes to self-awareness by enhancing physical strength, attractiveness, and awareness of one's abilities. Individuals with high self-awareness are more likely to have higher self-esteem and self-confidence (Bekmezci, 2020). Consequently, exercise supports physical development while fostering greater social acceptance (Erdoğanoğlu & Tunç, 2020). Physical activity not only helps individuals achieve their desired body shape but also positively influences their body image (Makar, 2016). Body image encompasses both physical development and bodily functions and shapes individuals' feelings and thoughts about their bodies (Kara & Eryılmaz, 2018). Social pressures and psychological factors can significantly influence people's perceptions and feelings about their bodies (Yarar et al., 2022). Body dissatisfaction experienced by individuals with a negative body image and low self-esteem often leads to concerns about inadequate muscle mass, prompting efforts to further increase muscle mass (Çağlayan & Koz, 2020; Yarar et al., 2022).

The urge to become more muscular reflects an individual's perception of insufficient muscle mass and the desire to enhance it (Katra et al., 2022). Skeletal muscles, which account for approximately 50% of total body mass, are regulated by the processes of muscle protein synthesis and muscle protein degradation. Muscle protein synthesis is influenced by dietary protein intake and physical activity (Köroğlu et al., 2023). Adequate protein intake is essential for maintaining a positive balance in muscle protein synthesis (İlhan & Şekir, 2016). Moreover, the quality of protein intake, in addition to quantity, should also be considered (Eskici, 2020). Consuming foods with high-quality protein more effectively supports muscle mass production. Protein quality in the diet correlates with an increase in the body's protein synthesis (Oğuz & Saka, 2021). Animal-derived proteins, which are rich in essential amino acids and easier to digest, generally have higher protein quality. In contrast, plant-based proteins often have lower digestibility and are deficient in certain essential amino acids such as leucine, lysine, and methionine (Eskici, 2020). When a diet with low protein quality is consumed, the body compensates by breaking down its own tissues to sustain metabolic activities. This can slow growth, development, and repair processes, resulting in significant muscle tissue loss and negatively impacting physical performance (Kurt, 2018).

The aim of this study was to examine and analyze the relationship between muscle-building-oriented eating habits and the quality of protein consumption among students with varying levels of physical activity. Understanding this relationship is crucial for promoting not only optimal physical performance and muscle development but also for preventing potential nutritional imbalances and disordered eating behaviors linked to muscularity-oriented attitudes. The findings of this study are expected to inform targeted dietary interventions and contribute to the development of evidence-based nutritional guidelines, particularly for young adults engaged in regular exercise. Furthermore, it may raise awareness within the sports and fitness communities about the importance of balancing protein quality with healthy eating attitudes, ultimately supporting long-term physical and mental well-being.

METHOD

Research Model

The descriptive and cross-sectional study was conducted in Ankara between 15 January and 15 April 2024.

Participants

This study included university students aged 19–24 years. Participants who exercised at least three days a week for a minimum of eight weeks, with each session lasting at least 60 minutes, were considered regular exercisers. Individuals with a doctor-diagnosed psychiatric illness were excluded from the study. The minimum sample size was calculated as 150 exercisers and 256 non-exercisers, assuming a 5% margin of error and 80% statistical power, using G*Power 3.1. Initially, 163 exercisers and 329 non-exercisers were recruited. However, participants with missing anthropometric, demographic, or dietary data were excluded, resulting in a final sample size of 149 exercisers and 301 non-exercisers. The study was conducted in accordance with the principles of the Declaration of Helsinki, and approval was obtained from the Ankara Yıldırım Beyazıt University Health Sciences Ethics Committee on 23 November 2023, with decision number 09-422. A Voluntary Consent Form was signed by each individual participating in the study.

Data Collection Tools

Demographic Structure Questionnaire

The Demographic Structure Questionnaire consisted of 22 questions designed to gather information on participants' gender, age, body weight, height, grade level, type of exercise, weekly exercise frequency, food and beverage consumption before and after exercise, the types of food and beverages consumed, and the use of ergogenic nutritional supplements.
Participants' height (in cm) and body weight (in kg) were measured by the researchers while the participants stood upright and looked straight ahead (Frankfort Plane) (Lohman, 1988).

International Physical Activity Questionnaire (IPAQ)

This study, conducted to evaluate the types of physical activity individuals engage in during their daily lives, was based on the validity and reliability of the IPAQ, as established by Öztürk (2005). This questionnaire provides information about the time spent on walking, sitting, moderate, and vigorous activities. The energy expended during these activities is calculated using the Metabolic Equivalent of Task (MET)-minute score, and MET values are derived to assess the daily or weekly physical activity levels of the activities performed (Çalışkan & Alim, 2021).

Muscularity-Oriented Eating Test (MOET)

The Turkish validity and reliability of this scale were conducted by Gözde Çalışkan and Nural Erzurum Alim. It is used to determine whether university students who exercise follow a muscularity-oriented nutrition plan. The Cronbach's alpha coefficient reflecting the reliability and consistency of the test was found to be 0.88, indicating high reliability. The Muscularity-Oriented Eating Test was developed by Murray et al. in 2019 to detect muscularity-focused disordered eating behaviors and muscularity-oriented eating disorders. The test consists of 15 questions, with a 5-point scale ranging from positive to negative responses (Çalışkan & Alim, 2021).

Frequency of Food Consumption and Protein Quality Calculation

The BeBiS program, which has an international database, will be used to calculate the daily nutrient intake and average daily energy of participants based on data obtained from the food consumption frequency questionnaires (BeBİS) The following 12 food groups were selected: full-fat and low-fat dairy products, fatty and lean meat products, red and processed meats, potatoes, refined cereals, eggs, nuts, and seafood. These nutrients were calculated using the dietary Protein Quality Index (PQI) formula:

*PQI = [fsh (lean and fatty) + seafood + lean meat + pulses + eggs + nuts + (low) fat dairy product+proteins from whole grains (g/day)]/ [proteins from red and (ultra) processed meats (g/day) + (full and lean) fat dairy products + potatoes and refined cereals] (*De La O and Ruiz-Canela, 2023).

Data Evaluation

Statistical analyses were performed using the SPSS software package (IBM SPSS Statistics 24). The Independent Sample t-test (t-table value) was used to compare the measurement values of two independent groups with normal distribution, while the Mann-Whitney U test (Z-table value) was used for data without normal distribution. The ANOVA test (F-table value) was used to compare measurement values from three or more groups with normal distribution. The Kruskal-Wallis H test (χ^2-table value) was applied when the data did not follow a normal distribution. The Pearson correlation coefficient was used to examine the relationship between two quantitative variables with normal distribution, and the Spearman correlation coefficient was used for non-normally distributed data. Regression analysis was performed to determine the factors affecting protein quality. A p-value of less than 0.05 was considered statistically significant.

RESULT

The mean age of the participants was 21.95±1.91 years. The weekly exercise duration among the exercising individuals was 3.36±1.57 hours (p<0.05). The MOET score and protein quality score of the exercisers were significantly higher compared to the non-exercisers (p<0.05) (Table 1).

Regarding food groups, it was observed that the consumption of fatty and fat free fish, seafood, lean meat, pulses, eggs, oilseeds, low-fat dairy products, whole grains, and red and processed meat products was significantly higher in individuals who exercised than in those who did not (p<0.01) (Table 1).

Table 1. Demographic, anthropometric, and MOET score averages by exercise status

Regular Exercise				
	Yes (n:149)	No (n:351)	Total	p*
	X±SS	**X**±SS	**X**±SS	
Age (y)	22,13±1,89	21,87±1,92	21,95±1,91	0,105
Weight (kg)	67,91±15,15	65,3±14,24	66,16±14,58	0,077
Weekly exercise duration (d)**	3,36±1,57	-	1,12±1,82	
MOET	19,1±11,06	13,22±9,11	15,17±10,17	**<0,001**
Protein quality score	2,4±2,62	1,6±1,31	1,9±1,88	**0,001**
Food groups (g)				
Fatty and fat-free fish	9,38±12,98	8,47±13,71	8,77±13,47	0,199
Seafood	2,75±7,26	2,01±9,26	2,26±8,65	**<0,001**
Lean meat	70,68±86,4	51,29±45,6	57,71±62,72	**0,010**

Pulses	44,42±42,84	37,5±39,92	39,79±41	0,106
Eggs	57,99±49,03	45,29±36,72	49,5±41,58	**0,033**
Oily seeds	27,98±27,68	25,69±28,47	26,45±28,2	0,105
Fat dairy products ((low)	77,63±104,28	48,65±87,57	58,25±94,31	**0,001**
Whole grains	9,85±9,42	6,71±6,49	7,75±7,72	**<0,001**
Red and processed meat	27,05±32,12	24,8±29,2	25,55±30,18	0,451
Fat dairy products (full and skim)	239,51±153,47	215,42±144,42	223,4±147,74	0,122
Potatoes and refined grains	196,68±117,74	202,7±126,45	200,71±123,53	0,833

*Mann Whitney U test, ** Only those who exercised were asked.
MOET: Muscularity-Oriented Eating Test

Of the participants who exercised, 57.7% were female and 42.3% were male. Among those who exercised, 99.3% stated they exercised due to their profession, 59.7% for a hobby, and 35.6% for their own health. The percentage of participants using ergogenic support among exercisers was 24.8%. According to the International Physical Activity Questionnaire (IPAQ), 78 participants who exercised were categorized as active, while 185 non-exercisers were categorized as moderately active (Table 2).

Table 2. Distribution of exercisers and non-exercisers by selected variables

Regular exercise						
			Yes (n:149) n (%)	No (n:351) n (%)	Total (n:450) n (%)	p*
Gender		Female	86 (57,7)	203 (67,4)	289 (64,2)	**0,043**
		Male	63 (42,3)	98 (32,6)	161 (35,8)	
Purpose of Exercising**	Health	Yes	53 (35,6)	-	-	**<0,001**
		No	96 (64,4)	-	-	
	Hobby	Yes	89 (59,7)	-	-	**<0,001**
		No	60 (40,3)	-	-	
	Professional	Yes	148 (99,3)	-	-	0,331
		No	1 (0,7)	-	-	
Ergogenic Aid Usage		Yes	37 (24,8)	-	-	**<0,001**
		No	106 (71,1)	-	-	
IPAQ		Low	23 (15,4)	102 (33,9)	125 (27,8)	**<0,001**
		Modereate	48 (32,2)	185 (61,5)	233 (51,8)	
		High	78 (52,3)	14 (4,7)	92 (20,4)	

*Chi-square test
** Only those who exercised were asked, and more than one option was selected.
IPAQ: International physical activity

The MOET value (14.7±7.95) of participants in the exercising group with protein quality Q2 was found to be statistically lower than that of other groups. CHO (%), protein (g), and protein (%) values of participants who exercised and were in the Q5 group were statistically higher than those in the Q1 group. The lowest fat (%) and fiber intake were observed in the Q1 group (33.33±7.49 g and 16.95±6.56 g, respectively) ($p<0.05$) (Table 3).

The MOET value of non-exercising participants in the Q1 and Q2 groups was found to be statistically lower than that of other groups. The lowest protein (g), protein (%), and fiber values were observed in the Q1 group ($p<0.05$) (Table 3).

Table 3. Values of MOET, energy, and macronutrients by protein quality ındex

Regular Exercise	Protein Qulity Index		MOET score	Energy (kcal)	Carbonhydrate %	Protein (g)	Protein %	Fat (%)	Fiber (g)
Yes	Q1[1]	**X**±SS	16,08±11,85	1565,93±492,85	49,17±8,34	66,02±18,87	17,5±3,04	33,33±7,49	16,95±6,56
	Q2[2]	**X**±SS	14,7,±7,95	1794,15±714,03	43,95±5,11	83,37±41,28	18,8±3,16	37,15±6,67	19,53±8,61
	Q3[3]	**X**±SS	17,04±7,61	1691,11±892,03	41,74±8,95	78,56±42,31	19,07±3,51	39,04±8,51	20,34±13,48
	Q4[4]	**X**±SS	20,53±11,85	1900,17±802,59	46,95±8,7	87,48±34,79	19,13±2,91	33,95±8,59	27,31±14,57
	Q5[5]	**X**±SS	23,29±11,9	1858,40±743,39	40,89±10,34	97,98±42,5	21,74±4,14	37,42±9,91	27,22±11,56
	p*		**0,026 [2-1,3,4,5]**	0,409	**0,002 [1-5]**	**0,002 [1-5]**	**0,002 [1-5]**	**0,037 [1-2,3,5] [4-2,3,5]**	**<0,001 [1-2,3,4,5]**
No	Q1[1]	**X**±SS	10,77±6,98	1525,18±568,58	43,29±7,1	61,38±23,55	16,94±3,75	39,79±6,32	14,77±6,36
	Q2[2]	**X**±SS	11,59±8,68	1771,59±606,48	43,79±7,62	75,31±26,32	17,94±3,76	38,36±6,68	19,74±8,03
	Q3[3]	**X**±SS	14,14±10,79	1756,01±651,64	42,19±7,54	77,11±30,84	18,14±3,43	39,71±6,69	20,63±10,6
	Q4[4]	**X**±SS	13,86±9,18	1652,92±619,78	41,66±8,21	78,51±31,9	19,6±3,63	38,8±7,4	21,57±10,03
	Q5[5]	**X**±SS	16,73±8,68	1536,22±599,35	42,54±10,48	68,4±28,7	18,6±4,48	38,92±10,8	22,4±11,48
	p*		**0,003 [1-3,4,5], [2-3,4,5]**	0,052	0,668	**0,004 [1-2,3,4,5]**	**0,006 [1-2,3,4,5]**	0,728	**<0,001 [1-2,3,4,5]**

*Mann Whitney U test
MOET: Muscularity-oriented eating test

In the multivariate analysis of factors affecting protein quality, MOET, energy, folate, vitamin B12, calcium, phosphorus, and magnesium were identified as significant variables. In the model, a one-unit increase in MOET increased protein quality by 0.024-fold, folate by 0.007-fold, and phosphorus by 0.006-fold, while energy (-0.002-fold), vitamin B12 (-0.613-fold), calcium (-0.004-fold), and magnesium (-0.006-fold) were negatively associated with protein quality (Table 4).

Table 4. Regression analysis of MOET score and selected food groups

Variables	Univariable					Multivariable				
	B	SE	Standart	t	P	B	SE	Standart	t	P
MOET	0,045	0,008	0,245	5,331	**<0,001**	0,024	0,007	0,131	3,258	**0,001**
Energy (kcal)	-0,000019	0,00013	-0,007	-0,139	0,890	-0,002	0,0004	-0,608	-4,284	**<0,001**
Carbonhydrate (%)	-0,20	0,010	-0,089	-1,892	0,059	-0,013	0,14	-0,059	-0,093	0,926
Protein (%)	0,113	0,022	0,231	5,033	**<0,001**	0,067	0,142	0,136	0,469	0,639
Fat (%)	-0,003	0,011	-0,014	-0,300	0,765	0,041	0,139	0,177	0,297	0,766
Vitamin B6 (mg)	0,619	0,159	0,181	3,902	**<0,001**	-0,392	0,403	-0,115	-0,973	0,331
Vitamin B9 (mcg)	0,004	0,001	0,185	3,993	**<0,001**	0,007	0,003	0,374	2,919	**0,004**
Vitamin B12 (mcg)	-0,093	0,052	-0,085	-1,795	0,073	-0,613	0,103	-0,556	-5,928	**<0,001**
Calcium (mg)	-0,001	0,00028	-0,118	-2,524	**0,012**	-0,004	0,001	-0,7	-7,321	**<0,001**
Phosphorus (mg)	0,00038	0,00016	0,111	2,374	**0,018**	0,006	0,001	1,844	6,134	**<0,001**
Magnesium(mg	0,002	0,001	0,158	3,390	**0,001**	-0,006	0,002	-0,477	-2,518	**0,012**

MOET: Muscularity-Oriented Eating Test

DISCUSSION AND CONCLUSION

The amount of carbohydrates, fats, and proteins in consumed foods directly affects exercise performance and recovery after exercise (Ömür & Ersoy, 2023; Bayraktar & Zorba, 2020). In a study by Furkan Demir (2019), 72.72% (16 individuals) of sedentary adolescents consumed sausage sandwiches, while 68.2% (15 individuals) of athletic adolescents consumed chicken. Additionally, 63.6% (14 individuals) of sedentary adolescents consumed sugar buns, whereas 77.3% (17 individuals) of athletic adolescents consumed wholemeal or whole wheat bread (Demir, 2019). In another study, foods preferred by women who regularly engaged in sports for breakfast included eggs (81.3%), bread (80%), milk and dairy products (69.3%), and beverages (58.7%). Women who did not exercise regularly preferred bread (89.3%), eggs (76%), milk and dairy products (69.3%), and beverages (64%). Interestingly, the proportion of those who consumed meat products at breakfast was higher among women who did not exercise regularly (25.3% in the exercising group versus 32% in the non-exercising group) (İzgi, 2011). In the present study, the consumption of seafood, lean meat, and eggs was found to be higher among individuals who exercised compared to those who did not. When comparing these findings with previous studies, it was concluded that individuals who exercise tend to consume more protein-rich foods (Table 1). This may be attributed to their focus on achieving a muscular physique and their emphasis on physical appearance.

Today, the growing importance of exercise and the increasing rate of participation in physical activity are closely associated with individuals' desire to maintain a healthy lifestyle from socio-cultural, psychological, and physical perspectives. This awareness also influences the types of exercise chosen (Arslanoğlu, 2018). In one study, most male students cited staying fit (n = 219), entertainment (n = 134), and health (n = 182) as their main reasons for engaging in physical activity. In contrast, female students primarily reported health (n = 251), staying fit (n = 251), and entertainment (n = 236) as their motivations (Carballo-Fazanes et al., 2020). Another study involving 600 participants found that 270 individuals exercised for bodybuilding purposes, while 530 participants identified health as their primary motivation (Kutlu et al., 2020). Similarly, Berk and Bingöl (2023) reported that participants exercised to maintain a fit appearance (n = 188), build muscle (n = 156), lose weight (n = 77), and for fun (n = 54). In a separate study, it was shown that female participants were primarily motivated by health, weight control, and appearance enhancement, whereas male participants were more driven by challenge, enjoyment, health, and a sense of belonging (Zayed & Frieze, 2015). In the present study, when university students who engaged in exercise were asked about their motivations, the most frequently cited reasons were for personal health (n = 53) and as a hobby (n = 89). The proportions of those exercising for health and as a hobby were found to be significant (Table 2). Overall, the literature indicates that the primary motivations for engaging in exercise among participants include health, physical appearance, and enjoyment.

Although the term "physical activity" is used in various contexts, it is generally defined as any bodily movement that results in energy expenditure and involves the contraction of skeletal muscles. In a study conducted among university students, 24.3% (37.1% of males and 18.0% of females) were found to have an adequate level of physical activity, while 49.3% had a low level, and 26.6% were classified as inactive (Kasırga et al., 2021). According to IPAQ scores reported in a study by Çalışkan and Erzurum Alim (2020), 14.1% of participants were physically inactive, 34.2% were minimally active, and 51.7% were highly active (Çalışkan & Alim, 2021). Similarly, Oğuz and Saka (2021) found that 45.8% of individuals were inactive, 37.5% were minimally active, and 16.7% were highly active. Among those who reported exercising, 63.6% were minimally active and 36.4% were highly active. In contrast, 84.6% of non-exercisers were inactive, and 15.4% were minimally active. A statistically significant relationship was found between MET classification and exercise status ($p < 0.05$). In the study conducted by Acar Tek et al. (2020), 26.9% of participants were sedentary or low active, 59.7% were active, and 13.4% were highly active. In this study, 15.4% of those who exercised were low active, 32.2% were moderately active, and 52.3% were high active. Among those who did not exercise, 33.9% were low active, 61.5% were moderately active, and 4.7% were high active (Table 2).

The urge to achieve a muscular body often manifests through protein-focused diets and exercise programs aimed at increasing body weight and muscle mass in men, and weight loss and body toning in women (Hamurcu, 2023). In a study by Hamurcu (2023), a moderate positive correlation was found between Muscularity-Oriented Eating Test (MOET) scores and Exercise Addiction Scale scores ($r = 0.472$, $p = 0.001$), as well as a weak but significant correlation between MOET and IPAQ scores ($r = 0.305$, $p < 0.001$). Similarly, Arslan Kabasakal (2024) also reported a significant positive relationship between exercise addiction and muscularity-oriented eating behavior. In another study, as IPAQ scores increased among university students, scores on the Muscle Appearance Satisfaction Scale also increased (Arslan et al., 2022). Çalışkan and Erzurum Alim (2021) observed a weak yet meaningful association ($r = 0.62$) between training behavior scores related to muscularity and MOET. Another study found that individuals with higher levels of muscularity also exhibited higher levels of physical activity. Likewise, de Carvalho and Laus (2023) reported that physically active individuals had significantly higher MOET scores than physically inactive ones ($p < 0.05$). According to the same study, participants with the highest protein quality index (Q5) had the highest MOET scores among both exercisers and non-exercisers (Table 3). Regression analysis further revealed that a one-unit increase in MOET was associated with a 0.045 increase in protein quality and a 0.113 increase in protein intake (Table 4), suggesting that individuals with stronger muscularity-oriented eating behaviors place greater emphasis on protein quality. As no previous studies have specifically addressed this relationship, the findings of this research offer novel insights into the intersection of eating behavior, exercise, and protein quality.

Both muscle protein synthesis and muscle protein breakdown increase with exercise (Kurt, 2018; Oğuz & Saka, 2020). As a result, individuals who engage in regular physical activity require a higher protein intake than their sedentary counterparts (Aydın et al., 2020). In a study by De La O and Ruiz-Canela (2023), individuals classified in the lowest protein quality group (Q1) had the lowest exercise levels (18.8 ± 20.4), while those in the highest group (Q5) exhibited the highest exercise levels (24.8 ± 25.3). Findings from the NHANES study revealed that physically active individuals consumed more daily protein than those who were inactive, and their protein sources were of higher quality (Bina & Tonser, 2024). Similarly, a study conducted among older adults showed that those who exercised had significantly higher daily protein intake compared to non-exercisers and consumed higher-quality protein sources (Lourida et al., 2021). In the current study, the protein quality score of individuals who exercised was statistically higher than that of non-exercising individuals ($p < 0.05$; Table 1). Among exercisers, the highest protein quality was observed in the Q5 group (97.98 ± 42.5), and the lowest in the Q1 group (66.02 ± 18.87). Additionally, protein intake levels among exercising individuals were higher across all protein quality groups compared to non-exercisers (Table 3). This may be attributed to the fact that one of the determinants of protein quality is the amount of protein consumed, and those who exercise tend to consume more protein. Moreover, regression analysis revealed that a one-unit increase in protein intake resulted in a 0.113-point increase in protein quality (Tables 3 and 4). Given the limited number of studies exploring this topic, the findings of the current research provide novel contributions to the existing literature on the relationship between exercise, protein intake, and protein quality.

This study's cross-sectional design prevents the establishment of causal relationships. Additionally, the observation of participants only once and the reliance on self-reported data may have led to issues such as social desirability bias and response errors. Additionally, the analyses examining the relationship between protein quality and muscularity-focused eating behavior may have been influenced by confounding factors, such as participant demographics. Furthermore, the quality and quantity of protein consumed by athletes varied across periods before, during, and after exercise, which makes it difficult to generalize the results. As these limitations may impact the generalizability of the study's findings, future research is needed.

It was found that individuals who exercised consumed a diet with higher protein quality and tended to follow a muscularity-oriented eating pattern. The positive association between muscularity-oriented eating and protein quality suggests that exercise motivation—especially related to body image—can shape dietary choices. These findings highlight the importance of promoting balanced, high-quality protein intake among physically active individuals. Additionally, identifying key nutrients affecting protein quality may guide more targeted nutrition strategies, especially for young adults engaged in regular exercise.

Recommendations

Future research should explore the longitudinal effects of exercise programs on protein quality and evaluate the timing of protein intake before and after exercise in relation to muscle development. Also, personalized nutrition plans should support individuals with high muscularity-oriented eating tendencies by ensuring dietary adequacy and psychological well-being. Interventions aimed at improving protein quality may enhance not only performance but also mitigate potential risks associated with disordered eating behaviors in this population. Larger-scale and multi-center studies are recommended to generalize findings across broader populations.

Recommendations for sport scientists:

- Future research should incorporate objective biomarkers (e.g., blood amino acid profiles or nitrogen balance) to validate dietary intake data.
- Longitudinal and interventional study designs are needed to clarify causal pathways between muscularity-oriented eating attitudes and protein quality.
- More nuanced assessment tools that distinguish between healthy goal-oriented eating and disordered behaviors related to muscularity should be developed.
- Future studies should stratify participants based on sex, athletic level, and sport type to uncover subgroup-specific patterns.
- Nutritional periodization strategies should be examined in relation to protein quality and performance outcomes across different training phases.

Recommendations for athletes and coaches:

- Athletes should prioritize not only protein quantity but also quality by incorporating a variety of high-biological-value protein sources (e.g., lean meats, eggs, low-fat dairy, and seafood).
- Coaches should be aware that an extreme focus on muscular appearance may influence eating behavior; education on balanced nutrition should be integrated into training programs.
- Muscularity-oriented individuals may benefit from nutritional counseling to ensure that their protein-focused diets also meet micronutrient and fiber requirements.
- Utilizing tools like the Protein Quality Index (PQI) can help athletes and nutritionists monitor and improve dietary choices for muscle growth and recovery.
- Athletes should be encouraged to match protein timing (especially post-exercise intake) with quality to optimize muscle protein synthesis and long-term adaptation.

Funding: This study was supported by the TÜBİTAK-BİDEB 2209/A University Students Research Projects Support Programme.

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