ORİJİNAL MAKALE / ORIGINAL ARTICLE
Balıkesir Sağlık Bilimleri Dergisi / BAUN Sağ Bil Derg
Balıkesir Health Sciences Journal / BAUN Health Sci J
ISSN: 2146-9601- e ISSN: 2147-2238
Doi: https://doi.org/10.53424/balikesirsbd.1791644

Relationship Between Meat Attachment, Food Technology Neophobia and Physical Activity Levels in Young Adults

Ramazan Mert ATAN[1], Derya AZIM[2], Kevser TARI SELCUK[1]

[1] Bandirma Onyedi Eylul University, Faculty of Health Sciences, Department of Nutrition and Dietetics
[2] Bandirma Onyedi Eylul University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation

Geliş Tarihi / Received: *26.09.2025,* ***Kabul Tarihi / Accepted:*** *09.11.2025*

ABSTRACT
Objective: This study aimed to investigate associations between meat attachment, food technology neophobia and physical activity levels in young adults. **Materials and Methods:** In this cross-sectional study, data collected from 775 young adults were analyzed. To collect the data, the Descriptive Information Form, Meat Attachment Questionnaire (MAQ), Food Technology Neophobia Scale (FTNS) and International Physical Activity Questionnaire-Short Form (IPAQ-SF) were used. In data analysis, descriptive statistics, simple and multiple linear regression analyses were performed. The significance level of statistical tests was accepted as $p<0.05$. **Results:** The mean scores obtained by the participants from the MAQ and FTNS were 3.47±0.81 and 50.20±12.70, respectively. Most participants (55.6%) had low physical activity levels. According to the results of the linear regression analysis, meat attachment was positively associated with the "New Food Technologies are Unnecessary" (β:0.214, $p<0.05$) and "Perception of Risks" (β:0.220, $p<0.05$) subscales and negatively associated with the "Healthy Choice and Information/Media" subscale (β:-0.100, $p<0.05$) of the FTNS. Meat attachment was positively associated with physical activity levels in the unadjusted model but showed no independent association after adjusting for sociodemographic factors ($p>0.05$). **Conclusion:** It has been found that young adults who are strongly attached to meat suffer more from concerns and reluctance related to new food technologies.
Keywords: Food Preferences, Food Technology, Meat, Physical Activity.

Genç Yetişkinlerde Et Tüketimine Bağlılık ile Gıda Teknolojisi Neofobisi ve Fiziksel Aktivite Düzeyleri Arasındaki İlişki

ÖZ
Amaç: Bu çalışma, genç yetişkinlerde et bağlılığı ile gıda teknolojileri neofobisi ve fiziksel aktivite düzeyleri arasındaki ilişkiyi araştırmayı amaçlamıştır. **Gereç ve Yöntem:** Bu kesitsel çalışmada, 775 genç yetişkinden toplanan veriler analiz edilmiştir. Verilerin toplanması için Tanımlayıcı Bilgi Formu, Et Bağımlılığı Anketi (MAQ), Gıda Teknolojileri Neofobi Ölçeği (FTNS) ve Uluslararası Fiziksel Aktivite Anketi-Kısa Formu (IPAQ-SF) kullanılmıştır. Veri analizinde; betimsel istatistikler, basit ve çoklu doğrusal regresyon analizleri gerçekleştirilmiştir. İstatistiksel testlerin anlamlılık düzeyi $p<0,05$ olarak kabul edilmiştir. **Bulgular:** Katılımcıların MAQ ve FTNS'den elde ettikleri ortalama puanlar sırasıyla 3.47±0.81 ve 50.20±12.70'di. Katılımcıların çoğu (55.6%) düşük fiziksel aktivite düzeyine sahipti. Doğrusal regresyon analizi sonuçlarına göre, ete bağlılık, 'Yeni Gıda Teknolojileri Gereksizdir' (β:0.214, $p<0.05$) ve 'Risk Algısı' (β:0.220, $p<0.05$) alt ölçekleriyle pozitif, 'Sağlıklı Seçim ve Bilgi/Medya' alt ölçeği (β:-0.100, $p<0.05$) ile negatif ilişkiler göstermiştir. Et bağlılığı düzeltilmemiş modelde fiziksel aktivite düzeyleri ile pozitif ilişki göstermiş, ancak sosyo-demografik faktörler için düzeltme yapıldıktan sonra anlamlı bir ilişki göstermemiştir ($p>0.05$). **Sonuç:** Ete bağlılık düzeyleri daha yüksek olan genç yetişkinlerin yeni gıda teknolojileriyle ilgili korku ve endişe duydukları tespit edilmiştir.
Anahtar Kelimeler: Besin Tercihleri, Gıda Teknolojisi, Et, Fiziksel Aktivite

Sorumlu Yazar / Corresponding Author: Ramazan Mert ATAN, Bandirma Onyedi Eylul University, Faculty of Health Sciences, Department of Nutrition and Dietetics, Balikesir, Türkiye
E-mail: ratan@bandirma.edu.tr

Bu makaleye atıf yapmak için / Cite this article: Atan, R. M., Azim, D., & Tari Selcuk, K. (2026). Relationship between meat attachment and food technology neophobia and physical activity levels in young adults. *BAUN Health Sci J, 15*(1), 98-106. https://doi.org/10.53424/balikesirsbd.1791644

BAUN Health Sci J, OPEN ACCESS https://dergipark.org.tr/tr/pub/balikesirsbd
This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License

INTRODUCTION

In the "2030 Agenda for Sustainable Development", adopted by the United Nations (UN) at the Sustainable Development Summit in 2015, issues such as reducing poverty and increasing welfare worldwide, preventing environmental damage, and providing healthy and quality life were included (United Nations, 2015); thus, key priority was given to issues such as limiting the consumption of animal-based foods significantly and increasing the consumption of plant-based foods. Achieving these sustainability goals requires not only systemic changes in food production but also modifications in consumer behavior (Willett et al., 2019). However, there are many obstacles in terms of consumer behavior when transitioning from an animal-based to plant-based diets. Meat attachment, one of these obstacles, is defined as meat consumption considered not as a physical need but as an emotional bond. Generally, individuals whose meat attachment level is high tend to prefer traditional meat and meat products and have a strong reluctance to change their eating habits (Graça et al., 2015; Hartmann & Siegrist, 2017).

Although conventional meat produced by rearing animals is an important source of protein and micronutrients for humans, it significantly contributes to global climate change through many problems such as greenhouse gas emissions, deforestation, and freshwater consumption (Bryant et al., 2018). In addition, excessive consumption of red meat and processed meat is associated with an increased incidence of various chronic diseases such as obesity, type 2 diabetes mellitus, cardiovascular diseases, and some types of cancer (Battaglia et al., 2015; Giromini & Givens, 2022). Accordingly, recent developments in food technologies promise hope in terms of healthy nutrition and sustainability (Rabadán et al., 2021).

Today, different technologies have been developed at various stages of food production from harvesting to processing and storage. Among the developments in the food industry, ultrasound, high hydrostatic pressure, pulsed electric fields, and cold plasma methods have frequently taken their places on the agenda in recent years. It is also reported that sustainable packaging solutions, nanotechnology, genetic engineering, in vitro meat production, and three-dimensional (3D) food printing technology have low environmental impacts (Kahriman & Baş, 2024). However, transforming global food production and consumption patterns remains a major challenge (Valoppi et al., 2021). Since consumers' perceptions and preferences play a decisive role in determining the market acceptance and success of new food technologies, understanding consumers' behavioral responses is of vital importance (Wang et al., 2023). Food technology neophobia is defined as consumers' fear of new food technologies and products (Cox & Evans, 2008). Food technology neophobia has been reported to be a determining factor in consumers' tendency to accept new food technology products, and in their eating habits (Jezewska-Zychowicz & Królak, 2015). However, whether there is a relationship between meat attachment and food technology neophobia is still unclear. Moreover, meat attachment is perceived as an obstacle to the transition to a plant-based and alternative protein-based diet, which negatively affects environmental sustainability (Kühn et al., 2023).

Another factor that may be associated with meat attachment is the physical activity levels of individuals. There are common motivations for both eating habits and physical activity participation, including improvements in physical health, appearance, and sports performance, which indicates the presence of complex and mutual interactions between eating habits and physical activity (Ashton et al., 2017). As reported in many cohort studies, there is a negative relationship between red meat consumption and physical activity level (Grosso et al., 2017; Pan et al., 2012). From a nutritional perspective, physical activity increases protein requirements, and it has been reported that athletes may need more protein than sedentary individuals (Jäger et al., 2017). In the context of sports, a prevailing view holds that animal-based proteins are superior and that following an omnivorous diet is essential for achieving athletic goals (di Corcia et al., 2022). In contrast, when energy requirements, dietary variety, and supplementation are appropriately planned, there is growing evidence that plant-based diets can adequately support athletic performance (Roberts et al., 2022, Lynch et al., 2018). Therefore, the relationship between physical activity and meat consumption stems not only from nutritional requirements but also from numerous socio-cultural factors. However, whether there is a relationship between meat attachment and physical activity levels is still unclear.

Analysis of factors associated with meat attachment may contribute to the change of meat consumption patterns and reveal the obstacles to the adoption of healthy and sustainable diets (Graça et al., 2015). The young adult period is a critical life stage during which individuals develop their dietary preferences and habits. During this time, attitudes related to meat attachment may undergo dynamic changes. Therefore, the present study aimed to determine the levels of meat attachment, food technology neophobia and physical activity among young adults, and to examine the relationships among these variables.

MATERIALS AND METHODS

Study design and participants

The population of this cross-sectional study comprised 1,994 students actively studying at the faculty of health sciences of a state university in Türkiye. The minimum

sample size to be included in the study was calculated as 652 people in the G*Power 3.1.9.7 program (power: 95%, significance level: α=0.05, and effect size: f^2=0.02 (Faul et al., 2009; Faul et al., 2007). However, considering the possibility of withdrawals and/or losses during the study, we decided to include 30% more people in the sample. Thus, in the sample, 848 people were included. The data were collected between January 2024 and June 2024, and the questionnaires were completed face-to-face under the supervision of researchers. Stratified sampling method was used in determining the study group. In the faculty whose students constituted the population of the study, there are five departments, namely Nutrition and Dietetics, Physiotherapy and Rehabilitation, Nursing, Healthcare Management and Social Service, in which students take four-year education. Stratified sampling was applied proportionally by department and academic year. In accordance with the ratio of the sample to population, 848 young adults were selected from students studying in different years in each department. Participants who did not follow a special diet were included. Of them, those who did not agree to participate in the study (n=14), those who were not in the age group of 18-24 years (n=4), those who had undergone bariatric surgery (n=1), those who were diagnosed with psychiatric diseases (n=11) or eating disorders (n=6), those who had never consumed meat or meat products (n=32), those who were allergic to meat or meat products (n=2), and those who were pregnant or breastfeeding (n=3) were excluded from the study. Thus, data obtained from 775 young adults were analyzed within the scope of the study.

Instruments

Descriptive information form

The form consists of items questioning the general information of the participants such as age, gender, nationality, marital status, having a diagnosed disease, smoking and alcohol use status.

Meat Attachment Questionnaire (MAQ)

The MAQ developed by Graça et al. (2015) is used to measure a positive bond towards meat consumption. The MAQ consists of 16 items whose responses are rated on a 5-point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree) and the following 4 dimensions regarding individuals' behaviors towards meat attachment; hedonism, affinity, entitlement, and dependence. Items 4, 6, 9, 13, and 14 are reverse-scored (Graça et al., 2015). The validity and reliability study of the Turkish version of the MAQ was conducted by Gunalan, Parmaksiz, & Mutlu (2024), and Cronbach's alpha coefficient was found to be 0.91.

Food Technology Neophobia Scale (FTNS)

The FTNS developed by Cox & Evans (2008) is used to determine consumer segments accepting or rejecting new food technologies. The FTNS has 12 items whose responses are rated on a 7-point Likert-type scale ranging from 1 to 7, and the following 3 factors: New Food Technologies Are Unnecessary, Perception of Risks, and Healthy Choice and Information/Media. The sum of the scores obtained from all the items yields the score for the overall FTNS. The higher the score is the higher the level of antipathy towards new food technologies (Cox & Evans, 2008). The validity and reliability study of the Turkish version of the FTNS was conducted by Kahriman & Baş (2024), and and Cronbach's alpha coefficient was found to be 0.85.

International Physical Activity Questionnaire-Short Form (IPAQ-SF)

The IPAQ-SF was developed by Craig et al. (2003) to determine the physical activity levels of adults. The "MET minutes/week" score is obtained by multiplying the minutes, days and Metabolic Equivalent of Task (MET) value of each activity. Physical activity levels are classified as physically inactive (<600 MET - min/week), low physical activity level (600-3000 MET - min/week) and sufficient physical activity level (>3000 MET - min/week) (Craig et al., 2003). The validity and reliability study of the Turkish version of the IPAQ-SF was conducted by Saglam et al. (2010).

Statistical analysis

The data were analyzed using the SPSS (Statistical Package for the Social Sciences) 26.0 program. In the analysis of the data, numbers, percentages, arithmetic mean and standard deviation were calculated for the descriptive statistics. Whether the data obtained from the sub-dimensions of the FTNS were normally distributed was confirmed with the kurtosis and skewness coefficients. Variables whose kurtosis and skewness coefficients were in the range of [(-1) - (+1)] were considered to conform to a normal distribution (Kim, 2013). The relationship between meat attachment, food technology neophobia and physical activity levels was examined using the simple and multiple linear regression analysis (enter method). While meat attachment was classified in the regression models as an independent variable, levels of Food Technology Neophobia and physical activity were classified as dependent variables, and variables such as age, sex, nationality, marital status, perceived financial status, place of residence, department, smoking status, alcohol consumption, the number of main meals, food label reading were classified as covariates. These variables were considered covariates variables because they are sociodemographic and lifestyle factors that may be related to meat consumption, attitudes toward technology, and physical activity level (Graça et al., 2015; Gunalan et al., 2024; Cox & Evans, 2008; Craig et al., 2003). The explanatory power of the model was evaluated with Adj. R^2, Multicollinearity and autocorrelation were evaluated with the Variance Inflation Factor (VIF<10) and Durbin Watson Statistics (DW: 0<DW<4) coefficients. The significance level of statistical tests was accepted as $p<0.05$.

Ethical consideration

The present study was performed in line with the ethical standards established in the Declaration of

Helsinki. Before the study was conducted, ethical approval was obtained from Bandirma Onyedi Eylul University Non-Interventional Ethics Committee (decision date: November 11, 2023, decision number: 2023-207).

RESULTS

The mean age of the participants was 21.03±3.02 years and 81.3% were women. Other descriptive characteristics of the participants are shown in Table 1.

Table 1. Descriptive characteristics of the participants (n=775).

Descriptive Characteristics	Number (n)	Percentage (%)
Age (Mean±SD: 21.03±3.02, Min:18, Max:24 years)		
18-20	356	45.9
21-24	419	54.1
Sex		
Women	630	81.3
Men	145	18.7
Nationality		
Republic of Türkiye	718	92.6
Others	57	7.4
Marital status		
Married	15	1.9
Single	760	98.1
Perceived financial status		
Good	160	20.6
Moderate	534	68.9
Low	81	10.5
Place of residence		
With family	53	6.8
Own house	178	23.0
Dormitory/Apartment	544	70.2
Department		
Nutrition and dietetics	155	20.0
Physical therapy and rehabilitation	173	22.3
Nursing	241	31.1
Healthcare Management	131	16.9
Social service	75	9.7
Presence of chronic disease		
No	676	87.2
Yes	99	12.8
Smoking status		
Current smoker	131	16.9
Non smoker	644	83.1
Alcohol consumption		
Yes	203	26.2
No	572	73.8
The number of main meals		
1-2	514	66.3
3	242	31.2
4	19	2.5
Reading food labels		
Yes	627	80.9
No	148	19.1

SD: Standard Deviation. Min: Minimum. Max: Maximum.

The mean score obtained from the overall MAQ was 3.47±0.81. The mean scores obtained from the overall FTNS, and its New Food Technologies Are Unnecessary, Perception of Risks, and Healthy Choice and Information/Media subscales were 50.20±12.70, 24.18±9.18, 13.62±5.01, and 12.40±4.22, respectively. The mean MET-min/week of the participants obtained from the IPAQ-SF was 2114.20±2173.83. According to the MET-min/week

score cut-off points, 55.6% of the participants had a low physical activity level (Table 2).

Table 2. MAQ, FTNS and IPAQ-SF and subscale mean scores of participants.

Scale	Mean±SD	Min-Max	Range
MAQ	3.47±0.81	1.00-5.00	1.00-5.00
Hedonism	3.16±1.21	1.00-5.00	1.00-5.00
Affinity	4.36±0.79	1.00-5.00	1.00-5.00
Entitlement	3.62±1.09	1.00-5.00	1.00-5.00
Dependence	2.94±1.01	1.00-5.00	1.00-5.00
FTNS	50.20±12.70	18.00-84.00	12.00-84.00
New Food Technologies Are Unnecessary	24.18±9.18	6.00-42.00	6.00-42.00
Perception of Risks	13.62±5.01	3.00-21.00	3.00-21.00
Healthy Choice and Information/Media	12.40±4.22	3.00-21.00	3.00-21.00
IPAQ-SF (MET - min/week)	2114.20±2173.83	0-10986.00	-
Physical activity level	**%(n)**	-	-
Inactive (<600 MET - min/week)	21.7(168)	-	-
Low (600-3000 MET - min/week)	55.6(431)	-	-
Adequate (>3000 MET - min/week)	22.7(176)	-	-

MAQ: Meat Attachment Questionnaire, FTNS: Food Technology Neophobia Scale, IPAQ-SF: International Physical Activity Questionnaire-Short Form

In Table 3, the relationship between meat attachment and food technology neophobia according to linear regression analysis was presented. Meat attachment was positively associated with New Food Technologies Are Unnecessary and Perception of Risks subscales scores in all models (βs:0.206-0.224, p<0.05). In contrast, meat attachment was negatively associated with Healthy Choice and Information/Media subscale scores in all models [βs:(-0.100)-(-0.108), p<0.05) (Table 3).

In Table 4, the relationship between meat attachment and physical activity level according to the linear regression analysis was presented. Meat attachment was positively associated with physical activity level in Model 1 (β:0.105, p<0.05). There is no relationship between meat attachment and physical activity level in other Models (Table 4).

Table 3. Relationship between meat attachment and food technology neophobia according to linear regression analyses.

Models	New Food Technologies Are Unnecessary			Perception of Risks			Healthy Choice and Information/Media		
	B (SE)	β	95% CI	B (SE)	β	95% CI	B (SE)	β	95% CI
Model 1	*(Adj.R^2:0.044, F:36.945, p:<0.001)*			*(Adj.R^2:0.047, F:39.231, p:<0.001)*			*(Adj.R^2:0.010, F:7.773, p:<0.05)*		
Meat attachment	2.398 (0.394)	0.214	1.623;3.172***	1.348 (0.215)	0.220	0.925;1.770***	-0.515 (0.185)	-0.100	-0.878;-0.152**
Model 2	*(Adj.R^2:0.051, F:11.325, p:<0.001)*			*(Adj.R^2:0.065, F:14.520, p:<0.001)*			*(Adj.R^2:0.013, F:3.515, p:<0.05)*		
Meat attachment	2.312 (0.404)	0.206	1.519;3.105***	1.366 (0.219)	0.223	0.936;1.796***	-0.558 (0.190)	-0.108	-0.930;-0.186**
Model 3	*(Adj.R^2:0.091, F:8.079, p:<0.001)*			*(Adj.R^2:0.077, F:6.879, p:<0.001)*			*(Adj.R^2:0.011, F:1.812, p:<0.05)*		
Meat attachment	2.276 (0.399)	0.203	1.493;3.058***	1.344 (0.219)	0.219	0.913;1.775***	-0.526 (0.191)	-0.102	-0.902;-0.151**
Model 4	*(Adj.R^2:0.072, F:8.533, p:<0.001)*			*(Adj.R^2:0.071, F:8.381, p:<0.001)*			*(Adj.R^2:0.013, F:2.229, p:<0.05)*		
Meat attachment	2.311 (0.401)	0.206	1.524;3.098***	1.372 (0.219)	0.224	0.941;1.802***	-0.546 (0.190)	-0.106	-0.920;-0.173**

B: Unstandardized coefficient, β: Standardized (beta) coefficient, CI: Confidence Interval, *p<0.05, **p<0.01, ***p<0.001. Variables included in the model: **Model 1:** Meat attachment (Constant); **Model 2:** Model 1 + Age (Constant), Sex (Women:0, Men:1), Nationality (Others:0, Republic of Türkiye:1); **Model 3:** Model 2 + Marital status (Single:0, Married:1), Perceived financial status (Good/Moderate:0, Bad:1), Place of residence (Family:0, House/Dormitory/Apartment:1), Department (Nutrition and dietetics: 0, Other: 1). Smoking status (Nonsmoker:0, Current smoker:1), Alcohol consumption (No:0, Yes:1), The number of main meals (3:0, 1/2/4:1), **Model 4:** Model 3 + Food label reading (Yes:0, No:1).

Table 4. Relationship between meat attachment and physical activity level according to the linear regression analyses.

Models	Physical activity level (MET- min/week)		
	B (SE)	β	95% CI
Model 1	*(Adj.R^2:0.010, F:8.694, p:<0.001)*		
Meat attachment	280.199 (95.027)	0.105	93.656; 466.741**
Model 2	*(Adj.R^2:0.073, F:16.231, p:<0.001)*		
Meat attachment	132.710 (94.472)	0.050	-52.743;318.163
Model 3	*(Adj.R^2:0.072, F:6.478, p:<0.001)*		
Meat attachment	132.340 (95.306)	0.050	-54.754;319.433
Model 4	*(Adj.R^2:0.073, F:6.091, p:<0.001)*		
Meat attachment	132.502 (95.258)	0.050	-54.498;319.502

B: Unstandardized coefficient, β: Standardized (beta) coefficient, CI: Confidence Interval. *p<0.05, **p<0.01, ***p<0.001. Variables included in the model: **Model 1:** Meat attachment (Constant); **Model 2:** Model 1 + Age (Constant), Sex (Women:0, Men:1), Nationality (Others:0, Republic of Türkiye:1); **Model 3:** Model 2 + Marital status (Single:0, Married:1), Perceived financial status (Good/Moderate:0, Bad:1), Place of residence (Family:0, House/Dormitory/Apartment:1), Department (Nutrition and dietetics: 0, Other: 1). Smoking status (Nonsmoker:0, Current smoker:1), Alcohol consumption (No:0, Yes:1), The number of main meals (3:0, 1/2/4:1), **Model 4:** Model 3 + Food label reading (Yes:0, No:1).

DISCUSSION

According to the main recommendations for a healthy and sustainable diet, animal-based foods should be limited significantly, and the consumption of plant-based foods should be increased (Willett et al., 2019). Despite the strong evidence indicating that plant-based diets and alternatives to meat improve health, high meat consumption continues in many populations, which is due to the dominant cultural norms. In addition, a significant number of people report that adhering to a plant-based diet is inconvenient because it is time-consuming and skills for food preparation and cooking are needed (Jeżewska-Zychowicz, Sajdakowska, Gębski, Kosicka-Gębska, & Gutkowska, 2024). In studies conducted with adults, the mean overall MAQ scores were 3.40 ± 0.95 in Germany (Kühn et al., 2023), 3.76 ± 0.81 in the USA, 3.70 ± 0.54 in China, 3.28 ± 0.78 in India (Bryant et al., 2019), and 3.47 ± 0.81 in the present study. Differences observed between countries are probably due to factors such as cultural norms, economic conditions, health and environmental awareness, education level, religious beliefs, and taste preferences. Currently, the inability to meet the nutritional needs of the growing population, negative effects of traditional meat production on environmental sustainability, and other sustainability concerns have led to significant innovations in food technologies (Bryant et al., 2019). Within this context, it is assumed that new food technologies have positive contributions to both environmental sustainability and healthy nutrition (Kahriman & Baş, 2024). However, the main obstacles to new food technologies are that consumers do not want to adopt them and are willing to maintain their traditional food preferences, which may delay the acceptance of new food technology products by society and slow down the dissemination process of them (Tziva, Negro, Kalfagianni, & Hekkert, 2020). Therefore, the adoption of new food technologies is not solely dependent on technological advancements but is also closely related to consumers' perceptions of trust, openness to innovation, and psychological responses (Wendt & Weinrich, 2023; Siegrist & Hartmann, 2020). In this regard, consumers' psychological tendencies toward innovation emerge as a critical determinant in the acceptance of new food technologies (Siegrist & Hartmann, 2020). Food technology neophobia emerges from the complex effects of cultural values, individual differences, and environmental factors (Cox & Evans, 2008). In the present study, the mean score the participants obtained from the FTNS was 50.20±12.70, which suggests that they have neophobia at a moderate level. In a systematic review, the FTNS total score was reported to vary between 38.70 and 77.20 in different populations (Wendt & Weinrich, 2023), which probably stemmed from differences between characteristics of the populations included in the studies. Neophobia towards food technologies is affected by factors such as age, sex, income level, education level, and region of residence (Siegrist & Hartmann, 2020).

Despite the increasing number of new food technology products in recent years, populations that are particularly strongly committed to meat consumption resist such innovative products (Bryant et al., 2019). In the present study, meat attachment was positively associated with the subscales of "New Food Technologies are Unnecessary" and "Risk Perception", which indicated that as the participants meat attachment levels increased, they tended to think that food technologies were unnecessary and perceived them as risky. These findings may be due to the fact that individuals whose meat attachment levels are high are more resistant to changing their traditional dietary habits. Individuals with meat attachment may perceive new food technologies in particular as a threat to their traditional meat and meat products that they are accustomed to (Hartmann & Siegrist, 2017). In addition, meat consumption is originated from the traditions of many populations (Jeżewska-Zychowicz et al.,

2024), which may increase resistance to food technologies. On the other hand, another finding of the present study is that meat attachment is negatively associated with "Healthy Choice and Information/Media Subscale". This is an interesting result because those strongly attached to meat continue to consume meat because they perceive meat consumption as a healthy choice and may consider new food technologies as an unhealthy choice. However, in several studies, it has been reported that individuals whose meat consumption is low have higher levels of health awareness and tendency to question information about healthy nutrition (Janssen, Busch, Rödiger, & Hamm, 2016; Radnitz, Beezhold, & DiMatteo, 2015). Therefore, individuals who consume meat less may question the long-term health consequences of new food technology products more, may be prejudiced against these products and may be more affected by negative news in the media about food technology products. However, the relatively low explanatory power of these models suggests that other unmeasured individual, psychological, or contextual factors may also play a role in the observed relationships.

The other finding of the present study was that meat attachment was positively associated with physical activity levels. However, when confounding factors were included, the significant positive relationship disappeared. There are complex relationships between meat consumption and physical activity levels, both of which affect each other. Pan et al. (2012) found that individuals who consumed more red meat were less likely to be physically active. In their meta-analysis, Grosso et al. (2017) determined that there were positive relationships between red meat consumption and low physical activity levels, and between fruit and vegetable consumption and high physical activity levels. On the other hand, individuals who do anaerobic activities (weightlifting, boxing, etc.) attach more importance to animal-based protein consumption for muscle protein synthesis (di Corcia et al., 2022). There is a prevailing view that athletes require meat to maintain their athletic performance, and therefore, even if they wish to do so for environmental or other reasons, they are unable to adopt a plant-based diet (Nebl et al., 2019). This may encourage those strongly attached to meat are high to participate in physical activities more. On the other hand, among physically active men in particular, meat consumption is emphasized not only as a physiological necessity but also as a component of identity representation and conformity to social norms. Therefore, meat consumption can be perceived not only as a behavior aimed at enhancing athletic performance but also as an indicator of masculine identity (van der Horst, Sällylä & Michielsen, 2023). The disappearance of the significant relationship after the inclusion of demographic and socioeconomic confounding factors in the present study indicates that the relationship between the participants' dietary preferences and physical activity levels is multidimensional and cannot be explained by a single variable. Furthermore, since the sample of this study consisted mostly of female participants, the results obtained may differ between genders. Therefore, it is recommended that future studies be designed taking gender differences into account and examine the mediating or moderating role of gender in the relationship between attachment to meat and physical activity. In addition, the relationship between meat attachment and the level of participation in different types of physical activities is still unclear.

Study limitations and strengths

The present study is one of the pioneering studies investigating the relationship between meat attachment, food technology neophobia and physical activity levels in young adults. The use of stratification method in sample selection ensured that different subgroups were adequately represented in the study. Other strengths of the study include the use of validated Turkish scales, a large sample size, and controlled for potential confounding factors. On the other hand, the study has some limitations. The first limitation is that the study was conducted only with young adults studying at a university's health sciences faculty. This situation may lead to the individuals in the sample having a higher level of knowledge about nutrition compared to the general young adult population. Additionally, the predominance of female participants suggests that gender-based differences may have influenced the results. The other limitation of the study is that it is cross-sectional in nature and therefore it is not possible to observe the sequential nature of causal relationships. Additionally, dietary intake of the participants was not assessed in this study; this limitation restricts the ability to determine the extent to which individuals consume products developed with new food technologies and how nutrient intake varies according to levels of physical activity participation.

CONCLUSION

The results of the present study demonstrated that young adults strongly attached to meat are more reluctant or skeptical about new food technologies. Given the positive effects of new food technologies on environmental sustainability, reducing meat attachment could contribute to efforts aimed at mitigating global climate change. Future researchers should focus on the role of education and awareness campaigns aimed at reducing meat attachment to increase the acceptance of new food technologies. In this way, the adoption of healthier and more sustainable diets on a global scale may be accelerated. On the other hand, another finding of the study is that there was no significant relationship

between meat attachment and physical activity levels after the inclusion of confounding factors, which suggests that the relationship between meat attachment and physical activity levels is complex and multifactorial. In future studies to be conducted with different populations, key points for changing meat consumption patterns could be identified and barriers to adopting healthy and sustainable diets could be eliminated globally.

Acknowledgement
The authors would like to extend their sincere thanks to anyone who contributed to this study.

Conflict of Interest
The authors declare no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Author Contributions
Plan, design: RMA**; Material, methods and data collection:** RMA, DA, KTS**; Data analysis and comments:** RMA, KTS**; Writing and corrections:** RMA, DA, KTS**.**

Funding
No support received.

Ethical Approval
Institution: Bandirma Onyedi Eylul University Non-Interventional Ethics Committee
Date: 11.11.2023
Approval no: 2023-207

REFERENCES

Ashton, L. M., Hutchesson, M. J., Rollo, M. E., Morgan, P. J. & Collins, C. E. (2017). Motivators and barriers to engaging in healthy eating and physical activity. *American Journal of Men's Health*, 11, 330-343. https://doi.org/10.1177/1557988316680936

Battaglia Richi, E., Baumer, B., Conrad, B., Darioli, R., Schmid, A. & Keller, U. (2015). Health risks associated with meat consumption: a review of epidemiological studies. *International Journal for Vitamin and Nutrition Research*, 85, 70-78. https://doi.org/10.1024/0300-9831/a000224

Bryant, C., Szejda, K., Parekh, N., Deshpande, V. & Tse, B. (2019). A survey of consumer perceptions of plant-based and clean meat in the USA, India, and China. *Frontiers in Sustainable Food Systems*, *3*, 432863. https://doi.org/10.3389/fsufs.2019.00011

Cox, D. N. & Evans, G. (2008). Construction and validation of a psychometric scale to measure consumers' fears of novel food technologies: the food technology neophobia scale. *Food Quality and Preference,* 19, 704-710. https://doi.org/10.1016/j.foodqual.2008.04.005

Craig, C. L., Marshall, A. L., Sjöström, M., Bauman, A. E., Booth, M. L., Ainsworth, B. E., Pratt, M., Ekelund, U., Yngve, A., Sallis, J. F. & Oja, P. (2003). International physical activity questionnaire: 12-country reliability and validity. *Medicine & Science in Sports & Exercise*, 35, 1381-1395. https://doi.org/10.1249/01.Mss.0000078924.61453.Fb

di Corcia, M., Tartaglia, N., Polito, R., Ambrosi, A., Messina, G., Francavilla, V. C., Cincione, R. I., Della Malva, A., Ciliberti, M. G., Sevi, A., Messina, G. & Albenzio, M. (2022). Functional properties of meat in athletes' performance and recovery. *International Journal of Environmental Research and Public Health,* 19, 5145. https://doi.org/10.3390/ijerph19095145

Faul, F., Erdfelder, E., Buchner, A. & Lang, A. G. (2009). Statistical power analyses using G*Power 3.1: tests for correlation and regression analyses. *Behavior Research Methods,* 41, 1149-1160. https://doi.org/10.3758/brm.41.4.1149

Faul, F., Erdfelder, E., Lang, A. G. & Buchner, A. (2007). G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, 39, 175-191. https://doi.org/10.3758/bf03193146

Giromini, C. & Givens, D. I. (2022). Benefits and risks associated with meat consumption during key life processes and in relation to the risk of chronic diseases. *Foods*, 11, 2063. https://doi.org/10.3390/foods11142063

Graça, J., Calheiros, M. M. & Oliveira, A. (2015). Attached to meat? (un)willingness and intentions to adopt a more plant-based diet. *Appetite*, 95, 113-125. https://doi.org/10.1016/j.appet.2015.06.024

Grosso, G., Micek, A., Godos, J., Pajak, A., Sciacca, S., Galvano, F. & Boffetta, P. (2017). Health risk factors associated with meat, fruit and vegetable consumption in cohort studies: a comprehensive meta-analysis. *PLoS One*, 12, e0183787. https://doi.org/10.1371/journal.pone.0183787

Gunalan, E., Parmaksiz, A., & Mutlu, H. (2024). Sex and income level can be determinants for meat attachment behavior among Turkish university students. *North African Journal of Food and Nutrition Research*, 8, 217-228. https://doi.org/10.51745/najfnr.8.18.217-228

Hartmann, C. & Siegrist, M. (2017). Consumer perception and behaviour regarding sustainable protein consumption: a systematic review. *Trends in Food Science & Technology,* 61, 11-25. https://doi.org/10.1016/j.tifs.2016.12.006

Jäger, R., Kerksick, C. M., Campbell, B. I., Cribb, P. J., Wells, S. D., Skwiat, T. M., ... & Antonio, J. (2017). International Society of Sports Nutrition position stand: protein and exercise. *Journal of the International Society of Sports Nutrition*, *14*(1), 20. https://doi.org/10.1186/s12970-017-0177-8.

Janssen, M., Busch, C., Rödiger, M. & Hamm, U. (2016). Motives of consumers following a vegan diet and their attitudes towards animal agriculture. *Appetite*, 105, 643-651. https://doi.org/10.1016/j.appet.2016.06.039

Jezewska-Zychowicz, M. & Królak, M. (2015). Do consumers' attitudes towards food technologies and motives of food choice influence willingness to eat cereal products fortified with

fibre? *Polish Journal of Food and Nutrition Sciences*, 65, 281-291. https://doi.org/10.2478/pjfns-2013–001

Jeżewska-Zychowicz, M., Sajdakowska, M., Gębski, J., Kosicka-Gębska, M. & Gutkowska, K. (2024). Predictors of eating less meat and more plant-based food in the Polish sample. *Nutrients*, 16, 1646. https://doi.org/10.3390/nu16111646

Kahriman, M. & Baş, M. (2024). Reliability and validity of the food technology Neophobia scale in a Turkish sample. *International Journal of Food Science & Technology,* 59, 2603-2611. https://doi.org/10.1111/ijfs.17000

Kim, H. Y. (2013). Statistical notes for clinical researchers: assessing normal distribution (2) using skewness and kurtosis. *Restorative Dentistry & Endodontics*, 38(1), 52-54. http://doi.org/10.5395/rde.2013.38.1.52

Kühn, D., Profeta, A., Krikser, T. & Heinz, V. (2023). Adaption of the meat attachment scale (MEAS) to Germany: interplay with food neophobia, preference for organic foods, social trust and trust in food technology innovations. *Agricultural and Food Economics*, 11, 38. https://doi.org/10.1186/s40100-023-00278-3

Lynch, H., Johnston, C., & Wharton, C. (2018). Plant-based diets: Considerations for environmental impact, protein quality, and exercise performance. Nutrients, 10(12), 1841. https://doi.org/10.3390/nu10121841.

Nebl, J., Schuchardt, J. P., Wasserfurth, P., Haufe, S., Eigendorf, J., Tegtbur, U., & Hahn, A. (2019). Characterization, dietary habits and nutritional intake of omnivorous, lacto-ovo vegetarian and vegan runners–a pilot study. *BMC Nutrition,* 5(1), 51. https://doi.org/10.1186/s40795-019-0313-8.

Pan, A., Sun, Q., Bernstein, A. M., Schulze, M. B., Manson, J. E., Stampfer, M. J., Willett, W. C. & Hu, F. B. (2012). Red meat consumption and mortality: results from 2 prospective cohort studies. *Archives of Internal Medicine,* 172, 555-563. https://doi.org/10.1001/archinternmed.2011.2287

Rabadán, A., Nieto, R. & Bernabéu, R. (2021). Food innovation as a means of developing healthier and more sustainable foods. *Foods*, 10, 2069. https://doi.org/10.3390/foods10092069

Radnitz, C., Beezhold, B. & DiMatteo, J. (2015). Investigation of lifestyle choices of individuals following a vegan diet for health and ethical reasons. *Appetite*, 90, 31-36. https://doi.org/10.1016/j.appet.2015.02.026

Roberts, A. K., Busque, V., Robinson, J. L., Landry, M. J., & Gardner, C. D. (2022). SWAP-MEAT Athlete (study with appetizing plant-food, meat eating alternatives trial)–investigating the impact of three different diets on recreational athletic performance: a randomized crossover trial. Nutrition Journal, 21(1), 69. https://doi.org/10.1186/s12937-022-00820-x

Saglam, M., Arikan, H., Savci, S., Inal-Ince, D., Bosnak-Guclu, M., Karabulut, E. & Tokgozoglu, L. (2010). International physical activity questionnaire: reliability and validity of the Turkish version. *Perceptual and Motor Skills,* 111, 278-284. https://doi.org/10.2466/06.08.Pms.111.4.278-284

Salter, A. M. (2018). The effects of meat consumption on global health. *Revue Scientifique et Technique,* 37, 47-55. https://doi.org/10.20506/rst.37.1.2739

Siegrist, M. & Hartmann, C. (2020). Consumer acceptance of novel food technologies. *Nature Food*, 1, 343-350. https://doi.org/10.1038/s43016-020-0094-x

Tziva, M., Negro, S., Kalfagianni, A. & Hekkert, M. (2020). Understanding the protein transition: The rise of plant-based meat substitutes. *Environmental Innovation and Societal Transitions,* 35, 217-231. https://doi.org/10.1016/j.eist.2019.09.004

United Nations. (2015). Transforming Our World: The 2030 Agenda For Sustainable Development. Retrieved from https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf. Accessed July 1, 2025.

Valoppi, F., Agustin, M., Abik, F., Morais de Carvalho, D., Sithole, J., Bhattarai, M., Varis, J. J., Arzami, A. N., Pulkkinen, E. & Mikkonen, K. S. (2021). Insight on current advances in food science and technology for feeding the world population. *Frontiers in Sustainable Food Systems,* 5, 626227. https://doi.org/10.3389/fsufs.2021.626227

van der Horst, H., Sällylä, A., & Michielsen, Y. (2023). Game changers for meat and masculinity? Male athletes' perspectives on mixed and plant-based diets. *Appetite*, 187, 106585. https://doi.org/10.1016/j.appet.2023.106585

Wang, K., Cong, L., Mirosa, M., Hou, Y. & Bremer, P. (2023). Food Technology Neophobia Scales in cross-national context: consumers' acceptance of food technologies between Chinese and New Zealand. *Journal of Food Science*, 88, 3551-3561. https://doi.org/10.1111/1750-3841.16693

Wendt, M.-C. & Weinrich, R. (2023). A systematic review of consumer studies applying the Food Technology Neophobia Scale: Lessons and applications. *Food Quality and Preference*, 106, 104811. https://doi.org/10.1016/j.foodqual.2023.104811

Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., . . . Murray, C. J. L. (2019). Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems. *Lancet*, 393, 447-492. https://doi.org/10.1016/s0140-6736(18)31788-4