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Research article

Assessment of sustainable nutrition practices among individuals attending the gym

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Abstract

Sustainable diets refer to diets with low environmental impacts and positive impacts on food security and health. Considering resource depletion and environmental pollution, it is thought that foods with low environmental impact should be chosen instead of foods with high environmental impact. However, given the high protein consumption of individuals who go to the gym, it is thought that they pose a risk for a sustainable future. Therefore, the aim of this study is to determine the behaviors of gym-going individuals towards sustainable nutrition. A total of 203 individuals with a mean age of 28.57±9.97 years were included in this cross-sectional study. A questionnaire containing demographic information was prepared by the researchers. In addition, the Sustainable Nutrition Behavior Scale was administered to the participants. An overwhelming majority of the participants, specifically 97.5%, reported consuming meat, chicken, or fish at least once or twice a week. The mean total score of the sustainable dietary behavior scale was 97.65±21.59. There was no significant difference between the body mass index values of the participants and the total score of the sustainable nutrition behavior scale (p>0.05). The total score of the behavior scale for sustainable nutrition was lower in participants with active sports duration of less than 5 years, single marital status, and male participants (p<0.05). Studies on sustainable nutrition are mostly focused on the general population. However, it is important to reveal the sustainable nutrition knowledge levels of individuals practicing sports.

Keywords: *Dietary behavior; environmental impact; sports nutrition; sustainable nutrition*

1. Introduction

Nutrition is regarded as a key component of athletic performance, with post-exercise nutritional recommendations being crucial for effective recovery and adaptation processes. Consequently, an effective recovery strategy between workouts or during competition can enhance adaptive responses to various fatigue mechanisms, improve muscle function, and increase exercise tolerance (Kerksick et al., 2017). The adaptive response to exercise training is influenced by several factors, including the duration, intensity, type, and frequency of exercise, as well as the quality and quantity of pre- and post-exercise nutrition (Meyer et al., 2020). A healthy and balanced diet is of great importance for athletes and active people to improve sports performance and general health (Amawi et al., 2024). It is known that athletes have a health advantage and that engaging in sports promotes a sustainable lifestyle (Meyer et al., 2020). Sustainable eating behaviors aim to increase the consumption of plant foods such as vegetables, fruits, and legumes and reduce the consumption of animal foods (Pinarli Falakacilar and Yucecan, 2024). However, animal protein consumption is recommended because it contains amino acids traditionally considered important for muscle growth (Goldman et al., 2024).

However, the continued emphasis on animal protein consumption raises concerns that it could lead to environmental problems as the world population and demand for meat grows.

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The environmental impacts of animal proteins and diminishing resources necessitate the search for alternative protein sources (López-Martínez et al., 2022). While meeting protein requirements for sustainability in athletes through plant-based approaches has been proposed, mitigation options such as reducing food waste and prioritizing seasonal produce have also been presented. However, more research is needed on the effects of plant-based strategies on performance and health, packaging, and food waste (Meyer et al., 2020). All of this highlights the need for continued research and reflection to balance sports nutrition and sustainability.

2. Materials and methods

2.1. Study design

The study was conducted to determine the sustainable nutrition behaviors of individuals applying to the gym. Sustainable food consumption behaviors of individuals were determined with the Sustainable Nutrition Scale. The sample of this cross-sectional study consisted of 203 voluntary individuals aged 19-65 years who exercised for 150 minutes or more in a private gym in Istanbul. This cross-sectional study was conducted following the guidelines outlined in the Declaration of Helsinki. The data collection process of the study was carried out after obtaining permission from the Istanbul Bilgi University Human Research Ethics Committee (2024-04/03).

2.2. Questionnaire

A questionnaire was prepared by the researchers to determine the demographic characteristics, exercise routines, dietary habits, and sustainable eating behaviors of the participants. Participants' sustainable food consumption behaviors were evaluated with the Sustainable Dietary Behavior Scale. This Likert-type five-point scale consists of 29 items and 4 sub-dimensions: reducing food waste and buying seasonal and local food. All items in the scale are scored by giving a numerical value from 1 to 5, from "never" to "always." The highest score that can be obtained from the scale is 145, and the lowest score is 29. Sub-dimension scores are calculated by dividing the sum of the scores given by individuals to the questions within each sub-dimension by the number of questions in that sub-dimension. Higher overall and sub-dimension scores indicate that the individual exhibits more sustainable nutrition behaviors (Garipoglu et al., 2023).

2.3. Data analysis

The data obtained were evaluated in SPSS software (version 28.0) Inc., Chicago package program. Statistical significance was set at $p<0.05$ for all analyses. Descriptive statistics encompassed the percentage, mean, number, median, minimum, maximum values, and standard deviation. The Kolmogorov-Smirnov test was used to check the data for normal distribution. The relationship between continuous variables was determined by Spearman correlation analysis. Mann-Whitney U and Kruskal-Wallis tests were employed to evaluate sustainable nutrition scores across various parameters. Multiple linear regression was utilized to estimate the effects of independent variables on the dependent variable, sustainable nutrition behavior. The variables of sport duration, sport branch, gender, and marital status were added to the model.

3. Results

Table 1 presents the general characteristics of the individuals. The average age of the participants was 28.57±9.97 years, and the average body weight was 71.35±15.45 kg. 50.7% of the participants were female and 82.8% were single. The education level of 74.4% of the participants was a bachelor's degree and above (Table 1).

Table 1
General characteristics of individuals applying to the gym (n=203).

Characteristics	Mean±SS	Med. (Min.-Maks.)
Age (year)	28.57±9.97	24 (18-59)
Height (cm)	171.82±9.16	170 (155-195)
Body weight (kg)	71.35±15.45	70 (42-125)
BMI (kg/m²)	23.88±4.29	23.66 (0-37.87)
Characteristics	**n**	**%**
Gender		
Men	100	49.3
Female	103	50.7
Marital status		
Single	168	82.8
Married	35	17.2
Educational background		
Bachelor's degree and higher	151	74.4
High School	34	16.7
Associate Degree	18	8.9

*BMI: body mass index

Table 2
Sports and nutrition habits of individuals.

Characteristics		n	%
Duration of active sport	0-6 months	52	25.6
	6-12 months	29	14.3
	1-2 years	32	15.8
	3-4 years	29	14.3
	5 years and above	61	30.0
Sport branch	Endurance	72	35.5
	Power/Strength	37	18.2
	Both	94	46.3
Sports nutrition knowledge level	No Information	17	8.4
	I know more than enough	31	15.3
	I have enough information	86	42.4
	I don't know enough	69	34.0
Meal skipping	No	60	29.6
	Yes	143	70.4
Frequency of meat/chicken/fish consumption per week	1-2 days	56	27.6
	3-4 days	78	38.4
	5-6 days	34	16.7
	Every day	30	14.8
	Never	5	2.5

Table 3
Behavior scale scores for sustainable nutrition.

	Mean±SS	Med. (Min.-Maks.)
Seasonal local nutrition	27.35±7.2	28 (10-40)
Food preference	17.84±5.53	18 (6-30)
Food purchasing	20.15±5.65	20 (6-30)
Reducing food waste	31.93±7.38	32 (13-45)
Total	97.65±21.59	97 (40-145)

The sports and nutrition habits of the individuals who applied to the gym are given in Table 2. Thirty percent of the participants have been practicing sports for 5 years or more, and

Table 4
The relationship between age and anthropometric measurements and the total score and subscale scores of the sustainable nutrition behavior scale.

		Food preference	Reducing food waste	Seasonal local nutrition	Food purchasing	Total
Age	r	0.361	0.302	0.252	0.314	0.387
	p*	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**
Body weight	r	-0.275	-0.093	-0.111	-0.169	-0.156
	p*	**<0.001**	0.189	0.119	**0.018**	**0.032**
Height	r	-0.336	-0.207	-0.214	-0.238	-0.276
	p*	**<0.001**	**0.003**	**0.002**	**0.001**	**<0.001**
BMI	r	-0.138	0.020	-0.012	-0.064	-0.022
	p*	0.052	0.779	0.871	0.373	0.768

**Spearman's correlation; BMI: body mass index

Table 5
The relationship between the sustainable nutrition behavior scale and demographic characteristics, sports and eating habits.

Characteristics		Food preference Mean±SS Med. (Min.Maks.)	Reducing food waste Mean±SS Med. (Min.Maks.)	Seasonal local nutrition Mean±SS Med. (Min.Maks.)	Food purchasing Mean±SS Med. (Min.Maks.)	Total Mean±SS Med. (Min.Maks.)
Gender	Men	15.64±5.56 16 (6-30)	30.15±7.4 30 (13-45)	25.23±7.18 25 (10-40)	18.47±5.6 18 (6-30)	90.06±21.23 90 (40-133)
	Female	19.92±4.64 20 (9-30)	33.64±6.99 34 (17-45)	29.43±6.64 29 (11-40)	21.77±5.23 21 (7-30)	104.92±19.4 101 (50-145)
	p[1]	**<0.001**	**0.001**	**<0.001**	**<0.001**	**<0.001**
Marital status	Single	17.36±5.34 18 (6-30)	31.29±7.41 31 (13-45)	26.56±7.07 27 (10-40)	19.82±5.52 20 (6-30)	95.37±21.5 95.5 (40-145)
	Married	20.18±5.89 19.5 (8-30)	34.94±6.56 36 (21-44)	31.06±6.77 31 (10-40)	21.79±6.1 21 (7-30)	108.91±18.51 108 (71-141)
	p[1]	**0.009**	**0.008**	**<0.001**	0.076	**0.002**
Educational background	Bachelor's degree and higher	17.54±5.6 18 (6-30)	32.07±7.24 32 (14-45)	26.99±7.09 27 (10-40)	19.81±5.69 20 (6-30)	96.82±21.59 96 (47-145)
	High School	18.61±5.36 19 (6-30)	30.58±7.73 31 (13-44)	29.0±7.42 30 (11-40)	21.85±4.95 22 (10-30)	100.31±21.8 102,5 (40-141)
	Associate Degree	19.57±5.4 18.5 (10-30)	32.63±8.29 34.5 (18-42)	26.33±7.47 26 (14-40)	19.43±5.98 20.5 (9-28)	98.42±22.17 95.5 (63-133)
	p[2]	0.625	0.448	0.294	0.263	0.715
Duration of active sport	0-6 months	16.76±4.98 18 (6-28)	30.9±7.44 30 (15-45)	26.92±7.14 26 (11-40)	19.73±4.8 19 (11-30)	95.27±20.01 94 (47-138)
	6-12 months	17.89±5.11 18 (9-30)	32.39±7.15 33.5 (14-44)	27.28±7.07 27 (14-40)	19.72±4.96 19 (9-28)	97.64±20.61 94.5 (48-141)
	1-2 years	16.66±6.09 17 (6-30)	30.94±7.49 30 (13-45)	26.97±8.26 27.5-(11-40)	18.45±6.36 18 (6-30)	92.03±24.69 89 (40-145)
	3-4 years	15.96±6.28 15,5 (6-29)	28.17±6.11 28 (18-41)	24.97±7.29 24 (10-37)	17.17±5.87 17 (7-28)	87.11±20.24 91 (50-133)
	5 years and above	20.29±4.75 21 (6-30)	35.0±6.95 37 (21-45)	29.14±6.44 30 (10-40)	23.12±4.92 24 (14-30)	108.25±18.21 110 (60-142)
	p[2]	**0.001**	**0.001**	0.104	**<0.001**	**<0.001**
Sport branch	Endurance	18.47±5.35 19- (6-30)	33.04±7.83 34- (14-45)	28.35±7.06 29- (10-40)	20.84±5.46 21- (9-30)	101.52±21.54 101- (48-145)
	Power/Strength	14.95±5.76 15- (6-25)	29.3±7.02 28- (13-44)	24.05±7.03 24- (10-39)	17.72±6.26 17- (6-30)	86.28±21.51 85- (40-138)
	Both	18.54±5.24 19 (6-30)	32.13±6.98 31.5 (15-45)	27.9±7.08 29 (10-40)	20.59±5.33 20.5 (9-30)	99.37±20.27 101 (47-142)
	p[2]	**0.006**	**0.034**	**0.006**	**0.023**	**0.001**
Meal skipping	No	19.71±5.15 20 (8-30)	34.22±7.21 36 (19-45)	28.35±7.23 29 (11-40)	21.96±5.62 22 (7-30)	104.63±20.05 103 (63-141)
	Yes	17.07±5.51 18 (6-30)	30.99±7.27 30.5 (13-45)	26.95±7.18 27 (10-40)	19.43±5.52 19 (6-30)	94.88±21.62 95.5 (40-145)
	p[1]	**0.004**	**0.007**	0.273	**0.004**	**0.007**

[1]Mann Whitney U test, [2]Kruskal Wallis test

46.3% of them stated that they practiced both endurance and power/strength sports. 42.4% of the participants stated that they had sufficient knowledge about sports nutrition. In addition, 70.4% of the participants skip meals. 14.8% of the participants consume meat/chicken/fish every day (Table 2).

Sustainable nutrition behavior scale scores are given in Table 3. The mean total score was 97.65±21.59. The mean score of the food preference subscale was 17.84±5.53, while the mean score of the food waste reduction subscale was 31.93±7.38 (Table 3).

The relationship between the total and subscale scores of the sustainable eating behavior scale and age and anthropometric measurements is shown in Table 4. When the relationship between the mean total sustainable nutrition behavior score of the participants and age and anthropometric measurements was evaluated, a significant negative correlation was found with height and body weight values and a significant positive correlation with age (p<0.05). However, no statistically significant difference was found between the participants' BMI values and the scale total score and subscale scores (p>0.05) (Table 4).

The relationship between the total score and sub-dimension scores of the sustainable nutrition behavior scale and demographic characteristics, sports, and eating habits is given in Table 5. Female participants had higher averages than male participants in seasonal local nutrition, food preference, food purchasing, food waste reduction, and total score (p≤0.001). Regarding marital status, married participants scored higher than single participants in food preference, reducing food waste, seasonal local nutrition, and total score (p<0.05). Participants who have been exercising for 5 years or more have more sustainable food preferences (p≤0.001). Those involved in endurance and endurance and power/strength sports had higher values in sustainable nutrition sub-dimensions food preference, food waste reduction, seasonal local diet, food purchasing, and total score than those involved in power/strength sports only (p<0.05). In addition, participants who reported not skipping meals had higher values in food preference, food waste reduction, food purchasing, and total score than participants who reported skipping meals (p<0.05) (Table 5).

Multiple linear regression analysis was performed with the variables found to be effective on the total score of the sustainable nutrition behavior scale (Table 6). According to the regression analysis, the variables affecting sustainable nutrition behaviors were duration of active sports, gender, and marital status (p<0.05). Consequently, having an active sport duration of less than 5 years negatively impacted the total score (p<0.05). Additionally, being male had a negative effect on the total score (p<0.001). Single participants also showed a negative effect on the total score (p<0.05) (Table 6).

4. Discussion

The concept of sustainable nutrition focuses on a health-promoting diet that is culturally acceptable, accessible, and environmentally friendly while reducing environmental costs for current and future generations (Gibas-Dorna and Żukiewicz-Sobczak, 2024). Individuals engaged in sports have varying nutrient requirements depending on their training intensity, performance goals, and health status, and therefore sustainability is often overlooked when planning athletes' diets (Meyer et al., 2020; Lim et al., 2021). In this context, this study aimed to determine the behaviors of individuals engaged in sports toward sustainable food consumption and to draw attention to the concept of sustainability in sports nutrition.

In a cross-sectional study published in 2020, 74.75% of 298 individuals who applied to 20 different gyms consumed red meat at least once a week (Bert et al., 2020). In our study, 97.5% of the participants consumed meat/chicken/fish 1-2 days a week or more. Increased demand for animal-based protein is expected to increase greenhouse gas emissions, require more water and land use, and thus have a negative impact on the environment (Henchion et al., 2017). Although the positive effects of some animal proteins on sports performance are available in the literature, increasing concerns about sustainability are expected to increase approaches to finding alternative sources (López-Martínez et al., 2022).

In our study, the participants who stated that they had information on sports nutrition were the majority (57.7%). In a study conducted by Calella et al. (2021), results contrary to our study were obtained. According to the study, gym members had a similar level of sports nutrition knowledge as individuals who were not actively involved in sports. However, the educational status of the participants was not specified in this study. In our study, 74.4% of the participants completed their undergraduate education. In one study, it was observed that those with a higher level of education had the best knowledge of sports nutrition (Finamore et al., 2022).

In this present study, the mean total score of the behavior scale for sustainable nutrition was 97.65±21.59. In previous studies, the sustainable nutrition compliance of individuals was generally found to be insufficient (Macit-Celebi et al., 2023; Oliveira Neta et al., 2023). Factors such as low awareness of healthy eating (Harray et al., 2022) and high animal protein consumption (Tepper et al., 2021) may be cited as the reason for this inadequacy. In our study, the sub-dimension of reducing food waste has the highest mean score. Similar to our study, in the study conducted by Żakowska-Biemans et al. (2019) with young adults, participants most frequently avoided food waste. In another study, students of the Department of Nutrition and Dietetics had a higher mean score on the food waste avoidance factor (Yolcuoglu and Kiziltan, 2022). Since food waste is a global problem, reducing food waste is essential to ensure sustainable food security for present and future generations (Palmisano et al., 2021).

In our study, 70.4% of individuals skipped meals and these individuals had a lower food preference subscale score (p=0.004). In a study conducted on university athletes, 51.2% of

Table 6
Multiple regression analysis of various variables on the total score of individuals' sustainable nutrition behavior scale.

		Adjust	Durbin Watson	Significance Level p	F Value	
Model	0.523	0.274	1.831	**<0.001**	9.791	
		Not standardized	**Standard Error**	**Standardized**	**Significance Level p**	**VIF Value**
Constant		122.066	3.919		**0.000**	
Sport duration 0-6 months		-14.611	3.771	-.295	**0.000**	1.451
Sport duration 6-12 months		-13.320	4.407	-.219	**0.003**	1.319
Sport duration 1-2 years		-12.142	4.389	-.208	**0.006**	1.422
Sport duration 3-4 years		-16.207	4.525	-.267	**0.000**	1.391
Sport: strength/strength		-7.355	3.754	-.134	0.052	1.170
Gender: male		-13.960	2.839	-.324	**0.000**	1.088
Marital status: single		-7.418	3.755	-.129	**0.048**	1.067

the participants skipped meals (Celik and Dagdeviren, 2022). Skipping meals is associated with a decrease in daily nutritional quality (Zeballos and Todd, 2020). For example, skipping meals is associated with low fruit and vegetable consumption (Pourrostami et al., 2020). In another study, when the food preferences of individuals were evaluated, it was observed that individuals with behaviors supportive of sustainable nutrition consumed more vegetables and fruits, while individuals with negative behaviors against sustainable nutrition consumed more processed and red meat (Irazusta-Garmendia et al., 2023). In another study with university students, positive perceptions of environmental sustainability and a desire to mitigate climate change were associated with lower red meat consumption (Slotnick et al., 2023).

According to the correlation analysis, a significant positive relationship was found between the total and all sub-dimension scores of the sustainable eating behavior scale and age. In a study, generational differences in sustainable food consumption behavior were evaluated and the organic food purchasing behavior of young individuals (Generation Z) was found to be the lowest (Kamenidou et al., 2020). This may be due to younger individuals' lower awareness of the environmental impacts of their dietary choices (Bogueva and Marinova, 2022). In addition, there was a significant negative correlation between participants' body weight and sustainable food preference and food purchasing sub-dimensions. In a prospective cohort study, participants in the first quartile reflecting the lowest sustainable dietary pattern were found to be at higher risk of obesity. In addition, higher consumption of vegetables and fruits, which contributes to reducing the energy density of the diet, is thought to reduce the risk of obesity in participants in the last quartile reflecting sustainable diets (Seconda et al., 2020).

According to the regression analysis, the variables affecting the total score of the sustainable nutrition behavior scale were gender, marital status, and duration of active sports. In our study, the average total sustainable nutrition behavior score of women was significantly (p<0.001) higher than that of men, indicating that women have higher sustainable nutrition behaviors. In a study published in 2022 with undergraduate students, similar to our study, sustainable nutrition behavior score was found to be significantly higher in women compared to men (Engin and Sevim, 2022). Women may tend to have more positive attitudes towards food and nutrition literacy compared to men (Mortas et al., 2023). Food and nutrition literacy not only improves the nutrition and health of individuals but also helps individuals understand the effects of their food choices on the environment (Teng and Chih, 2022).

The study shows that the average total sustainable dietary behavior score of married participants was higher than that of single participants. In a cross-sectional study investigating the change in individuals' food choices according to sustainability issues, it was observed that married participants took sustainability into account more than single participants when making food choices (Guiné et al., 2021). In another study, it was found that married participants were more likely to consume at least 5 servings of vegetables and fruits per day compared to never-married participants, and it was stated that this may be associated with the behavior of one of the spouses that would pave the way for a diet rich in fruits and vegetables (Kabwama et al., 2019). In addition to the consumption of animal-derived food due to the lifestyle of athletes, processed and packaged food consumption and food waste are critical points related to the environment (Meyer et al., 2020). However, in our study, the total score of the behavior scale for sustainable nutrition was found to be significantly higher in those who have been doing sports for 5 years or more. It is thought that the increase in the duration of active sports increases awareness and positively affects the behavior towards sustainable nutrition.

In the findings of our study, the mean total sustainable dietary behavior score of participants who practiced endurance sports or both endurance and strength/strength sports was higher than that of participants who practiced only strength/strength sports. In a study conducted by Jansen et al. (2024), outdoor sports athletes showed the highest values in terms of sustainable attitudes and behaviors but since the data of the study is based on self-report, larger studies with larger samples are needed. The result of this study may be related to the fact that outdoor athletes are more intertwined with nature than indoor athletes. For example, marathon runners may show more concern for the environment, as marathons are often held in places surrounded by nature (Konecke et al., 2021).

Nowadays, some recreational runners have adopted a flexitarian, vegetarian, or vegan diet due to better sports performance, ecological aspects, animal ethics, and current trends in sustainable nutrition (Tanous et al., 2024). However, the global number of vegetarian athletes is unknown (Baroni et al., 2023). According to a systematic review assessing the relationship between a vegetarian diet and sports performance, vegetarian athletes do not have a higher sports performance compared to omnivorous athletes (Hernández-Lougedo et al., 2023). However, another systematic review and meta-analysis showed that plant-based nutrition has the potential to aid aerobic performance and does not compromise strength/power performance. This result is especially valuable for athletes with plant-based diets, but more studies comparing the effects of omnivorous and plant-based diets are needed in the literature. (Damasceno et al., 2024).

5. Conclusion

Based on the results obtained from this study, we suggest that the sustainable nutrition behaviors of individuals applying to the gym should be improved. Sustainable nutrition is an approach that both takes into account the nutrient adequacy of the individual and optimizes global inequalities, food waste, and environmental impacts. The total score of the sustainable nutrition behavior scale was lower in those whose active sports duration was less than 5 years, those whose marital status was single, and male participants. Our study will be a reference for future studies that will evaluate the behaviors of individuals applying to the gym towards sustainable nutrition. In addition, dietitians should raise awareness about healthy and sustainable nutrition among individuals who are active in sports.

Conflict of interest: The authors declare that they have no conflict of interests.

Informed consent: The authors declare that this manuscript did not involve human or animal participants and informed consent was not collected.

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