Clinical and Experimental Health Sciences

Impact of Nutrition Education on Dietary Inflammatory Index and Anthropometric Measurements in Individuals Who Regularly Engage in Exercise

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Received: April 15, 2025 **Accepted:** May 21, 2025

ABSTRACT

Objective: This study aims to evaluate the effects of nutrition education on Dietary Inflammatory Index (DII) and anthropometric measurements in individuals who engage in regular exercise.

Methods: This study, involving individuals who engaged in regular exercise, was conducted at a sports center between September and November 2024. In this study, one hundred participants received nutrition education, pre-test anthropometric measurements were made on the same day, and 24-hour food consumption records were taken. Post-test anthropometric measurements were taken 30 days after the initial measurement, 24-hour food consumption records were collected, and food consumption was evaluated using Bebis software, while DII was calculated.

Results: One month after nutrition education, it was shown that the levels of Vitamin A (U=908; p<.05) and Vitamin E (t=2.503; p<.05) intake in males had increased significantly compared to females. Statistically significant decreases were observed in the hip circumference (p=.030), triceps (p=.008), suprailiac (p=.010), chest (p=.013), and femur (p<.001) skinfold thickness measurements when comparing pre – and post-training values. There was no statistically significant difference between the pretest and posttest total DII scores of the participants (p>.05).

Conclusions: The findings indicate a positive impact of nutrition education on anthropometric measurements; however, no significant effect was observed regarding DII scores.

Keywords: dietary inflammatory index; anthropometry; nutrition education; exercise

1. INTRODUCTION

In the general population, regular exercise is widely recognized for its positive impacts on physical fitness, including increased aerobic capacity and muscle strength. These benefits are crucial for maintaining a physically active lifestyle and for overall health. To assess the role of regular exercise in managing overweight or obesity in adults, examining its impacts on physical fitness within this specific group is essential. In general, physical fitness (per kilogram of body weight) is lower in individuals with high BMI or obesity than in those of normal weight (1).

Nutrition is defined as a conscious behavior aimed at maintaining and improving health and enhancing the quality of life by consuming the necessary nutrients in adequate amounts and at appropriate times. As stated in the current literature, adequate and balanced nutrition is among the protective factors that play a role in reducing health problems caused by nutrition (2).

Nutrition-related health issues are highly prevalent among both children and adults. Nutrition serves as a significant risk factor that notably influences people's health and is changeable. Indeed, dietary patterns, including food choices, consumption occasions, and habitual behaviors, have been demonstrated to exert a pivotal influence on the determination of individuals' health status (3). A state of energy imbalance, characterized by an excess of energy intake relative to expenditure, can lead to adverse health consequences, including overweight and obesity. It is imperative to maintain a balance between energy

How to cite this article: Zelka FZ, Aytulu T. Impact of Nutrition Education on Dietary Inflammatory Index and Anthropometric Measurements in Individuals Who Regularly Engage in Exercise. Clin Exp Health Sci 2025; 15: 453-460. https://doi.org/10.33808/clinexphealthsci.1676934

expenditure and intake to ensure optimal health and well-being. Consequently, diet quality is a pivotal factor in maintaining a healthy body mass index (BMI). A healthy diet consists of consuming a variety of foods on a daily basis, including plant-based options (i.e., fruits and vegetables), grains, proteins, dairy, and fats. Additionally, following a healthy diet includes: a. selecting foods and beverages in portions that contribute to achieving and sustaining a healthy weight, b. consuming five or more servings of various vegetables and fruits each day, c. favoring whole grains over refined grains, and d. reducing the intake of red meat and processed meat products (4).

The benefits of nutrition and physical activity are often examined separately. However, it is becoming increasingly evident that strategies integrating nutrition and physical activity may yield more substantial and favorable health outcomes compared to approaches that focus on just one of these aspects. This dual approach may also contribute to immune system strengthening (5). Research by Sánchez-Díaz et al (6) suggests that implementing nutritional education for athletes participating in team sports can effectively improve their eating habits, anthropometry, and nutritional knowledge.

The Dietary Inflammatory Index (DII) was first developed by Cavicchia et al (7), demonstrating a negative correlation between DII and C-reactive protein (CRP). In adults, it is particularly associated with CRP, Interleukin-6 (IL-6), and tumor necrosis factor alpha (TNF-α) (8). The DII is a tool that is used to further examine the processes through which various dietary components contribute to inflammation. The method under discussion is predicated on a total of 45 food parameters, encompassing a range of compounds, nutrients, and food items that have been identified in the extant literature as having either anti – or pro-inflammatory properties. A notable advantage of DII is that, in contrast to the analysis of individual dietary compounds, it examines dietary patterns, thereby elucidating the intricate interplay among nutrients and compounds present within foods and diets. A substantial body of observational research has examined the association between DII and the risk of developing chronic diseases (9). A study found that people with a low DII score who were active had a 39% reduced risk of all-cause mortality when compared to those with a higher DII score who were sedentary. DII and physical activity were each found to be associated with mortality; specifically, DII was positively linked and physical activity was inversely linked to the risk of all-cause mortality (10).

This study aimed to examine the impacts of nutrition education on anthropometric measurements and the DII in individuals engaging in regular exercise.

2. METHODS

2.1. Research Group and Ethics Approval

In our study, a total of 100 individuals aged between 18 and 45 who engage in exercise regularly at a sports center in Istanbul were included. Regular exercise was defined as engaging in a minimum of 150 to 300 minutes of moderate-intensity aerobic physical activity or a minimum of 75 to 150 minutes of high-intensity aerobic physical activity weekly, as recommended by the World Health Organization (WHO) (11). Ethics committee approval for the research was obtained from the Üsküdar University Noninvasive Clinic Research Ethics Committee (Approval date: 26.03.2024; Number:03). Prior to participation, informed consent was obtained from all subjects who had volunteered for this study in either written or oral form.

2.2. Sample Size

The G*Power 3.1.9.4 package program was utilized to calculate the sample size of the study. When the effect size was set at 0.5, the study's power was determined to be 0.95, and the Type I error level was set at 0.05, the minimum required sample size was determined to be 54 individuals. Considering the possibility of missing data and losses in the study and to make the results of the study more representative of the general population, we increased the sample size to 100.

2.3. Inclusion And Exclusion Criteria

Healthy individuals between the ages of 18-45 years and regularly engage in exercise according to WHO criteria (11) were included in the study. Individuals suffering from chronic diseases who adhered to a particular dietary regimen, along with pregnant women, were excluded from the study.

2.4. Research Design

Two different measurements were taken using anthropometric methods before and one month after nutrition education was provided to the participants who consented to be part of the study, and 24-hour food consumption records were collected simultaneously with these measurements. Based on this data, alterations in the anthropometric measurements of the subjects were examined, and DII values were computed from the food consumption records.The food consumption record form, which was prepared by the researcher, was completed by the subjects retrospectively for a 24-hour period. A thorough evaluation of the collected food consumption records was conducted using the Nutrition Information System (BeBis).

Table 1. *Descriptive statistics of demographic, health and habit findings of individuals according to gender*

	Male (n=49)		Female (n=51)		Total (n=100)	
	N	%	N	%	N	%
Age (years)	24.57 6.49		30.35 8.40		27.52 8.03	
Marital Status						
Married	6	12.2	20	39.2	26	26.0
Single	43	87.8	31	60.8	74	74.0
Education Status						
High School	21	42.9	15	29.4	36	36.0
Bachelor's degree	24	49.0	31	60.8	55	55.0
Postgraduate	4	8.2	5	9.8	9	9.0
Profession						
Officer	1	2.0	3	5.9	4	4.0
Worker/Private Sector	19	38.8	17	33.3	36	36.0
Self-employment	4	8.2	4	7.8	8	8.0
Student	24	49.0	14	27.5	38	38.0
Housewife	0	0.0	9	17.6	9	9.0
Not working	1	2.0	4	7.8	5	5.0
Income Level						
My Income is Less than My Expenses	23	46.9	26	51.0	49	49.0
My Income Equals My Expenses	17	34.7	12	23.5	29	29.0
My Income Exceeds My Expenses	9	18.4	13	25.5	22	22.0
Nutritional Supplement Use						
Yes	5	10.2	13	25.5	18	18.0
No	44	89.8	38	74.5	82	82.0
Type of Dietary Supplement Used*						
Omega3	1	20.0	7	53.8	8	44.4
Vitamin D	2	40.0	6	46.2	8	44.4
Vitamin C	1	20.0	3	23.1	4	22.2
Multivitamin	1	20.0	2	15.4	3	16.7
Magnesium	3	60.0	1	7.7	4	22.2
Smoking Status	**N**	**%**	**N**	**%**	**N**	**%**
Yes	22	44.9	10	19.6	32	32.0
No.	27	55.1	41	80.4	68	68.0
Amount of Smoking (pcs/day) ()	14.00 5.00		8.80 4.89		12.38 5.47	
Alcohol Use Status						
Yes	11	22.4	11	21.6	22	22.0
No	38	77.6	40	78.4	78	78.0
Amount of Alcohol Use (drinking cups/month) ( )	2.36 1.21		2.64 1.36		2.50 1.26	
Daily Water Consumption (ml/day) ( )	2122.45 780.83		1815.69 624.94		1966.00 718.76	
Duration of Physical Activity (hours/week) ( )	7.77 3.64		5.98 2.81		6.85 3.35	

*: Multiple responses have been provided.

2.5. Dietary Inflammatory Index (DII)

Calculations were made using BeBis using z-scores from each participant's daily food/nutrient intake. Z-scores were determined by calculating the difference between an individual's daily intake and the standard global intake, and dividing this by the standard deviation of the nutrient or nutrients in question. Subsequently, these z-scores were converted into percentile scores. To obtain a distribution that is symmetric about the mean, each percentile score was multiplied by two and then added to one. The centralized percentile values obtained for nutrients and nutrients were then multiplied by the "customized complete inflammatory effect score" calculated by Shivappa et al. (8). The results were aggregated to calculate the dietary inflammatory index (DII) score, which indicates the inflammatory burden of people's daily diets.If a nutrient or nutrient had a proinflammatory effect on inflammation markers such as C-reactive protein, it was scored as (+1). If it had an anti-inflammatory effect, it was scored as (-1). If it had no effect, it was scored as (0). The utilization of this scoring method was intended to ascertain the inflammatory or anti-inflammatory potential of nutrients.

2.6. The Content of The Nutrition Education

Individuals received face-to-face nutrition education sessions lasting an average of 20 minutes. During these sessions, they were informed about the daily requirements of macro and micronutrients, water consumption, and physical activity. Additionally, the training covered how to organize nutrition in terms of carbohydrates, proteins, and fats to support physical activity, as well as the consumption of nutritional supplements.

2.7. Data Collection

The researchers measured a number of anthropometric variables, including body weight, height, hip and waist circumference, triceps skinfold thickness (ST), biceps ST, scapula ST, suprailiac ST, chest ST, abdomen ST, thigh ST, and upper middle arm circumference. Furthermore, a 24-hour dietary record was documented. The measurements were taken prior to the intervention and once more one month after the conclusion of the nutrition education program. The BMI was computed and subsequently classified in accordance with the criteria established by WHO (12).

2.8. Data Analysis

Descriptive statistics pertaining to categorical variables are expressed as frequency and percentage. The statistical test known as the "Shapiro-Wilk test" was employed to verify whether the numerical variables conformed to a normal distribution. The descriptive statistics of the numerical variables were presented as the mean ± standard deviation ($\bar{X}$ ± SD) for data that was normally distributed and as the median (min-max) for data that was non-normally distributed. The comparison of two independent groups with normal distribution was made with an Independent Sample t-test. The comparison of two dependent groups with normal distribution was made with the "Dependent Sample T Test," and the comparison of two dependent groups without normal distribution was made with the "Wilcoxon Signed

Table 2. Comparison of energy, macronutrients and micronutrients differences after nutrition education among individuals according to gender

	Male		Female			
		Median (min-max)		Median (min-max)	t-U	P
Energy (kcal)	97,72534,95	93,9 (-1467,8-1012,8)	-52,40387,20	26,4 (-825,9-1058,6)	t=1.612	.110
CHO (g)	15,4995,97	13,2 (-245,7-201,3)	-11,3073,19	-18,1 (-156,5-193,3)	t=1.573	.119
Protein (g)	-6,1730,80	-6,5 (-90,8-64,1)	-1,5825,99	-0,8 (-78,3-59,3)	t=-0.808	.421
Fat (g)	6,0626,88	3,2 (-55,7-78,6)	-0,8626,60	0,9 (-57,4-64,4)	t=1.295	.198
Saturated Fat (g)	4,0531,43	-1,8 (-22,3-201,2)	0,9123,17	-0,8 (-22,5-145,8)	U=1191	.687
Monounsaturated Fat (g)	5,3723,92	1,8 (-18,3-149,9)	2,1419,46	-0,8 (-25,2-102,2)	U=1180	.632
Polyunsaturated Fat (g)	2,8410,85	0,8 (-29,6-27,9)	0,559,79	-0,7 (-18,3-27,8)	U=1074	.226
Fiber (g)	6,6513,12	4 (-29,2-36,2)	4,2514,98	1,4 (-20,3-81,4)	U=1034	.137
Vitamin A (µg)	223,191697,92	192,6 (-8634,3-2252,7)	108,381002,74	98,9 (-1503,9-5538,8)	**U=908**	**.019***
Vitamin D (µg)	-10,0065,35	-13,5 (-117,9-234,9)	-5,8963,32	-8,2 (-162,6-156,7)	U=1146	.475
Vitamin E (mg)	3,619,28	2,1 (-19-27,8)	-1,129,60	-1,4 (-34,1-18)	**t=2.503**	**.014***
Vitamin K (µg)	77,47205,07	22,2 (-386,9-540,3)	48,65210,75	22 (-732,6-402,1)	U=1249	.997
Vitamin B1 Thiamine (mg)	0,070,73	0,1 (-3,5-1,5)	0,010,75	-0,04 (-2,1-2,6)	U=1080.5	.244
Vitamin B2 Riboflavin (mg)	-0,141,03	-0,1 (-4,8-3,2)	0,110,58	-0,01 (-0,8-2,8)	U=1099	.299
Niacin (mg)	-0,4112,14	0,4 (-30,8-48,2)	0,808,57	1 (-27,9-27,8)	U=1158	.528
Vitamin B6 (mg)	0,383,09	-0,03 (-8,3-16,2)	1,267,89	0,2 (-6,2-55,4)	U=1078.5	.238
Vitamin C (mg)	49.80±105.56	34.5 (-170.7-310.4)	41.06±66.87	37.7 (-90.4-208.8)	U=1248	.992
Sodium (mg)	-2630.80±15917.74	-265 (-61569.5-51563.6)	-2036.67±11144.03	-225.5 (-61490.4-10694.7)	U=1234	.915
Potassium (mg)	402.69±1133.77	371.7 (-1917.1-2795)	359.17±1455.00	223.3 (-1455.1-8190.2)	U=1136	.434
Calcium (mg)	60.72±574.86	48.5 (-976.8-2896)	84.28±307.34	47.3 (-448.6-1053.1)	U=1196	.712
Magnesium (mg)	67.99±162.56	35.8 (-220.4-747.1)	13.22±148.60	-4.2 (-343.6-586)	U=1010	.099
Iron (mg)	1.80±9.81	1.1 (-15.6-52.5)	4.39±36.76	-0.7 (-16.8-258.6)	U=1071	.218
Zinc (mg)	0.42±5.57	1.1 (-12-10.6)	-0.77±3.91	-0.9 (-8.9-9.6)	t=1.229	.223

t: Independent Sample T Test; U: Mann-Whitney U Test

*p<.05

Rank Test." The relationships between numerical variables were analyzed using two distinct methods: Pearson's Product-Moment Correlation Coefficient for normally distributed data and Spearman's Rank Correlation Coefficient for non-normally distributed data. The following criteria were used in the interpretation of the correlation coefficient: The correlation was determined to be "very weak" if it was less than 0.2, "weak" if it fell between 0.2 and 0.4, "moderate" if it was between 0.4 and 0.6, "high" if it was between 0.6 and 0.8, and "very high" if it was greater than 0.8 (13). The statistical significance level was established as "p<.05, p<.01, p<.001" in all calculations and interpretations. Hypotheses were established bidirectionally. The statistical data analysis was performed using SPSS v27 (IBM Inc., Chicago, IL, USA).

3. RESULTS

Among the participants in the study, 49% were male and 51% were female. The mean age of males was 24.57 6.49 years, 87.8% were single, 49% had a bachelor's degree, 49% were students, 46.9% had income less than expenses, 10.2% used nutritional supplements, and 44.9% were smokers. It was found that the mean amount of smoking was 14.00 5.00 pieces/day, 22.4% drank alcohol, the mean amount of alcohol consumption was 2.36 1.21 drinking cups/month, the mean amount of daily water consumption was 2122.45 780.83 ml/day, and the mean amount of physical activity was 7.77 3.64 hours/week (Table 1).

The mean age of the females who participated in the study was 30.35 8.40 years, 60.8% were single, 60.8% had a bachelor's degree, 33.3% were workers or in private sector, 51% had an income less than their expenses, 25.5% used dietary supplements.It was found that 19.6% smoked cigarettes, the mean amount of cigarette smoked was 8.80 4.89 pieces /day, 21.6% drank alcohol, the mean amount of alcohol consumption was 2.64 1.36 drinking cups/month, the mean amount of daily water consumption was 1815.69 624.94 ml/day and the mean amount of physical activity was 5.98 2.81 hours/week (Table 1).

Statistically significant differences were observed between the genders of the individuals participating in the study in terms of the difference values of Vitamin A (µg) (U=908; p<.05) and Vitamin E (mg) (t=2.503; p<.05) one month after the nutrition education. Upon examining the results, it was found that the median difference values of Vitamin A (µg) were higher in males [192.6 (-8634.3-2252.7)] compared to females [98.9 (-1503.9-5538.8)], and the mean difference values of Vitamin E (mg) were higher in males (3.61±9.28) compared to females [0.1 (-120.2-15.4)] one month after the education (Table 2).

Table 3. *Comparison of anthropometric measurement pre-test – post-test values of individuals*

	Pre-Test		Post-Test			
		Median (min-max)		**Median (min-max)**	**T-W**	**P**
BMI	23.70 3.30	23.5 (16.5-32.4)	23.57 3.15	23.3 (16.5-31.8)	**T=2.577**	**.011***
Waist Circumference	79.20 10.76	79 (60-105)	78.81 10.56	78.3 (60-105)	**W=-4.260**	**<.001*****
Hip Circumference	100.72 6.92	101 (88-119)	99.67 6.46	100 (87-117)	**T=10.103**	**<.001*****
Waist/Hip Ratio	0.79 0.08	0.8 (0.6-1)	0.79 0.08	0.8 (0.6-1)	**T=-3.165**	**.002****
Triceps ST	20.46 6.66	20 (5-39)	20.35 6.53	20 (5-38)	**T=3.002**	**.003****
Biceps ST	13.07 6.18	11.5 (5-35)	13.02 6.14	11.5 (5-35)	**W=-2.121**	**.034***
Subscapular ST	19.04 7.25	18 (7-42)	18.97 7.22	18 (7-42)	**W=-2.640**	**.008****
Suprailiac ST	21.62 9.00	22 (6-44)	21.50 8.90	22 (6-44)	**W=-3.500**	**<.001*****
Chest ST	20.98 7.6	20 (7-42)	20.87 7.50	20 (7-41)	**T=3.591**	**<.001*****
Abdominal ST	28.24 8.71	26.5 (12-52)	27.94 8.62	26 (12-51)	**T=6.335**	**<.001*****
Femur ST	32.25 10.35	30 (13-57)	31.85 10.04	30 (13-55)	**W=-5.388**	**<.001*****
Femur Circumference	52.52 5.26	52.3 (43-65)	51.74 5.27	51.8 (42-64)	**T=12.482**	**<.001*****
Upper Mid Arm Circumference	30.22 4.35	30 (21.5-42)	29.92 4.38	29.3 (21-42)	**W=-5.136**	**<.001*****

T: Dependent Sample T Test; W: Wilcoxon Signed Rank Test
*p<.05; **p<.01; ***p<.001
Abbreviations:BMI, Body Mass Index; ST, Skinfold Thickness

Statistically significant differences were observed between the pre-test and post-test measurements for waist circumference (p<.001), BMI (p<.05), hip circumference (p<.001), waist/hip ratio (p<.01), triceps ST (p<.01), subscapular ST (p<.01), suprailiac ST (p<.001), biceps ST (p<.05), chest ST (p<.001), abdominal ST (p<.001), femur ST (p<.001), femur circumference (p<.001), and upper mid-arm circumference (p<.001) among study participants. Upon examining the results, pre-test values for waist circumference, BMI, hip circumference, waist/hip ratio, triceps, biceps, subscapular, suprailiac, chest, abdominal, and femur ST, as well as femur circumference and upper mid-arm circumference, were statistically higher than the post-test values (Table 3).

The study revealed statistically significant strong negative correlations between the male participants' total DII difference scores and the difference values of "Fiber (g)", "Vitamin E (mg)", "Potassium (mg)", and "Magnesium (mg)" (p<.001). Additionally, there were statistically significant weak negative correlations between the total DII difference scores and the difference values of "Vitamin A (µg)",

Table 4. *Correlation coefficients between total difference scores of DII and energy, macro and micronutrient difference values after nutrition education of individuals according to gender*

	Male		Female	
	DII Total		DII Total	
	R-s	P	R-s	P
Energy (kcal)	R=-0.044	.765	R=-0.122	.394
CHO (g)	R=0.032	.829	R=0.106	.458
Protein (g)	R=0.073	.617	**R=-0.373**	**.007****
Fat (g)	R=-0.169	.245	R=-0.168	.237
Saturated Fat (g)	S=0.158	.278	**S=0.286**	**.042***
Monounsaturated Fat (g)	S=-0.150	.304	S=-0.120	.400
Polyunsaturated Fat (g)	**R=-0.389**	**.006****	**S=-0.472**	**<.001*****
Fiber (g)	**R=-0.603**	**<.001*****	**S=-0.619**	**<.001*****
Vitamin A (µg)	**S=-0.464**	**<.001*****	**S=-0.516**	**<.001*****
Vitamin D (µg)	S=-0.136	.353	R=-0.036	.800
Vitamin E (mg)	**R=-0.690**	**<.001*****	**R=-0.493**	**<.001*****
Vitamin K (µg)	**S=-0.334**	**.019***	**S=-0.521**	**<.001*****
Vitamin B1 (mg)	**S=-0.422**	**.002****	**S=-0.680**	**<.001*****
Vitamin B2 (mg)	S=-0.101	.488	S=-0.239	.091
Niacin (mg)	S=-0.034	.818	**S=-0.475**	**<.001*****
Vitamin B6 (mg)	**S=-0.417**	**.003****	**S=-0.402**	**.003****
Vitamin C (mg)	**S=-0.456**	**0.001****	**R=-0.493**	**<.001*****
Sodium (mg)	S=0.060	.683	S=-0.115	.422
Potassium (mg)	**R=-0.632**	**<.001*****	**S=-0.653**	**<.001*****
Calcium (mg)	S=-0.124	.394	**S=-0.398**	**.004****
Magnesium (mg)	**S=-0.627**	**<.001*****	**S=-0.666**	**<.001*****
Iron (mg)	**S=-0.365**	**.010***	**S=-0.463**	**<.001*****
Zinc (mg)	R=-0.240	.097	**R=-0.425**	**.002****

r: Pearson Product Moment Correlation Coefficient; s: Spearman Rank Difference Correlation Coefficient
*p<.05; **p<.01; ***p<.001

"Vitamin B1 (mg)", "Vitamin B6 (mg)", "Vitamin C (mg)", "Polyunsaturated Fat (g)", "Vitamin K (µg)", and "Iron (mg)" (p<0.05; p<0.01) (Table 4).

Upon examination of the results, it was observed that as the total DII difference scores for males increased, the difference values decreased by 38.9% for "Polyunsaturated Fat (g)", 60.3% for "Fiber (g)", 46.4% for "Vitamin A (µg)", 69% for "Vitamin E (mg)", 33.4% for "Vitamin K (µg)", 42.2% for "Vitamin B1 (mg)", 41.7% for "Vitamin B6 (mg)", 45.6% for "Vitamin C (mg)", 43.2% for "Potassium (mg)", 62.7% for "Magnesium (mg)", 36.5% for "Iron (mg)", and 49.6% for "Copper (mg)". These findings indicate that as the total DII difference scores increase, the difference values for these nutrients decrease (Table 4).

Significantly strong negative correlations were identified between the total DII difference scores of the females in the study and their difference values of "Fiber (g)", "Vitamin B1 (mg)", "Potassium (mg)", and "Magnesium (mg)" (p<.001). Additionally, there were statistically significant moderate negative correlations between the total DII difference scores and the difference values of "Polyunsaturated Fat (g)", "Vitamin A (µg)", "Vitamin C (mg)", "Iron (mg)", "Zinc (mg)", and "Copper (mg)" (p<.01; p<.001), and weak negative correlations with "Protein (g)" and "Calcium (mg)" (p<.05).

Table 5. Comparison of DII pre-test-post-test and total DII difference scores of individuals

			Median (min-max)	t-T	p
DII Total Score – Pre-test		0.00 1.85	0.1 (-4.1-4.2)	T=0.000	1.000
DII Total Score – Post-test		0.00 1.65	-0.2 (-3.1-4.3)		
DII Total Score	Male	-0.32 1.97	-0.2 (-5-4.2)	t=-1.625	.107
	Female	0.31 1.91	0.2 (-3.2-5.1)		

T: Dependent Sample T Test; t: Independent Sample T Test

There was also a statistically significant weak positive correlation with the difference values of “Saturated Fat (g)” (p<.05). These findings indicate that as the total DII difference scores increase, the difference values for these nutrients decrease, but the difference values for saturated fat slightly increase (Table 4).

Table 6. Correlation coefficients between DII difference total scores and anthropometric measurement difference values of individuals according to gender

	DII Total Score					
	Male		Female		Total	
	r*	P	r*	P	r*	P
BMI	-0.199	.170	0.079	.582	-0.024	.811
Waist Circumference	0.005	.971	-0.029	.841	-0.004	.967
Hip Circumference	0.057	.698	-0.181	.203	-0.100	.324
Waist/Hip Ratio	-0.007	.964	0.097	.498	0.051	.616
Triceps ST	-0.031	-.031	-0.053	.712	-0.069	.495
Biceps ST	0.245	.245	-0.015	.918	0.032	.751
Subcapular ST	-0.162	-.162	-0.040	.778	-0.101	.317
Subrailac ST	0.007	.960	-0.156	.273	-0.125	.214
Chest ST	0.007	.960	-0.087	.543	-0.101	.320
Abdominal ST	-0.063	.667	-0.129	.367	-0.111	.271
Femur ST	-0.093	.524	-0.074	.604	-0.141	.162
Femur Circumference	0.053	.720	-0.124	.387	-0.045	.655
Upper Mid Arm Circumference	0.043	.770	0.064	.656	0.042	.676

*Spearman Rank Difference Correlation Coefficient

ST Skinfold Thickness

Upon examination of the results, it was noted that the total DII difference scores for females increased, the difference values decreased by 37.3% for “Protein (g)”, 47.2% for “Polyunsaturated Fat (g)”, 61.9% for “Fiber (g)”, 51.6% for “Vitamin A (µg)”, 49.3% for “Vitamin E (mg)”, 52.1% for “Vitamin K (µg)”, 68% for “Vitamin B1 (mg)”, 47.5% for “Niacin (mg)”, 40.2% for “Vitamin B6 (mg)”, 49.3% for “Vitamin C (mg)”, 65.3% for “Potassium (mg)”, 39.8% for “Calcium (mg)”, 66.6% for “Magnesium (mg)”, 46.3% for “Iron (mg)”, 42.5% for “Zinc (mg)”, and 50.8% for “Copper (mg)”, while the difference values of “Saturated Fat (g)” increased by 28.6% (Table 4).

The analysis revealed no statistically significant difference (p > .05) in the total DII scores between the pre-test and post-test for the study participants, nor in the total DII difference scores among study participants based on gender (Table 5).

The study revealed no significant correlation observed (p>.05) between the total DII difference scores and the anthropometric difference values of male and female participants (Table 6).

4. DISCUSSION

This study’s participants comprised a total of one hundred subjects, with 51 of these subjects being female and 49 male. The study aimed to examine the impacts of nutrition education on the DII and anthropometric values in individuals who engaging in regular exercise. Anthropometric measurements were obtained prior to the training and 30 days after, while DII values were calculated based on food consumption records.

In the systematic review by Sánchez-Díaz S et al. (6), it is emphasized that nutrition education interventions generally improve eating habits, with these improvements applicable to both male and female athletes. However, the study demonstrated that one month after nutrition education, the levels of Vitamin A and Vitamin E intake in males increased significantly compared to females. A comprehensive analysis assessing the efficacy of nutrition education interventions on dietary intake in young Black males (14–21 years old) revealed insufficient evidence regarding the effectiveness of these interventions among young Black males (14). The observed discrepancies across studies may be attributable to variations in age and educational levels. Debnath M et al. (15) conducted a study to examine the effects of an eight-week nutrition education program on the daily dietary intake of young males. This study found that nutrition education interventions significantly increased the macro and micronutrient intakes of young male athletes. Significant increases were observed in the daily intake of calories, protein, calcium, phosphorus, iron, zinc, and selenium. Additionally, substantial increases were documented in the intake of vitamins A, C, E and B12 (15).

One of the most significant findings of the study was the impact of nutrition education on anthropometric measurements. Specifically, a notable decrease in BMI, hip and waist circumference, waist-to-hip ratio, and skinfold thickness at the triceps, biceps, subscapular, subiliac, chest, abdominal, and femur sites was observed one month after the nutrition education intervention compared to pre-test values. Additionally, decreases in femur circumference and upper mid-arm circumference were noted. Furthermore, a study on professional football players highlighted the association between nutritional status, anthropometric measurements and DII, demonstrating that enhanced nutritional status was linked with improved anthropometric outcomes and reduced DII scores (16). A study was conducted among adults in Northern Serbia to examine the impact of nutrition education interventions on metabolic syndrome indicators. This study observed a statistically significant decrease in BMI six months after the nutrition education intervention (17). The study results reflect the changes observed only one month after the nutrition education intervention. Despite the relatively short duration, we demonstrated significant reductions in various anthropometric measurements.

Another significant finding in the study was the relationship between DII levels and nutrients. The observed differences between men and women suggest that dietary habits and DII levels may affect each gender differently. For male subjects, an increase in total DII difference scores was associated with a decrease in the difference values for fiber, vitamin E, potassium, and magnesium. For female subjects, a similar trend was observed, with increasing total DII difference scores corresponding to a decline in nutrient difference values, with the exception of saturated fat, which exhibited a slight increase. A comparison of the eating habits and dietary preferences of women and men reveals that they may differ from each other. In some cases, women may prefer foods that contain more saturated fat, which could explain the positive correlation between DII scores and saturated fat consumption (18). These findings are in line with a study that examined the inflammatory effects of diet, which reported that groups receiving an anti-inflammatory diet had higher intakes of iron, magnesium, niacin, vitamin C, and riboflavin compared to groups receiving a pro-inflammatory diet (19). In accordance with the findings of a study that examined the inflammatory effects of diet, anti-inflammatory diet groups exhibited higher intakes of iron, vitamin C, magnesium, niacin, and riboflavin compared to pro-inflammatory diet groups among a sample of young women and men who regularly engaged in physical activity (20). Additionally, an umbrella review examining the link between the DII and several health outcomes found that adherence to a pro-inflammatory diet model was significantly positively associated with 71% of the health outcomes examined (9). In a study conducted on young, physically active men found that DII is a promising method for identifying the risk of inflammation. Participants adhering to diets with the most anti-inflammatory properties exhibited significantly higher consumption of protein, magnesium, iron, zinc, antioxidant vitamins, and B vitamins (21).

Our study has several limitations. It was designed as an experimental study, but a control group was not established. Nutrition education was provided only once, and while we compared the short-term results of the education, the long-term results were not examined. Additionally, the subject group was limited.

5. CONCLUSION

Our study demonstrated that nutrition education can enhance anthropometric measurements even one month after the intervention in individuals who regularly engage in exercise. However, a short-term evaluation is inadequate for measuring changes in DII scores. To evaluate the effectiveness of nutrition education in this area, prospective, longitudinal studies with larger sample sizes, more extended follow-up periods, and more frequent nutrition education sessions are necessary.

Acknowledgements: *The authors would like to thank all participants. This study is derived from Fatmanur Zehra Zelka's master's thesis entitled "Evaluation of the Impact of Nutrition Education on Dietary Inflammatory Index and Anthropometric Measurements in Individuals Who Exercise Regularly".*
Funding: *The authors received no financial support for the research.*
Conflicts of interest: *The authors declare that they have no conflict of interest.*
Ethics Committee Approval: *This study was approved by Ethics Committee of Üsküdar University, Noninvasive Clinic Ethics Committee (Approval date: 26.03.2024; Number:03)*
Peer-review: *Externally peer-reviewed*
Author Contributions:
Research idea: FZZ, TA
Design of the study: TA
Acquisition of data for the study: FZZ
Analysis of data for the study: FZZ
Interpretation of data for the study: TA
Drafting the manuscript: FZZ, TA
Revising it critically for important intellectual content: FZZ, TA
Final approval of the version to be published: FZZ, TA

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