

The Effect of Nutrition Education on Adherence to the Mediterranean Diet and Sustainable Healthy Eating Behaviors in University Students

Tuba Tekin, Nurcan Baglam, Emine Dincer

Abstract—This study aimed to examine the effects of nutrition education received by university students on sustainable healthy eating behaviors and adherence to the Mediterranean diet. The 2nd, 3rd, and 4th-grade university students studying at the Faculty of Health Sciences, Nutrition and Dietetics, Midwifery, Nursing, Physical Therapy, and Rehabilitation departments of universities in Turkey were included in the study. Students' adherence to the Mediterranean diet was evaluated using the Mediterranean Diet Adherence Scale, and their sustainable and healthy eating behaviors were evaluated using the Sustainable and Healthy Eating Behaviors Scale. In addition, the body weight and height of the students were measured by the researchers, and the Body Mass Index (BMI) value was calculated. A total of 181 students, 85 of whom were studying in the Department of Nutrition and Dietetics and 96 of whom were educated in other departments, were included in the study; 75.7% of the students in the sample are female, while 24.3% are male. The average body weight of the students was 61.17 ± 10.87 kg, and the average BMI was 22.04 ± 3.40 kg/m². While the mean score of the Mediterranean Diet Adherence Scale was 6.72 ± 1.84 , in the evaluation of adherence to the Mediterranean diet, it was determined that 25.4% of the students had poor adherence and 66.9% needed improvement. When the adherence scores of students who received and did not receive nutrition education were compared, it was discovered that the students who received nutrition education had a higher score ($p < 0.05$). Students who received nutrition education had a higher total score on the Sustainable and Healthy Eating Behaviors scale ($p < 0.05$). A moderately positive correlation was found between the Sustainable and Healthy Eating Behaviors scale total score and the Mediterranean Diet Adherence scores ($p < 0.05$). As a result of the linear regression analysis, it was revealed that a 1-unit increase in the Mediterranean diet adherence score would result in a 1.3-point increase in the total score of the Sustainable and Healthy Eating Behaviors scale. Sustainable and healthy diets are important for improving and developing health and the prevention of diseases. The Mediterranean diet is defined as a sustainable diet model. The findings revealed the relationship between the Mediterranean diet and sustainable nutrition and showed that nutrition education increased knowledge and awareness about sustainable nutrition and increased adherence to the Mediterranean diet. For this reason, courses or seminars on sustainable nutrition can be organized during educational periods.

Keywords—Healthy eating, Mediterranean diet, nutrition education, sustainable nutrition.

I. INTRODUCTION

THE global food system is unable to supply the nutritional demands of the world population due to factors including rising world population, climate change, and increased food

waste. Considering the increase in world population in the last 70 years, the global population has grown by 200%, reaching 7.6 billion people. This trend is expected to continue, with the population reaching above 8 billion in 2030 and more than 9 billion in 2050 [1]. Because of the world's rapid population growth, global warming causes a decline in biodiversity, a depletion of energy and water resources, and poses a major threat to future generations [2]. For this reason, sustainable development goals have been determined to protect the needs of future generations [3]. One of the ways to eliminate these threats in line with sustainable development goals is to regulate the food preferences of individuals. These regulations have revealed the concept of "sustainable nutrition" in recent years [4]. The World Commission on Environment and Development first used the term "sustainability" or "sustainable development" in 1983, and the Commission defined sustainability as "meeting the needs of current generations while preserving the ability of future generations to meet their own needs" [5]. Advancements in food production and distribution have expanded the access of food to more diverse populations. Food waste and food loss pose a threat to food security, sustainability, biodiversity, soil health, fresh water supplies, and contribute to an increase in greenhouse gas emissions due to the overconsumption of fresh water and fossil fuels [6]. The significance of biodiversity for food security has been acknowledged in recent years. Biodiversity is essential in combating hunger and malnutrition, as well as in understanding the connection between biodiversity, nutrition, and nutrients. A program focusing on nutrition, nutrients, and biodiversity was introduced in 2010, and it was integrated with sustainable diets. The Food and Agricultural Organization (FAO) described sustainable nutrition as "using human and natural resources in the best way, respectful to biodiversity and ecosystems, culturally acceptable, easy to obtain, inexpensive, nutritionally adequate, reliable, and ecologically friendly diets with a minimal nutrient footprint" in 2010 [7]. Considering the reduction of resources and environmental pollution, food or nutrition models with a low water footprint and low carbon footprint, which have less impact on the environment, are considered suitable for sustainable nutrition. Furthermore, sustainable nutrition should be nutritious, easily accessible, and provide nutritional diversity [8]. Sustainable nutrition includes plant-based goods, minimally processed food choices, organic

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foods, locally and seasonally sourced products, cost-effective commercial options, resource-efficient services, and a palatable food culture [9].

A sustainable nutrition pattern over the course of the life cycle allows for optimal and healthy nutrition. According to the World Health Organization (WHO), non-communicable chronic illnesses are the primary and most common cause of mortality worldwide. The WHO's goal is to decrease avoidable nutrition-related non-communicable illnesses and malnutrition. Thus, it is advisable to follow both healthy and sustainable diets [10]. The Mediterranean diet, Nordic diet, vegan or vegetarian diet, DASH (Dietary Approach to Stop Hypertension) diet, and double pyramid diet are among the most sustainable diets when the nutritional models used today are considered in terms of sustainable healthy nutrition [11]-[13]. The Mediterranean Diet is defined as a sustainable diet pattern and recommended by the authorities in terms of its effects on health. The Mediterranean diet is a nutrient-rich model characterized by a high intake of olive oil, vegetables and fruits, whole grains, legumes, and oilseeds; a moderate intake of semi-skimmed milk and dairy products, wine, eggs, chicken, fish and seafood; and a low intake of red meat, saturated fat, and sugary foods. As a result, it provides a diet with a healthy and balanced fat pattern, a low glycemic index, plenty of fiber, and antioxidants [14]. The Mediterranean diet is primarily a dietary pattern based on the intake of plant-based foods. Because it relies on plant-based nutrients, it plays a crucial role in mitigating climate change and minimizing water footprint. The Mediterranean diet has four sustainable advantages: health and nutrition benefits, minimal environmental impact and biological diversity, high sociocultural nutritional values and heritage of culture, and positive local economic returns [15]. In terms of biodiversity and sustainable diets, the FAO classified the Mediterranean diet as a sustainable diet in 2010 [7]. The implementation of sustainable nutrition is important for both human and environmental health. Individuals' adoption of sustainable nutrition models has an impact on the health and nutrition of future generations. Students, as future consumers, can make a substantial contribution to sustainable nutrition by changing their eating habits. In this context, the nutrition education received by the students affects their sustainable healthy eating behaviors, knowledge, and awareness level. In this study, it was aimed to examine the effect of nutrition education obtained by university students on adherence to the Mediterranean diet and sustainable healthy eating behaviors.

II. MATERIAL AND METHODS

The study was conducted at the Faculty of Health Sciences at four different universities in Turkey. The 2nd, 3rd, and 4th-grade students from the Nutrition and Dietetics, Midwifery, Nursing, Physical Therapy and Rehabilitation departments studying at four different faculties were included in the study. First of all, the students were asked questions about their age, gender, department, and class. The adherence of individuals to the Mediterranean diet was evaluated with the Mediterranean Diet Adherence Scale. The scale was first used by Martínez-González et al. [16], then the questionnaire form created by

Schröder et al. [17] was validated. The scale has 14 questions in total. 12 of the questions concern food consumption frequency, while two concern food consumption habits. The scale is scored from 0 to 14. Those with a total score of ≤ 5 is classified as bad, 6-9 points should be improved, and those with ≥ 10 points are classified as good [17]. Sustainable healthy eating behaviors were determined using the Sustainable and Healthy Eating Behaviors Scale developed by Zakowska-Biemans et al [18]. The scale consists of 32 questions and seven sub-dimensions. The sub-dimensions of the scale are divided into Quality Marks, Seasonal Foods and Avoidance of Waste, Animal Health, Reducing Meat Consumption, Healthy and Balanced Nutrition, Local Food and Low Fat. The scale offers a Likert-type rating and has options such as never, very rarely, rarely, sometimes, often, very often or always; with Never = 1, Very Rarely = 2, Rarely = 3, Sometimes = 4, Often = 5, Very Often = 6, and Always = 7 points [18]. Validity and reliability assessments were carried out in Turkey for the Mediterranean Diet Adherence Scale and the Sustainable and Healthy Eating Behaviors Scale used in the research. We also measured the students' height and weight, calculating the students' BMI score. The study was approved by the Sivas Cumhuriyet University Non-Interventional Clinical Research Ethics Committee.

A. Statistical Analysis

The data obtained from the study were evaluated with the SPSS 23.0 program. Continuous variables obtained from participants were mean and standard deviation; categorical variables are given as frequency and percentage values. The normality of the data was evaluated with the Shapiro-Wilk test; data showing normal distribution were denoted as $\bar{x} \pm SD$, and data not showing normal distribution were denoted as the median. An independent sample t-test was used for two independent groups of normally distributed data. Non-parametric two-sample t-tests were used for two independent groups in the data that did not show a normal distribution. The state, direction, and degree of the relationship between the normally distributed continuous variables were analyzed using the Pearson correlation coefficient. The state, direction, and degree of the relationship between non-normally distributed continuous variables were analyzed using the Spearman correlation coefficient. Simple linear regression analysis was used to determine the variables affecting the scale total score. A score of $p < 0.05$ was considered statistically significant.

III. RESULTS

A total of 181 students, 85 from the Department of Nutrition and Dietetics, 68 from the Department of Nursing-Midwifery, and 28 from the Department of Physical Therapy and Rehabilitation, were included in the study. The evaluation was made by dividing the sample into two groups: those who received nutrition education and those who did not. While 75.7% of the sample consisted of female students, 81.8% of the class distribution was found to be in the 2nd grade. The mean age of the students was 20.47 ± 1.28 years (range: 18–30 years). The average body weight of the students is 61.17 ± 10.82 kg (range: 40–112 kg), the average height is 1.66 ± 0.07 m (range:

1.50-1.90 m), and the average BMI is $22.04 \pm 3.40 \text{ kg/m}^2$ (range: 15.28-36.16 kg/m^2) has been identified. When the BMI evaluation was examined, it was seen that 12.7% of the students were underweight, 71.3% were normal, and 13.8% were in the overweight category. Table I displays the age, anthropometric measures, and Mediterranean Adherence Scale scores of the students who received or not received nutrition education.

The students' mean Mediterranean diet adherence score was found to be 6.72 ± 1.84 (range: 2-11). When the Mediterranean diet adherence score was examined in categories, 25.4% were evaluated as bad, 66.9% as improving, and 7.7% as good. When the sample was divided into groups as those who received nutrition education and those who did not, the Mediterranean diet adherence score of the students who received nutrition education was 7.14 ± 1.76 , and the adherence score of the students who did not receive nutrition education was 6.35 ± 1.84 . A statistically significant difference was found between the students who received and did not receive nutrition education in terms of Mediterranean diet adherence scores ($p = 0.004$). The correlation between the Mediterranean diet adherence score and body weight and BMI was also examined. As a result of the analysis, a weak negative correlation was found between the Mediterranean diet adherence score and BMI ($r = -0.153$, $p = 0.039$). There was no correlation between the score on the Mediterranean diet adherence scale and body weight ($p = 0.077$).

TABLE I
 COMPARISON OF STUDENTS' AGE, ANTHROPOMETRIC MEASUREMENTS, AND MEDITERRANEAN ADHERENCE SCALE SCORES BASED ON NUTRITION EDUCATION

Variables	Nutrition Education $\bar{x} \pm ss$	Non- Nutrition Education $\bar{x} \pm ss$	Mean $\bar{x} \pm ss$
Age (year)	20.22 ± 0.93	20.69 ± 1.49	20.47 ± 1.28
Body Weight (kg)	58.86 ± 8.53	63.21 ± 12.19	61.17 ± 10.82
Height (m)	1.65 ± 0.05	1.67 ± 0.09	1.66 ± 0.07
BMI (kg/m^2)	21.60 ± 3.07	22.42 ± 3.65	22.04 ± 3.40
The Mediterranean diet adherence score	7.14 ± 1.76	6.35 ± 1.84	6.72 ± 1.84

The Sustainable and Healthy Eating Behaviors Scale sub-dimension score and the total score of the scale according to nutrition education are shown in Table II. Students who received nutrition education had higher Sustainable and Healthy Eating Behaviors Scale sub-dimension scores and an average of the sub-dimension scores. There was a statistically significant difference between the groups in terms of the sum of the sub-dimension scores on the scale and the mean scores of the sub-dimensions according to nutrition education ($p < 0.05$). It was observed that the sub-dimension scores of Quality Marks, Seasonal Foods and Avoidance of Waste, Animal Health, Reducing Meat Consumption, and Healthy and Balanced Nutrition were higher in students who received nutrition education. There was a significant difference between the groups in terms of these sub-dimensions ($p < 0.05$).

The correlation between the Sustainable and Healthy Eating Behaviors Scale total score and body weight and BMI was examined. No significant correlation was seen between the total

score of the scale and body weight or BMI ($p > 0.05$). The correlation between the Mediterranean diet adherence scores and the sub-dimension total score of the Sustainable and Healthy Eating Behaviors Scale was examined. As a result of the correlation analysis, a moderately positive correlation was found between the adherence scores, and the total score of the scale sub-dimensions ($r = 0.420$, $p = 0.001$). A simple regression analysis was used to determine the relationship between the Mediterranean diet adherence score and the Sustainable and Healthy Eating Behaviors scale score. The regression analysis found that a 1-unit increase in the Mediterranean diet adherence score would result in a 1.3-point increase in the total score of the Sustainable and Healthy Eating Behaviors scale.

TABLE II
 SUSTAINABLE AND HEALTHY EATING BEHAVIORS SCALE SUB-DIMENSION SCORES AND TOTAL SCORES BASED ON NUTRITION EDUCATION

Sub-Dimension	Nutrition Education $\bar{x} \pm ss$	Non- Nutrition Education $\bar{x} \pm ss$	P value
Quality Marks	4.14 ± 0.96	3.70 ± 3.90	0.002*
Seasonal Foods and Avoiding Food Waste	4.61 ± 0.76	4.20 ± 0.93	0.002*
Animal Health	4.14 ± 1.12	3.78 ± 1.18	0.037*
Reducing Meat Consumption	3.78 ± 1.10	3.35 ± 1.16	0.013*
Healthy and Balanced Nutrition	4.60 ± 0.89	4.28 ± 0.87	0.016*
Local Food	3.77 ± 1.33	3.59 ± 1.46	0.394
Low Fat	4.90 ± 0.97	4.61 ± 1.10	0.067
Sub-Dimension Total Score	29.96 ± 5.23	27.54 ± 5.87	0.004*
Sub-Dimension Total Score Average	4.28 ± 0.74	3.93 ± 0.83	0.004*

* $p < 0.05$

IV. DISCUSSION

The Mediterranean diet is gaining popularity as a sustainable nutrition model for the transition to sustainable food systems and diets. The Mediterranean diet, being a plant-based diet, is seen as a sustainable nutritional approach with minimal environmental implications [19]. The effect of nutrition education on adherence to the Mediterranean diet and sustainable healthy eating behaviors was investigated in this research. According to the results, students who received nutrition education showed an increase in both the Mediterranean diet adherence score and the sustainable healthy eating habits score. Furthermore, it has been shown that there is a link between Mediterranean diet adherence and sustainable healthy eating habits. Sustainable healthy eating behaviors improve as the score for adherence to the Mediterranean diet rises. Similar results were obtained in another study that was conducted. It has been determined that nutrition education has positive effects on sustainable and healthy eating behaviors [20]. In a study examining the nutritional status and adherence to the Mediterranean diet of university students, it was found that the students who received nutrition education had significantly higher scores on adherence to the Mediterranean diet [21]. Another research with university students investigated the students' level of knowledge about the concept of sustainable nutrition. According to the results of the research,

students who received nutrition education had a higher rate of knowledge of the concept of sustainable nutrition and a higher score of adherences to the Mediterranean diet [22]. The study examining university students' sustainable nutrition level of knowledge indicated that there is a significant lack of knowledge about the components of sustainable nutrition. Students from the faculty of health sciences constitute 29.9% of the study sample. However, the effect of nutrition education on sustainable nutrition was not examined in the study [23]. Research was conducted with tenth-grade German secondary school students to evaluate their understanding of sustainable nutrition across five sub-dimensions. The study revealed that students emphasized the health factor in their perception of sustainable nutrition. Students struggle to connect ecological, social, economic, and cultural aspects with sustainable nutrition [24]. A comprehensive review analyzed data on the efficacy of web-based nutrition education programs designed to encourage sustainable and healthy eating behaviors in young adults. The study demonstrated that web-based interventions can effectively promote certain sustained diet-related outcomes in young adults. It was emphasized that there is a requirement to create more extensive programs to help young adults in making healthy and sustainable eating choices [25]. Cox et al. conducted a study to investigate the impact of nutrition education on vegetable and fruit consumption in adults. The study revealed a notable rise in fruit and vegetable consumption due to traditional dietary practices [26]. Lua and colleagues conducted review research on the efficacy of nutrition education programs, including web-based instruction, lectures, and supplementary provisions, among university students. The study found that there were notable changes in the eating habits of university students following specific educational interventions [27]. The results demonstrate how nutrition education influences the development of sustainable and healthy dietary practices. The study highlighted the significance of nutrition education in developing enduring and healthy eating habits. Evidence indicates that nutrition education positively impacts scale scores associated with healthy and sustainable nutrition. The data collected from the literature align with the findings of this investigation.

V.CONCLUSION

Current environmental issues such global climate change, biodiversity loss, land degradation, water shortages, and water pollution demand immediate action. The issues affecting long-term food security stem from present eating habits and agricultural methods. Diet and eating habits have a substantial influence on the environment. Eating more plant-based foods, avoiding animal products, and reducing calorie consumption and food waste can all help minimize these consequences. In this context, sustainable nutrition is becoming increasingly important today. Healthy, sustainable diets are crucial for enhancing health and warding off illnesses. The Mediterranean diet, as a sustainable diet model, is important for both public health and environmental health. The study's findings demonstrated a relationship between the Mediterranean diet and sustainable and healthy nutrition. Moreover, nutrition education

was determined to have an impact on sustainable and healthy eating behaviors, as well as increased adherence to the Mediterranean diet. Nutrition education is very important, with its contribution to both healthy and balanced nutrition of individuals and sustainable nutrition resources for the environment. In order to increase the awareness of society on this issue, more importance should be given to nutrition education, and necessary approaches should be taken.

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