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Evaluation of University Students' Knowledge of and Practices for Sustainable Nutrition

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Abstract

The world is faced with many significant environmental challenges, such as climate change, on a global scale. Sustainable nutrition has an important role in solving these problems. In this study, we aimed to determine the sustainable nutrition knowledge and attitudes of university students. The study was completed with 889 students. It was found that 71.2% of male students think that foods have no effect on the environment. All students had a mean sustainable nutrition knowledge score of 16.0 ± 5.3 . As income increased, sustainable nutrition practices scores decreased ($p < 0.05$). Sustainable nutrition knowledge scores of overweight and obese individuals were found to be lower than those of participants with normal BMIs ($p < 0.05$). Red meat is eaten 1-2 days a week by 73.7% of the students. Also, 85.7% of students do not separate their wastes. This study is the first to provide data on the knowledge and attitudes of Turkish university students on food sustainability from a national and holistic perspective. The results show that there is a significant lack of knowledge regarding the characteristics of sustainable nutrition. It is extremely important to help people understand how food affects the environment. In this context, various research and training approaches are needed.

Keywords: Sustainable nutrition, Environmental issues, Climate change, University student

Introduction

Sustainability is the fulfillment of the needs of current generations by preserving the existence and quality of resources that the next generations will need (Akay & Demir, 2020). The Food and Agriculture Organization of the United Nations (FAO) has stated that in 2050, it will be necessary to increase food production by at least 60% in order to fulfill the demands of world population growth and the rising demand for animal nutrition (Alexandros & Bruinsma, 2012). The 2018 global warming report of the Intergovernmental Panel on Climate Change (IPCC) (Masson-Delmotte et al., 2018) and the sustainable nutrition recommendation report from the EAT-Lancet Commission on Food, Planet, Health (EAT2019) (Willett et al., 2019) have increased interest in this subject.

At present, more than 2 billion people worldwide are

known to suffer from malnutrition (Bailey et al., 2015) and approximately 860 million people from hunger (McGuire, 2013), while about 2 billion people are overweight or obese (WHO, 2016). Taking into consideration that the world population is expected to rise by an additional 2.2 billion by 2050, both worsening hunger and obesity (Nations, 2015) and environmental pressure with scarcity of resources and climate change stand as inevitable facts that seriously threaten our future. In the last 50 years, alongside the constantly increasing need for food, there has been a rapid jump in production in the food industry and livestock sector. Increasing animal food production, in particular, is shown as one of the reasons for global climate change (Masson-Delmotte et al., 2018). The entire food production system is estimated to contribute 30% of global greenhouse gas emissions (Vermeulen et al., 2012),

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and the FAO stated that meat and dairy production contributed 14.5% of all greenhouse gas emissions globally (Gerber et al., 2013). Agricultural production is responsible for 70-80% (Jägerskog & Jøneh Clausen, 2012) of all human water use and 38% (Foley et al., 2011) of land degradation. It is very important to evaluate food systems and diets in terms of sustainability in order to eliminate the serious threat of the mentioned rise in production for climate change and to solve the nutritional problems experienced worldwide (Mason & Lang, 2017).

The concept of sustainable nutrition was first proposed in 1986 by Gussow and Clancy, who argued that sustainability is vital for a healthy diet (Gussow & Clancy, 1986; Johnston et al., 2014). In 2010, the FAO defined sustainable diets as “those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations.” By adding five equally important principles (environment, health, equity, culture, and economics) to the previous definition, diets that are “protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources” have been defined as sustainable diets (FAO, 2010).

Reducing animal protein consumption, increasing the consumption of vegetable protein instead of animal protein and consuming fruits and vegetables from various sources, choosing seasonal local food, eating sufficiently and avoiding waste by using leftovers, and composting food waste are currently emphasized as the principles of sustainable nutrition in order to significantly reduce global warming, improve global nutritional health, and preserve food resources for the next generations (Guillaumie et al., 2020).

In light of these recommendations, encouraging individuals to embrace sustainable diets will reduce greenhouse gas emissions (Hoek et al., 2017). It has been reported that organic farms have on average 25% lower greenhouse gas emissions than conventional farms (Hülsbergen & Küstermann, 2008; Von Koerber et al., 2017). Short distances of food from farm to table reduce energy consumption and greenhouse gas emissions. Seasonal planting causes lower levels of carbon dioxide emissions because it does not require heating oil like greenhouses or plastic tunnels. Seasonal products that are not produced in heated greenhouses or plastic tunnels often also contain fewer residues such as nitrates and pesticides, which is important for the sustainability of the planet (Von Koerber et al., 2017). Minimally processed foods generally contain higher levels of nutrients with less energy. Processed products often contain high amounts of fat, sugar, and salt; they also include possible food additives such as preservatives, coloring, and flavoring agents. At the same time, food processing requires considerable energy and causes pollutant emissions. Moreover, food processing requires large amounts of virtual water (Stranieri et al., 2017; Von Koerber et al., 2017). Along with all these considerations, it is necessary to develop suitable guidelines for sustainable diet models. As a result of the studies conducted on this subject, it has been reported that the Mediterranean and Nordic diets are suitable

for health-promoting and sustainable nutrition (Renzella et al., 2018). In addition, another study showed that the lacto-ovo-vegetarian diet and some plant-based diets are more environmentally sustainable than diets containing foods of animal origin (Esteve-Llorens et al., 2019). Foods with low greenhouse gas emissions (<1 kg CO₂e/kg) include pasta, noodles, bread, and oats; potatoes, onions, peas, carrots, and corn; apples, pears, citrus fruits, plums, and grapes; and sugar. Foods with medium greenhouse gas emissions (1-4 kg CO₂e/kg) include chicken, milk, butter, yogurt, eggs, rice, cereals, and oilseeds; strawberries, bananas, and melons; and cauliflower, mushrooms, broccoli, and green beans. Foods with high greenhouse gas emissions (>4 kg CO₂e/kg) include beef, lamb, and fish (Macdiarmid et al., 2012).

Sustainable nutrition will also reduce nutrient losses and waste (Willett et al., 2019). Approximately one-third of the food produced in the world is wasted (Von Koerber et al., 2017). Reducing food waste and nutrient losses will also reduce greenhouse gas emissions caused by more food production (Hyland et al., 2017). Sustainable nutrition is a concept with health, environmental, social, economic, and cultural subdimensions. Although it is a very current issue, it has been reported that it is not well understood (García-González et al., 2020). There are studies suggesting that a majority of people think that sustainable nutrition is expensive, despite the perception that it is healthy (Dwyer & Drewnowski, 2017; Johnston et al., 2014; Masset et al., 2014). There is a strong relationship between nutrition and purchasing power.

In solving the world's threats to the environment, sustainable nutrition plays a key role. It is very important to evaluate the knowledge and attitudes of university students, who are young adults who will build the future, on this issue. At the same time, the concepts of sustainability and sustainable food production in Turkey have not been explored in the scientific literature. In this study, we aimed to determine sustainable nutrition knowledge and practices of university students studying in Istanbul, which is Turkey's most metropolitan and cosmopolitan city.

Materials and Methods

This cross-sectional study was conducted in April and May of 2020. The population of the study comprised students studying at universities (n=52) in Istanbul. The total number of students constituting this population is 621,549 (306,621 female students and 314,928 male students) (YÖK, 2020). The sample size was calculated as 384 students with 5% precision and 95% confidence interval. All students studying in any faculty of a university in Istanbul were invited to participate in this study. The study was completed with 889 students (674 female, 215 male).

The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Institutional Review Board (or Ethics Committee) of the University of Health Sciences (protocol code 20/141 and date of approval 24 April 2020). Before completing the questionnaire, students were informed about the purpose of the research and those who agreed to participate were asked to approve the questionnaire.

Study plan and collecting data

This study was conducted to determine the level of knowledge and practices of university students regarding sustainable nutrition in Turkey's metropolitan city of Istanbul. There is no scale in Turkish for evaluating sustainable nutrition knowledge or practices. For this reason, we designed a questionnaire by reviewing the literature. We tested this questionnaire with 40 volunteering students to evaluate it. As a result, we collected the data with the finalized sustainable nutrition information and practices questionnaire consisting of 3 parts and 50 questions. In addition, we obtained information on the demographics and nutritional habits of the students.

Data collection tool

Demographic Information: Students' age, gender, body weight, height, health status, field of university study, place of residence, and nutrition budget were questioned.

Nutrition Habits: The students were asked about their diet, their preferences, and reasons for their consumption of animal and plant foods, whether they had heard of the concept of sustainable nutrition before, and whether they would change their diet for the environment.

Section 1: Consists of 14 questions on sustainable nutrition knowledge. Each correct answer was given 1 point and wrong answers 0 points. The total possible score is 22 points, referred to as the "knowledge score."

Section 2: Consists of 12 questions on sustainable nutrition practices. Two questions are scored on a 5-point Likert-type scale. The total possible score is 29 points, referred to as the "practices score."

Section 3: Contains 24 questions about purchasing attitudes within the scope of sustainable nutrition. All questions are arranged according to a 5-point Likert-type scale (never = 0 points, rarely = 1, sometimes = 2, generally = 3, always = 4). The total possible score is 96 points, referred to as the "shopping attitude score."

Study data were collected online. Before the online questionnaire was administered, the participants were asked for approval. The link to the questionnaire was sent to the e-mail addresses of the student clubs of all universities in Istanbul and the clubs were asked to share this with students.

Data processing and analysis

All collected data were first examined according to the inclusion criteria. Unsuitable participants were excluded from the study by examining university and department declarations. Three individuals were excluded from the study because they were not students and four individuals because they studied at a university in another province. It was then checked whether all questions were answered completely. At this stage, 81 further individuals were excluded. Those students wrote anything about "nutrition budget". These students were excluded from the study. However, 120 students who wrote either "I don't know" or "I don't want to say". These students were not excluded from the study.

While processing the data, the answers in sections 1, 2, and 3 of the Nutrition Habits Questionnaire were scored and the total score of each section was obtained. The scoring of Likert-type questions was graded, those whose answers were not suitable were given zero points, and suitable answers were

given 1, 2, 3, or 4 points, respectively. Correct answers to other questions were given 1 point. Thus, the sustainable nutrition knowledge score (0-22), sustainable nutrition practices score (0-29), and shopping attitude score (0-96) were calculated.

Body mass index (BMI: body weight (kg)/height (m²)) was calculated according to the height and body weight of the students. BMI values were classified in accordance with the World Health Organization (<18.5 kg/m², underweight; 18.5-24.9 kg/m², normal; 25.0-29.9 kg/m², overweight; ≥30.0 kg/m², obese) (WHO, 2020).

Descriptive statistics were analyzed for all variables. The answers in sections 1, 2, and 3 of the Nutrition Habits Questionnaire were scored. Obesity was categorized. When parametric test assumptions were fulfilled, variance analysis was used when comparing the data obtained from more than two independent groups. The Tukey test was used to find the difference between groups with a level of significance if the assumption of variance homogeneity was met. In the comparison of the averages of two independent groups, Student's t-test was used when the assumption of normality was met, and the Mann-Whitney U test was used when it was not. The data obtained from qualitative variables were summarized with number and percentage distributions. All analyses were performed using IBM SPSS Statistics 22 (IBM Corp.) and $p < 0.05$ was considered significant.

Results

This study was completed with 889 students. All of the students were between 18 and 25 years old. Students participated in the survey from 31 universities and 14 different faculties in Istanbul. The highest participation was from faculties of health sciences (29.9%). Most students (41.3%) lived with their families and 75.8% of the students were female. While 10.5% of all students had a diagnosed chronic disease, 86% of those were female students. It was also found that 71.6% of all students had a normal BMI and 13.5% ($n = 120$) did not specify the monthly money spent on their own food, while 62.2% ($n = 889$) spent 500 Turkish Liras (\$73) per month (Table 1).

Questions were asked about students' opinions on both their diets and environmental problems. The answers for female and male students are shown separately. The number of women participating in the study was approximately three times that of men. For this reason, statistical evaluation between the genders is not shown (Table 2).

The rate of those who had heard about the concept of sustainable nutrition before was 58.27% and the majority of these (81.66%) were female students ($\chi^2 = 23.125$, $df = 1$, $p = 0.001$). Female students ($n = 200$, 48.43%) heard about this concept most in academic/scientific activities, while male students ($n = 41$, 43.16%) heard about it mostly from social media. The majority of the students had a mixed diet (97.19%), consuming both vegetable and animal foods, and this type of diet was considered to be healthier. Types of vegetarianism practiced by the students were ovo-vegetarianism ($n = 4$), lacto-vegetarianism ($n = 5$), pescatarianism ($n = 3$), and semi-vegetarianism ($n = 6$). There was no significant difference by gender between those who consumed plant-based foods as

replacements for meat and those who did not ($\chi^2 = 23.125$; $df = 1$; $p = 0.001$). The question “Is sustainable nutrition expensive?”

was asked and 40.80% of female students answered “I don’t know”; this rate was 46.51% among male students (Table 2).

Table 1. Characteristics of students (n=889)

	n	%
Gender		
Female	674	75.8
Male	215	24.2
Faculty		
Health Sciences	266	29.9
Engineering	166	18.7
Spots Sciences	51	5.7
Law	29	3.3
Architecture and Design	46	5.2
Science	60	6.7
Theology	36	4.0
Education	64	7.2
Economics and Administrative Sciences	45	5.1
Social Sciences	39	4.4
Fine Arts	6	0.7
Dentistry	30	3.4
Pharmacy	23	2.6
Medicine	28	3.1
Housing		
Student House	222	25.0
Family House	367	41.3
Dormitory	270	30.3
Other	30	3.4
Diagnosed Chronic Disease		
Yes	93	10.5
No	796	89.5
BMI (kg/m ²)		
Underweight	110	12.4
Normal weight	637	71.6
Overweight	117	13.2
Obese Class I	25	2.8
Budget (Spent to feed) (TL*/month) (n=769)		
<500	553	71.9
500-1000	181	23.5
1001-1500	23	3.0
1501-2000	6	0.8
>2000	6	0.8

*1 Dollar (\$) =6.85 Turkish Lira (TL)

Table 2. Characteristics of the eating habits of students

	Female (n=674)		Male (n=215)		Total (n=889)	
	n	%	n	%	n	%
Have You Heard of the Concept of Sustainable Nutrition?						
Yes	423	62.8	95	44.2	518	58.3
No	251	37.2	120	55.8	371	41.7
Nutrition Style						
Mixed Diet	653	96.9	211	98.1	864	97.2
Vegetarian (all types)	14	2.1	4	1.9	18	2.0
Vegan	7	1.0	-	-	7	0.8
Healthy Eating Model						
Mixed Nutrition	586	86.9	176	81.9	762	85.7
Animal-based Nutrition	15	2.2	30	13.9	45	5.1
Plant-based Nutrition	62	9.2	9	4.2	71	8.0
Purely Herbal Nutrition	11	1.6	-	-	11	1.2
Consuming Meat Substitutes Such as Soya Ground						
Yes	83	12.3	23	10.7	106	11.9
No	591	87.7	192	89.3	783	88.1
Is Sustainable Nutrition Expensive?						
Yes	164	24.3	53	24.7	217	24.4
No	235	34.9	62	28.8	297	33.4
I don't know	275	40.8	100	46.5	375	42.2

The students who consumed foods of animal origin (red meat, chicken, fish, eggs, and milk and other dairy products) were asked the reasons for eating them, and the first three answers to this question among both women and men were the same: liking the taste (71.1% and 73.5% for female and male students, respectively), being healthy (70.2% and 69.8%), and habit (46.0% and 35.8%). In addition, 26.5% of men preferred meat because it is “satisfying.”

The average, median, and quartile distributions of quantitative data in the study are shown in Table 3. The mean age and BMI of all students were 21.1 ± 1.7 years and 22.2 ± 6.7 , respectively. A total of 120 students answered the question

of “What is the average money you spend on nutrition per month?” with either “I don't know” or “I don't want to say.” Excluding those students, 769 students spent on average 487.2 ± 391.4 TL and 75% of the students had a budget of 600 TL or less. While the lowest budget specified was 25 TL, the highest budget was 3500 TL. The lowest obtained sustainable nutrition knowledge score was 2 and the highest was 27, and 75% of participants had a score of 20 points or less. While an average of 11.1 ± 2.8 points was obtained for the sustainable nutrition practices score, the highest score was 92 for shopping attitude.

Table 3. Descriptive Related to Quantitative Variables

	n	Mean	Median	SD	Min	Max	Q1	Q3
Age	889	21.1	21.0	1.7	18.0	25.0	20.0	22.0
BMI	889	22.2	21.5	6.7	14.2	190.3	19.5	23.9
Budget	769	487.2	400.0	391.4	25.0	3500.0	250.0	600.0
Knowledge score	889	16.0	16.0	5.3	2.0	27.0	12.0	20.0
Practice score	889	11.1	11.0	2.8	2.0	19.0	9.0	13.0
Shopping attitude score	889	57.0	60.0	16.6	8.0	92.0	48.0	69.0

Table 4 shows the distribution of the answers given by the students to some questions about sustainable nutrition and its practices. In this table, the rate of students who think that local food consumption will contribute to sustainable nutrition is 55.6% and the rate of students who consume products grown in their region is 57.1%. While almost all the students (95.9%) thought that a meat-based diet was not sustainable, the majority (52.5%) did not consume free-range chicken eggs. Also, 9.1%

of students consumed red meat every day.

In Table 5, which shows the students' attitudes toward sustainable nutrition while shopping, the rate of those who always use their own shopping bags is 26.2%. The rate of those who always consume seasonal food is 27.4%, and the rate of those consuming ultra-processed food is 7.1%. While 25.3% of the students usually buy local products, 29.1% pay attention to the place where food is generally produced.

Table 4. Frequency distribution of responses by students according to some questions on knowledge and practices in sustainable nutrition

		n	%
What's sustainable nutrition?	Those who do not know	295	33.2
	Those who know	594	66.8
Does the consumption of local foods contribute to sustainable nutrition?	Yes	494	55.6
	No	395	44.4
Is the consumption of seasonal food in the context of sustainable nutrition?	Yes	853	96.0
	No	36	4.0
Does the food production chain (both vegetable and animal) cause an increase in greenhouse gases?	Yes	547	61.5
	No	342	38.5
Does the production of animal food (cattle farms) cause water pollution?	Yes	557	62.7
	No	332	37.3
Which food group has the least environmental impact?	Fruits, vegetables	388	43.6
	Bread and the likes	103	11.6
	Milk and milk products	210	23.6
	Meat and meat products	188	21.2
Which of the following types of meat do you think causes more greenhouse gas emissions?	Bovine meat	615	69.2
	Chicken meat	111	12.5
	Small ruminant meat	44	4.9
	Fish meat	119	13.4
What kind of meat do you consume more in your diet?	I don't eat	11	1.2
	Red meat	377	42.5
	White meat	457	51.4
	Fish meat	44	4.9
Indicate the consumption of red meat (independent of the amount)	No	11	1.2
	1-2 times a week	655	73.4
	1 in 15 days	97	10.9
	Everyday	81	9.1
	1 per month	45	5.1
Do you consume regional food grown in the area where you live?	Yes	508	57.1
	No	381	42.9
Is sustainable nutrition related to animal rights or animal welfare?	Yes	470	52.9
	No	419	47.1
When you buy eggs do you buy free-range chicken eggs?	I don't eat	19	2.2
	Yes	403	45.3
	No	467	52.5
Do you buy fish suitable for the season?	Yes	758	85.3
	No	131	14.7
Do you separate the waste or garbage (plastic, paper, glass, food waste, etc)?	Yes	762	85.7
	No	127	14.3
Which of the following are examples of sustainable diets?			
A diet based on vegetables and fruit, chicken protein, fish and legumes, reduced fat and less sweet.		794	89.3
A diet that does not consume sugary food, nuts are consumed in abundance, fruits are consumed very little. snacks are not made fats and meat products are unlimited.		59	6.6
A diet based on red meat. in which vegetables and fruit are consumed less fats are not restricted, and dessert is free.		36	4.1

A statistically significant difference was found between the male and female group averages in terms of all scores. In terms of shopping attitude score, the difference between the averages of female (58.05 ± 16.95) and male students (53.6 ± 15.08) was found to be statistically significant ($t = 3.441$, $p = 0.001$). In terms of practices score, the difference between the averages of female (11.5 ± 2.81) and male students (9.9

± 2.6) was statistically significant ($t = 7.387$, $p < 0.001$). In terms of knowledge score, the difference between the averages of female (16.8 ± 5.07) and male students (13.51 ± 5.12) was statistically significant ($t = 8.267$, $p < 0.001$) (Table 6).

There was no statistically significant difference between budget groups in terms of shopping attitude score ($F = 0.135$, $p = 0.874$). A statistically significant difference was found

between budget groups in terms of practices score ($F = 3.777$, $p = 0.023$). The average score of the group with a budget of >600 TL per month (10.58) was statistically significantly lower than the scores of the groups with average budgets of 250-600 TL per month (11.23) and <250 TL per month (11.21). There was no statistically significant difference between budget groups in terms of knowledge score ($F = 2.065$, $p = 0.128$) (Table 7).

There was no statistically significant difference between BMI groups in terms of shopping attitude score ($F = 0.737$, p

$= 0.479$). There was also no statistically significant difference between BMI groups in terms of practices score ($F = 2.607$, $p = 0.074$). A statistically significant difference was found between BMI groups in terms of knowledge score ($F = 6.092$, $p = 0.002$). The average knowledge score was statistically significantly lower for the group with above-normal BMIs (14.68 ± 5.06) compared to the average of the group with normal BMIs (16.35 ± 5.37) (Table 8).

Table 5. Distribution of responses from students according to some questions about shopping attitudes

		Never	Rarely	Sometimes	Usually	Always
I check whether the packaging of any product I purchase is recyclable or reusable	n	184	315	229	117	44
	%	20.7	35.4	25.8	13.2	4.9
I usually use my own shopping bag when shopping	n	97	123	172	264	233
	%	10.9	13.8	19.4	29.7	26.2
I read information on the product label	n	66	155	209	226	233
	%	7.4	17.4	23.5	25.4	26.2
I buy local products	n	89	163	302	225	110
	%	10.0	18.3	34.0	25.3	12.4
I pay attention to where the food is produced or grown	n	143	205	259	176	106
	%	16.1	23.1	29.1	19.8	11.9
I buy certified organic food products in my food shopping	n	140	230	273	162	84
	%	15.7	25.9	30.7	18.2	9.5
I buy suitable food for the season	n	66	108	172	299	244
	%	7.4	12.1	19.3	33.6	27.4
I buy ultra-processed packaged food	n	125	218	288	195	63
	%	14.1	24.5	32.4	21.9	7.1
I pay attention to the portion size of the food I take in order not to leave food waste	n	62	123	234	295	175
	%	7.0	13.8	26.3	33.2	19.7
I take care that the products I buy are environmentally friendly	n	104	175	273	221	116
	%	11.7	19.7	30.7	24.9	13.0

Table 6. Gender Comparison in Terms of Evaluation Scores

	Female (n=674)	Male (n=215)	t	p
Knowledge score	16.8±5.07	13.51±5.12	8.267	<0.001
Practice score	11.5±2.81	9.9±2.6	7.387	<0.001
Shopping attitude score	58.05±16.95	53.6±15.08	3.441	0.001

Table 7. Comparison of Budget Groups According to Evaluation Scores

	<250 TL (n=178)	250-600 TL (n=384)	>600 TL (n=207)	F	p
Knowledge score	15.42±5.07	16.03±5.3	16.51±5.32	2.065	0.128
Practice score	11.21±2.79 ^a	11.23±2.8 ^a	10.58±3.07 ^b	3.777	0.023
Shopping attitude score	56.28±17.32	56.81±16.74	56.11±16.93	0.135	0.874

Table 8. Comparison of BMI Groups According to Evaluation Scores

	Below normal (n=110)	Normal (n=637)	Above normal (n=142)	F	p
Knowledge score	15.71±4.66 ^{a,b}	16.35±5.37 ^a	14.68±5.06 ^b	6.092	0.002
Practice score	11.55±2.77	11.12±2.87	10.73±2.74	2.607	0.074
Shopping attitude score	58.64±16.63	56.87±16.69	56.15±16.33	0.737	0.479

Discussion

Based on our findings, more than half of the students (66.8%) knew about sustainable nutrition. However, they did not have enough information about the scope of sustainable nutrition (health, ecological, social, economic, and cultural subdimensions). At the same time, compared to their knowledge scores, they had poorer practices scores related to sustainable nutrition. As income increased, sustainable nutrition practices scores decreased ($p < 0.05$). Sustainable nutrition knowledge scores of overweight and obese individuals were found to be lower than those of students with normal BMIs ($p < 0.05$). In a previous study, it was found that those with lower nutritional knowledge scores were less likely to adopt the Mediterranean diet and had higher BMIs (Bonaccio et al., 2013). Application of knowledge is as important as the level of knowledge. Therefore, both eating habits and shopping attitudes of the students were scored. The score achieved by 50% of all students for sustainable nutrition practices (11.0) was 37.9% of the total possible score (29.0). This score can be evaluated as quite low. However, the median value (60.0) obtained for the shopping attitude score was 62.5% of the total possible score. The average monthly money spent for nutrition by these students was 487.2 ± 391.4 TL. This budget seems to be insufficient in Turkey, where high inflation of food prices is observed.

University students generally have bad eating habits and do not consume the recommended daily amounts of fruits and vegetables; it has been found that they consume sugar, processed meats, and high-fat and high-calorie foods more often (Blondin et al., 2016). In this study, 51.2% of the students thought that they had a healthy diet and almost all of them (97.2%) were mixed-nutrition diets. The percentage of those who thought that the healthiest diet is mixed nutrition was 85.71%. Meanwhile, 21 students, all female, described their diets as vegetarianism and vegan. Existing food production and consumption patterns are among the main causes of environmental degradation (Ruini et al., 2016). Sustainable nutrition is a concept that includes changes in dietary preferences to reduce excessive consumption and facilitate the transition to nutritious diets with lower environmental impacts, as well as reducing losses and waste in food systems. It has been reported that there are developments in solid waste disposal in Turkey, but the performance is unsatisfactory (Kıyan & İkizoğlu, 2020). Providing adequate nutrition within sustainable nutrition systems is very important globally (Alsaffar, 2016). In the transition from adolescence to young adulthood, young adults have difficulty in making healthy food choices due to increased independence (Stok et al., 2018). In our study, it was the female students who tended to eat healthier. At the same time, the sustainable nutrition knowledge and practices scores of female students were higher than those of male students ($p < 0.05$).

While nutrition directly affects our health, it also affects the environment. It has been determined that the environmental effects of nutrition are not known by young people (Dornhoff et al., 2020; Willett et al., 2019). In our study, the rate of those who thought that foods have no effect on the environment was 48.2% and 71.2% among women and men, respectively ($p <$

0.05). According to this result, students need more information about the relationship between nutrition and the environment, which is based on sustainable nutrition. Moreover, the rate of those who did not consider “climate change as an environmental problem associated with sustainable nutrition” was 62.7%. However, an increase in the average temperature of the world by 1.5 °C disrupts the ecological balance and serious nutrient shortages and nutrient deficiencies, such as cereals containing less Zn, are expected (Alexandratos & Bruinsma, 2012; Masson-Delmotte et al., 2018; Solomons & Schumann, 2017).

It has been stated that older consumers are more sensitive to and dependent on sustainable nutrition, and it has been determined that more insensitive individuals who do not care about the environment include younger individuals, those of male gender, those with lower income or lower education levels, and those with less inclusion in society (Gilg et al., 2005). Participants in the present study are very young (median age: 21 years) and are in serious need of sustainable nutrition education. For example, 40.8% and 46.5% of female and male students, respectively, said “I have no idea” regarding whether sustainable nutrition has an economic dimension ($p < 0.05$). Individual nutritional habits supporting sustainability among university students, who are the consumers and decision-makers of the future, can have a positive effect on their personal and social environments and actively contribute to the sustainable development of the nutrition system (United Nations Educational & Organization, 2014). In this study, it was determined that those who heard about sustainable nutrition had mostly (25.8%) heard about it from academic and scientific activities, such as lectures and conferences. Information will make an important contribution in universities and even at earlier educational levels.

Among all students, only 8.3% thought that a plant-based diet was more beneficial. However, the frequency of students consuming meat every day was only 9.1%. There is important food price inflation in Turkey and meat prices are particularly high. According to the most extensive nutritional study conducted in Turkey, among individuals between 19 and 30 years of age, daily animal protein consumption is 34.1 g among men and 24.5 g among women (T.R.HealthMinistry, 2014). It can be asserted that the economic situation of the students affects their frequency of meat consumption. It is known that red meat has a particularly high environmental impact, and it was determined that 73.4% of the students consumed red meat 1-2 times a week. This situation can be evaluated as positive in terms of sustainability. There was no significant relationship between the incomes of the students and the frequency of meat consumption, but 71.9% of the students who declared their income had a monthly nutrition budget of 500 TL (~\$75). Considering the greenhouse gas effects of animal products, it can be said that the carbon footprints of the students are small in this context. The IPCC reported that undeveloped or developing countries have smaller greenhouse gas effects (Masson-Delmotte et al., 2018). However, this is not the case regarding waste reduction; such countries have very limited recycling activities (Umut et al., 2015). For example, in Turkey, there is no activity or obligation for either municipalities or

homes for composting food waste.

Studies have shown that both high school students (Dornhoff et al., 2020) and adults (Macdiarmid et al., 2016) essentially perceive nutrition individually and hardly notice the environmental effects of their own diets. In other words, they are either unaware of the effect of their own nutrition behavior on the global food system or they think that it is very insignificant (Dornhoff et al., 2020; Macdiarmid et al., 2016). In a study conducted in Italy, only 31% of university students thought that their consumption affected the environment (Vecchio & Annunziata, 2013). Studies have shown that women have more sensitive behaviors towards environmental problems and environmental protection (Shivakumara et al., 2015; Xiao & McCright, 2015). In studies conducted with university students, it was found that female students' environmental attitude scores and environmental awareness averages were significantly higher than those of male students (Çabuk, 2003; Şenyurt et al., 2011). In our study, a parallel result was found. In addition, in our study, the question "If you knew that it was more beneficial for the environment, would you change your diet?" was asked, and 89.2% of the female students but only 20.0% of the males answered "Yes."

According to the FAO's 2010 definition, sustainable diets should be protected and respected as the best use of natural resources, biological diversity, and ecosystems (FAO, 2010), and one of the most important criteria in sustainable nutrition is the low impact of nutrition on the environment. In our study, the rate of students who always chose recyclable or reusable packaging when they bought packaged products while shopping was 4.9%. This rate is very low. According to gender, this rate was 5.2% among women and 4.2% among men ($p < 0.05$). However, even though the rate of those who read labels was lower among men than women, the rate of "usually" and "always" reading label information among all students was 51.6%. Regarding the use of local products, although 16.1% of the students never paid attention to the origin of their foods, it was found that 4.0% of female students and 4.2% of males always bought imported food ($p > 0.05$). In the use of packaged products, it is extremely important to separate packages according to their materials. However, in Turkey, there is no law regarding separation at the source. It is necessary to provide training on the importance of disposal of wastes and recycling and recovery.

In the study of Serafini and Toti, it was determined that obesity may have large ecological costs to the environment due to excessive consumption of foods. It is thought that excessive consumption of foods leading to obesity may cause the waste of resources and unnecessary greenhouse gas emissions. Moreover, foods that are eaten beyond biological requirements are considered as metabolic waste. Most of the metabolic food waste is caused by animal products, followed by cereals, pulses and starchy roots, sugar and sweets, and alcohols, respectively. It has been suggested that reducing the frequency of obesity may also reduce greenhouse gas emissions (Serafini & Toti, 2016). In our study, the frequency of being obese and overweight was 2.8% and 13.2%, respectively. In another study (Ayşe & Ali, 2020), the prevalence of obesity and

overweight among university students was 4.9% and 18.8%, respectively. These findings are similar to each other. Obesity etiology is based on very complex factors and, accordingly, many disciplines should work together in its treatment. In the future, it can be expected that obesity will be on the agenda more within the scope of sustainable nutrition.

In conclusion, this study is the first to provide data on the knowledge and attitudes of Turkish university students regarding food sustainability from a national and holistic perspective. The results show that there are different levels of knowledge and different attitudes regarding the characteristics of sustainable nutrition. It is also understood that there could be other variables affecting this situation. It is extremely important to help people understand how food affects the environment. In this context, various research efforts, training programs, and political support are needed.

Compliance with Ethical Standards

Conflict of interest

The authors declare no conflict of interest.

Author contribution

Aysun Yuksel conceived, designed, and did statistical analysis & editing of the manuscript. Hulya Yilmaz Onal did data collection and manuscript writing. All authors contributed to and have approved the final version.

Ethical approval

From University of Health Sciences, Hamidiye Scientific Research Ethics Committee, protocol code: 20/141; date of approval: 24.04.2020

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Data availability

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Consent for publication

Not applicable.

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