



Is food insecurity related to sustainable and healthy eating behaviors?

Kevser Tari Selcuk¹ · Ramazan Mert Atan^{1,2} · Sedat Arslan¹ · Nursel Sahin¹

Received: 20 December 2022 / Accepted: 12 May 2023 / Published online: 19 May 2023
© The Author(s), under exclusive licence to Springer-Verlag GmbH Germany, part of Springer Nature 2023

Abstract

In this cross-sectional study, it was aimed to investigate the relationship between sustainable and healthy eating behaviors such as nutritional insecurity and a healthy and balanced diet, interest in regional and organic food products, consumption of seasonal food and avoidance of food waste, preference for locally produced foods, reduction of meat consumption, preference for eggs from free-range chickens, and sustainable fishery products, and consumption of low-fat food products in adults. The study included 410 adults who were reached through social media applications. Data were collected through an online questionnaire including the Descriptive Information Form, the Household Food Insecurity Access Scale (HFIAS), and the Sustainable Healthy Eating Behaviors Scale (SHEBS). The proportion of participants determined as mildly food insecure, moderately food insecure, and severely food insecure was 10.2%, 6.6%, and 7.6%, respectively. Linear regression analysis revealed that in Models 1, 2, and 3, there was a statistically significant negative association between food insecurity and the components of sustainable and healthy eating behaviors such as healthy and balanced diet ($\beta - 0.226, p < 0.001$), quality labels ($\beta - 0.230, p < 0.001$), seasonal foods, which are of avoidance of food waste ($\beta - 0.261, p < 0.001$), animal welfare ($\beta - 0.174, p < 0.001$), and fat intake ($\beta - 0.181, p < 0.001$). In conclusion, food insecurity negatively affects healthy and balanced diet behaviors, interest in regional and organic food products, seasonal food products consumption and avoidance of food waste, consumption of low-fat food products, and the choice of products such as free-range chicken eggs, and sustainable fisheries.

Keywords Food insecurity · Sustainability · Nutrition · Sustainable environment · Eating behaviors · Adults

Introduction

Food insecurity has been defined as “individuals’ being unable to obtain the energy and nutrients they need to sustain their lives and having difficulty in obtaining adequate food in socially acceptable ways (Thomas et al. 2019).” Food

insecurity is a serious public health problem, and unhealthy eating behaviors are associated with poor diet quality and chronic diseases (Leung et al. 2014; Gregório et al. 2018).

Food insecurity often results from socioeconomic inequalities that make it difficult to access food (Reeves et al. 2021). Therefore, individuals living in food insecure households are reported to have inadequate nutrient intakes (Mello et al. 2010; Smith et al. 2017). Individuals who are food insecure may consume foods with high nutritional value such as fruits and vegetables less, since they are more expensive than ready-to-eat, low-quality, energy-intensive processed foods. Hirvonen et al. (2020) reported that fruits and vegetables take the lead in terms of the cost of an optimal sustainable healthy diet (31.2%), and that this cost cannot be afforded by individuals living in low-income countries (Hirvonen et al. 2020). The fact that nutritious foods such as fruits and vegetables are grown seasonally reduces their availability and increases the cost since they are extremely perishable (Sarfo et al. 2022). In addition to socioeconomic inequality, food insecurity which is a chronic stress factor affects individuals’ nutritional behaviors. Many individuals

Responsible Editor: Philippe Garrigues

✉ Kevser Tari Selcuk
kselcuk@bandirma.edu.tr

Ramazan Mert Atan
ratan@bandirma.edu.tr

Sedat Arslan
sarslan@bandirma.edu.tr

Nursel Sahin
nurselsahin@bandirma.edu.tr

¹ Department of Nutrition and Dietetics, Bandirma Onyedi Eylul University, Balikesir, Turkey

² Department of Nutrition and Dietetics, Institute of Health Sciences, Istanbul Medipol University, Istanbul, Turkey

consume more food under chronic stress conditions. Therefore, food insecure individuals are likely to have increased daily energy intake and to display a food addiction behavior to cope with stress (Leung et al. 2014). Food insecure individuals are reported to have diets rich in simple carbohydrate, fat, and energy content due to all these factors (Naja et al. 2020). Dietary patterns that are associated with better health outcomes (in industrialized countries) may also have a lower environmental footprint. For instance, switching to plant-based diets results in reduced pressure on soil and water resources and leads to less environmental pollution—less nitrogen and carbon-based greenhouse gas emissions. According to the estimates, 26–35% of greenhouse gasses originate from food production, most of which is attributed to animal foods (Poore and Nemecek 2018; Xu et al. 2021).

Sustainability should be considered as part of the long-term temporal dimension when assessing food security (Berry et al. 2015). From a broader perspective, food security is related to sustainable food and agriculture sectors where the needs of current and future generations are met depending on environmental, social, and economic dimensions (Guiné et al. 2021). Sustainable diets and sustainable food systems put emphasis on the protection of long-term health and environment (Berry et al. 2015). Among the leading obstacles in ensuring food security in Turkey are fluctuations and imbalances in food production, which change over years (Koca and Somuncu 2021). According to the Global Food Safety Index report, Turkey ranks 49th among 113 countries and the prevalence of undernourishment there is 2.5% (GFSI 2022).

In order to realize sustainable nutrition, it is necessary to analyze consumer behaviors (Żakowska-Biemans et al. 2019). Among the sustainable and healthy eating behaviors are purchasing local and organic foods, reducing meat consumption, avoiding products with excessive packaging, consuming only seasonal vegetables and fruits, buying products with a sustainability label, and buying meat or poultry labeled free range or cage-free (Tobler et al. 2011; Weller et al. 2014; Verain et al. 2015). In previous studies, the focus was not on a holistic approach to sustainable healthy eating behavior but on a certain area of sustainable food, such as purchasing organic food and traditional food and reducing meat consumption (Pieniak et al. 2009; Hallström et al. 2014; Lee and Hwang 2016). In addition, in these studies, it was ignored whether food insecurity had an effect on sustainable healthy eating behaviors. Among the nutrition-related goals of the “2030 Agenda for Sustainable Development” adopted at the United Nations (UN) Sustainable Development Summit are promoting sustainable and healthy diets and ensuring food security globally (FAO 2016). From this perspective, not only should sustainable healthy eating behaviors be evaluated holistically but also the relationship between such behaviors and food insecurity should be revealed.

In the present study, the aim was to investigate the relationship between sustainable and healthy eating behaviors such as nutritional insecurity and a healthy and balanced diet, interest in regional and organic food products, consumption of seasonal food and avoidance of food waste, preference for locally produced foods, reduction of meat consumption, preference for eggs from free-range chickens, and sustainable fishery products, and consumption of low-fat food products in adults.

Materials and methods

Study type and sample

The research is of cross-sectional type. The population of the study consisted of adults aged 19–64 years living in Turkey. The study was carried out with people who were contacted through social media applications such as Facebook, Instagram, and WhatsApp between June 2022 and November 2022. The online questionnaire was sent to their smartphones via a link sent by way of their social media accounts. The minimum sample size to be reached in the study was calculated as 395 people in the G*Power 3.1.9.7 program (power: 80%, significance level $\alpha=0.05$, effect size $d=0.02$) (Faul et al. 2007, 2009). In the study, of the 450 individuals who stated that they agreed to participate in the study were as follows: not pregnant or were not breastfeeding, 7 who were not in the 19–64 age group, and 33 who did not complete the questionnaire were excluded from the study. Thus, we analyzed the data collected from the 410 participants.

Data collection tools

The researchers collected the study data with an online questionnaire including the Descriptive Information Form they developed, HFIAS, and SHEBS.

Descriptive information form

The form consists of 12 items questioning the following: age, sex, marital status, education level, the number of people the participant lives with, health insurance status, smoking status, alcohol consumption status, presence of a chronic disease, diet for the chronic disease, skipping meals, and the amount of water consumed daily. In the Descriptive Information Form, the age was questioned with an open-ended question and the participants were assigned into three groups: those aged ≤ 29 years, those aged between 30 and 44 years, and those aged ≥ 45 years. Of the variables, sex (female, male), marital status (married, single), and health insurance (yes, no) were questioned in two categories. Educational status was

questioned in five categories as literate but not a graduate of any school, primary school, secondary school, high school, university, and above, taking into account the last school the participant graduated, and they were categorized in two groups: high school and below and university and over. The number of households was determined by asking the following open-ended question: “How many people live in your house, including yourself?” and they were categorized in two groups: three and fewer and four and more. To question their smoking status, the participants were asked to tick one of the following options appropriate for themselves: non-smoker, at least one cigarette a day, sometimes, and ex-smoker. To question their alcohol use status, the participants were asked the following question: Do you drink at least one glass of alcohol per day? Whether the participants had a chronic disease was questioned as follows: Do you have a disease diagnosed by a physician or do you have any disease/diseases that would require you to use regular medication? They were asked to answer as “yes” or “no.” Of the participants, those who answered as “yes” were asked to indicate whether they followed a special diet for their chronic disease. Meal skipping status was questioned in three categories as “yes,” “no,” and “sometimes.” To determine how many liters of water per day they drank, the participants were asked an open-ended question. Their answers were presented in two categories: less than 2 L and 2 L or more.

Household Food Insecurity Access Scale (HFIAS)

The HFIAS developed by Coates et al. (2007) as part of the Food and Nutrition Technical Assistance II Project is used to determine individuals’ food insecurity levels. It measures the degree of food insecurity in the household over the past 4 weeks (Coates et al. 2007). The Turkish version of the HFIAS whose validity and reliability study was conducted by Bor (2018) consists of 1 dimension and 18 items. The Cronbach’s alpha coefficient of the scale was 0.876 in Bor’s study (2018). Nine of the 18 questions in the scale are occurrence questions whereas the remaining nine are frequency-of-occurrence questions. The higher the score obtained from the overall HFIAS is, the severer the food insecurity experienced by households is (Coates et al. 2007; Bor 2018). In the present study, food insecurity was categorized as food secure, mildly food insecure, moderately food insecure, and severely food insecure according to the instruction in the study conducted by Coates et al. (2007).

Sustainable and Healthy Eating Behaviors Scale (SHEBS)

The SHEBS developed by Żakowska-Biemans et al. (2019) is used to assess sustainable and healthy nutritional behaviors of individuals. The SHEBS, which questions sustainable and healthy eating behaviors together, provides a better

understanding of how consumers interpret these concepts and reflect them on their food choices. The scale questions the participant’s behaviors based on self-report. The validity and reliability study of the Turkish version of the SHEBS was performed by Köksal et al. (2022). The Cronbach’s Alpha coefficient was 0.912 in Köksal et al. (2022) study. SHEBS consists of 32 items and the following 7 factors: quality labels, seasonal foods and avoidance of food waste, healthy and balanced diet, local foods, meat reduction, animal welfare, and fat intake. Quality labels’ factor questions consumers’ interest in food products with distinctive features such as regional and organic food. In the seasonal foods and avoidance of food waste factor which has seven questions, behaviors towards consuming seasonal foods and avoiding food waste are questioned. In the healthy and balanced diet factor which has four questions, healthy, nutritious, natural, and generally balanced eating behaviors are questioned. The three questions in the local foods’ factor are asked to determine whether locally produced foods are preferred. In the three-question meat reduction factor, behaviors towards replacing meat with vegetable protein-based food products and reducing meat consumption in general are questioned. In the three-question animal welfare factor, the behaviors towards the preference of free-range chickens’ eggs and sustainable fishery products are evaluated. The three questions in the fat intake factor are asked to determine behaviors towards the consumption of food products with low fat content. Responses given to the items in the scale are scored on a Likert-type scale as follows: “never,” “very rarely,” “rarely,” “sometimes,” “often,” “very often,” and “always.” Factor scores are calculated by taking the average of the scores (between 1 and 7 points) given to the items in that factor. The score for the overall scale is calculated by taking the average of the scores given to all the factors into account. An increase in the mean score for the overall SHEBS indicates an increase in displaying the behavior (Żakowska-Biemans et al. 2019).

Data analysis

Numbers, percentages, arithmetic mean, standard deviation, and Student’s *t* test were used in the analysis of the data. Whether the data were normally distributed, it was determined with the kurtosis and skewness coefficients and the variables whose kurtosis-skewness coefficients ranged between -1.0 and $+1.0$ were accepted that they were normally distributed. While the dependent variable of the study is sustainable and healthy eating behaviors (quality labels, seasonal foods and avoidance of food waste, healthy and balanced diet, local foods, meat reduction, animal welfare, and fat intake), its independent variable is household food insecurity. Pearson correlation analysis was used to find out whether there was a linear relationship between food insecurity and sustainable and healthy eating behaviors. The relationship

between food insecurity and sustainable and healthy eating behaviors was investigated with simple and multivariate linear regression models using the enter method. Sustainable and healthy eating behaviors were included in the regression models as the dependent variables, food insecurity as the independent variable, and age, sex, marital status and educational status variables as covariates. While only household food insecurity (continuous) was included in Model 1, household food insecurity (continuous), age (continuous), and sex (male: 0, female: 1) were included in Model 2, and household food insecurity (continuous), age (continuous), sex (male: 0, female: 1), marital status (single: 0, married: 1), and education level (high school and below: 0, university and above: 1) variables were included in Model 3. For each model, the percentage of variance in sustainable and healthy eating behaviors explained by household food insecurity and other variables in the model was evaluated with R^2 . The level of significance for statistical tests was $p < 0.05$. Variance inflation factor ($VIF < 10$) and Durbin Watson ($DW: 0 < DW < 4$) values were taken into account in the evaluation of multicollinearity and autocorrelation.

Ethical approval

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Before it was conducted, ethical approval was obtained from the Bandirma Onyedi Eylul University Health Sciences Non-Interventional Research Ethics Committee (decision date and number: January 07, 2022/2021–82).

Results

The mean age of the participants was 35.53 ± 11.98 years. Of them, 39.6% were ≥ 29 years old, 70.7% were women, 59.8% were married, 79.5% were graduates of university or above, 53.9% lived with three or fewer people, 93.2% had health insurance, 19.3% smoked at least 1 cigarette a day, 30.0% consumed alcohol, 37.8% skipped meals, 42.4% consumed less than 2 L of water per day, and 11.2% were diagnosed with a chronic disease. Of those with a chronic disease, 43.5% followed a special diet for their disease. The mean score the participants obtained from the overall HFIAS was 1.48 ± 3.57 (min:0, max:26). According to the answers given to the scale items were determined as food secure, mildly food insecure, moderately food insecure, and severely food insecure was 75.6%, 10.2%, 6.6%, and 7.6%, respectively (Table 1).

The mean scores the participants obtained from the SHEBS and the comparison of their mean scores according to the HIFAS were given in Table 2. The mean scores they obtained from the healthy and balanced diet, quality labels, seasonal

Table 1 Descriptive characteristics of the participants

Descriptive characteristics	Number (n)	Percentage (%)
Age (mean \pm SD: 35.53 ± 11.98 , min: 19, max:64) years		
≤ 29 years	162	39.6
30–44 years	142	34.7
≥ 45 years	105	25.7
Sex		
Women	290	70.7
Men	120	29.3
Marital status		
Single	165	40.2
Married	245	59.8
Educational status		
High school and below	84	20.5
University and over	326	79.5
The number of people living together		
≤ 3	221	53.9
≥ 4	189	46.1
Having health insurance		
Yes	383	93.2
No	28	6.8
Smoking status		
Non-smoker	271	66.1
At least one cigarette a day	79	19.3
Sometimes	43	10.5
Ex-smoker	17	4.1
Alcohol consumption		
No	287	70.0
Yes	123	30.0
Having a chronic disease		
No	364	88.8
Yes	46	11.2
Diet for the chronic disease		
Yes	20	43.5
No	26	56.5
Skipping meals		
Yes	155	37.8
No	78	19.0
Sometimes	176	42.9
Amount of water consumed daily		
< 2 L	158	42.4
≥ 2 L	215	57.6
Household food insecurity (mean \pm SD: 1.48 ± 3.57 (min:0, max:26))		
Food secure	319	75.6
Mildly food insecure	42	10.2
Moderately food insecure	27	6.6
Severely food insecure	31	7.6

Mean \pm SD mean \pm standard deviation, Min minimum, Max maximum

foods and avoidance of food waste, local foods, meat reduction, animal health, and fat intake factors were 4.33 ± 1.38 , 4.13 ± 1.46 , 4.30 ± 1.38 , 3.30 ± 1.56 , 3.28 ± 1.68 , 3.75 ± 1.79 ,

and 4.26 ± 1.74 , respectively. Of the participants, those who were mildly/moderately/severely food insecure obtained significantly lower mean scores from the healthy and balanced diet, quality labels, seasonal foods and avoidance of food waste, animal welfare, and fat intake factors than did those who were food secure ($p < 0.05$, Table 2).

The relationship between household food insecurity and sustainability healthy eating behaviors was given in Table 3. According to Pearson correlation analysis, household food insecurity was statistically significantly, negatively and weakly correlated with healthy and balanced diet ($r = 0.226$, $p < 0.05$), quality labels ($r = 0.230$, $p < 0.05$), seasonal foods and avoidance food waste ($r = 0.261$, $p < 0.05$), animal welfare ($r = 0.174$, $p < 0.05$), and fat intake ($r = 0.181$, $p < 0.05$) behaviors (Table 3).

The relationship between food insecurity and sustainable and healthy eating behaviors according to the linear regression analysis was given in Table 4. According to this relationship, in Model 1, Model 2, and Model 3, there was a statistically significantly negative association between food insecurity and healthy and balanced diet ($\beta = 0.226$, $p < 0.001$), quality labels ($\beta = 0.230$, $p < 0.001$), seasonal foods and avoidance of food waste ($\beta = 0.261$, $p < 0.001$), animal welfare ($\beta = 0.174$, $p < 0.001$), and fat intake ($\beta = 0.181$, $p < 0.001$), which are the components of sustainable and healthy eating behaviors, but there was no association between food insecurity and local food and meat reduction behaviors' components (Table 4).

Discussion

This cross-sectional study is the first study in which the relationship between food insecurity and sustainable and healthy eating behaviors in adults was investigated, and it was determined that food insecurity negatively affected

Table 3 The relationship between household food insecurity and sustainable and healthy eating behaviors

Sustainable and Healthy Eating Behaviors Scale	Household food insecurity	
	<i>r</i>	<i>p</i> *
Healthy and balanced diet	−0.226	<0.001
Quality labels	−0.230	<0.001
Seasonal foods and avoidance of food waste	−0.261	<0.001
Local foods	−0.073	0.138
Meat reduction	−0.016	0.740
Animal welfare	−0.174	<0.001
Fat intake	−0.181	<0.001

*Pearson's correlation analysis

healthy and balanced diet behaviors, interest in regional and organic food products, seasonal food products consumption and avoidance of food waste, consumption of low-fat food products, and preferences for free-range chicken eggs, and sustainable fishery products.

Food insecurity, which is defined as limited or uncertain access to adequate nutritious food for a healthy life, is a global public health problem (Coleman-Jensen et al. 2022). Several factors such as climate change, conflict, economic slowdowns and recessions, socioeconomic inequalities, social exclusion, and rapid population growth affect food insecurity (Militao et al. 2022). In addition, the prevalence of food insecurity has increased worldwide due to the impact of the COVID-19 pandemic. For instance, in recent studies, the rate of food insecurity has been determined as 10.2% in US households (Coleman-Jensen et al. 2022), 14.2% in UK adults (Pool and Dooris 2022), and 15.9% in Jordan adults (Olaimat et al. 2022). In the present study, the rate of mildly, moderate, and severe food insecure adults was 24.4%. In Turkey, although there

Table 2 Distribution of mean scores obtained from the Sustainable and Healthy Eating Behaviors Scale according to the household food insecurity

Sustainable and Healthy Eating Behaviors Scale	Mean \pm SD	Min–max	Food secure	Mildly/moderately/ severely food insecure	<i>p</i> value*
			Mean \pm SD	Mean \pm SD	
Healthy and balanced diet	4.33 ± 1.38	1.00–7.00	4.51 ± 1.31	3.79 ± 1.46	<0.001
Quality labels	4.13 ± 1.46	1.00–7.00	4.30 ± 1.40	3.58 ± 1.52	<0.001
Seasonal foods and avoidance of food waste	4.30 ± 1.38	1.00–7.00	4.49 ± 1.30	3.70 ± 1.47	<0.001
Local foods	3.30 ± 1.56	1.00–7.00	3.38 ± 1.51	3.05 ± 1.67	0.068
Meat reduction	3.28 ± 1.68	1.00–7.00	3.29 ± 1.66	3.24 ± 1.75	0.790
Animal welfare	3.75 ± 1.79	1.00–7.00	3.93 ± 1.77	3.18 ± 1.71	<0.001
Fat intake	4.26 ± 1.74	1.00–7.00	4.44 ± 1.73	3.71 ± 1.69	<0.001

Mean \pm SD mean \pm standard deviation, Min minimum, Max maximum

*Student's *t* test

Table 4 The relationship between household food insecurity and sustainable and healthy eating behaviors in linear regression analysis

Sustainable and healthy eating behaviors									
Variables	Model 1			Model 2			Model 3		
	β	Standard error	95% confidence interval	β	Standard error	95% confidence interval	β	Standard error	95% confidence interval
Healthy and balanced diet									
Household Food Insecurity Access Scale	-0.226	0.019	-0.125; -0.051**	-0.223	0.019	-0.123; -0.049**	-0.213	0.019	-0.120; -0.045**
Quality labels									
Household Food Insecurity Access Scale	-0.230	0.020	-0.133; -0.055**	-0.225	0.020	-0.130; -0.053**	-0.219	0.020	-0.128; -0.050**
Seasonal foods and avoidance of food waste									
Household Food Insecurity Access Scale	-0.261	0.019	-0.137; -0.065**	-0.264	0.019	-0.139; -0.066**	-0.258	0.019	-0.137; -0.063**
Local foods									
Household Food Insecurity Access Scale	-0.073	0.022	-0.074;0.010	-0.075	0.022	-0.075;0.010	-0.066	0.022	-0.072;0.014
Meat reduction									
Household Food Insecurity Access Scale	-0.016	0.023	-0.054;0.038	-0.011	0.023	-0.051;0.041	-0.008	0.024	-0.050;0.043
Animal welfare									
Household Food Insecurity Access Scale	-0.174	0.024	-0.135; -0.039**	-0.169	0.024	-0.132; -0.036*	-0.154	0.025	-0.126; -0.029*
Fat intake									
Household Food Insecurity Access Scale	-0.181	0.024	-0.135; -0.041**	-0.179	0.024	-0.134; -0.041**	-0.181	0.024	-0.136; -0.040**

Variables included in the model: Model 1 household food insecurity (continuous), Model 2 household food insecurity (continuous), Age (continuous), Sex (male: 0, female: 1), Model 3 household food insecurity (continuous), Age (continuous), Sex (male: 0, female:1), Marital status (single:0, married 1), Education level (high school and below:0, university and above:1)

β , standardize regression coefficient

* $p < 0.01$

** $p < 0.001$

are very few studies conducted to determine the prevalence of food insecurity at the local level, no studies have been conducted at the national level (Eştürk 2015; Bulucu Büyüksoy 2021). In her study conducted with mothers and fathers with a high school education level and below in the city center of Kırşehir, a province in central Turkey,

Büyüksoy reported that the prevalence of household food insecurity was approximately 65% (Bulucu Büyüksoy 2021). In another study conducted by Eştürk in Adana, a province in the Mediterranean region of Turkey, in 2015, the prevalence of food insecurity in households with children was reported as approximately 69% (Eştürk 2015). In

Turkey, of the population, approximately 33% are adults in the age group of ≥ 45 years, and 50% are women. Of the population aged 25 and above, 23% have a university or higher education level (TSI 2022a; TSI 2022b). In the present study, of the participants, about 26% were in the age group of 45 and above, 71% were women, and 80% had a university or higher education level, which indicates that the participants included in our study were younger, more educated, and mostly women compared to general Turkish population. This is probably due to the fact that our study data were collected via online surveys on social media platforms whose users are usually younger and more educated people. In studies conducted in Turkey, low education level is indicated as one of the most important risk factors for food insecurity (Eştürk 2015; Bulucu Büyüksoy 2021). The frequency of food insecurity calculated in the present study was lower than was that calculated in studies conducted at the local level in Turkey. This difference may be due to the fact that the participants in our study was different from the general population in terms of some sociodemographic characteristics such as age, sex, and education level, that the measurement tools used to determine food insecurity varied from one study to another, and that food inflation rates in the years in which the studies were conducted were different. According to a study conducted in Turkey, the rate of food insecurity has increased more than 1.5 times every year since 2014 (Ipek 2022). It is stated that in Turkey, the rate of food insecurity has increased due to such factors as increase in food demand and prices, consumers' low level of awareness, drought and fluctuations in agricultural production, increased migration from rural areas to cities, and socio-economic and cultural diversity among households due to the change in ethnic structure (Eştürk and Oren 2014; Ipek 2022). In addition, it is thought that decreasing household income and food availability in Turkey due to the impact of the COVID-19 pandemic has also increased the rate of food insecurity.

While food insecurity can be obesogenic due to its association with unhealthy diet, it can also lead to weight loss due to hunger (Morales and Berkowitz 2016). Accordingly, food insecurity has been associated with several negative health outcomes such as obesity (Myers et al. 2020), diabetes, hypertension (Pérez-Escamilla et al. 2014), malnutrition (Grammatikopoulou et al. 2019), and depression (Abrahams et al. 2018). According to several studies, adults who were food insecure have modifiable health behaviors such as unhealthy eating habits and poor diet quality (Ranjit et al. 2020; Dubelt-Moroz et al. 2022). For instance, in the present study, a negative relationship was determined between food insecurity and healthy and balanced eating behavior. A negative relationship was also determined between food insecurity and preference for low-fat foods and low-fat

intake behavior questioned by the items regarding avoidance of high-fat foods. Food insecure individuals have a diet poor in fruits and vegetables, but rich in fat and simple carbohydrate content of energy dense foods (Morales and Berkowitz 2016). In a study, it has been shown that food insecure households with children prefer fast-cooking frozen foods and obesogenic foods more (Nackers and Appelhans 2013). On the other hand, Larson et al. (2020) found that in emerging adults, food insecurity was associated with lower levels of fruit and vegetable, whole grain, vitamin D, calcium and fiber intakes and with higher levels of sugary drinks, extra sugar, and saturated fat intakes (Larson et al. 2020). It is thought that low economic levels of individuals with food insecurity led to the emergence of this result.

People can reduce the environmental impact of their eating behavior without compromising their nutrient intake and prevent the development of chronic diseases by adopting a more sustainable diet (Springmann et al. 2018). Sustainable and healthy diet is associated not only with ecological behaviors such as avoiding food waste, consuming local and seasonal foods but also with healthy eating behaviors such as consuming low-fat foods and reducing meat consumption (Żakowska-Biemans et al. 2019). Food insecurity is one of the leading risk factors for SHE behaviors (Pérez-Escamilla 2017). According to the report released by the “State of Food Security and Nutrition in the World,” the number of people affected by hunger in 2021 ranged between 702 and 828 million and it is estimated that around 670 million people will be undernourished in 2030 (FAO 2022). Ending hunger, ensuring food security, improving nutrition, and promoting sustainable agriculture globally are among the United Nations (UN) 2030 Sustainable Development Goals (FAO 2016). These goals are bi-directionally related to food insecurity (Pérez-Escamilla 2017). For instance, in the present study, it was determined that food insecurity negatively affected healthy and balanced diet behaviors, interest in regional and organic food products, seasonal food products consumption and avoidance of food waste, consumption of low-fat food products, and preferences for free-range chicken eggs, and sustainable fishery products.

Today, in parallel with the increase in urbanization, the farming workforce has decreased, and the arable lands in or near urban areas have been replaced by housing and industrial facilities, which has led to an increase in food prices due to the reduced food supply capacity (Akparibo et al. 2021). In addition, due to urban lifestyle, individuals prefer processed, packaged, and/or ready-to-eat foods (Holdsworth et al. 2020). In a study, low-income adults are reported to consume processed meat, sweets, and sugary drinks more than the recommended limits (Leung et al. 2012). Due to these factors, it is thought that food insecure individuals prefer local and organic foods and seasonal foods less.

The fact that no relationship was found between food insecurity and behaviors to reduce meat consumption in the present study is an expected result because the costs of foods with lower energy density, such as lean meat and fish, are high (Kastorini et al. 2021). Food insecure individuals are likely to consume meat and fish less and processed meat more. In addition, individuals' dislike of consuming meat and meat products or adopting a diet similar to a vegetarian diet may also lead to the emergence of this result.

On the other hand, the negative relationship between food insecurity and preferences for free-range chicken eggs and sustainable fishery products may be caused by egg consumption of individuals. The energy cost of eggs is significantly lower than that of other foods such as meat, poultry, and fish (Walker and Baum 2022). Therefore, it is thought that food insecure individuals prefer eggs especially those of caged-raised chickens, which are relatively cheaper, as an alternative to more expensive animal protein sources. However, free-range chicken eggs have a lower greenhouse gas emission footprint (Taylor et al. 2014).

Food waste at the consumption level has become an important problem affecting global food security and food sustainability (Attig et al. 2021). According to Althumiri et al. (2021), food waste and food insecurity may coexist in the same household. Similarly, in the present study, the mean score obtained by the food insecure participants from the seasonal foods and avoidance of food waste factor reflecting the consumption of seasonal food products and the behavior of avoiding food waste was lower than was that obtained by the food secure participants. In addition, it is thought that the negative relationship between food insecurity and avoidance of food waste behavior may be caused by factors such as not reading food labels, inadequate food preparation and cooking skills, and inadequate nutritional literacy in food insecure individuals. The relationship between food insecurity and food waste may be clarified through studies to be conducted in the future. Addressing the problem of food waste can be an important opportunity to improve levels of food sustainability and food insecurity (Althumiri et al. 2021).

Limitations of the study

The present study has some limitations. The first one is that the study was conducted with the participants who had internet access through social media platforms, had a smart phone, and could read and write in Turkish through an online survey (selecting bias). Therefore, the results cannot be generalized to the whole population. The other limitation of the study is that the data were collected based on self-report (reporting bias) and the food intakes of individuals with and without food security were not investigated.

Conclusion

The results of the study demonstrated that food insecurity had serious reflections on sustainable and healthy eating behaviors and that food insecurity should be considered as an important component of sustainability studies. Therefore, it is thought that the prevention of food insecurity in the society will have positive effects on sustainable and healthy nutrition behaviors. Within this context, global interventions are needed to reduce food insecurity and its effects. In addition, supporting sustainable food production systems, increasing the number of qualified agricultural workers, and reducing agricultural imports are of great importance in ensuring sustainability. On the other hand, there is a need for comprehensive research that sheds light on food policies that enable households to access healthy foods and present healthy and sustainable eating habits to the society. It may be recommended to conduct studies in the future in which community-based, sustainable and healthy eating behaviors are evaluated with dietary records.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s11356-023-27694-8>.

Author contribution K.T.S., conceptualization, data curation, formal analysis, investigation, methodology, software, supervision, visualization, writing—review and editing, project administration; R.M.A., conceptualization, data curation, formal analysis, investigation, methodology, software, writing—original draft; S.A., conceptualization, data curation, investigation, methodology, supervision, writing—review and editing; N.S., conceptualization, data curation, investigation, methodology, visualization, writing—review and editing.

Data availability The data that support the findings of this study are available from the corresponding author, KTS, upon reasonable request.

Declarations

Ethical approval The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Before it was conducted, ethical approval was obtained from the Bandirma Onyedi Eylul University Health Sciences Non-Interventional Research Ethics Committee (decision date and number: January 07, 2022/2021–82).

Consent to participate Informed written consent was obtained from the participants in the study.

Consent for publication All authors read and approved the final manuscript and give their consent for the publication of the study.

Competing interests The authors declare no competing interests.

References

Abrahams Z, Lund C, Field S, Honikman S (2018) Factors associated with household food insecurity and depression in pregnant South African women from a low socio-economic setting:

- a cross-sectional study. *Soc Psychiatry Psychiatr Epidemiol* 53(4):363–372. <https://doi.org/10.1007/S00127-018-1497-Y>
- Akparibo R, Aryeetey RNO, Asamane EA, Osei-Kwasi HA, Ioannou E, Solar GI, Cormie V, Pereko KK, Amagloh FK, Caton SJ, Cecil JE (2021) Food security in Ghanaian Urban Cities: a scoping review of the literature. *Nutrients* 13(10):3615. <https://doi.org/10.3390/NU13103615>
- Althumiri NA, Basyouni MH, Duhaim AF, Almousa N, Aljuway-sim MF, Bindhim NF (2021) Understanding food waste, food insecurity, and the gap between the two: a nationwide cross-sectional study in Saudi Arabia. *Foods* 10(3):681. <https://doi.org/10.3390/FOODS10030681>
- Attiq S, Chau KY, Bashir S, Habib MD, Azam RI, Wong WK (2021) Sustainability of household food waste reduction: a fresh insight on youth's emotional and cognitive behaviors. *Int J Environ Res Public Heal* 18(13):7013. <https://doi.org/10.3390/IJERPH18137013>
- Berry EM, Dernini S, Burlingame B, Meybeck A, Conforti P (2015) Food security and sustainability: can one exist without the other? *Public Health Nutr* 18(13):2293–2302. <https://doi.org/10.1017/S136898001500021X>
- Bor H (2018) Investigation of the relationship between obesity and food insecurity among university students. Dissertation, Hacettepe University
- BulucuBüyüksöy GD (2021) The determination of the prevalence of household food insecurity in a region of Central Anatolia. *Health and Society* 31(1):159–166
- Coates J, Swindale A, Bilinsky P (2007) Household Food Insecurity Access Scale (HFAS) for measurement of food access: indicator guide: version 3. https://www.fantaproject.org/sites/default/files/resou rces/HFIAS_ENG_v3_Aug07.pdf. Accessed 11 November 2022
- Coleman-Jensen A, Rabbitt MP, Gregory CA, Singh A (2022) Household food security in the United States in 2021. <https://www.ers.usda.gov/webdocs/publications/104656/err-309.pdf>. Accessed 11 November 2022
- Dubelt-Moroz A, Warner M, Heal B, Khalesi S, Wegener J, Totoso de Zepetnek JO, Lee JJ, Polcronicone T, El-Sarraj J, Holmgren E, Bellissimo N (2022) Food insecurity, dietary intakes, and eating behaviors in a convenience sample of Toronto youth. *Child (basel, Switzerland)* 9(8):1119. <https://doi.org/10.3390/CHILDREN9081119>
- Eştürk Ö (2015) Household consumption at different levels of food security habits: the case of Adana. *JFEAS* 1(2):249–264
- Eştürk Ö, Oren MN (2014) Agricultural policies and food security in Turkey. *YYU J AGR SCI* 24(2):193–200. <https://doi.org/10.29133/YYUTBD.235933>
- FAO (2016) FAO and the 17 Sustainable Development Goals. <https://www.fao.org/3/i4997e/i4997e.pdf>. Accessed 11 November 2022
- FAO (2022) The State of Food Security and Nutrition in the World 2022. <https://www.fao.org/documents/card/en/c/cc0639en>. Accessed 11 November 2022
- Faul F, Erdfelder E, Lang AG, Buchner A (2007) G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav Res Methods* 39(2):175–191. <https://doi.org/10.3758/BF03193146>
- Faul F, Erdfelder E, Buchner A, Lang AG (2009) Statistical power analyses using G*Power 3.1: tests for correlation and regression analyses. *Behav Res Methods* 41(4):1149–1160. <https://doi.org/10.3758/BRM.41.4.1149>
- Global Food Security Index (GFSI) (2022). <https://impact.economist.com/sustainability/project/food-security-index/explore-countries/turkey>. Accessed 22 March 2023
- Grammatikopoulou MG, Gkiouras K, Theodoridis X, Tsisimiri M, Markaki AG, Chourdakis M, Goulis DG (2019) Food insecurity increases the risk of malnutrition among community-dwelling older adults. *Maturitas* 119:8–13. <https://doi.org/10.1016/J.MATURITAS.2018.10.009>
- Gregório MJ, Rodrigues AM, Graça P, de Sousa RD, Dias SS, Branco JC, Canhão H (2018) Food insecurity is associated with low adherence to the Mediterranean diet and adverse health conditions in Portuguese adults. *Front Public Health* 6:38. <https://doi.org/10.3389/FPUBH.2018.00038>
- Guiné RDPF, Pato MLDJ, Costa CAD, Costa DDVTAD, Silva PBCD, Martinho VJPD (2021) Food security and sustainability: discussing the four pillars to encompass other dimensions. *Foods* 10(11):2732. <https://doi.org/10.3390/foods10112732>
- Hallström E, Rööös E, Börjesson P (2014) Sustainable meat consumption: a quantitative analysis of nutritional intake, greenhouse gas emissions and land use from a Swedish perspective. *Food Policy* 47:81–90. <https://doi.org/10.1016/j.foodpol.2014.04.002>
- Hirvonen K, Bai Y, Headey D, Masters WA (2020) Affordability of the EAT–Lancet reference diet: a global analysis. *The Lancet Glob Health* 8(1):e59–e66. [https://doi.org/10.1016/S2214-109X\(19\)30447-4](https://doi.org/10.1016/S2214-109X(19)30447-4)
- Holdsworth M, Pradeilles R, Tandoh A, Green M, Wanjohi M, Zotor F, Asiki G, Klomegh S, Abdul-Haq Z, Osei-Kwasi H et al (2020) Unhealthy eating practices of city-dwelling Africans in deprived neighbourhoods: evidence for policy action from Ghana and Kenya. *Glob Food Sec* 26:100452. <https://doi.org/10.1016/J.GFS.2020.100452>
- Ipek O (2022) The dynamics of household food insecurity in Turkey. *Sosyoekonomi* 30(53):195–208. <https://doi.org/10.17233/SOSYO EKONOMI.2022.03.10>
- Kastorini CM, Markaki I, Tsiampalis T, Critselis E, Petralias A, Linos A (2021) Dietary patterns and food insecurity of students participating in a food aid programme: the Mediterranean perspective. *Eur J Public Health* 31(1):143–150. <https://doi.org/10.1093/EURPUB/CKAA178>
- Koca R, Somuncu M (2021) An evaluation for Turkey on food security. *Ankara Univ J Environ Sci* 8(2):1–11
- Köksal E, Bilici S, Çitar Daziroglu ME, Gövez NE (2022) Validity and Reliability of the Turkish Version of the Sustainable and Healthy Eating Behaviors Scale. *Br J Nutr* 1–20. <https://doi.org/10.1017/S0007114522002525>
- Larson N, Laska MN, Neumark-Sztainer D (2020) Food insecurity, diet quality, home food availability, and health risk behaviors among emerging adults: findings from the EAT 2010–2018 Study. *Am J Public Health* 110(9):1422–1428. <https://doi.org/10.2105/AJPH.2020.305783>
- Lee HJ, Hwang J (2016) The driving role of consumers' perceived credence attributes in organic food purchase decisions: a comparison of two groups of consumers. *Food Qual Prefer* 54:141–151. <https://doi.org/10.1016/j.foodqual.2016.07.011>
- Leung CW, Ding EL, Catalano PJ, Villamor E, Rimm EB, Willett WC (2012) Dietary intake and dietary quality of low-income adults in the Supplemental Nutrition Assistance Program. *Am J Clin Nutr* 96(5):977–988. <https://doi.org/10.3945/AJCN.112.040014>
- Leung CW, Epel ES, Ritchie LD, Crawford PB, Laraia BA (2014) Food insecurity is inversely associated with diet quality of lower-income adults. *J Acad Nutr Diet* 114(12):1943–1953. <https://doi.org/10.1016/J.JAND.2014.06.353>
- Mello JA, Gans KM, Risica PM, Kirtania U, Strolla LO, Fournier L (2010) How is food insecurity associated with dietary behaviors? An analysis with low-income, ethnically diverse participants in a nutrition intervention study. *J Am Diet Assoc* 110(12):1906–1911. <https://doi.org/10.1016/J.JADA.2010.09.011>
- Militao EMA, Salvador EM, Uthman OA, Vinberg S, Macassa G (2022) Food insecurity and health outcomes other than malnutrition in Southern Africa: a descriptive systematic review. *Int J Environ Res Public Health* 19(9):5082. <https://doi.org/10.3390/IJERPH19095082>

- Morales ME, Berkowitz SA (2016) The relationship between food insecurity, dietary patterns, and obesity. *Curr Nutr Rep* 5(1):54. <https://doi.org/10.1007/S13668-016-0153-Y>
- Myers CA, Mire EF, Katzmarzyk PT (2020) Trends in adiposity and food insecurity among US adults. *JAMA Netw Open* 3(8):e2012767. <https://doi.org/10.1001/JAMANETWOR.KOPEN.2020.12767>
- Nackers LM, Appelhans BM (2013) Food insecurity is linked to a food environment promoting obesity in households with children. *J Nutr Educ Behav* 45(6):780–784. <https://doi.org/10.1016/J.JNEB.2013.08.001>
- Naja F, Itani L, Kharroubi S, Diab El Harake M, Hwalla N, Jomaa L (2020) Food insecurity is associated with lower adherence to the Mediterranean dietary pattern among Lebanese adolescents: a cross-sectional national study. *Eur J Nutr* 59(7):3281–3292. <https://doi.org/10.1007/S00394-019-02166-3>
- Olaimat AN, Alshami IK, Al Hourani H, Sarhan W, Al-Holy M, Abughoush M, Al-Awwad NJ, Hoteit M, Al-Jawaldeh A (2022) Food insecurity, dietary diversity, and coping strategies in Jordan during the COVID-19 pandemic: a cross-sectional study. *Nutrients* 14(11):2252. <https://doi.org/10.3390/NU14112252>
- Pérez-Escamilla R (2017) Food Security and the 2015–2030 Sustainable development goals: from human to planetary health: perspectives and opinions. *Curr Dev Nutr* 1(7):e000513. <https://doi.org/10.3945/CDN.117.000513>
- Pérez-Escamilla R, Villalpando S, Shamah-Levy T, Méndez-Gómez Humarán I (2014) Household food insecurity, diabetes and hypertension among Mexican adults: results from Ensanut 2012. *Salud Publica de Mexico* 56(1):62–70. <https://doi.org/10.21149/SPM.V56S1.5167>
- Pieniak Z, Verbeke W, Vanhonacker F, Guerrero L, Hersleth M (2009) Association between traditional food consumption and motives for food choice in six European countries. *Appetite* 53(1):101–108. <https://doi.org/10.1016/j.appet.2009.05.019>
- Pool U, Dooris M (2022) Prevalence of food security in the UK measured by the Food Insecurity Experience Scale. *J Public Health (oxf)* 44(3):634–641. <https://doi.org/10.1093/PUBMED/FDAB120>
- Poore J, Nemecek T (2018) Reducing food's environmental impacts through producers and consumers. *Science* 360(6392):987–992. <https://doi.org/10.1126/science.aag0216>
- Ranjit N, Macias S, Hoelscher D (2020) Factors related to poor diet quality in food insecure populations. *Transl Behav Med* 10(6):1297–1305. <https://doi.org/10.1093/TBM/IBAA028>
- Reeves A, Loopstra R, Tarasuk V (2021) Wage-setting policies, employment, and food insecurity: a multilevel analysis of 492 078 people in 139 countries. *Am J Public Health* 111(4):718–725. <https://doi.org/10.2105/AJPH.2020.306096>
- Sarfo J, Pawelzik E, Keding GB (2022) Are processed fruits and vegetables able to reduce diet costs and address micronutrient deficiencies? Evidence from rural Tanzania. *Public Health Nutr* 25(9):2637–2650. <https://doi.org/10.1017/S1368980022000982>
- Smith MD, Rabbitt MP, Coleman-Jensen A (2017) Who are the world's food insecure? new evidence from the Food and Agriculture Organization's Food Insecurity Experience Scale. *World Dev* 93:402–412. <https://doi.org/10.1016/J.WORLDDEV.2017.01.006>
- Springmann M, Wiebe K, Mason-D'Croz D, Sulser TB, Rayner M, Scarborough P (2018) Health and nutritional aspects of sustainable diet strategies and their association with environmental impacts: a global modelling analysis with country-level detail. *Lancet Planet Heal* 2(10):e451–e461. [https://doi.org/10.1016/S2542-5196\(18\)30206-7](https://doi.org/10.1016/S2542-5196(18)30206-7)
- Taylor RC, Omed H, Edwards-Jones G (2014) The greenhouse emissions footprint of free-range eggs. *Poult Sci* 93(1):231–237. <https://doi.org/10.3382/PS.2013-03489>
- Thomas MMC, Miller DP, Morrissey TW (2019) Food insecurity and child health. *Pediatrics* 144(4):e20190397. <https://doi.org/10.1542/PEDS.2019-0397>
- Tobler C, Visschers VHM, Siegrist M (2011) Eating green. Consumers' willingness to adopt ecological food consumption behaviors. *Appetite* 57(3):674–682. <https://doi.org/10.1016/J.APPET.2011.08.010>
- Turkish Statistical Institute (TSI) (2022a) Women in Statistics, 2022a. <https://data.tuik.gov.tr/Bulten/Index?p=Istatistiklerle-Kadin-2022a-49668>. Accessed 21 March 2023
- Turkish Statistical Institute (TSI) (2022b) Address Based Population Registration System Results, 2022b. <https://data.tuik.gov.tr/Bulten/Index?p=Adrese-Dayali-Nufus-Kayit-Sistemi-Sonuc-lari-2022b-49685>. Accessed 21 March 2023.
- Verain MCD, Dagevos H, Antonides G (2015) Sustainable food consumption. product choice or curtailment? *Appetite* 91:375–384. <https://doi.org/10.1016/J.APPET.2015.04.055>
- Walker S, Baum JI (2022) Eggs as an affordable source of nutrients for adults and children living in food-insecure environments. *Nutr Rev* 80(2):178–186. <https://doi.org/10.1093/NUTRIT/NUAB019>
- Weller KE, Greene GW, Redding CA, Paiva AL, Lofgren I, Nash JT, Kobayashi H (2014) Development and validation of Green Eating Behaviors, Stage of Change, Decisional Balance, and Self-Efficacy Scales in college students. *J Nutr Educ Behav* 46(5):324–333. <https://doi.org/10.1016/J.JNEB.2014.01.00>
- Xu X, Sharma P, Shu S, Lin TS, Ciais P, Tubiello FN, Smith P, Campbell N, Jain AK (2021) Global greenhouse gas emissions from animal-based foods are twice those of plant-based foods. *Nat Food* 2(9):724–732. <https://doi.org/10.1038/s43016-021-00358-x>
- Żakowska-Biemans S, Pieniak Z, Kostyra E, Gutkowska K (2019) Searching for a measure integrating sustainable and healthy eating behaviors. *Nutrients* 11(1):95. <https://doi.org/10.3390/NU11010095>

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.