

Food Insecurity and Cardiometabolic Risk among Turkish Adults: A Cross-Sectional Study

Esra Bozdemir, Aysun Yuksel*

Department of Nutrition and Dietetics, University of Health Sciences, 34668 Istanbul, Türkiye

ABSTRACT

This study examined 175 volunteers aged 18–64 to explore the connection between food insecurity and anthropometric measurements, diet quality scores and cardiometabolic risk factors. The design of the study is cross-sectional, and the data were obtained using a number of questionnaires applied to individuals who visited the diet clinic. Participants' diet quality was assessed using the Healthy Eating Index-2015 (HEI-2015) and food security was evaluated using the Household Food Insecurity Access Scale. Cardiometabolic risk factors were determined based on HEI-2015 scores, Body Mass Index (BMI), waist circumference, waist/height ratio, physician-diagnosed diabetes, hypertension, dyslipidemia, regular physical activity status, and smoking habits. As a result of the study, 41.1% of the participants were found to be food-insecure, and 77.8% had diet quality that needed improvement. The average BMI value of food-insecure women was found to be higher than that of food-secure women (32.37 ± 7.77 kg/m² and 29.86 ± 5.22 kg/m², respectively) ($p=0.003$). Furthermore, food-insecure women had a higher average waist circumference ($p=0.001$). A significant negative relationship was determined between BMI value, waist circumference and waist/height ratio, which are among the cardiometabolic risk factors, and food insecurity.

Keywords: cardiometabolic risk, diet quality, food insecurity, healthy eating index, obesity

INTRODUCTION

Food security involves the continuous availability of clean, safe, and nutritious foods, as outlined by the FAO, which emphasizes availability, access, utilization, and sustainability (FAO 1996). Conversely, food insecurity, the inability to obtain necessary nutrients and sufficient food, affects billions globally (FAO 2022). This issue is exacerbated in developing countries due to population growth, low production, and weak markets, leading low-income families to consume cheaper, less nutritious options (Maiangwa *et al.* 2010). Such diets, high in unhealthy fats and low in nutritional quality, contribute to cardiometabolic diseases like diabetes, obesity, and metabolic syndrome (Laraia 2013).

Cardiometabolic diseases are a global health concern (Kılıçkap *et al.* 2018), closely linked to nutrition. Poor diets and food insecurity increase risks, particularly in developing countries (Kontas *et al.* 2014). Unhealthy diets cause plaque buildup and inflammation, raising cardiometabolic risks (Cardoso Lde *et al.* 2016).

Balanced diets with appropriate fats are essential, but food insecurity limits access to quality foods (Eicher-Miller & Zhao 2018).

Food insecurity also correlates with obesity, as low-income individuals resort to inexpensive, high-fat foods, increasing body fat (Nettle *et al.* 2017). Stress-induced emotional eating worsens obesity (Rasmusson *et al.* 2018), while poor diets impair glycemic control (Beltrán *et al.* 2022) and heighten Hypertension (HT) risk due to inadequate nutrient intake (Helmick *et al.* 2018). Smoking further amplifies cardiometabolic risks (Levine *et al.* 2013; Pan *et al.* 2015; Hackshaw *et al.* 2018).

This study aims to assess food insecurity among participants and explore its relationship with cardiometabolic risk.

METHODS

Design, location, and time

This cross-sectional study took place in Gölcük District Health Directorate, Kocaeli Province, Türkiye, from October to December 2020. The study was conducted according to

*Corresponding Author: tel: +902164189616, email: aysun.yuksel@sbu.edu.tr

(Received 19-12-2023; Revised 16-02-2024; Accepted 22-03-2024; Published 31-07-2024)

This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License

the guidelines of the Declaration of Helsinki and approved by the Institutional Review Board (or Ethics Committee) of the Institute of Health Sciences of the University of Health Sciences in Istanbul, Türkiye (protocol code 20/352 and date of approval 25 September 2020).

Sampling

A total of 175 volunteers aged 18–64 participated, excluding pregnant and lactating women. The number of individuals visiting the diet clinic of the community health center where the study was to be conducted was 244. Accordingly, it had been calculated that the sample size for the study should be a minimum of 150 individuals with a 95% confidence interval and a 5% precision (Samp Size Calculator 2023).

Data collection

Face-to-face interviews were conducted, gathering demographic, health and dietary information using a questionnaire. Additionally, Retrospective 24-Hour Food Consumption Records and the Household Food Insecurity Access scale were utilized. Educational, marital and employment statuses were recorded through a 23-question survey. Anthropometric measurements and body composition analysis (TANITA BC418 MA) were performed.

Food insecurity assessment-2007. The Household Food Insecurity Access Scale (2007) was developed by the United States Agency for International Development to determine the levels of food insecurity of individuals. The score from the scale is a continuous measure of the degree of food insecurity in a household over the past four weeks (30 days). There are nine questions with a four-point Likert structure combining each occurrence and frequency question out of a total of 18 questions. If a participant experienced the situation stated in an occurrence question, an accompanying frequency question would explore how often he or she experienced such a situation during the last four weeks (0=never, 1=rarely, 2=sometimes, 3=often). If the participant's answer to the occurrence question was “no”, he or she was asked to move on to the next occurrence question without answering the frequency question for that occurrence question. The food insecurity score was calculated by summing up the scores of the frequency questions for the occurrence questions for which “yes” was the answer. As

it was a categorical variable, households were categorized either as food-secure or as food-insecure. The answers to the questions (never=0 points, rarely=1 point, often=3 points) were scored. All answer scores were collected. It has been stated that the severity of food insecurity increases as the total score on the scale increases. Specifically, households with a total score of 0-1 are classified as food-secure, while households with a score of 2 or higher are classified as food-insecure (Coates *et al.* 2007).

Diet quality evaluation. Through an analysis of food consumption records, the average daily intake of energy and nutrients for each individual was calculated. The Nutrition Information System (BeBIS 15.0) computer software was employed to assess the energy and nutrient contents derived from the participants' daily dietary intake. The energy and nutrient values were used to calculate the HEI-2015 scores of individuals. HEI-2015 was used to evaluate individuals' diet quality. It consists of 13 components. Nine components—total fruits, whole fruits, total vegetables, dark green leafy vegetables and legumes, whole grains, milk and dairy products, total protein foods, seafood and vegetable proteins and fatty acids—constitute the components of the index that should be taken in sufficient quantities. Refined foods, sodium, added sugar and saturated fat are the components of the index that should be reduced. Individuals' 24-hour food consumption was recorded, and their average daily calorie intake was calculated. In the index, a reference score corresponding to 1,000 kcal is given for each food group. According to his or her calorie intake, an individual's score for that food group was calculated using ratio and proportion. The total score was obtained by adding up the scores from all food groups. The highest score of the index is 100; scores ≤ 50 indicate “poor diet quality”, scores of 51–80 indicate a “need to be improved” and scores ≥ 80 indicate “good diet quality” (Krebs-Smith *et al.* 2018).

BMI, waist circumference and waist/height ratio. BMI value and waist circumference were measured to evaluate cardiometabolic risk. BMI value was calculated by dividing weight (kg) by the square of height (m^2). BMI was classified according to World Health Organization (WHO 1995) criteria. Waist circumference, indicative of abdominal fat, was categorized based on

gender-specific thresholds. For men, a waist circumference <94 cm is indicative of low risk for chronic diseases, a waist circumference between 94 and 102 cm is indicative of high risk and a waist circumference >102 cm is indicative of very high risk. For women, a waist circumference <80 cm is indicative of low risk, a waist circumference between 80 and 88 cm is indicative of high risk and a waist circumference >88 cm is indicative very high risk (WHO 1995). Waist/height ratio, a recent criterion for obesity and cardiometabolic risk, was calculated using waist circumference and height. A ratio below 0.5 indicates low risk (WHO 2000). Hip circumference was measured at a level parallel to the floor at the largest circumference of the buttocks. Other data of anthropometric measurements used in the study—body weight, body fat mass and percentage, lean body mass and percentage and body water content ratio—were obtained and recorded by the researcher with TANITA BC418 MA.

Cardiometabolic diseases and physical activity. Diagnoses of diabetes, hypertension and dyslipidemia were made by the physician taking into account certain criteria. An oral glucose tolerance test was performed when the fasting blood glucose was at the level of 126 mg/dL or higher. Diabetes was diagnosed after the individual drank 200 mL of sugar water and the blood glucose value rose beyond 200 mg/dL after the 2nd hour (Nkonge *et al.* 2020). Hypertension was diagnosed by measuring the blood pressure. The diagnosis was made when the systolic blood pressure was constantly at 140 mmHg or above and the diastolic blood pressure was at 90 mmHg (Jones *et al.* 2020). Plasma total cholesterol \geq 190 mg/dL, LDL cholesterol \geq 130 mg/dL and HDL cholesterol \leq 50 mg/dL in women (\leq 40 mg/dL in men) led to a dyslipidemia diagnosis (Berberich & Hegele 2022). Diagnoses were made by specialist physicians. To evaluate their physical activity level, individuals were asked whether they did any regular physical activity.

Data analysis

The NCSS (Number Cruncher Statistical System) 2007 (Kaysville, Utah, USA) program was used for the statistical analysis of the data obtained from the research. A chi-square analysis was used to determine the relationship between qualitative data. Simple and multiple logistic regression analyses were used to determine the

independent variables affecting the dependent variable. The dependent variable was determined as food security status, and the independent variables were determined as age, BMI value, waist circumference, waist/height ratio, education level (primary school and university levels) and employment status (housewife included). The statistical significance in the analyses was evaluated at $p < 0.05$.

RESULTS AND DISCUSSION

Information on the demographic characteristics such as education status and socioeconomic status of the food-secure and food-insecure participants is presented in percentages (%) in Table 1. The percentages of male and female representation were 11.4% and 88.6%, respectively. It was determined that 41.1% of the participants in the study were food-insecure, 64% were aged 35–64 and 76.6% were married. There was a significant difference in education levels between individuals with food security and those without food security ($p = 0.001$). The majority of the individuals, both with and without food security, were housewives (36.9% and 66.7%, respectively). A significant difference was observed in working statuses between food-secure and food-insecure individuals ($p = 0.001$). The average monthly total income of most households with food security (47.5%) was 5,000 Turkish lira (\$676). While most of the food-secure individuals (51.5%) stated that their income was equal to their expenses (for nutrition, clothing, shelter, etc.), most of the food-insecure individuals (52.8%) reported that their income was less than their expenses.

In Table 2, the number and percentage (%) values of diet quality of the food-secure and food-insecure participants according to their cardiometabolic characteristics are presented. Most of the participants ($n = 127$) had diet quality that needed improvement. The majority of the participants were obese.

Anthropometric measurements by food security status for males and females are detailed in Table 3.

Table 4 shows the results of a simple logistic regression analysis performed to determine the effect of age, BMI value, waist circumference, waist/height ratio, educational status (primary school and university level)

Table 1. Participants' descriptive characteristics according to their food security status

Variables	Total (n=175)	Food insecure (n=72)	Food Secure (n=103)	<i>p</i>
	n (%)	n (%)	n (%)	
Gender				
Female	155 (88.6)	64 (88.9)	91 (88.3)	0.556
Male	20 (11.4)	8 (11.1)	12 (11.7)	
Age (years)				
18–34	63 (36.0)	21 (29.2)	42 (40.8)	0.078
35–64	112 (64.0)	51 (70.8)	61 (59.2)	
Education status				
<High school	67 (38.3)	45 (62.5)	22 (21.4)	<0.001**
≥High school	108 (61.7)	27 (37.5)	81 (78.6)	
Marital status				
Single	41 (23.4)	17 (23.6)	24 (23.3)	0.962
Married	134 (76.6)	55 (76.4)	79 (76.7)	
Working				
Officer	26 (14.9)	1 (1.4) ^a	25 (24.3) ^b	0.001**
Worker	14 (8.0)	3 (4.2)	11 (10.7)	
Retired	6 (3.4)	2 (2.8)	4 (3.9)	
Self-employment	14 (8.0)	6 (8.3)	8 (7.8)	
Housewife	86 (49.1)	48 (66.7) ^a	38 (36.9) ^b	
Other	29 (16.6)	12 (16.7)	17 (16.5)	
Social insurance				
Yes	155 (88.6)	60 (83.3)	95 (92.2)	0.058
No	20 (11.4)	12 (16.7)	8 (7.8)	
Number of household members				
≤2	32 (18.3)	12 (16.7)	20 (19.4)	0.893
3–5	121 (69.1)	51 (70.8)	70 (68.0)	
>5	22 (12.6)	9 (12.5)	13 (12.6)	
Income of family (TL)				
<3,000	61 (34.8)	43 (59.7)	18 (17.5)	<0.001**
3,000–5,000	57 (32.6)	21 (29.2)	36 (34.9)	
>5,000	57 (32.6)	8 (11.1)	49 (47.5)	
Economic situation				
Income>Expense ^{***}	28 (16.0)	2 (2.8)	26 (25.2)	<0.001**
Income=Expense ^{***}	85 (48.6)	32 (44.4)	53 (51.5)	
Income<Expense ^{***}	62 (35.4)	38 (52.8)	24 (23.3)	

TL: Turkish Lira (1\$ = ~7.5TL); **p*<0.05, ***p*<0.01

***: Nutrition, clothing, shelter, bills, transportation, education, personal expenses, etc. are included in the expenses

and employed or housewife status on food insecurity. There was a significant negative relationship between age and food insecurity. As age increased, the frequency of food insecurity in individuals decreased. A negative relationship was also observed between individuals' BMI

values and food insecurity (*p*<0.001). Table 4 further shows that waist circumference had a significant negative relationship with the food insecurity score. Furthermore, the regression coefficient showed that the waist/height ratio ($\beta=0.003$, *p*<0.001) had a significant negative

Food insecurity, cardiometabolic risk and diet quality

Table 2. Participants' cardiometabolic characteristics according to their food security status

Cardiometabolic characteristics	Total (n=175)	Food insecure (n=72)	Food Secure (n=103)	p
	n (%)	n (%)	n (%)	
Healthy eating index score				
Poor diet quality	37 (21.1)	11 (15.3)	26 (25.3)	0.282
Need to be Improved	127 (72.6)	56 (77.8)	71 (68.9)	
Good diet quality	11 (6.3)	5 (6.9)	6 (5.8)	
Body mass index (kg/m²)				
Underweight (<18.50)	3 (1.7)	3 (4.2)	0	0.001**
Normal (18.50–24.99)	23 (13.1)	6 (8.3)	17 (16.5)	
Overweight (25.00–29.99)	64 (36.6)	18 (25.0)	46 (44.7)	
Obese (≥30.00)	85 (48.6)	45 (62.5)	40 (38.8)	
Waist circumference (cm)				
Low risk	30 (17.1)	9 (12.5)	21 (20.4)	0.042*
High risk	53 (30.3)	17 (23.6)	36 (34.9)	
Very high risk	92 (52.6)	46 (63.9)	46 (44.7)	
Waist/height ratio				
Low risk	26 (14.9)	7 (9.7)	19 (18.4)	0.082
High risk	149 (85.1)	65 (90.3)	84 (81.6)	
Diagnosis of diabetes				
Yes	26 (14.9)	11 (15.3)	15 (14.6)	0.530
No	149 (85.1)	61 (84.7)	88 (85.4)	
Diagnosis of hypertension				
Yes	36 (20.6)	20 (27.8)	16 (15.5)	0.038*
No	139 (79.4)	52 (72.2)	87 (84.5)	
Diagnosis of dyslipidemia				
Yes	54 (30.9)	26 (36.1)	28 (27.2)	0.138
No	121 (69.1)	46 (63.9)	75 (72.8)	
Regular physical activity				
Doing	89 (50.9)	34 (47.2)	55 (53.4)	0.258
Not doing	86 (49.1)	38 (52.8)	48 (46.6)	
Smoking				
Smoking	31 (17.7)	10 (13.9)	21 (20.4)	0.237
Used to smoke but not now	30 (17.2)	16 (22.2)	14 (13.6)	
Does not smoke	114 (65.1)	46 (63.9)	68 (66.0)	
Alcohol intake				
Yes	-	-	-	-
No	175 (100.0)	72 (100.0)	103 (100.0)	

*p<0.05 **p<0.01

relationship with the food insecurity level. As the food insecurity score increased, the severity of food insecurity also increased. However, the severity of food insecurity decreased as the waist/height ratio of individuals increased. The regression analysis results additionally revealed

a significant negative relationship between BMI value, waist circumference and waist/height ratio and food insecurity.

It was determined that the rate of food insecurity among housewives was higher than the rate among individuals working various

Table 3. Participants' anthropometric measurements according to their food security status (n=175)

	Female (n=155)		<i>p</i>	Male (m=20)		<i>p</i>
	Food insecure (n=64)	Food secure (n=91)		Food insecure (n=8)	Food secure (n=12)	
	Mean±SD	Mean±SD		Mean±SD	Mean±SD	
Age (year)	40.8±10.93	37.7±11.39	0.053	44.1±16.05	37.1±14.03	0.343
Body weight (kg)	83.5±15.86	77.6±13.9	0.007**	85.5±25.73	87.3±12.75	0.999
Height (cm)	159.6±5.88	161.3±5.9	0.137	172.9±8.85	176.9±7.82	0.305
BMI (kg/m ²)	32.4±7.77	29.7±5.2	0.003**	28.5±8.00	27.9±3.42	0.792
Waist circumference (cm)	93.4±9.92	87.8±9.2	0.001**	93.1±13.37	93.6±7.00	0.851
Hip circumference (cm)	115.5±10.86	123.0±105.7	0.060	112.6±10.13	112.4±11.09	0.851
Lean body mass (kg)	48.8±5.91	48.2±5.59	0.217	60.1±12.94	63.8±8.04	0.571
Lean body mass (%)	58.7±7.36	62.8±7.65	0.001**	73.0±11.17	73.8±6.22	0.970
Body fat mass (kg)	36.4±12.43	29.5±9.48	0.001**	25.1±14.78	23.0±7.82	0.851
Body fat percentage (%)	40.8±6.68	37.1±5.9	0.001**	27.0±11.16	26.0±5.92	0.910
Body water content ratio	43.1±5.05	45.9±4.5	0.001**	53.5±8.20	53.9±4.18	0.970

Mann whitney-U test **p*<0.05 ***p*<0.01

jobs. One of the reasons for this situation was that in most households, housewives took the role of food providers and babysitters, and they voluntarily prioritized the nutritional needs of other household members over their own.

Diet quality is an important risk factor for the incidence of chronic diseases. Higher HEI scores are associated with better prevention of obesity, type 2 DM and cardiovascular diseases and decreased mortality rates due to cardiometabolic diseases (Wang *et al.* 2015).

Individuals experiencing food insecurity cannot easily access food groups that provide the energy and nutrients they need. The lack of dietary diversity and the inability to consume the recommended food groups (meat, milk, fruit, etc.) reduce the quality of the diet. In earlier studies, food insecurity has been associated with low HEI-2015 scores (La Mantia 2020; Landry *et al.* 2019). Similarly, among 1,568 participants, food insecurity was associated with lower diet quality (Larson *et al.* 2020). However, the cost

Table 4. Logistic regression analysis for food insecurity

Variables	OR	95% CI	<i>p</i>
Age (year)	0.974	0.947-1.001	0.001**
BMI (kg/m ²)	0.942	0.897-0.987	0.001**
Waist circumference	0.949	0.915-0.984	0.001**
Waist/height ratio	0.003	0.000-0.006	0.001**
Education status			0.001**
University	1		
Primary school	0.196	0.105-0.287	
Employment status			0.001**
Employed	1		
Housewife	0.292	0.173-0.411	

***p*<0.001

of nutrition in each country differs. The prices of packaged and ready-to-consume meals and frozen foods, among others, are higher in Türkiye. For example, a pack of frozen potatoes or pizza costs more than a kilo of fresh vegetables (Atay-Haspolat 2020). In this context, an individual living and possibly working in a food-secure household may not have time to prepare meals, so they turn to consuming more practical ready-to-cook frozen products or ready-to-eat meals. The diet quality of individuals who are constantly fed in this way may deteriorate. This study showed that the percentage of food-secure individuals with poor diet quality was higher than that of food-insecure individuals with poor diet quality. This finding contradicts those findings in existing literature described above.

Food insecurity may differ by gender. The distribution of food insecurity by gender may also differ by geographical region. For example, a study conducted in Europe showed that women were more exposed to food insecurity than men (Grimaccia & Naccarato 2022). This study, yielded no statistically significant correlation between food insecurity and gender. Within the study cohort, males were a minority (n=20). More male participants could have been included in the study for a more balanced gender distribution. Nonetheless, the low number of males accessing the study site constrained this effort.

Waist circumference is one of the most important indicators of abdominal obesity. A high waist circumference is parallel to increased risk of developing cardiometabolic diseases. In this study, a significant negative correlation was found between food insecurity and waist circumference. In Mexico, a study with women found that those without nutritional security had higher waist circumference values (Lopez-Gambino *et al.* 2020).

Waist/height ratio is a currently used method in the assessment of obesity and chronic disease risk. In a study conducted with 10,419 adults in China, after an average of 2.8 years of follow-up, waist/height ratio were found to be positively associated with diabetes risk (Fan *et al.* 2020). In another study conducted in Mexico with adults older than 20 years of age, participants with higher waist-to-height ratios had higher risk of developing dyslipidemia, hypertension and insulin resistance than participants with low waist-to-height ratios (Rangel-Baltazar *et*

al. 2019). In this study, based on a regression analysis, a significant negative correlation was found between waist/height ratio and food insecurity. This shows that as the waist/height ratio increased, food insecurity would decrease. This study further revealed that the percentage of food-secure individuals with high risk according to their waist/height ratios was found to be higher than that of food-insecure individuals. Increasing waist/height ratio means increasing cardiometabolic risk. However, the results found in this study did not support the hypothesis that food insecurity may increase cardiometabolic risk.

One of the important factors affecting cardiometabolic risk is DM. Individuals with food insecurity may develop peripheral insulin resistance as a result of constant food shortages. This may increase the risk of developing DM. In this study, the percentage of food-secure individuals diagnosed with diabetes was found to be higher than that of food-insecure individuals ($p>0.05$). Individuals with food insecurity consume more processed foods with high sodium content and less amounts of certain nutrients (magnesium, vitamin C, etc.), which affects the development of HT (Helmick *et al.* 2018). In this study, the percentage of food-insecure individuals diagnosed with HT was found to be higher than that of food-secure individuals ($p<0.05$). Similar to our results, several earlier studies have found a positive relationship between food insecurity and the incidence of HT (Irving *et al.* 2014; Murillo-Castillo *et al.* 2018).

A diet high in saturated fat causes an increase in serum LDL cholesterol levels. Several works have reported findings on this (Shin *et al.* 2015; Murillo-Castillo *et al.* 2018). Shin *et al.* (2015), reported that individuals with food insecurity have lower serum HDL levels compared to those with food security. This study, the percentage of food-insecure individuals diagnosed with dyslipidemia was lower than that of food-secure individuals ($p>0.05$).

The risk of cardiometabolic disease can be reduced with regular physical activity (WHO 2020). In this study, it was found that individuals who engaged in regular physical activity were more likely to have food security ($p>0.05$). Food-insecure individuals do not spare time for regular physical activity as they spend most of their time during the day generating income or

housekeeping. Furthermore, from a societal perspective, nutritionally insecure societies lack sufficient information about the importance of regular physical activity (WHO 2020).

It has been determined that anxiety due to food insecurity triggers stress, leading individuals to smoke as a coping mechanism (Twyman *et al.* 2014). In food-insecure households, smoking may suppress appetite during periods of limited food availability. Increased smoking among nutritionally insecure individuals can elevate the incidence of smoking-related bronchitis, lung cancer, and prostate cancer, as well as other diseases and health expenditures, creating a vicious cycle. Conversely, some individuals with food insecurity may quit smoking to allocate their limited budget to essential needs (Farrelly & Shafer 2017). Therefore, studies examining the effect of smoking status on food insecurity have shown conflicting results in the literature. A positive relationship between smoking rate and food insecurity (Kim-Mozeleski *et al.* 2019; Kim *et al.* 2017) or a negative relationship (Bergmans 2019) can both be observed in the literature. In this study, however, no significant relationship was found between smoking status and food insecurity.

Data collection coincided with the Covid-19 pandemic, affecting sample size and resulting in the minimum planned participant numbers being reached. Additionally, the small number of male participants, and the selection of the sample from those visiting the diet outpatient clinic are limitations.

CONCLUSION

In this study, out of the 175 adult participants, 58.9% were found to be food-secure, while 41.1% were food-insecure. Of all these participants, only 6.3% had good diet quality. The presence of hypertension, one of the cardiometabolic risk factors, was found to be associated in food-secure and food-insecure individuals. However, since this study was designed as a cross-sectional study, it cannot provide a cause-effect association. Therefore, further studies are needed for more definitive results.

ACKNOWLEDGEMENT

We are grateful to the participants who answered the questionnaires.

DECLARATION OF CONFLICT OF INTERESTS

The authors declare no potential conflicts of interest.

REFERENCES

- Atay Haspolat N. 2020. Dynamics of consumer behavior and policies in sustainable food systems in Turkey [Thesis]. Türkiye: Middle East Technical University.
- Beltrán S, Arenas D-J, Pharel M, Montgomery C, Lopez-Hinojosa I, DeLisser HM. 2022. Food insecurity, type 2 diabetes, and hyperglycaemia: A systematic review and meta-analysis. *Endocrinol Diabetes Metab J* 5(1):e00315. <https://doi.org/10.1002/edm2.315>
- Berberich AJ, Hegele RA. 2022. A modern approach to dyslipidemia. *Endocr Rev* 43(4):611–653. <https://doi.org/10.1210/edrev/bnab037>
- Bergmans RS. 2019. Food insecurity transitions and smoking behavior among older adults who smoke. *Prev Med* 126:105784. <https://doi.org/10.1016/j.ypmed.2019.105784>
- Cardoso Lde O, Carvalho MS, Cruz OG, Melere C, Luft VC, Molina MDCB, Faria CPD, Benseñor IM, Matos SMA, Fonseca MDJMD *et al.* 2016. Eating patterns in the Brazilian Longitudinal Study of Adult Health (ELSA-Brasil): An exploratory analysis. *Cad Saude Publica* 32:e00066215. <https://doi.org/10.1590/0102-311X00066215>
- Coates J, Swindale A, Bilinsky P. 2007. Household Food Insecurity Access Scale (HFIAS) for Measurement of Food Access: Indicator Guide (V.3). Washington (USA): Food and Nutrition Technical Assistance.
- Eicher-Miller HA, Zhao Y. 2018. Evidence for the age-specific relationship of food insecurity and key dietary outcomes among US children and adolescents. *Nutr Res Rev* 31(1):98–113. <https://doi.org/10.1017/S0954422417000245>
- Fan Y, Wang R, Ding L, Meng, Z, Zhang Q, Shen Y, Hu G, Liu M. 2020. Waist circumference and its changes are more strongly associated with the risk of type 2 diabetes than body mass index and changes in body weight in

- Chinese adults. *J Nutr* 150(5):1259–1265. <https://doi.org/10.1093/jn/nxaa014>
- [FAO] Food and Agriculture Organization. 1996. World food summit. Rome declaration and world food summit plan of action. <http://www.fao.org/3/w3613e/w3613e00.htm> [Accessed 9th September 2023]
- [FAO] Food and Agriculture Organization. 2022. The state of food security and nutrition in the World. <https://data.unicef.org/resources/sofi-2022/> [Accessed 9th September 2023]
- Farrelly MC, Shafer PR. 2017. Comparing trends between food insecurity and cigarette smoking among adults in the United States, 1998 to 2011. *Am J Health Promot* 31(5):413–416. <https://doi.org/10.1177/0890117116660773>
- Grimaccia E, Naccarato A. 2022. Food insecurity in Europe: A gender perspective. *Soc Indic Res* 161(2):649–667. <https://doi.org/10.1007/s11205-020-02387-8>
- Hackshaw A, Morris JK, Boniface S, Tang JL, Milenković D. 2018. Low cigarette consumption and risk of coronary heart disease and stroke: Meta-analysis of 141 cohort studies in 55 study reports. *BMJ* 360:j5855. <https://doi.org/10.1136/bmj.j5855>
- Helmick M, Smith TM, Parks CA, Hill JL. 2018. Food insecurity increases odds of diabetes and hypertension, not obesity in medically underserved region. *J Hunger Environ Nutr* 15:128–139. <https://doi.org/10.1080/19320248.2018.1538921>
- Irving SM, Njai RS, Siegel PZ. 2014. Peer reviewed: Food insecurity and self-reported hypertension among Hispanic, black, and white adults in 12 states, Behavioral Risk Factor Surveillance System, 2009. *Prev Chronic Dis* 11:e161. <https://doi.org/10.5888/pcd11.140190>
- Jones NR, McCormack T, Constanti M, McManus RJ. 2020. Diagnosis and management of hypertension in adults: NICE guideline update 2019. *British J Gen Pract* 70(691):90–91. <https://doi.org/10.3399/bjgp20X708053>
- Kılıçkap M, Barçın C, Göksülük H, Karaaslan D, Özer N, Kayıkçıoğlu M, Ural D, Yılmaz MB, Abacı A, Arıcı M *et al.* 2018. Data on prevalence of hypertension and blood pressure in Turkey: Systematic review, meta-analysis and meta-regression of epidemiological studies on cardiovascular risk factors. *Turk Kardiyol Dern Ars* 46(7):525–545. <https://doi.org/10.5543/tkda.2018.15679>
- Kim-Mozeleski JE, Pandey R, Tsoh JY. 2019. Psychological distress and cigarette smoking among U.S. households by income: Considering the role of food insecurity. *Prev Med Rep* 16:100983. <https://doi.org/10.1016/j.pmedr.2019.100983>
- Kim JE, Flentje A, Tsoh JY, Riley ED. 2017. Cigarette smoking among women who are homeless or unstably housed: Examining the role of food insecurity. *J Urban Health* 94:514–524. <https://doi.org/10.1007/s11524-017-0166-x>
- Kontas M, Ergüder T, Tello J, Loring B, Hawkins L, Jakab M. 2014. Better noncommunicable disease outcomes: Challenges and opportunities for health systems: Turkey: Country assessment. World Health Organization. Regional Office for Europe. <https://iris.who.int/handle/10665/350492> [Accessed 10th September 2023]
- Krebs-Smith SM, Pannucci TE, Subar AF, Kirkpatrick SI, Lerman JL, Tooze JA, Wilson MM, Reedy J. 2018. Update of the healthy eating index: HEI-2015. *J Acad Nutr Diet* 118(9):1591–1602. <https://doi.org/10.1016/j.jand.2018.05.021>
- La Mantia C. 2020. Diet quality in relation to income, education, and food insecurity among Canadian adults [Thesis]. Canada: University of Toronto
- Landry MJ, van den Berg AE, Asigbee FM, Vandyousefi S, Ghaddar R, Davis JN. 2019. Child-report of food insecurity is associated with diet quality in children. *Nutrients* 11(7):1574. <https://doi.org/10.3390/nu11071574>
- Laraia BA. 2013. Food insecurity and chronic disease. *Adv Nutr* 4(2):203–212. <https://doi.org/10.3945/an.112.003277>
- 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. *American journal of public health*, 110(9):1422–1428. <https://doi.org/10.2105/AJPH.2020.305783>

- Levine MD, Bush T, Magnusson B, Cheng Y, Chen X. 2013. Smoking-related weight concerns and obesity: Differences among normal weight, overweight, and obese smokers using a telephone tobacco quit line. *Nicotine Tob Res* 15(6):1136–1140. <https://doi.org/10.1093/ntr/nts226>
- Lopez-Gambino, L, Castro-Acosta, M-L, Zepeda-Gomez E, Angulo-Leyva E, Galindo P. 2020. Food insecurity and cardiometabolic disease risk factors in Mexican women from Sinaloa. *Curr Dev Nutr* 4:nzaa043_082.
- Maiangwa M, Omolehin R, Adeniji O, Mohammed US. 2010. Food insecurity: challenges of agricultural extension in developing countries. *J Agric Ext* 14(2). <https://doi:10.4314/jae.v14i2.64126>
- Murillo-Castillo K-D, Frongillo E-A, López-Teros V, Haby MM, Corella-Madueño MA, Díaz-Zavala RG, Porquen-Plata T. 2018. Food insecurity was associated with low quality diet and low HDL level in mothers of Northwest Mexico relying on fisheries for livelihood. *Nutr Hosp* 35(6):1379–1386. <http://dx.doi.org/10.20960/nh.1923>
- Nettle D, Andrews C, Bateson M. 2017. Food insecurity as a driver of obesity in humans: The insurance hypothesis. *Behav Brain Sci* 40:e105. <https://doi.org/10.1017/S0140525X16000947>
- Nkonge KM, Nkonge DK, Nkonge TN. 2020. The epidemiology, molecular pathogenesis, diagnosis, and treatment of maturity-onset diabetes of the young (MODY). *Clinical Diabetes and Endocrinology* 6(1):1–10. <https://doi.org/10.1186/s40842-020-00112-5>
- Pan A, Wang Y, Talaei M, Hu FB, Wu T. 2015. Relation of active, passive, and quitting smoking with incident type 2 diabetes: A systematic review and meta-analysis. *Lancet Diabetes Endocrinol* 3(12):958–967. [https://doi.org/10.1016/S2213-8587\(15\)00316-2](https://doi.org/10.1016/S2213-8587(15)00316-2)
- Rangel-Baltazar E, Cuevas-Nasu L, Shamah-Levy T, Shamah-Levy T, Rodríguez-Ramírez S, Méndez-Gómez-Humarán I, Rivera JA. 2019. Association between high waist-to-height ratio and cardiovascular risk among adults sampled by the 2016 half-way national health and nutrition survey in Mexico (ENSANUT MC 2016). *Nutrients* 11(6):1402. <https://doi.org/10.3390/nu11061402>
- Rasmusson G, Lydecker JA, Coffino JA, Whote MA, Grilo CM. 2018. Household food insecurity is associated with binge-eating disorder and obesity. *Int J Eat Disor* 52(1):28–35. <https://doi.org/10.1002/eat.22990>
- Samp Size Calculator. 2023. <https://sampsizе.sourceforge.net/iface/> [Accessed 29th February 2024].
- Shin JI, Bautista LE, Walsh MC, Malecki C, Nieto FJ. 2015. Food insecurity and dyslipidemia in a representative population-based sample in the US. *Prev Med* 77:186–190. <https://doi.org/10.1016/j.ypmed.2015.05.009>
- Twyman L, Bonevski B, Paul C, Bryant J. 2014. Perceived barriers to smoking cessation in selected vulnerable groups: A systematic review of the qualitative and quantitative literature. *BMJ Open* 4(12):e006414. <http://dx.doi.org/10.1136/bmjopen-2014-006414>
- Wang DD, Li Y, Chiuve SE, Hu FB, Willett WC. 2015. Improvements in US diet helped reduce disease burden and lower premature deaths, 1999–2012; Overall Diet Remains Poor. *Health Aff (Millwood)* 34(11):1916–1922. <https://doi.org/10.1377/hlthaff.2015.0640>
- [WHO] World Health Organization. 1995. Physical status: The use and interpretation of anthropometry. Report of a WHO expert committee Geneva: WHO. <https://www.who.int/publications/i/item/9241208546> [Accessed 10th February 2024]
- [WHO] World Health Organization 2000. Obesity: Preventing and managing the global epidemic: Report of a WHO consultation on obesity. <https://iris.who.int/handle/10665/42330> [Accessed 20th December 2023]
- [WHO] World Health Organization. 2022. Physical activity. <https://www.who.int/news-room/fact-sheets/detail/physical-activity> [Accessed 10th September 2023].