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An Overview of the Effect of Covid-19 on Household Food Waste: How Does the Pandemic Affect Food Waste at the Household Level?

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ABSTRACT

The COVID-19 outbreak created one of the largest pandemics globally, with the world health organization (WHO) declaring several measures, including restriction of movement to curtail the spread of the virus. Reducing food waste is critical to achieving healthy nutrition and sustainability in food systems. In this regard, private households have consistently been regarded as key actors in food waste generation. Hence, this study examined the effects of the COVID-19 pandemic on food waste in homes. A total of 1098 respondents were asked questions on how the pandemic affected their food preparation and consumption pattern, food purchasing and food waste. Compared with the situation before COVID19, there is a significant increase in kitchen spending and bread-making at home. Moreover, food waste generation and the frequency of eating out and food purchasing were reduced. Waste generation was higher in bakery products, left-over foods, and fruits and vegetables. Respondents suggested prudent meal preparation and consumption, increased awareness, and food purchasing restrictions as measures to reduce food waste. Overall, the pandemic has led to more stringent planning in household spendings and attitudinal changes regarding food preparation and consumption, resulting in a significant reduction in food waste and may have contributed to curtailing the spread of the COVID-19 virus.

Keywords: *COVID-19; Household; Food Waste; Environment; Consumer Survey*

1 Introduction

Food waste negatively affects the supply of adequate and nutritious foods critical for the survival of human beings and the sustainability of food systems (Eckert Matzembacher et al., 2020). According to the United Nations, the world population is projected to reach 9.8 billion by 2050; hence, the over-exploitation of natural resources and the rising demand for food pose a significant threat to the environment and societal welfare. Moreover, the current strategies to increase food production by 50-70% to address food security concerns have failed to address the underlying causes of food insecurity: food losses and wastages (Wakefield and Axon, 2020). Currently, 1.3 billion tons of foods, translating to one third of the total amount produced globally, is wasted every year according to the report by the United Nations Food and Agriculture Organization (FAO) (Schanes et al., 2018).

Food waste widely occurs from field to the fork and is recorded at all stages of the food chain (Bräutigam et al., 2014), especially in Europe and the USA. However, much of the food waste occurs at home (Buzby and Hyman, 2012; Jörissen et al., 2015). One of the most important reasons for food waste at home is buying foods beyond consumer needs (Quested et al., 2013). Similarly, the frequency of food purchases can affect food waste. Researchers looking at the effect of shopping frequency control in preventing food waste suggest that it would be important for consumers to estimate the amount of food required daily (Koester, 2013). Other studies indicated that it would be appropriate to do the weekly shopping, as daily shopping would have costs such as time, fuel, and money (Chaboud and Daviron, 2017).

Within the context of food waste, there is a great concern currently about the consequences of COVID-19 food security and food supply globally. The novel coronavirus (COVID-19) has challenged the world with no vaccines yet, and the limited treatment capacity experienced in many countries. The pandemic has led to widespread national and international travel restrictions in many countries (Gössling et al., 2020). Food and beverage establishments, the locomotives of the tourism industry that carry out gastronomic activities, are undoubtedly affected by the pandemic. Restaurants in many countries have had to close, and restaurants are only allowed takeaways in some countries.

The question of whether people's eating habits, as well as attitudes and perceptions towards food waste, have changed during the pandemic period warrants further investigation. This is because the accumulation of the environmental impact throughout the entire life cycle of foods further highlighted the importance of addressing food waste at the consumption level (Wakefield and Axon, 2020). Also, efforts to reduce food waste at home are essential in preventing energy, labour, and economic losses on food harvesting, transportation, processing, packaging, and marketing, particularly during the pandemic. For this reason, studies to determine the effect of the COVID-19 pandemic on food consumption and food waste in homes are urgently needed. Hence, since the start of the pandemic, several studies were carried out to study the pandemic's effect on consumer household food waste in different countries and regions (Everitt et al., 2021; Lahath et al., 2021; Rodgers et al., 2021). For instance, Schmitt et al. (2021) determined Brazillian consumers' food consumption and wastage behaviours. Similarly, the food habits of consumers and influential factors affecting food waste generation during the first COVID-19 lockdown was determined in Spain by Vidal-mones et al. (2021). Likewise, Amicarelli and Bux (2021) studied how the COVID-19 pandemic imposed several changes in Italian households' food consumption and lifestyle and the effect of food waste generation. Unlike other studies, our study took a multifaceted approach to understand the effects of COVID-19 on food waste in homes, emphasizing several parameters before and during the pandemic in Turkey. These include effects on monthly kitchen expenses, frequency of eating out, ordering takeout, food shopping and bread-making at home, food consumption patterns, and consumer trust regarding the supply chain's ability to provide fresh and healthy foods.

2 Materials and Methods

2.1 Study design

The study examining the effects of food waste and the COVID-19 pandemic on food waste at home was carried out using a questionnaire survey. Responses from the administered questionnaires were used to generate various quantitative data. A questionnaire survey has many benefits, including efficiency and low cost, mainly using a web questionnaire against a face-to-face interview or a postal questionnaire (Wakefield and Axon, 2020). Moreover, this process also allows for viewing individual or collective responses and their retrieval and exportation into Microsoft Excel for data collation ensuring time efficiency and reducing human errors in the data processing.

For the questionnaire survey design, a meta-analysis in the context of respondent information that could influence their responses to questions on food waste were carried out. A number of studies were carefully

evaluated, particularly those that showed the prospects of questionnaire surveys in collecting adequate and reliable information from respondents (Çavuş et al., 2019; Ismail, B.B., Fuchs, R., Mohammad, 2017; Ismail and Yusuf, 2014; Schanes et al., 2018; Wakefield and Axon, 2020). This helped in preparing the questions and the delivery process. Besides, other studies that are critical of questionnaire surveys citing the possibility of underestimating the actual food waste were also considered to guide the ethical procedures and survey administration (van Herpen et al., 2019b, 2019a). After creating the survey draft, a preliminary evaluation was conducted with 30 respondents, observations were noted, and updates made where necessary.

2.2 Data collection and participant recruitment

Respondents were recruited from households living in 75 different cities in Turkey. Within the sample scope, households were asked about food waste during the COVID-19 pandemic period since a large amount of food waste during the food consumption process is generated at home. Also, the feedback to be obtained from people who directly cause food waste can be valid and consistent, although previous surveys documented that questionnaire surveys could likely underestimate the amount of food waste generated (van Herpen et al., 2019a, 2019b). The sample was determined following the convenience sampling method, one of the random sampling methods. Valid survey data obtained from 1098 respondents were analyzed.

For the data collection, respondents were recruited to participate in the survey through a web link distributed over e-mail and social media. Data collection took place between March and June 2020. Overall, 1098 respondents completed the online questionnaire, which consists of 3 parts and 40 questions. The first part included questions about the demographic information of the respondents. In the second part, food purchasing and consumption behaviours before and during the COVID-19 pandemic were included. Lastly, questions were asked about their perceptions of food waste before and during the pandemic.

2.3 Analysis of data

In the research scope, valid data obtained from 1098 respondents from 75 different Turkey cities were analyzed using statistical methods. Before analyzing the data, the status of carrying normal distribution was evaluated as a homogeneous distribution with the Levene test and normal distribution analysis with the Kolmogorov-Smirnov test ($p > 0.05$) (Otsu and Taniguchi, 2020). Then, the histogram, Q-Q Plot Graph, Box Plot Graph, and Stem-Leaf Graph confirmed the normal distribution of the data. The validity and reliability of the data were analyzed by Cronbach Alpha values, factor analysis, and internal consistency analysis methods (Çavuş et al., 2019). After that, the appropriateness of the data was determined, followed by the statistical analysis. In the research, frequencies and percentage values, averages for 5 and 7 Likert scale questions, and t-test were used to make comparisons (Çavuş et al., 2019).

3 Results

3.1 Demographic and socio-economic characteristics of the respondents

Based on the 2020 census data, the current population in Tukey stands at 83 614 362 (Turkish Statistical Institute, 2020). The distribution of this population according to variables such as age, gender, education level and marital status is shown in Table S1. According to Yamane (1967), Cohen (1988), and other researchers, a sample of 1098 participants is sufficient for sample selection of this population using the random sampling method. Although statistical comparison was not made according to the demographic variables within the scope of the research, the country's population is shown in the Table according to the variables to show the sample's representative adequacy. Based on the respondents' demographic information in Table S1, the spread of the respondents' gender was even as 59.2% of the respondents were women and 40.8% men. The respondents' age group's distribution showed 56.6% of the respondents were 18-25, 23.2% were 26-35 and 11.2% 36-45 years. The spread of respondents across the age groups was not even, and this skewed age distribution may have affected the responses to the questions. Furthermore, approximately half of the respondents living in 75 different cities are from Ankara, Istanbul, Bolu, Eskişehir, Bursa, Antalya, Izmir, and 73% being university graduates. The results suggested a strong correlation between the respondents' age group and their level of education. According to the Organisation for Economic Co-operation and Development (OECD), tertiary attainment levels in Turkey continue to increase, particularly among young adults, and more than a quarter of this age group had achieved a bachelor's and higher degrees (OECD, 2012).

The current socio-economic conditions in households are shown in Table S2. Regarding the socio-economic conditions of the respondents, 87.3% live with their families. The houses' total monthly income ranged between 2000-4999 lira in 42.3% of the respondents and between 5000-7999 lira in 27% of respondents. The result also suggested that there are 2-3 people in 34.7% of houses and 48.8% have 4-5 people. When the respondents'

demographic information was examined, it can be assumed that the sample appropriately addresses the research hypothesis. In this study, the respondents were asked about the change in income during the COVID-19 pandemic period, and 53.6% stated that there was no change, while 43.4% stated that their income has decreased.

3.2 Household behaviours regarding food purchasing and consumption before and during the COVID-19

Responses to questions regarding food shopping and consumption behaviors were presented in Table 1. The monthly kitchen expenditures (in Turkish lira (₺) of the respondents increased significantly from 500 to 2000 and aboveduring thepandemic. Before the pandemic, the mean monthly kitchen expenditure was 2.13 ± 1.01 and increased significantly (p≤0.05) during the pandemic to 2.51 ± 1.11.

Table 1.
Comparison of monthly kitchen expenses before and during the pandemic

Monthly kitchen expenses before the pandemic					**Monthly kitchen expenses during the pandemic**			
	F	**%**	**x̄**	**s**	**F**	**%**	**x̄**	**s**
500 TL and less	321	29.2	2.1330	1.01878	200	18.2	2.5128	1.11602
500-999 TL	458	41.7			410	37.3		
1000-1499 TL	208	18.9			284	25.9		
1500-1999 TL	74	6.7			133	12.1		
2000 TL or more	37	3.4			71	6.5		
Total	1098	100.0			1098	100.0		

	Paired Differences			**T**	P
Difference:	**x̄**	**S**	**$s_{\bar{x}}$**		
Before COVID-19 During COVID-19	-0.37978	0.72501	0.02188	-17.358	0.000

x̄: Mean, s: Std. Deviation, $s_{\bar{x}}$: Std. Error Mean, T: t value, P: Sig. *(1€=7.46₺; 15.05.2020)

Regarding the respondents' shopping frequency, the results were presented in Table 2. It is clear from the results that the shopping frequency across different food categories decreased significantly during the pandemic period. A Marjinal Homogeneity Test was performed to examine further the statistical significance of the decrease in shopping frequency. The mean frequency of food shopping by the respondents before the COVID-19 pandemic was 3.30 ± 1.01 and significantly decreased (p ≤ 0.05) during the pandemic to 3.16 ± 0.97.

Table 2.
Comparison of frequencies of food shopping before and during the COVID-19 pandemic

Frequencies of food shopping before COVID-19					**Frequencies of food shopping during the pandemic period**			
	F	**%**	**x̄**	**s**	**F**	**%**	**x̄**	**s**
Once a month or less	65	5.9	3.3033	1.01224	72	6.6	3.1621	0.97421
2-3 times a month	159	14.5			164	14.9		
Once a week	344	31.3			442	40.3		
2-3 times a week	438	39.9			354	32.2		
Every day and more	92	8.4			66	6.0		
Total	1098	100.0			1098	100.0		

	Paired Differences		**MH**	**P**
Difference:	**$\bar{x}_{MH}$**	**s_{MH}**		
Before COVID-19 During COVID-19	2202,500	17.812	4.351	**0.000**

F: Frequency, x̄: Mean, s: Std. Deviation, **s_{MH}**: Std. Deviation of MH, MH: Std. MH Statistic, P: Sig.

The respondents' responses regarding the purchase of different food categories before and during the COVID-19 pandemic were presented in Table 3. The respondents' food purchasing overall mean frequency before the COVID-19 pandemic was 3.10 ± 0.64 and decreased significantly (p ≤ 0.05) during the pandemic (3.04 ± 0.72).

The foods bought before the pandemic were examined and compared using the Marjinal Homogeneity Test with the frequencies of food purchased in the pandemic period. It was observed that there was a significant increase in the purchase of red meat and its products and cooking oils. On the other hand, a significant decrease was observed in the purchase of milk and dairy products, packaged take-home foods, bread, and flour products.

Table 3.
Frequencies of food purchasing before and during the pandemic

	Foods bought before the pandemic		**Foods bought during the pandemic**		**Paired Differences**	
Food categories	**x̄**	**s**	**x̄**	**s**	**MH**	**P**
Fresh fruits and vegetables	3.4290	0.73644	3.4454	0.80065	-0.674	0.501
Red meat and products	2.5883	0.92761	2.6393	0.98446	-2.388	**0.017**
White meat and products	2.8233	0.91065	2.8124	0.96017	0.500	0.617
Milk and milk products	3.5264	0.85596	3.4499	0.92555	3.202	**0.001**
Packaged take-home foods	2.8852	1.11978	2.7641	1.08772	4.501	**0.000**
Bread and flour products	4.4444	0.85669	4.0619	1.09352	12.332	**0.000**
Legumes	2.6421	1.06846	2.6503	1.11414	-0.353	0.724
Cooking oils	2.4900	1.16481	2.5537	1.15969	-2.979	**0.003**
General foods total	3.1036	0.64141	3.0471	0.72705	3.734	**0.000**

x̄: Mean, s: Std. Deviation, MH: Std. MH Statistic, P: Sig.

3.3 Households' food waste before and during the pandemic

Respondents were asked questions regarding food waste before and during the pandemic to ascertain the impact of the pandemic on food waste in general. Respondents were asked specific questions about bread making and bread waste in homes before and during the pandemic. Bread is Turkey's most prominent and staple food, with the world's highest per capita consumption of 199 kilos per person. At the same time, bread is also among the most wasted food, and nearly 6 million loaves of bread go to waste every day in Turkey (Salihoglu et al., 2018). Therefore, it is imperative to determine the respondents' habits regarding bread consumption before and during the pandemic. The frequency of bread making at home before and during the COVID-19 pandemic was presented in Table S3. Expectedly, the frequencies of making bread at home increased during the COVID-19 pandemic period from 32.1% to 64.9%. Moreover, the mean frequency of bread making during the pandemic (2.90 ± 1.75) increased significantly (P: 0,000; $p \leq 0.05$) when compared with the situation before the pandemic (1.79 ± 1.47).

It is equally interesting to determine how much of the bread produced is wasted on a comparative basis. Hence, the overall bread waste from any source generated by the respondents was presented in Table 4. Most respondents reported a significant reduction in bread waste. A large number of respondents (53.6%) reported no bread waste during the pandemic. Moreover, the mean bread waste at home before the COVID-19 pandemic was 1.89 ± 1.02 and decreased significantly ($p \leq 0.05$) to 1.65 ± 0.92 during the pandemic.

Table 4.
Comparison of bread waste generation before and during the pandemic

Wastage of bread before COVID-19 pandemic					Wastage of bread during the pandemic period			
	F	**%**	**x̄**	**s**	**F**	**%**	**x̄**	**s**
None	453	41.3	1.8953	1.02785	589	53.6	1.6576	0.9213
Less than 10%	428	39.0			374	34.1		6
10% -20%	136	12.4			86	7.8		
20% 30%	46	4.2			25	2.3		
30% -40%	18	1.6			12	1.1		
40% -50%	11	1.0			7	0.6		
50% and more	6	0.5			5	0.5		
Total	1098	100.0			1098	100.0		

	Paired Differences			**T**	**P**
Difference:	**x̄**	**s**	**$s_{\bar{x}}$**		
Before COVID-19 During COVID-19	0.23770	0.87243	0.02633	9.028	**0.000**

x̄: Mean, s: Std. Deviation, $s_{\bar{x}}$: Std. Error Mean, T: t value, P: Sig.

Furthermore, the amount of waste generated from all food categories was determined by considering the diversity of food products. First of all, respondents were asked two general questions. The first question was how much of the meals they thought was wasted before and during the pandemic (Table 5). In this way, the evaluations of the amount of wastage of the meals prepared at home were compared. Secondly, they were asked to evaluate the waste generated in 9 different food categories according to the pre-pandemic and pandemic period (Table 6). Finally, the overall averages of waste in 9 different categories were compared.

Interestingly, the amount of food waste generated significantly decreased during the pandemic period (Table 5). The respondents' mean food wastage was 2.07 ± 1.03 before the COVID-19 pandemic and decreased significantly ($p \leq 0.05$) during the pandemic (1.78 ± 0.90). Additionally, the respondents' average total food waste significantly reduced during the pandemic (Table 6).

Table 5.
Comparison of wastage of meals before and during the pandemic

Wastage of meals Before COVID-19					Wastage of meals during COVID-19			
	F	**%**	**x̄**	**s**	**f**	**%**	**x̄**	**s**
None	361	32.9	2.0765	1.03519	481	43.8	1.7878	0.90050
Less than 10%	433	39.4			451	41.1		
10% -20%	202	18.4			105	9.6		
20% 30%	71	6.5			42	3.8		
30% -40%	23	2.1			17	1.5		
40% -50%	5	0.4			2	.2		
50% and more	3	0.3			-	-		
Total	1098	100.0						

	Paired Differences			**T**	**P**
Difference:	**x̄**	**s**	**$s_{\bar{x}}$**		
Before COVID-19 During COVID-19	0.28871	0.90147	0.02721	10.612	**0.000**

x̄: Mean, s: Std. Deviation, $s_{\bar{x}}$: Std. Error Mean, T: t value, P: Sig.

The food waste in different categories of foods was also investigated and compared using a paired sample t-test. It was observed that in addition to a significant decrease in the wasted portion of meals, there is also a significant decrease in food waste across different food categories such as fresh fruits and vegetables, red meat, milk and dairy products, packaged take-home foods, bread, and flour products and legumes, etc.

Table 6.
Food waste before and during the pandemic across different food categories

	Food Waste Before the Pandemic		Food Waste During the Pandemic		Paired Differences	
Food Wastage	x̄	s	x̄	s	T	P
Fresh vegetables and fruits	1.8260	0.87494	1.5455	0.74093	11.573	**0.000**
Red meat and products	1.1931	0.52213	1.1767	0.52445	1.130	**0.259**
White meat and products	1.2395	0.62463	1.1776	0.49645	3.874	**0.000**
Milk and milk products	1.4153	0.72752	1.2614	0.57125	7.851	**0.000**
Packaged take-home foods	1.5064	0.82600	1.4135	0.82148	4.028	**0.000**
Bread and flour products	1.7805	0.88237	1.5219	0.73211	11.113	**0.000**
Legumes	1.3752	0.70252	1.3042	0.63505	4.018	**0.000**
Cooking oils	1.3115	0.65697	1.2805	0.60052	1.891	**0.059**
Leftover foods	2.0146	0.99670	1.7359	0.86109	11.330	**0.000**
Food waste average	1.5180	0.52966	1.3797	0.47949	10.730	**0.000**

*1) None 2) Less than 10% 3) 10% -20% 4) 20% 30% 5) 30% -40% 6) 40% -50% 7) 50% and more
**Simple average of 9 categories

Respondents were also asked about the food categories that are mostly wasted in the kitchen, and the results were depicted in Fig. 1a. Answers to this open-ended question were classified in frequencies and percentages with the responses presented in food categories. Bakery products (43%) top the list of the most wasted food product in the kitchen. This is followed by the left-over foods (20.8%) and fruits and vegetables (16.9%). Salihoglu et al. (2018) noted that fruits and vegetables, bakery products were are among the most wasted items, which agree with the findings of this study. The food categories that were least wasted were milk and dairy products (2.7%), beverages (1.8%), cooking oil and related products 1.7%, and legumes (1.3%).

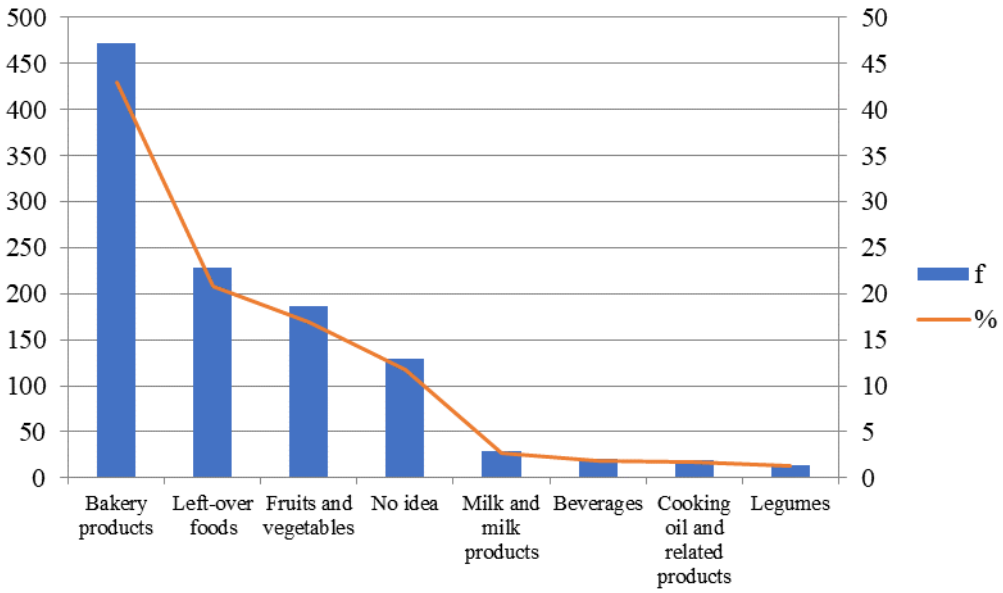

Figure 1(a). Distribution of food products considered most wasted at the household level

3.4 Respondents' trust in supply chain ability to provide foods during the pandemic

The pandemic has caused a unique situation begging for extraordinary measures. Therefore, it is imperative to determine how the respondents' trust in the supply chain's stable food supply may have affected household food waste. Two food categories of food were selected for their relevance to the situation caused by the pandemic. The restriction of movement can affect the supply of fresh foods. On the other hand, many people believe that the consumption of healthy foods could help boost their immune systems, resulting in preventing COVID-19 infection or at least keeping the body and mind healthy during stressful times. The results (Table S4) showed an increase in the confidence level that the respondents have in the provision of fresh foods during the pandemic is significantly higher than their trust in providing healthy and safe foods. When the two categories were compared, their trust in providing healthy and reliable foods was found to be significantly less than their confidence in providing fresh foods. This showed that the supply chain is believed to fulfill its duties effectively and functionally, however, the relevant supply chain, businesses and public planners should work on the health and safety aspects of food.

3.5 Food waste preventive measures

In Turkey, except for the bread waste prevention campaign, which helped save approximately 6 million loaves of bread per day, there has not been any declaration on the specific strategy for preventing and managing food waste (FUSIONS, 2015). Hence, to understand the respondents' level of awareness regarding the preventive measures against food waste, they were asked an open-ended question to recommend how food waste can be reduced. According to Tracy (2020, p. 212), in order to examine the qualitative data obtained from open-ended questions, firstly, the data are classified. Then the focal points are determined. Finally, the data, which are classified in a systematic, inclusive and organized form, are presented in categories with their themes and codes. The answers obtained in the question asked for the suggestions of the participants were categorized by this method. Results are shown in percentages.

Fig. 1b shows the respondents' suggestions.

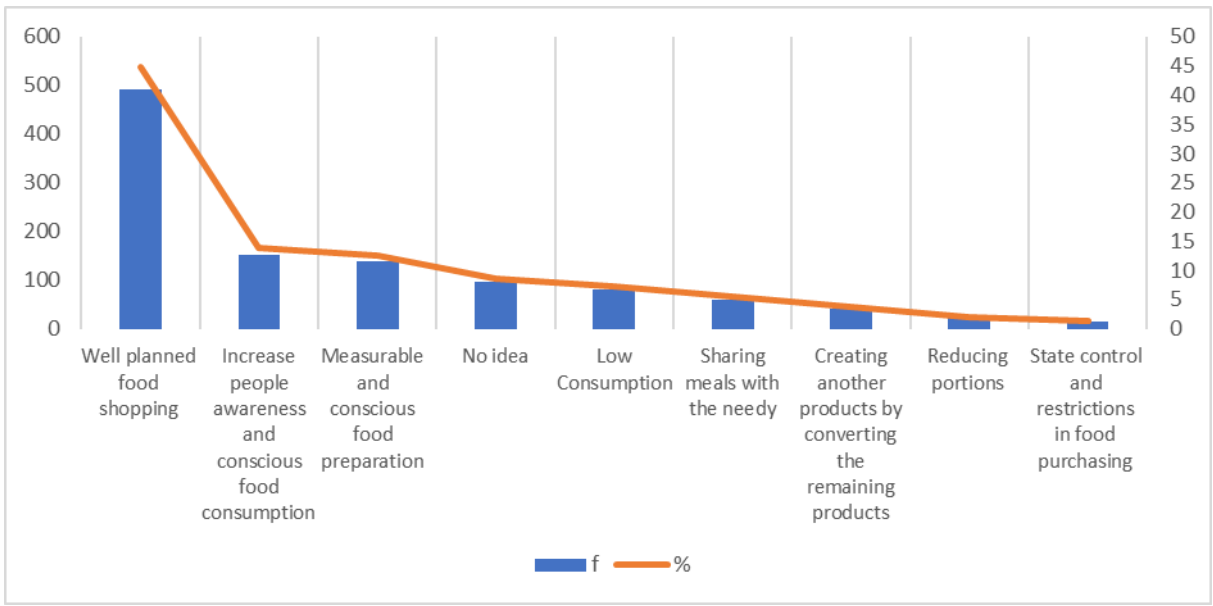

Figure1(b). Distribution of respondents' recommendations for the prevention of food waste

The results suggested that many respondents (44.9%) recommended planning and conscious food shopping. Other recommendations include conscious consumption, increased awareness (13.8%), and measurable and conscious meal preparation (12.6%). It is to note that a small percentage of the respondents recommended state control and restrictions in food purchasing (1.3%) as a measure to reduce food waste in homes.

4 Discussion and policy implications

COVID-19 pandemic has challenged every aspect of human endeavours. However, it may have offered opportunities for achieving sustainable food production and consumption in compliance with the UN sustainable

development goals through policy changes regarding food security. There is an urgent need for globally feasible strategies to curve food waste and increase food security.

Food waste is a problem not only from the food scarcity standpoint but also a hindrance to food availability, particularly in the parts of the world with limited food supply and negative impact on the environment causing unnecessary greenhouse gases release and inefficiency in the use of water and land around the globe (Salihoglu, 2018). Household food waste is one of the most critical sustainability challenges that need to be addressed by the current and future municipal governments (Everitt et al., 2021). Besides, reducing food waste in homes will positively impact human health and well-being, reduce environmental damage and ensure balanced use of resources to reach future generations (Wakefield and Axon, 2020). In this context, this study examines the differences in food consumption and food waste during the COVID-19 pandemic compared to the circumstances before the pandemic. This is important because changes in consumer behaviour, including overbuying, is among the major drivers of food waste, and the pandemic situation provides avenues for a significant change in consumer behaviour (Lahath et al., 2021)

This study indicated a significant increase in the respondents' monthly kitchen expenses during the pandemic. This is not surprising, particularly with the decrease in the number of people eating outside their homes and spending most of their time at home as a measure to curtail the spread of the virus. This scenario would have a potentially positive impact on reducing food waste by creating the possibility of an increased home cooking. Besides, previous studies have established a strong link between home cooking and reduced food waste. Moreover, the perception of engaging in more frequent cooking than normal is related to the perception of reduced food waste (Rodgers et al., 2021).

In this study, a significant decrease in the frequency of food shopping was observed during the pandemic. Besides, a statistically significant increase in the purchasing of red meat and its products and cooking oils was observed. On the other hand, a significant decrease was observed in the purchase of milk and dairy products, packaged ready foods, bread, and bakery products. These changes observed in food purchasing patterns are vital because they provide data from a developing country. People's eating preferences may vary depending on countries, their level of knowledge and awareness, food and agriculture policies, beliefs, and cultures. However, when the changes in the foods taken are analyzed, it is crucial in terms of the fact that the decrease in ready-made foods, bakery products, and dairy products and the increase in red meat consumption during the pandemic period can reveal that people are trying to eat healthier and immune-boosting foods as recommended by the World Health Organization. These findings were in accordance with previous studies (Vidal-mones et al., 2021). In studies conducted by Fooladi et al. (2019) and Pedersen and Vilgis (2019), it was observed that the collaboration of food stakeholders, especially gastronomy actors, scientists, academia, and other disciplines, has intensified. Thanks to these studies, it is thought that the correct and efficient use of food will reduce the negative impact on natural resources.

Regarding bread making at home during the pandemic period, it was observed that people developed the habit of bread making at home and sharing the bread they make and similar foods with their social environment in televisions and various social media applications. A significant increase in the frequency of bread making at home was observed during the pandemic. Therefore, this perception that can be observed in mass media and social media applications has been shown and realized at the level of social behaviour change. People can be prone to food preferences and cooking, and the fact that social media can influence them has been demonstrated by different studies (Garnett, 2013; Sheahan and Barrett, 2017). Besides, empirical findings supported the fact that social media is among the critical factors that correlate positively with food waste (Lahath et al., 2021). However, it has been shown that new gastronomic attitudes and behaviours may emerge and become widespread at the social level under the conditions created by each social event.

The rate at which bread is wasted at home is reduced significantly during the pandemic. Similarly, it was observed that there was a significant difference between the average food waste at home and the average food waste during the pandemic period, and the respondents' food loss at home decreased significantly during the pandemic. These suggested that the COVID-19 pandemic has caused a reduction in food waste. A number of factors could lead to the increasing attention attached to food waste, including rapid population increase leading to increasing food demand (Buzby and Hyman, 2012), need to ensure food security (FAO, 2013; Gustavsson, Cederberg and Sonesson, 2011), and the difficulties in food production due to the global climate crisis (Garnett, 2013). However, the decrease observed in food waste during the COVID-19 pandemic revealed that even slight changes in people's consumption habits could effectively minimize food waste. Besides, other studies suggested that the current pandemic and its aftermath may reduce day-to-day household food waste due to improved household skills and management practices (Roe et al., 2021; Vidal-mones et al., 2021). Furthermore, food waste reduction due to COVID-19 may further provide insights for future strategies to reduce bread waste and add value to the current campaign to reduce bread waste, which has helped save about 6 million loaves per day (Salihoglu et al., 2018).

Among all the categories of foods consumed by the respondents in this study, a significant decrease in food waste was observed in all categories such as fresh fruit and vegetables, red meat and products, white meat and products, milk and dairy products, packaged ready-to-eat foods, bread and bakery products, legumes, cooking oil and left-over foods. The main food types generally wasted comprise the most perishable commodity groups (Salihoglu et al., 2018). These results agreed with the recent findings in Canada (Everitt et al., 2021) and Italy (Amicarelli and Bux, 2021). The decrease in food waste observed mostly in fresh fruits and vegetables, milk and dairy products, bread and bakery products, and left-over foods showed that people had developed a relatively efficient way of reducing food waste during the pandemic period. Different studies have demonstrated that meat, poultry and fish, vegetables, and dairy products (Buzby and Hyman, 2012) rank first in food loss in countries like the USA. Bräutigam et al. (2014) and Bräutigam, Jörissen et al. (2015) stated that waste in food groups in Europe is concentrated in fruits and vegetables, animal foods, and bakery products. The new situation created by the pandemic shows that the foods that are wasted can change according to the countries' culinary culture and development level. However, when asked about the products they think are the most wasted, the respondents listed bakery products, left-over foods, fruit and vegetables, dairy products, cooking oils and legumes. Therefore, it is possible to organize social campaigns and training according to the quantity of food waste in a country. Also, Bilska et al. (2016) proposed that food businesses implement a series of procedures under applicable laws to use food for social purposes and reduce food waste effectively. Converting food waste into animal feed will contribute to the use of less agricultural land and energy for animal feed production, thereby reducing greenhouse gas emissions. Similarly, the use of food wastes as fertilizer will reduce the use of chemical fertilizers, provide safer and organic foods and reduce environmental and water pollution (Chaboud and Daviron, 2017; Lundqvist et al., 2008). Besides, preventing food waste at home will provide economic prosperity to all stakeholders in the food chain (Buzby and Hyman, 2012; Lacirignola et al., 2014; Quested et al., 2013). Also, there is a wide consensus in the literature that strategies to put food consumers at the centre of their needs to tackle food waste meaningfully contribute to the overall amount of food waste in the EU, especially at home. Therefore, there is a need for studies to deeply understand the insights into people's motivation to throw edible food and studies to identify and eliminate obstacles to reducing waste.

Many respondents suggested well-planned food shopping and conscious consumption and increased people's awareness as measures to prevent food waste. Other recommendations include low consumption, sharing the remaining meals with the needy, transforming the remaining products, reducing portions and weights, state control, and restrictions in food purchasing. This finding indicated a certain degree of consumer awareness about food waste; however, it is not sufficiently reflected in attitudes, behaviours, and practices. It would be beneficial to show the factors such as environmental destruction caused by food waste, unhealthy life, poverty, and famine in different regions to people through different media and to share the negative results with people directly. It is known that more foods are produced to fill in the gap created by food waste with consequent negative effects, especially on natural resources. If the steps taken to prevent food waste are successful, it will ensure that food reaches many people on the edge of hunger, prevents global warming, keeps the environmental balance and economic developments, and provides consumers with safer food. (Chaboud and Daviron, 2017; FAO, 2013; Smith, 2013). Besides, many researchers agree that reducing or preventing food waste will make an economic contribution to food manufacturers and consumers (Buzby and Hyman, 2012; Chaboud and Daviron, 2017; Lipinski et al., 2016; Parry et al., 2015). Therefore, people being careful about preventing food waste and seeing the gains that may arise if they apply the specified measures can also contribute to making significant behavioural changes. In this research, the respondents' trust in the supply chain in providing pandemic foods was examined. While it was observed that they generally trusted the supply chain's ability to provide fresh and healthy/safe foods. However, when the two categories were compared, their trust in providing healthy and reliable foods was significantly less than their confidence in delivering fresh foods. This showed that the supply chain is believed to fulfil its duties effectively and functionally. However, the relevant supply chain, businesses, and public planners should work on the health and safety aspects of foods.

As a result, the effect of food waste and COVID-19 pandemic on food waste has shown that kitchen spending increased during the pandemic. It has been shown that bread consumption decreased and a significant increase in bread making at home. The significant reduction in food and bread waste was included in the positive environmental effects such as reducing air pollution observed in the pandemic period, decreasing damage to the ecosystem, and limiting the adverse impact on natural resources and wildlife. However, future work will be needed to compare the changes in food waste according to the level of development in the countries, the possibility of a continued food waste reduction after the pandemic, the changes that can be observed in food waste in different periods and what can be seen in similar periods. İn this regard, some influential factors that could impact food waste, such as the number of people and children in a household and different characteristics of the food environment, including the availability, density, and proximity of retail food outlets, can be considered (Everitt et al., 2021).

This study has several limitations. The study takes a global focus on determining the impact of the COVID-19 pandemic on consumer food waste. However, the quantitative data obtained were drawn from some areas in Turkey. Moreover, the study provides insights on a comparative basis into how food waste was generated in kitchens before and during the pandemic. Nevertheless, this may not be valid for other countries and cultures worldwide. The extent to which these inconsistencies can be discussed in a country or culture-specific fashion is beyond the scope of this study. However, this could potentially pave the way for further research in the area. Besides, recent studies determined the effect of the COVID-19 pandemic on household food waste in different countries (Amicarelli and Bux, 2021; Rodgers et al., 2021; Schmitt et al., 2021; van Herpen et al., 2019a; Vidal-mones et al., 2021). There is also a possibility of recall bias as the pre-pandemic figures require respondents to recall information that is no longer fresh in their minds. Hence, this may have impacted the study results, and it is very likely to have an overestimation (and vice versa) of the average food waste reported (Prati, 2017). Therefore, more studies should be carried out in mid-to-large-sized Turkish cities as this will provide a better understanding of the effect of the COVID-19 pandemic on household food waste and its economic, environmental, and social implications (Everitt et al., 2021).

In conclusion, the current study provided insights into the effect of the COVID-19 on food waste in homes. The restriction in movement and the increase in food preparation at home may have contributed to curtailing the spread of the virus. While participation at all levels is critical to making a difference in the current struggle to reduce food waste, this study will provide further insights into the change in consumer attitudes and perception regarding food waste resulting from the effects of the COVID-19 pandemic. Future studies should explore how demographic differences and characteristics of neighbourhood food environments such as the availability, density, and proximity of retail food outlets influence food waste in homes.

Ethical statement and disclosures

The ethics committee of Abant Izzet Baysal University approved this study. Authors have no conflict of interest to declare. No funding was received for the study.

Declaration of Competing Interest

None.

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Appendix

Table S1.
Demographic information of the respondents

	n	%	N (2020)
Gender			
Female	650	59.2	41 698 377 (49.9%)
Male	448	40.8	41 915 985 (50.1%)
Marital Status			
Married	379	34.5	39 540 631 (47.28%)
Single	719	65.5	23 915 271 (28.60%)
Age			
18-25	621	56.6	12 893 750 (15.42%) 15-24
26-35	255	23.2	12 689 848 (15.18%) 25-34
36-45	123	11.2	12 708 693 (15,20%) 35-44
46-55	66	6.0	10 148 298 (12.13%) 45-54
56 and more	33	3.0	16 105 536 (19.25%) 55+
City			
Ankara	179	16.3	5 663 322 (6.77%)
İstanbul	108	9.8	15 462 452 (18.49%)
Bolu	88	8.0	314 802 (0.38%)
Eskişehir	49	4.5	888 828 (1.06%)
Bursa	42	3.8	3 101 833 (3.71%)
Antalya	40	3.6	2 548 308 (3.05%)
İzmir	39	3.6	4 394 694 (5.26%)
Other cities	553	50.4	51 250 123 (61.28%)
Education			
Primary education	58	5.3	36 624 005 (43.80%)
High school	157	14.3	15 426 019 (18.44%)
University graduates	802	73.0	11 552 703 (13.81%)
Postgraduate	81	7.4	

Table S2.
Socio-economic conditions of the respondents

	N	%
People Living at Home		
Alone	88	8.0
With their family	959	87.3
With their friends	46	4.2
Others	5	0.5
Total Monthly Income at Home (1€=7.46₺; 15.05.2020)		
2000 TL or less	140	12.8
2000-4999 TL	464	42.3
5000-7999 TL	296	27.0
8000-10999 TL	116	10.6
11000 TL and more	82	7.5
Number of People Living at Home		
1	85	7.7
2-3	381	34.7
4-5	536	48.8
6-7	80	7.3
8 and more	16	1.5
0-6 Age Group Individuals at Home		
No	837	76.2
Yes. 1 individual	196	17.9
Yes. 2-3 individuals	62	5.6
Yes. 4 and more individuals	3	0.3
Changes in Income During the COVID-19 Pandemic Period		
No, it did not change	589	53.6
Yes, it decreased	477	43.4
Yes, it increased	32	2.9

Table S3.
Comparison of bread making at home before and during the pandemic

Bread making at home before the pandemic					**Bread making at home during the pandemic**			
	F	**%**	**x̄**	**s**	**F**	**%**	**x̄**	**s**
No	746	**67.9**	1.7987	1.47804	385	**35.1**	2.9044	1.75556
Yes	352	**32.1**			713	**64.9**		
Once a month or less	162	14.8			140	12.8		
2-3 times a month	71	6.5			156	14.2		
Once a week	52	4.7			174	15.8		
2-3 times a week	33	3.0			178	16.2		
Every day and more	34	3.1			65	5.9		
	Paired Differences				**MH**		**P**	
Difference:	**$\bar{x}_{MH}$**		**s_{MH}**					
Before COVID-19 During COVID-19	1671.000		43.322		-17.865		**0.000**	

*1) Once a month or less, 2) 2-3 times a month, 3) Once a week, 4-) 2-3 times a week, 5) Every day and more
F: Frequency, x̄: Mean, s: Std. Deviation, **s_{MH}**:Std. Deviation of MH, MH: Std. MH Statistic, P: Sig.

Table S4.
Consumer confidence in the food supply chain during thepandemic

Confidence in the supply chain about providing fresh foods in Turkey during the pandemic period					Confidence in the supply chain about providing healthy and safefoods in Turkey during the pandemic period			
	F	**%**	**$\bar{x}$**	**s**	**F**	**%**	**$\bar{x}$**	**s**
Completely disagree	62	5.6	4.4016	1.58786	80	7.3	4.1457	1.64228
Disagree	60	5.5			94	8.6		
Somewhat disagree	163	14.8			196	17.9		
Neither agree or disagree	300	27.3			283	25.8		
Somewhat agree	255	23.2			220	20.0		
Agree	119	10.8			111	10.1		
Completely agree	139	12.7			114	10.4		
Total	1098	100.0			1098	100.0		

	Paired Differences			**T**	**P**
Difference	**$\bar{x}$**	**s**	**$s_{\bar{x}}$**		
Before COVID-19 During COVID-19	.25592	1.05418	.03181	8.044	**0.000**

F: Frequency, $\bar{x}$: Mean, s: Std. Deviation, $s_{\bar{x}}$: Std. Error Mean, T: t value, P: Sig**.**