

A Study of Plate Waste in a Food Service

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Abstract. *Objective:* To determine the amount of plate waste of the personnel eating in a hospital food hall and to evaluate according to the food types. *Design:* A cross-sectional trial. *Setting:* Food hall of a state hospital in İstanbul. *Main Outcome Measures:* Plate wastes by food types. *Analysis:* In the analysis of quantitative variables, the interactive model was tested with two-way analysis of variance for the effects of 2 factors (meal and type of food). *Results:* During the research, 16,722 people's plate waste was weighed. 6.2% of the edible food that was served was disposed. The average amount of waste at dinner was found to be less than lunch ($p < 0.05$). According to the type of food, pastry desserts are disposed the least in lunch (1.8%; 95% CI, 1.67-1.94) and the most in dinner (5.8%; 95% CI, 4.78-5.50). *Conclusions and Implications:* In order for countries to create plans for preventing food loss, and waste, they must first conduct waste measurement research in every field of the aspect. Measuring food waste in institutional food services, determining the reasons, and informing the consumers are necessary for the continuation of sustainable development. Consumer awareness of food waste and food insecurity should be evaluated together.

Key words: Food service, food waste, plate waste, menu, public employee

Introduction

Food loss and waste is an important problem that affects both our present and future with environmental, economic, and social effects (1). Efficient management and evaluation of food waste are essential for the continuation of sustainable development. Meanwhile, the loss and waste in the food systems should be reduced for sustainable nutrition by transitioning to nutritious diets with lower environmental effects (2,3). It has been calculated that by minimizing food wastes, 800-1400 kg/ton of greenhouse gas emission can be reduced from preventable food wastes (4).

In a 2019 report, FAO reported that food loss and waste are seen in every stage from production to consumption of the food, and it varies for each country. Food waste seems as a problem more associated with high-income countries however, it is stated that emerging economies are facing this problem

increasingly too. Globally, food loss or waste occurs more during distribution and consumption in middle and high-income countries, whereas in low-income countries it occurs more in the fields and after harvest (5). A study was conducted in Turkey by FAO in 2013. In this study, it was found that when the food supply chain is considered as one, the highest loss rate is in agricultural production, which is the first link of this chain (6,7). However, in terms of food loss, the consumption process is a critical waste point for all food types. During consumption, 14-37% of animal products and 9-20% of fruits and vegetables are wasted (1). There are many causes of food waste by consumers however, the portion or package size of the food has been determined to be an important factor for food waste. A study conducted in Sweden (8) found that about a quarter of food waste is related to the package size. It has also been determined that the socio-economic and demographic characteristics

of a household or an individual affects the level of food waste (9).

FAO stated in a 2013 report (10) that 35% of food was wasted in households, restaurants and public consumption places. It has been also found that most of the food wasted in China is in the restaurant industry (11). There are approximately 8 million people that use institutional food services daily in our country, Turkey, and there are about 4.5 million public employees (12). Employees that are working in public hospitals are provided with lunch and dinner. In our country, there are a limited number of studies that measure the amount of waste happening during food production or consumption in hospital kitchens or food halls. It was found that food wasted in public hospitals constitutes approximately 50% of the total waste. In this context, hospitals can be considered as an important food waste producer. In this study, it was aimed to determine the amount of plate waste of the personnel eating in a hospital food hall and to evaluate the amount of waste according to food types.

Methods

Setting

This study was conducted between 4 November-3 December 2019 in the sultanbeyli State Hospital staff food hall, a public hospital in Istanbul. Plate and bread wastes of the hospital staff during lunch and dinner services in the food halls were measured.

Measures

Before the study, two food hall personnel were trained about the research plan. In the hospital, fixed 4-course meals with standard portion sizes are serviced to the staff without options. These 4-courses for each meal are; 1. Soup, 2. Main course with meat, 3. Grains such as rice, pasta, 4. Yogurt, salad, fruit, and dessert. In our study, the portion amount of all served meals were weighed and recorded separately before each service. In order to calculate the amount of plate waste, a waste bin was prepared for each food and beverage item that was in the daily menu of the hospital.

After the service, food waste was also collected in a separate waste box for each food item, weighed, and recorded by the food hall manager and the researcher. For packaged food, only the amount of actual food or beverage was weighed excluding the package weight. Measurements only included edible wastes, non-edible parts (bone, fruit peel, etc.) were not included. While collecting plate waste, the number of trays was also recorded which makes the number of people getting food service.

Ethics Approval, Data Collection, and Analysis

The authorization for our study has been planned in accordance with the guidelines published by Hamidiye Scientific Research Ethics Committee in Health Sciences University. In this directive, it is clearly indicated that as for studies on humans and animals' ethical consent is required. Therefore, since this study was not conducted on humans and only food waste was collected, an application for ethical authorization has not been made. To conduct the study, approval was obtained from the catering company serving the hospital. The amounts of the food and beverages served were recorded in grams using a Desis H2W brand digital precision scale (0.2 g Max: 6 kg). After the service, collected waste was weighed using a Cas brand electronic digital scale (max: 150 kg) and recorded in the Microsoft Excel program. SPSS (25th version) program was used for statistical analysis. Qualitative variables have been summarized as numbers and percentages, and quantitative variables as mean \pm standard deviation. In the analysis of quantitative variables, the interactive model was tested with two-way analysis of variance (Two-way ANOVA) for the effects of 2 factors (meal and type of food). 95% confidence intervals and effect sizes (Partial Eta Squared) are reported. Findings are also presented in bar-standard error graphs. Analysis results were evaluated at a 5% significance level.

Results

During this study, a total various of 240 different food and 60 meals were observed. 16,722 people (577 per day in average) were served. The total amount of waste was found to be 73.1 g per person (Table 1).

Table 1. The Total Amount of Food Served and Disposed at Lunch and Dinner According to Food Categories and The Amount of Waste Per Person

Category	Lunch (n=12,684)			Dinner (n=4,038)			Total (n=16,722)		
	Food served kg	Food waste kg (%)	Food waste per person (g)	Food served kg	Food waste kg (%)	Food waste per person (g)	Food served kg	Food waste kg (%)	Food waste per person (g)
Soups	1,789.2	156.2 (8.7)	12.3	598.9	34.0 (5.7)	8.4	2,388.1	190.2 (8.0)	20.7
Main Course	2,272.6	179.2 (7.9)	14.1	805.4	43.6 (5.4)	10.8	3,078.0	222.8 (7.2)	24.9
Grains	1,756.9	114.9 (6.5)	9.0	610.7	28.5 (4.7)	7.1	2,367.6	143.4 (6.1)	16.1
Salad/Fruit/Yogurt/Dessert	1,957.9	66.7 (3.4)	5.3	740.7	24.7 (3.3)	6.1	2,698.6	91.4 (3.4)	11.4
Total	7,776.7	517.0 (6.7)	40.8	2,755.6	130.8 (4.8)	32.4	10,532.3	674.8 (6.2)	73.1

n total number of people who were served

The total energy value of the soups served at lunch for thirty days was calculated to be 83,4233.8 kcal. 9.2% of this calorie was plate waste. Among the macronutrients, it was determined that the proteins were wasted the most (10.4%) (Table 2). The total energy of meals per person for each day was determined to be 1,245.2 kcal and 5.3% (66.4 kcal) of this energy was plate waste.

Except from the plate wastes, when the bread wastes were calculated, it was found that the daily averages for lunch were $3,074.0 \pm 806.13$ (min-max =

1,465-4,530) g, and the dinner was $1,608.67 \pm 588.69$ (min-max = 510-2945) g.

When the plate wastes are examined according to the food types, the wastes related to the soup types differs at lunch and dinner (According to the two-way ANOVA analysis, the interaction effect between the meal and soup types was found to be significant ($F(4,16711)=697,449$; $p<0.001$; Partial Eta Squared=0.143). In other words, the waste rates in lunch are mostly in soups containing meat (23.4%) and soups containing grains (14.8%), and at least in

Table 2. Total Energy, Protein, Fat and Carbohydrate Values of Food Served and Disposed at Lunch and Dinner According to Food Types

	Lunch				Dinner			
	Served (Disposed %)				Served (Disposed %)			
	Energy kcal (Disposed %)	Protein g (Disposed%)	Fat g (Disposed %)	CHO g (Disposed %)	Energy kcal (Disposed %)	Protein g (Disposed %)	Fat g (Disposed %)	CHO g (Disposed %)
Soup	834233.8 (9.2)	24718.2 (10.4)	45338.1 (9.0)	80982.8 (9.1)	306329.7 (5.5)	10993.4 (5.5)	15815.5 (5.5)	29635.4 (5.6)
Main Course	2714182.1 (7.0)	217950.0 (7.0)	145306.4 (7.6)	131433.4 (5.7)	1014943.5 (5.7)	85494.2 (6.1)	52972.1 (5.6)	48082.9 (5.1)
Grains	1878161.8 (6.6)	43033.2 (7.0)	89410.0 (6.7)	223432.0 (6.46)	768653.0 (4.5)	19408.4 (4.5)	31770.4 (4.0)	100273.0 (4.9)
Salad/Fruit/Yogurt/Dessert	1483527.4 (2.6)	36367.5 (3.2)	41938.5 (2.3)	232579.0 (2.6)	738446.5 (2.9)	16600.5 (3.0)	42422.5 (2.8)	70370.7 (3.0)

Table 3. A Comparison of Meal, Type and Interacting Factors Regarding the Amount of Soup Waste

Meal	Type	Mean±SS	95% Confidence Interval	
			Low	High
Lunch	Containing meat	23.4±0	22.97	23.79
	Traditional/Local	5.1±1.9	4.85	5.28
	Legume	8.4±6.1	8.19	8.52
	Vegetable	6.9±3.4	6.76	7.07
	Grain	14.8±12.4	14.57	15.09
	With yoghurt	5±0.2	4.36	5.65
Dinner	Containing meat	4.3±0.2	3.79	4.81
	Local	3.9±1.3	3.50	4.39
	Legume	5.8±2.3	5.53	6.07
	Vegetable	7.2±2.6	6.89	7.52
	With yoghurt	5.2±1.8	4.83	5.64
Variance Source	F	sd	p	Partial Eta Squared
Meal	1289.838	1	<0.001	0.072
Type	701.427	5	<0.001	0.173
Meal * Type	697.449	4	<0.001	0.143

sd(error)=16711

traditional/local (5.1%) and yoghurt soups (5%). For dinner time the rate of waste was mostly in vegetable soups (7.2%), at least in local (3.9%) and meat soups (4.3%) (Table 3). Main course plate waste differed in lunch and dinner according to the type of food ($F(4,16711)=273,673$; $p<0.001$; Partial Eta Squared=0.061). At lunch, waste rates are mostly in vegetables (13.5%) and least in legumes (3.9%). At dinner, waste rates are mostly in chicken (8.3%) and least in meatball type foods (3.9%) (Table 4).

Wastes related to rice-pasta group food types also found to be different in lunch and dinner (According to two-way ANOVA analysis, the interaction effect between meals and food in the rice-pasta group was found to be significant ($F(4,16710)=661,342$; $p<0.001$; Partial Eta Squared=0.137). In other words, the waste rates in lunch are mostly in pasta (11.7%) and vegetable foods with olive oil (11.1%) and at least in legumes with olive oil (3.4%). In the dinner, the waste rates are mostly in pasta (5.8%) and the least in pastry (non-sweet pastry types) (1.8%) (Table 5).

The waste rate at lunch is mostly in salad (6.5%) and least in pastry desserts (1.8%). In the dinner, the waste rates were mostly in pastry desserts (5.8%) and least in

pudding type desserts (1.8%). The wastes at lunch and dinner are different for salad /fruit /dessert /yoghurt according to the type of food ($F(5,16710)=258,800$; $p<0.001$; Partial Eta Squared=0.072) (Table 6).

Discussion

It is known that food waste is closely related to a country's economy. Also, consumer's role in plate waste is very big. In our study, 6.2% of the food served in a day was wasted. Some studies show that the amount of plate waste in the foodservice sector was found to be 30% in UK (13), 18.7% in USA (14), and 3.4% in Nigeria (15). The economic situation of the countries is an important determinant in terms of food waste. According to FAO data (16), consumer-based waste rate in middle and high-income countries is between 31-39%, while it is between 4-16% in low-income countries. Turkey is a country with very high food inflation and about 35% of the working population gets paid in minimum wage or under (17).

In the hospital we conducted our study, approximately 1200 people have the right to get food services,

Table 4. A Comparison of Meal, Type and Interacting Factors Regarding the Amount of Main Course Waste

Meal	Type	Ort±SS	95% Confidence Interval	
			Low	High
Lunch	Chicken	8.5±6.7	8.27	8.82
	Vegetable	13.2±9.7	13.05	13.40
	Meatball	2.5±2.4	2.25	2.82
	Legume	3.9±1.4	3.64	4.18
	Meat	5.7±3.8	5.52	5.92
	Fish	6.6±0	6.11	7.08
Dinner	Chicken	8.3±4.8	7.89	8.63
	Vegetable	5.4±1	5.15	5.70
	Meatball	2±0.4	1.45	2.52
	Legume	2.1±0.2	1.43	2.83
	Meat	4.9±3.1	4.47	5.26
Variance Source	F	sd	p	Partial Eta Squared
Meal	337.288	1	<0.001	0.020
Type	503.708	5	<0.001	0.131
Meal *Type	273.673	4	<0.001	0.061

sd(error)=16711

Table 5. A Comparison of Meal, Type and Interacting Factors Regarding the Amount of Grain Waste

Meal	Type	Ort±SS	95% Confidence Interval	
			Low	High
Lunch	Pasta	11.7±3.7	11.56	11.80
	Non-sweet Pastry	4.4±1.7	4.24	4.55
	Rice	4.1±2.1	4.02	4.23
	Bulgur Pilaf	4.8±3.2	4.69	4.89
	Vegetable with olive oil	11.1±5.4	10.98	11.26
	Fries	5.4±0	5.17	5.62
	Legumes with olive oil	3.4±0	3.12	3.61
Dinner	Pasta	5.8±2	5.63	5.90
	Non-sweet Pastry	1.8±1.3	1.57	2.12
	Rice	4±1.1	3.81	4.18
	Bulgur Pilaf	4.7±0.8	4.46	4.95
	Vegetable with olive oil	4.3±1.1	3.99	4.66
Variance Source	F	sd	p	Partial Eta Squared
Meal	2452.138	1	<0.001	0.128
Type	1334.235	6	<0.001	0.324
Meal *Type	661.342	4	<0.001	0.137

sd(error)=16710

Table 6. A Comparison of Meal, Type and Interacting Factors Regarding the Amount of Fourth Course (Yogurt / Fruit / Salad / Dessert) Waste

Meal	Type	Ort±SS	95% Confidence Interval	
			Low	High
Lunch	Salad	6.5±3.9	6.45	6.64
	Fruit Dessert	2.6±2.4	2.42	2.69
	Milk Group	2.9±3	2.85	3.04
	Fruit	2.9±2.5	2.79	2.99
	Pudding type dessert	2.5±0.9	2.36	2.68
	Pastry dessert	1.8±1.1	1.67	1.94
Dinner	Salad	4.4±1.5	4.23	4.59
	Fruit Dessert	2.8±0	2.43	3.26
	Milk Group	3±3	2.86	3.12
	Fruit	5±1.7	4.84	5.23
	Pudding type dessert	0.4±0.7	0.15	0.60
	Pastry dessert	5.1±1.7	4.78	5.50
Variance Source	F	sd	p	Partial Eta Squared
Meal	17.136	1	<0.001	0.001
Type	503.736	5	<0.001	0.131
Meal * Type	258.800	5	<0.001	0.072

sd(error)=16710

but at the end of the study, it was determined that an average of 577 people per day got served. Demographic data of the people getting food service were not taken, but as we saw during data collection, it was observed that employees with higher income (e.g. doctors) did not come to the food hall. The employees who got food service were mostly secretaries and janitors or caretakers. It can be thought as people with lower income will leave less plate waste. In a study conducted in Spain (18), consumers were asked whether the economic crisis reduced their food waste. 41% of the consumers participating in the survey stated that they reduced food waste and 13.7% said that they reused products such as oil. Consumer food waste was found to be low as a result of a FAO study in the Philippines, showing that buying small amounts of fruit and vegetables in both public markets and supermarkets reduces waste (19). At the end of our study, the amount of waste per person daily was determined to be 2.4 g. In a study in which plate waste was measured in the ordinary

daily lives of people in USA, it was determined that plate waste in daily was 5.6 g on average (20). There are common solution suggestions for all countries from a sectoral point of view, and especially in catering services, reducing portions and increasing consumer awareness are the most important messages to reduce wasted amount of food (21). In this context, Turkey also conducted a “zero waste” project (22), and various public institution’s waste reduction, and separation efforts are continuing within this framework.

The hospital catering service where we conducted our study, served fixed 4-course meals with standard portion sizes without options and 544.8 kcal was determined to be served for one person in an average meal. This calorie value is approximately 25% of the average 2000 referenced daily calories for adults (23). In fact, it is recommended that lunch should provide 33-50% of daily energy for employees. This shows us that either low-calorie meals were served, or portion amounts were lower than expected, in this study, the average portions

A STATE HOSPITAL STAFF MEAL LIST

DATE	LUNCH				DINNER			
	1. COURSE	2. COURSE	3. COURSE	4. COURSE	1. COURSE	2. COURSE	3. COURSE	4. COURSE
4.Nov.19	DUGUN	CHICKEN CHOP	SPAGHETTI	SEASONAL SALAD	MUSHROOMS	GREEN BEANS WITH MEAT	RICE WITH CHICKPEAS	AYRAN
5.Nov.19	TARHANA	STUFFED PEPPERS	ROSE PASTRY	CHERRY COMPOSTO	VEGETABLES	TAS KEBABU	BULGUR PILAF	TANGERINE
6.Nov.19	RED LENTIL	IZMIR MEATBALL	NOODLE	YOGHURT	EZOGE LIN	KAPUSKA	PASTA WITH SAUCE	REVANI
7.Nov.19	MUSHROOMS	BEANS WITH MEAT	TURKISH RICE	PICKLES	YAYLA	GRILLED MEAT BALLS	TURKISH RICE	SEASONAL SALAD
8.Nov.19	TOMATO	CHINESE CHICKEN	BULGUR PILAF	APPLE	TUTMAC	KAPUSKA	PASTA WITH CHEESE	KESKÜL
9.Nov.19	EZOGE LIN	CAULIFLOWER	PASTRY WITH POTATO	YOGHURT	TARHANA	CHICKEN SAUTE	RICE	TANGERINE
10.Nov.19	RED LENTIL	BAHÇEVAN KEBAB	TURKISH RICE	SUPANGLE	MUSHROOMS	PEAS WITH MEAT	NOODLE	AYRAN
11.Nov.19	TARHANA	KAPUSKA	OVEN PASTA	PEAR	TOMATO	TRAY KEBAB	TURKISH RICE	CACIK
12.Nov.19	NOODLE	SEASONED MEATBALLS	LENTIL BULGUR PILAF	YOGHURT	EZOGE LIN	POTATO PASTE	DUMPLINGS	SEASONAL SALAD
13.Nov.19	MUSHROOMS	CHICKPEAS WITH MEAT	TURKISH RICE	PICKLES	TARHANA	CHICKEN CHOP	LEEK WITH OLIVE OIL	KAZANDIBI
14.Nov.19	BROCCOLI	ROAST BEEF	BULGUR PILAF	AYRAN	TUTMAC	FRIED CAULIFLOWER	CHEESY PASTRY	YOGHURT
15.Nov.19	TOMATO	MEAT FRESH BEANS	TURKISH RICE	SEKERPARE	YAYLA	SINITZEL	PASTA SALAD	ORANGE
16.Nov.19	EZOGE LIN	HASANPASA MEATBALL	CELERY WITH OLIVE OIL	YOGHURT	VEGETABLES	BEANS WITH MEAT	TURKISH RICE	CACIK
17.Nov.19	NOODLE	ZUCCHINI MUSAKKA	BULGUR PILAF	SEASONAL SALAD	RED LENTIL	MEAT SOTE	NOODLE	RICE PUDDING
18.Nov.19	TARHANA	CHICKEN TOPKAPI	LEEK WITH OLIVE OIL	TANGERINE	KOYLU	TYPE	TURKISH RICE	YOGHURT
19.Nov.19	EZOGE LIN	PEAS WITH MEAT	RICE WITH CORN	AYRAN	DUGUN	IZMIR MEATBALL	BULGUR PILAF	SEASONAL SALAD
20.Nov.19	YAYLA	TAS KEBAB	NOODLE	GRAPE compote	TARHANA	EGGPLANT MUSAKKA	TURKISH RICE	AYRAN
21.Nov.19	MUSHROOMS	CHICKPEAS WITH MEAT	SEHRİYE BULGUR PILAF	CACIK	EZOGE LIN	BOILED CHICKEN	VEGETABLE KUSKUS	ORANGE
22.Nov.19	TARHANA	Y'EFKA KEBAB	CELERY WITH OLIVE OIL	IRMIC HALVA	TUTMAC	KAPUSKA	PASTA WITH CHEESE	YOGHURT
23.Nov.19	EZOGE LIN	MEAT FRESH BEANS	OVEN PASTA	SEASONAL SALAD	DUGUN	MEATBALLS	OLIVE OIL BARBUNIA	AYRAN
24.Nov.19	TOMATO	CURRY CHICKEN	TURKISH RICE	TANGERINE	MUSHROOMS	STUFFED PEPPERS	SU PASTRY	PEAR
25.Nov.19	NOODLE	KAPUSKA	PASTA WITH SAUCE	ASHURE	RED LENTIL	CHICKEN CHOP	TURKISH RICE	CARROT TARATOR
26.Nov.19	YAYLA	Roast Beef	BULGUR PILAF	ORANGE	VEGETABLES	BEANS WITH MEAT	RICE	PICKLES
27.Nov.19	TARHANA	POTATO PASTE	ROAST VEGETABLES	SEASONAL SALAD	TOMATO	MEAT SOTE	LENTIL BULGUR	SEKERPARE
28.Nov.19	RED LENTIL	HASANPASA MEATBALL	BULGUR PILAF	TANGERINE	EZOGE LIN	FRIED CAULIFLOWER	TURKISH RICE	YOGHURT
29.Nov.19	TARHANA	WHITE BEAN STEW WITH MEAT	TURKISH RICE	PICKLES	YAYLA	OVEN CHICKEN	TRAY PASTRY	GRAPE Compote
30.Nov.19	MUSHROOMS	CASSEROLE	ROAST VEGETABLES	AYVA DESSERT	TUTMAC	GREEN BEANS WITH MEAT	RICE	SEASONAL SALAD
1.Dec.19	SEHRİYE	STUFFED PEPPERS	SU PASTRY	CHERRY COMPOSTO	RED LENTIL	THE MIXED GRILL	BULGUR PILAF	CARROT TARATOR
2.Dec.19	EZOGE LIN	FISH (FRESH)	OLIVE OIL BARBUNIA	TAHINI HALVA	TARHANA	MEAT WITH PEAS	OVEN PASTA	KESKÜL
3.Dec.19	TOMATO	MIXED MUSAKKA	BULGUR PILAF	YOGHURT	DUGUN	TAS KEBAB	TURKISH RICE	CELERY SALAD

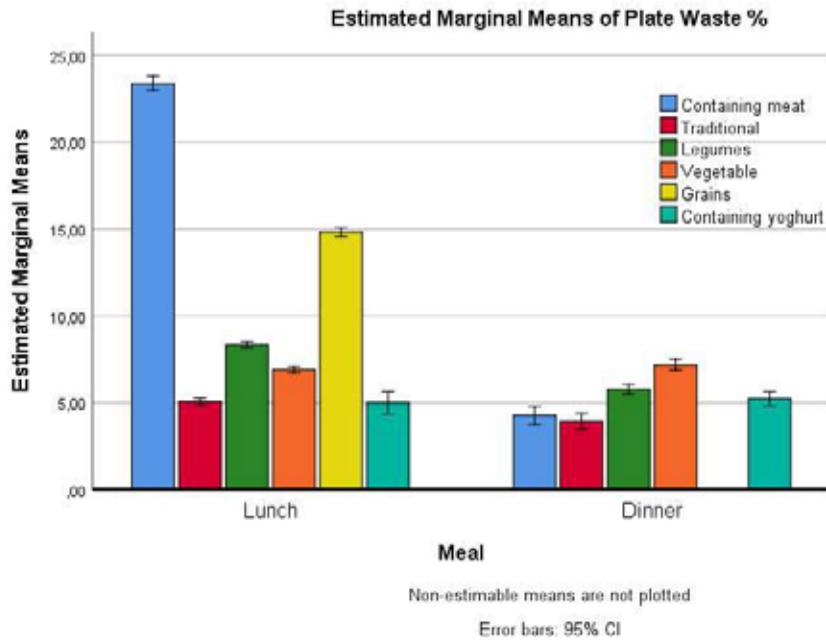


Figure 1 is the same as Table 3.

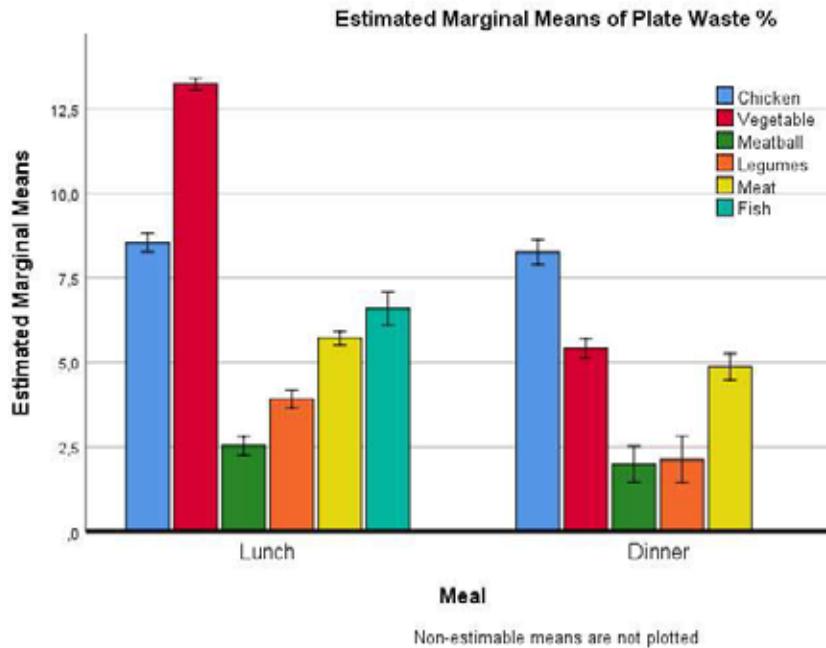


Figure 2 is the same as Table 4.

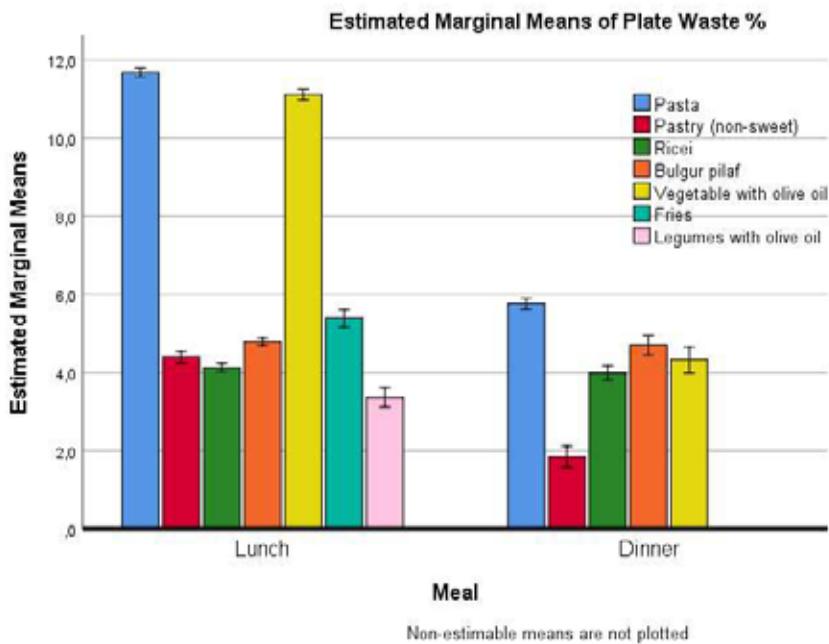


Figure 3 is the same as Table 5.

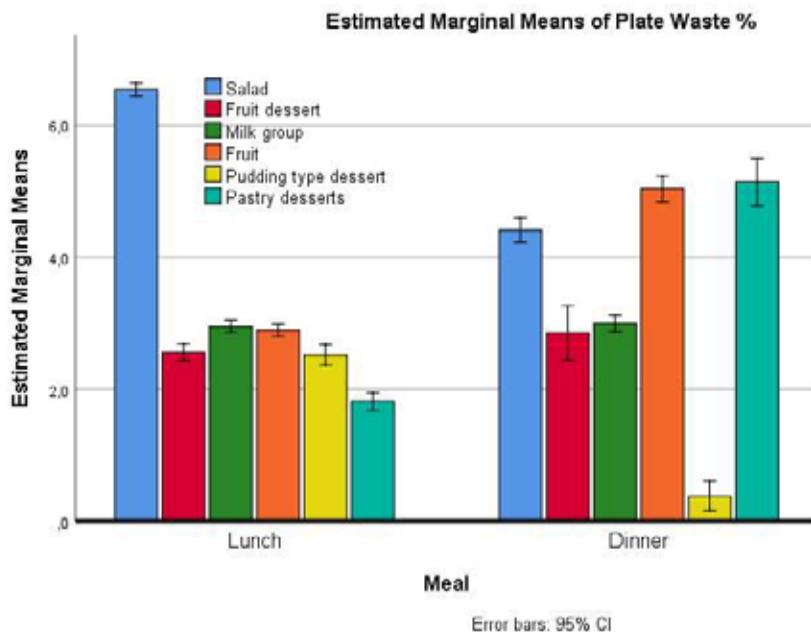


Figure 4 is the same as Table 6.

according to food types were found as following: Soup 141.1 g, main course 178.8 g, grains group 139.0 g and others 155.3 g. These amounts are lower than the standard values (soup 200 g, main course 200 g, grains group 150 g, milk group 180 g, fruit 150-200 g, salad 100 g, desserts 75-200 g). This is a good practice in terms of reducing plate waste, but it can be nutritionally inadequate. In addition, with the zero-waste project, the awareness of the hospital staff on plate waste has been increased. As a matter of fact, a campaign to reduce bread waste was started in 2013 in order to raise awareness of the public about food waste, to prevent losses throughout the supply chain and to encourage the consumption of whole wheat bread in our country. Thanks to the explanation of bread waste to the public and voluntary efforts, the bread waste decreased from 5.9 million in 2012 to 4.9 million in 2013 (6). Consumer studies show that consumers are unaware of the amount of food wasted. Therefore, the first step should be to inform consumers about the amount of food lost or wasted (24). In this study, it was determined that an average of 86.6 kg of bread was served daily and 4.7 kg (5.4%) of it was wasted. Bread is served in 50-gram bags. This amount includes the bread left in their unopened packages. It has been determined that the daily number of unopened packaged bread is 23 on average.

In a study conducted in Turkey (25), for the prevention and identification of food wastage rates in general, about 86% of population stated that they threw their non-consumed bread at home to the trash (226 g per person), their monthly expense for food items is an average of 443.3 Turkish Lira, the level of consciousness about food consumption was determined to be an average of 72%.

Food taste or personal tastes can affect the amount of waste (26). Evaluating plate waste according to food types can be used in menu planning as one of the waste reduction strategies. In a study conducted in Portugal (27), it was determined that 11.8% of soups, 19.8% of main courses, 18.8% of grains and a total of 14.9% of vegetables and fruits were wasted. In our study, among all courses, the least plate waste was in the 4th course which was served as ayran and rice pudding (0%) and the most waste was in the meat capuska with 36% from the main course. According to the food types, the least waste was

in Tarhana soup (0.5%) which is a traditional soup and the highest amount was in Dugun soup (23.4%).

It was determined that the least waste in the main course was sauté with 0.5%. The least waste from grain group dishes (0.5%) was found in Bulgur pilaf, rice with corn and Su pastry (non-sweet pastry), and the most waste (9.5%) was in the spaghetti dish. Among the other 4th course dishes, waste was the most with seasonal salad (10%). When the data obtained are evaluated, the low amount of plate waste can indicate the suitability of the menu. However, considering most wasted foods at the menu planning stage can be an important step for ending waste. For a sustainable life and nutrition in all over the World, avoiding waste of all edible foods and preserving food at every stage of the food chain are essential for our future.

Limitations

Not knowing the demographic characteristics, economic conditions and consumption behaviors of consumers are the limitations of our study. Although this study is only aimed to reveal the amount of plate waste, it is necessary to plan studies involving the consumer in order to reveal the causes of plate waste. In addition, alongside the amount of plate waste, non-edible food waste, packaging waste, etc. can also be measured. Lastly, we collected plate waste in our study, but we did not get an understanding of kitchen production wastes and food waste left in the cauldron in mass catering services.

Implications for Research and Practice

Determining the amount and type of waste consumers leave by evaluating their knowledge, attitudes and behaviors on food waste together with the level of food insecurity can enable more effective measures to be taken on waste management.

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References

1. FAO. The State of Food and Agriculture. Moving forward on food loss and waste reduction. Rome. 2019. (also available at <http://www.fao.org/3/CA6030EN/CA6030EN.pdf>)
2. FAO. Influencing food environments for healthy diets. Rome. 2016. (also available at <http://www.fao.org/3/a-i6484e.pdf>).
3. Conrad, Z., Niles, M.T., Neher, D.A., Roy, E.D., Tichenor, N.E. & Jahns, L. Relationship between food waste, diet quality, and environmental sustainability. *PLOS ONE*, 2018, 13(4): e0195405.
4. Buzby, J.C., Farah-Wells, H. & Hyman, J. The estimated amount, value, and calories of postharvest food losses at the retail and consumer levels in the United States. 2014.
5. Hodges, R.J., Buzby, J.C. & Bennett, B. Postharvest losses and waste in developed and less developed countries: opportunities to improve resource use. *The Journal of Agricultural Science*, 2011, 149(S1): 37–45.
6. Turkish Grain Board (TMO). The meeting held for the announcement of the results of the Campaign for Preventing Bread Waste. 2014. (also available at <http://www.tmo.gov.tr/Main.aspx?ID=1045>).
7. FAO & CIHEAM. Zero Waste in the Mediterranean. Natural Resources, Food and Knowledge. Paris, Presses de Sciences Po. 2016.
8. Williams, H., Wikström, F., Otterbring, T., Löfgren, M. & Gustafsson, A. Reasons for household food waste with special attention to packaging. *Journal of Cleaner Production*, 2012, 24: 141–148.
9. Parfitt, J., Barthel, M. & Macnaughton, S. Food waste within food supply chains: quantification and potential for change to 2050. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 2010, 365(1554): 3065–3081.
10. FAO. The State of Food and Agriculture 2013. Food systems for better nutrition. Rome. (also available at <http://www.fao.org/3/i33300e/i33300e.pdf>).
11. Liu, G. Food losses and food waste in China. A first estimate. *OECD Food, Agriculture and Fisheries Papers*, 2014.
12. Kaya, S. Y., & İlhan, S. Problems and Solution Proposals Related in The Catering Sector. *Journal of Contemporary Tourism Research*, 2018, 2(1), 553–581.
13. Ventour, L. The food we waste: Food waste report v2. United Kingdom: Banbury (UK): Waste and Resources Action Programme, 2008.
14. Pavone, Lauren, et al. Consumer Food Waste and Its Implications for Sustainable Food Management in the University Setting (OR20-05-19). *Current developments in nutrition*, 2019, 3. Supplement_1: nzz047. OR20-05-19.
15. Akerele, D., Afolayan, S. O., Oyawole, F. P., & Sanusi, R. A. Socioeconomic determinants of food waste among households in Abeokuta, Ogun State, Nigeris. *Nigerian Journal of Agricultural Economics*, 2017, 7(2066-2018-1341), 25–35.
16. FOOTPRINT, FAO. Food Wastage. Impacts on natural resources. Summary Report, 2013, 63.
17. Aslan, G. The Number of Minimum Wage Workers and the Change in Wage Levels (2003-2017 Household Labor Force Surveys Data Analysis). *Journal of Social Security*, 2019, 9(1), 141-159.
18. MAGRAMA. More food, less waste strategy program for the reduction of food losses and waste and the recovery of discarded food. 2013.
19. Esguerra, E.B., Del Carmen, D.R. & Rolle, R.S. Purchasing patterns and consumer level waste of fruits and vegetables in urban and peri-urban centers in the Philippines. *Food and Nutrition Sciences*, 2017, 08(10): 961–977.
20. Roe, Brian E., et al. Plate waste of adults in the United States measured in free-living conditions. *PloS one*, 2018, 13.2: e0191813.
21. ReFED. A roadmap to reduce US food waste by 20 percent. 2016. (also available at <https://www2.deloitte.com/us/en/pages/operations/articles/refed-roadmap-to-reduce-us-food-waste.html>).
22. T.R. Ministry of Environment and Urban <http://zerowaste.gov.tr/> Accessed May 12, 2020
23. T.R. Ministry of Health Primary Health; Services Directorate, Specific Nutrition Guide Turkey. Ankara, May 2004, 1-54.
24. Bond, M., Meacham, T., Bhunnoo, R., & Benton, T. G. Food waste within global food systems. *A Global Food Security Report*. 2013
25. Tatlıdil, F. F.; Dellal, I.; Bayramoglu, Z. Food losses and waste in Turkey. Country Report Prepared. National Adaptation Plans (NAPs), 2013.
26. Zhao, Xingyi; Manning, Louise. Food plate waste: factors influencing insinuated intention in a university food service setting. *British Food Journal*, 2019.
27. Carvalho, Joana Gonçalves; Lima, João Pedro Marques; Da Rocha, Ada Margarida Correia Nunes. Food waste and consumer satisfaction with the food service of Hotel and Tourism School of Coimbra, Portugal. *Demetra: Food, Nutrition & Health*, 2015, 10.2: 405-419.

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