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Drivers and Determinants of Food Waste Generation in Restaurants Serving Mediterranean Mezze-Type Cuisine

Ali Chalak ^{1,†} , Hussein F. Hassan ^{2,†}, Pamela Aoun ³  and Mohamad G. Abiad ^{3,4,*} 

¹ Department of Agriculture, Faculty of Agricultural and Food Sciences, American University of Beirut, P.O. Box 11-0236, Riad El Solh, Beirut 1107-2020, Lebanon; ac22@aub.edu.lb

² Nutrition Program, Department of Natural Sciences, School of Arts and Sciences, Lebanese American University, P.O. Box 13-5053, Chouran, Beirut 1102-2801, Lebanon; hussein.hassan@lau.edu.lb

³ Department of Nutrition and Food Sciences, Faculty of Agricultural and Food Sciences, American University of Beirut, P.O. Box 11-0236, Riad El Solh, Beirut 1107-2020, Lebanon; pga09@mail.aub.edu

⁴ Laboratories for the Environment, Agriculture, and Food (LEAF), Faculty of Agricultural and Food Sciences, American University of Beirut, P.O. Box 11-0236, Riad El Solh, Beirut 1107-2020, Lebanon

* Correspondence: ma192@aub.edu.lb; Tel.: +961-1-350000 (ext. 4412)

† These authors have contributed equally to this manuscript.

Abstract: Food waste from the food service and hospitality industry is increasing, especially in Mezza serving restaurants, where a variety of dishes are usually served. To date, information on the factors affecting food waste generation in restaurants is scarce. This study aimed to identify the drivers and determinants of food waste generation while dining out at restaurants serving Mezza-type cuisine. According to the results from a convenience sample of 496 restaurant clientele, gender, age, and marital status did not affect food waste generation. Diners in both low and high price range restaurants waste above the grand mean compared to middle-range ones. Waste generation decreased significantly as the number of diners per table increased. However, ordering water-pipe, alcohol, or more dishes contributed significantly to food waste generation. As food waste is not the outcome of a single behavior, our study puts food waste generation drivers and determinants while dining out in perspective.

Keywords: food waste; post-consumer waste; restaurants; dining out; waste



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1. Introduction

The projections of a world population increase to 9.6 billion individuals by 2050 has driven many commentators to note that food production needs to increase by a minimum of 70% to keep up with the pace [1–3]. However, increasing food production requires extensive use of resources, such as land, water, and fuel, among others, all of which are associated with massive environmental and economic burdens on the very populations they aim to feed adequately. Additionally, food producers are often challenged with massive competition for these resources, thus limiting the quantity of food that can be produced. A promising solution in this regard is to reduce the amount of food lost and wasted [4–8].

The Food and Agriculture Organization (FAO) describes “food loss” as a decrease in edible food in quantity or quality, typically occurring during production and distribution along the food supply chain, mainly due to the production and food supply system’s performance or its institutional and legal frameworks. On the other hand, “food waste” is considered to be suitable food for human consumption that has been disregarded from the food supply chain by choice or because it has spoiled or expired. Food waste can be attributed to economic or social behavior, poor stock management, or neglect at the retail, hospitality, or consumer levels [9]. Reducing food waste, including that generated

by restaurants, can save what is equivalent to 30% of available land used in agriculture, reduce greenhouse emissions, and feed malnourished people [10].

Much research has been carried out on household food waste but not the waste generated in the hospitality sector [11]. Food waste from the food service and hospitality industry is rising, especially since food is increasingly consumed out-of-home [12]. This can be attributed to increasing work hours, rapid urbanization, dietary transition, and lifestyle changes [13]. Additionally, consumers are spending more money on dining out than on groceries, which may be attributed to long working hours or a lack of cooking skills [14]. It is estimated that food services generate 20 to 25% of food waste, with plate waste being the largest waste source [15]. Plate waste is defined as the quantity of edible parts of the food served that has not been eaten [13]. According to the Food and Brand Lab at Cornell University, diners leave on average 17% of their meals uneaten, with 55% of edible leftovers being left at the restaurant [16]. A study conducted in the UK showed that more than a quarter of the respondents left food at the end of their meal [17]. To effectively control food waste in restaurants, it should become a component of the restaurants' management system [18]. Most of the studies in the literature on food waste at restaurants focus mainly on the quantity, rather than on the underlying causes, and the information on this issue remains scarce for Arab countries, including Lebanon [19,20].

Mezze is an essential component of Lebanese cuisine, not least in restaurants. It is similar to Tapas of Spain, Mezeluri of Romania, and Stuzzichini of Italy. Mezze consists of an elaborate variety of hot and cold small dishes placed before guests, creating a wide selection of flavors, colors, aromas, and textures. It may be as simple as bread, raw vegetables, pickles, and dips, such as hummus and baba ghanouj, or it may be a complete meal that consists of salads, grilled meats, and desserts. Mezze dishes are generally shared by different people at the table and consumed in small bites using a piece of flatbread. It can range from twenty to sixty dishes, making food waste inevitable [21,22].

In Lebanon, 60% of the people face challenges in getting enough to eat. Furthermore, it is estimated that 52.5% of the municipal solid waste in Lebanon is organic, mainly food debris and waste [23]. Such inefficiencies need immediate attention and action, including efforts to reduce food waste, all the more so in light of the severe economic crisis ravaging the country since the summer of 2019 and its repercussions on poverty levels and food security. To effectively reduce food waste, a clear understanding of the drivers and determinants influencing consumers' behaviors and perceptions regarding food waste is required. Understanding quantities, reasons, and food waste patterns is essential for exploring strategies to reduce food waste at the restaurant level [24–26] assessed the determinants of food waste generation at the household level in Lebanon. [27] explored food waste generation in the hospitality and food retail and wholesale sectors in 44 countries with developed economies. To the best of the authors' knowledge, this study was the first of its kind that aimed to identify the drivers and determinants of food waste generation while dining out at restaurants serving mezze type/Mediterranean-Lebanese foods.

2. Methodology

2.1. Questionnaire

A questionnaire, composed of 33 questions, was developed in English and translated into Arabic to assess the drivers and determinants of food waste generation among consumers dining out at restaurants serving mezze/Lebanese food. The questionnaire was piloted on 50 participants. On average, each survey took up to 20 min to be completed. The questionnaire comprised three different sections. The first section covered the participants' demographic characteristics; the second section included attitudes and culturally relevant behaviors related to food waste; the third section included ethical and religious questions related to food waste. The study was approved for ethical compliance by the Institutional Review Board (IRB) at our institution. Informed consent was obtained from all subjects involved in the study. To ensure respondents' anonymity, no personal identifiers were

collected. Participants were informed that the study was completely voluntary and that they could withdraw from the study at any time or refrain from answering any question.

2.2. Study Population

A convenience sample of 496 consumers dining out at different Lebanese restaurants located in the Greater Beirut area was interviewed between December 2018 and April 2019 by trained interviewers. The interview process consisted of two steps. First, the interviewer took the consent of the restaurant's manager to approach consumers while dining out. Next, the interviewer approached the consumers and explained the purpose of the study, its procedure, confidentiality, and risks/benefits to the participant. Each participant signed a written consent form to participate in the study. The study included only respondents over 18 and under 60 years of age. A full list of restaurants serving mezze/Lebanese food was obtained by using the Zomato application [28], which compiles all restaurants operating in Beirut, Lebanon. Zomato classifies restaurants into four categories based on the average meal price for two people. To ensure diversity among the restaurants, participants were recruited proportionally to the number of restaurants in each category. Sample characteristics are presented in Table 1.

Table 1. Socio-demographic characteristics of the study sample.

Participants' Characteristics	n = 496
Gender	
Female	297 (59.87)
Male	199 (40.12)
Age Group	
18–24	131(26.73)
25–34	178 (36.33)
35–44	82 (16.73)
45–54	68 (13.88)
55+	31 (6.33)
Marital Status	
Single	269 (54.23)
Married	209 (42.14)
Divorced	13 (2.62)
Widowed	2 (0.4)
Refuse to answer	3 (0.96)
Employment Status	
Self-employed	99 (19.96)
Student	78 (15.73)
Employed	254 (51.21)
Unemployed	65 (13.10)
Monthly Income	
Less than USD 450	21 (4.23)
Between USD 451 and USD 800	27 (5.44)
Between USD 801 and USD 1600	101 (20.36)
Between USD 1601 and USD 2399	75 (15.12)
Between USD 2400 and USD 4499	60 (12.1)
More than USD 4500	51 (10.28)
I don't know/Refuse to answer	1612 (32.46)

2.3. Food Waste Collection and Measurement

After completing the questionnaire, the interviewer waited for the consumers to finish eating, and then the waiter collected the remaining food in a plastic bag. The leftovers were then measured in grams using a portable balance. Knowing that Lebanese restaurants serve mezze-type foods, the dishes are always shared. For each survey, an average waste quantity was calculated by dividing the amount of food waste generated by the number of persons at the table.

2.4. Statistical Analysis

Given the substantial amount of left-censoring at zero in the data, food waste was null for 156 respondents (i.e., 31.5%). Model estimation was performed in a Tobit framework. Tobit models are recommended for fitting models with ‘limited dependent’ censored variables and are often referred to as ‘corner-solution’ models [29,30]. A set of covariates was selected to explain the systematic variation in food waste (expressed in grams per person). These are listed in Table 2, along with the proportions of their respective levels in the sample.

Table 2. List of covariate and sample characteristics.

Variable	N	Mean	Std. Dev.	Min.	Max.
Restaurant’s price range					
LBP50,000 or less for 2 people	146	0.294	0.456	0	1
LBP50,001-LBP120,000 for 2 people	273	0.550	0.498	0	1
More than LBP120,000 for 2 people	77	0.155	0.363	0	1
Number of people at the table					
1–2 people	250	0.504	0.500	0	1
3–4 people	168	0.339	0.474	0	1
6 people or more	78	0.157	0.364	0	1
Number of dishes per person					
Up to 2 dishes	254	0.512	0.500	0	1
2–4 dishes	130	0.262	0.440	0	1
More than 4 dishes	112	0.226	0.419	0	1
With whom are you dining out?					
Alone/Friends/Colleagues	253	0.510	0.500	0	1
Partner/Family	243	0.490	0.500	0	1
Main motive for dining out					
Leisure	446	0.899	0.301	0	1
Business/Convenience	50	0.101	0.301	0	1
Have you ordered narghile?					
Yes	250	0.504	0.500	0	1
No	246	0.496	0.500	0	1
Have you ordered alcoholic drinks?					
Yes	96	0.194	0.395	0	1
No	400	0.806	0.395	0	1
Are you on a diet					
Yes	162	0.327	0.469	0	1
No	334	0.673	0.469	0	1
How often do you eat everything you have ordered?					
Never/Rarely	92	0.185	0.389	0	1
Sometimes/Very often	262	0.528	0.500	0	1
Always	142	0.286	0.452	0	1
I always over order food when dining out					
(Strongly) Disagree/Neither agree nor disagree	336	0.677	0.468	0	1
(Strongly) Agree	160	0.323	0.468	0	1
I will make an effort to reduce food waste					
(Strongly) Disagree/Neither agree nor disagree	100	0.202	0.402	0	1
(Strongly) Agree	396	0.798	0.402	0	1

3. Results and Discussion

The Tobit model estimates calculated using Stata 16.1 are summarized in Table 3. In addition to these model estimates, we used the Tobit model estimates to derive expected food waste values (along with 95% confidence intervals) for the overall sample (grand mean). The various subsamples were codified utilizing the covariates’ various levels. Within each covariate, pairwise comparisons across the various subpopulations’ expected food waste values were conducted and reported in Table 3. Model and expected food waste estimates will be discussed jointly in the remainder of this section. We aimed to identify

the drivers and determinants of food waste generation while dining out at Mediterranean-Lebanese restaurants. The respondents' socio-demographic characteristics, such as gender, age, and marital status, did not affect the food waste generation. This was in line with other studies [31–34], which reported that socio-demographic characteristics are modest predictors of food waste generation.

Our results indicated that a Lebanese restaurant diner wasted an average of 179 g of food. When results are broken down by various restaurant price ranges, diners in both the lower- and higher-range restaurants wasted above the grand mean (208 and 205 g, respectively). While insignificantly different from each other, the food waste level of the former group was significantly different from that of mid-range restaurants, in which an average of 157 g of food was wasted per person (22 g less than the grand mean). [35] argued that food price is a significant determinant of food waste avoidance. Whereas diners in higher-price range restaurants tend to have higher incomes, ordering more food and thus paying higher bills is not an issue for them. Additionally, it is observed among such restaurants that the waiters give more suggestions and encourage customers to order more items, compared to lower priced restaurants, for the aim of generating more income, but this also increases food waste at the same time.

On the other hand, in lower price range restaurants, menu items are usually cheaper, and customers tend to over-order food. In contrast, diners at mid-range restaurants usually belong to the middle class, where price is a major determinant in their food choice [35,36]. To this category of customers, food waste is perceived as a financial loss [37]. Middle-class customers are price conscious and are reluctant to waste money [38,39]; therefore, they tend to produce less waste [40,41].

When breaking down food waste by the number of persons at the table, results showed that average food waste was highest (207 g per person) among diners at tables with 1–2 people. Food waste significantly dropped to approximately 150 g per person for tables with three or more people. On the other hand, the number of dishes per person turned out to be a strong food waste driver. Our results show that the average food waste increases significantly from 130 g per person from tables with up to two dishes served per person, to 205 g from tables with two to four dishes per person, then again to 281 g from tables where more than four dishes are served per person. Since Lebanese cuisine involves a large number of mezze platters, ordering more dishes broadens the range of selection for people sitting at the table, which will increase the likelihood of waste generation [42]. Furthermore, since the mezze platters are always shared, the food waste decreases as the number of people at the table increases.

In terms of the company/accompanying party at the restaurant, the results suggest that food waste generated from tables where the respondent is dining alone or with friends or colleagues (169 g per person) was insignificantly different from the amount of food waste generated from tables where the individual is dining out with one's partner or family member(s) (188 g). Likewise, the main motive for dining out had little significant influence over the amount of food waste generated when contrasting dining for leisure (180 g per person) with dining for business or for convenience (164 g). In terms of accompaniments to food typically ordered in Lebanese restaurants, both narghile and alcohol, when ordered to the table, seemed to contribute significantly to raising food wasted per person. When narghile was ordered to the table, average food waste significantly increased from 152 to 207 g. This can be attributed to the fact that, due to the suppression of appetite from nicotine, smokers tend to eat less and waste more than non-smokers [43]. On the other hand, when alcohol was ordered, food waste increased by a slightly lower amount, namely from 170 to 217 g. Whereas the average number of dishes ordered per person was lower at tables where waterpipe(s)/(hookah) was/were ordered (1.36 dishes vs. 1.70 in tables with no narghile(s)), it was higher in tables where alcohol was ordered (2.12 compared to 1.40 at tables with no alcohol).

Table 3. Model and expected food waste estimates.

Variable	Model	Expected Waste (g/Person)	95% Conf. Int.
Model and expected food waste estimates			
Constant/Grand mean	242.79 ***	178.5	(159.4–197.7)
Restaurant's price range			
LBP50,000 or less for 2 people	-	207.7 ^b	(166.8–248.6)
LBP50,001-LBP120,000 for 2 people	-81.98 **	157.1 ^a	(132.9–181.3)
More than LBP120,000 for 2 people	-3.55	205.3 ^{ab}	(150.6–260.1)
Number of people at the table			
1–2 people	-	206.8	(177.8–235.7)
3–4 people	-86.80 **	153.6 ^a	(123.5–183.8)
6 people or more	-94.66 **	149.2 ^a	(105.1–193.3)
Number of dishes per person			
Up to 2 dishes	-	130.1	(105.6–154.5)
2–4 dishes	128.55 ***	205.1	(165.3–245.0)
More than 4 dishes	234.81 ***	281.4	(228.3–334.5)
With whom are you dining out?			
Alone/Friends/Colleagues	-	169.4 ^a	(143.3–195.4)
Partner/Family	30.95	188.3 ^a	(160.6–216.1)
Main motive for dining out			
Leisure	-	180.2 ^a	(160.0–200.4)
Business/Convenience	-27.16	163.9 ^a	(107.6–220.3)
Have you ordered narghile?			
Yes	-	207.0	(178.0–236.0)
No	-90.02 ***	152.0	(126.7–177.3)
Have you ordered alcoholic drinks?			
Yes	-	216.7	(167.2–266.3)
No	-73.32 *	170.0	(148.9–191.0)
Are you on a diet			
Yes	-	142.5	(112.8–172.2)
No	93.32 ***	197.7	(173.5–222.0)
How often do you eat everything you have ordered?			
Never/Rarely	-	264.3	(212.5–316.0)
Sometimes/Very often	-96.24 **	196.9	(169.8–224.1)
Always	-260.93 ***	106.9	(79.8–134.1)
I always over order food when dining out			
(Strongly) Disagree/Neither agree nor disagree	-	165.8	(143.3–188.2)
(Strongly) Agree	65.99 *	207.0	(170.9–243.1)
I will make an effort to reduce food waste			
(Strongly) Disagree/Neither agree nor disagree	-	220.7	(174.8–266.5)
(Strongly) Agree	-81.27 **	168.7	(147.9–189.4)
<i>Model fit</i>			
Nr. Respondents	496		
Log-Likelihood	-2554.14		
Likelihood ratio χ^2 (<i>p</i> -value in brackets)	119.16 (0.000)		
Akaike information criterion (AIC)	5142.27		
Bayesian information criterion (BIC)	5213.78		

Note: (1) Legend: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$. (2) For each covariate, expected waste values sharing the same letter are insignificantly different at the 10% significance level. For example, with a covariate with three levels, if all three expected waste values share the letter 'a', then they are all insignificantly different. However, if one has next to it the letter 'a', the second 'b', and the third 'ab', then the first two are significantly different, while each is insignificantly different from the third. Finally, if no letters are found next to any of the three values, this means that any two of the three expected waste values are significantly different.

Moving to the behavioral and attitudinal characteristics of survey respondents answering on behalf of the surveyed tables, being on a diet significantly decreased average food waste from 198 to 143 g per person. People following a diet or watching their weight tend to pay more attention to what they eat, so they usually avoid over-ordering food; in doing so, they limit the quantity of food waste generation. The frequency of eating everything ordered seems to be the strongest determinant of food waste. Here, average food waste at tables whose respondents reported "never" or "rarely" eating everything ordered was

highest (264 g per person) and significantly more so compared to tables whose respondents reported doing so sometimes or very often (197 g). In turn, these had an average food waste that was significantly higher than tables whose respondents reported always eating everything ordered (107 g). As for the tendency to over-order food, respondents who (strongly) agreed they do so had an average food waste level (207 g per person) that was significantly higher than people who did not (166 g). Finally, in terms of attitudes and beliefs, the respondents' pledge to reduce food waste seemed to be significantly consequential, whereby tables with respondents who (strongly) agree to such a pledge had an average food waste figure of 169 g per person, which was significantly lower than tables whose respondents did not pledge to reduce food waste (221 g). This was in line with a study in Denmark which reported that attitudes towards and beliefs in the merits of reducing food waste were positively linked to the intention not to waste food [34,44]. Furthermore, when an individual had unfavorable evaluations of food waste behavior, the intention to reduce food waste increased [37,45–47].

Questionnaires were filled by one representative of the table, and one limitation is the fact that some degree of divergence between the behaviors and attitudes of different table customers exist; therefore, responses of one person may not fully reflect the table as a whole. Another limitation is that self-reporting questionnaires are strongly affected by the 'social desirability bias'. In other words, participants are prone to report on what they believe is the socially desirable behavior/attitude, which leads to biased waste estimates [39,48,49].

Food and beverages are deeply embedded in the Lebanese culture. The traditional meze-based Lebanese cuisine nurtures a love for variety, sharing, and authenticity amongst the Lebanese. The successful restaurateurs in the country rely on these cultural notions to win over the crowd and, most recently, to weather the economic slowdown in business. However, in a country like Lebanon, where the gap between the under-fed and the over-fed is widening rapidly (aggravated by the economic and financial crises, the Beirut blast of August 2020, and the COVID-19 pandemic), thousands of tons of food are wasted daily across the various levels of the supply chain. There is no government body addressing this problem, making it even more challenging. In addition, there is no effective law regarding food waste in Lebanon, nor any authority that checks on restaurants' food waste.

Tackling food waste in restaurants can be accomplished through negative and positive sanctions. Negative sanctions include the imposition of fines and taxes on restaurants that do not make efforts to reduce food waste, including donating their leftover food to charities. Negative sanctions affect the restaurant's image, and hence its clientele. This approach has been in place in Italy and France [50]. However, one also needs to be careful of such sanctions since restaurants may under-report or hide the amount of food waste to avoid sanctions.

On the other hand, positive sanctions involve incentives to motivate restaurants to donate their excess food. Incentivizing restaurants with tax rebates may encourage restaurants to give away their excess food to the needy. Organizations like Lebanese Food Bank, Beit Al Baraka, and Food Blessed have emerged recently in Lebanon, and they have programs to collect excess food from restaurants. One incentive can be issuing tax rebate certificates by these organizations to restaurants in return for food donations. However, the government will have to consider a mechanism to check the transparency of the process. Adopting such approaches across the restaurant sector and increasing awareness among customers can help reduce food waste generation at the restaurant level.

4. Conclusions

To address the growing issue of food waste at the restaurant level, an urgent need to effectively reduce plate waste is mandatory. As food waste is not the outcome of a single behavior, our study highlights the drivers and determinants of food waste generation while dining out in Mediterranean-Lebanese restaurants. Our results reported that variables, such as a higher number of people at the table, larger orders of dishes, and ordering

waterpipe (hookah) and alcohol, contributed significantly to food waste generation. In addition, being on a diet and pledging to reduce food waste significantly decreased food waste generation. In a typical Mediterranean-Lebanese restaurant, the dishes served are numerous and include many appetizers and salads, in addition to fewer main dishes and desserts. While appetizers and salads might be considered plate fillers, rather than part of the meal ordered, some customers do not consider these food types to be actual food.

Combatting food waste in restaurants requires the introduction of fiscal measures by imposing fines and taxes on customers and restaurants that do not make efforts to reduce their food waste. Additional studies must be conducted in the future in other regions of Lebanon. Furthermore, more studies must be carried out to characterize the food waste generated in restaurants.

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