

AMERICAN UNIVERSITY OF BEIRUT

FOOD WASTE GENERATION DRIVERS AMONG
CONSUMERS AT RESTAURANTS: THE CASE OF
LEBANON

by
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AN ABSTRACT OF THE THESIS OF

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Food waste is a global challenge with adverse effects on food security, the environment, and public health. Globally, 1.3 billion tons of food, equivalent to one-third of the food production worldwide, is lost or wasted annually. Food wastage is manifested in every stage of the food supply chain. This is attributed to mishandling or lack of coordination between various activities such as harvest, packing/packaging, transportation, manufacturing, storage, and distribution. On the other hand, a significant amount of food waste is primarily associated with consumers' values, attitudes and behaviors. In an attempt to explain and better understand the determinants of food waste generated while dining out, this research will assess the quantities of food loss produced, understand the consumers' behavior and relate the role of religiosity to food waste generation.

A purposive sample of 496 participants aged between 18 and 65 years were surveyed while dining in restaurants serving Mediterranean-Lebanese cuisine located in Greater Beirut, Lebanon, which were selected using random sampling. For each participant, the ordered meal was examined after consumption to estimate the quantity of plate food waste. Censored regression model, also known as Tobit analysis, was used to estimate the effect of various drivers and determinants on the consumers' food waste generation while dining out. Finally, expected values were calculated using margins, Tobit post estimation.

The results show that young adults aged between 18 and 34 waste more food when compared to older adults ($p= 0.03$). People on a diet showed a reduced wasteful behavior as compared to those who were not following a restrictive diet plan ($p<0.001$). Behaviors such as over-ordering food, smoking and drinking alcohol while eating were significantly associated with increased plate food waste generation by 41g/person/meal ($p<0.001$), 45g/person/meal ($p= 0.02$) and 46g/person/meal ($p= 0.04$); respectively. Furthermore, reporting an interest in "knowing the serving sizes before ordering food" ($p= 0.04$) and claiming to "always eat everything you have ordered" ($p<0.001$) highlighted a reduced wasteful behavior among the surveyed consumers. One's religion was not statistically significantly related to food waste but one's religiosity showed a negative association with the amount of food being wasted. "Highly religious" people

wasted less food (55g/person/meal) when compared to “not religious” (108g/person/meal) and “religious” people (103g/person/meal).

Understanding drivers and determinants of food waste generation among restaurant patrons is essential for developing and implementing strategies aimed at reducing plate food waste. This study is the first to investigate the challenges of food waste generation and associated determinants while dining out not only in Lebanon but globally as well.

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CHAPTER I

INTRODUCTION

The world's population is estimated to reach 9.6 billion individuals by 2050, and to support this increase, food production would need to increase by a minimum of 70% since there will be no less than three billion extra individuals to feed (Baig, Al-Zahrani, Schneider, Straquadine, & Mourad, 2018; Baulcombe et al., 2009; UN, 2014). Growing competition for water, fossil fuels and other resources in addition to the challenges of climate change suggest that a rapid transition is mandatory; thus, one of the promising solution is to reduce the amount of food lost and wasted (Alamar, Falagan, Aktas, & Terry, 2018; Godfray et al., 2010; Sakaguchi, Pak, & Potts, 2018; Scherhauser, Moates, Hartikainen, Waldron, & Obersteiner, 2018). The literature differentiates between these two terms by describing food loss as a reduction in mass (dry matter/quantity) or nutritional value (quality) of food initially considered for human consumption while classifying food waste as the food being discarded, whether or not after it is left to spoil or kept beyond its expiry date (Borma, 2017).

In recent years, food waste has been identified as a significant public policy concern. Worldwide, 1.3 billion tons of food, equivalent to one-third of the global food production, is lost or wasted yearly along the food supply chain (Gustavsson, Cederberg, Sonesson, Otterdijk, & Meybeck, 2011). Food loss and food waste have vast implications on the environment, food security and the individual and global economic cost.

Environmental impacts of food waste

The environmental costs associated with food waste are enormous, food waste has become the largest supplier of methane gas, which is twenty-five times more potent

than carbon dioxide, and it contributes to the dilemma of global warming (Dalilawati & Azwar, 2019). Studies have measured the environmental effects of food waste in terms of ecological footprint, water footprint and carbon footprint (Ludovica Principato, 2018). Reducing food waste can save approximately 1.4 billion hectares of land area, equivalent to 30% of available agricultural land used yearly to grow or farm food wasted (FAO, 2013). The food that is produced and lost is responsible for a water loss equivalent to the yearly flow of Russia's Volga River (FAO, 2013). If food waste could be represented as a country, it would be one of the top three greenhouse gas emitters following China and the USA (FAO, 2014).

The indirect environmental costs not reflected in the value of the food wasted itself, but resulting from food production, accounts for up to 2600 billion dollars and are called "externalities." These includes environmental pollution due to nutrient run-off, water shortages due to over-extraction, ecosystem disruption due to intensive harvesting, soil degradation and loss of biodiversity caused by land conversion or inappropriate management all together with greenhouse gases emission mainly nitrous oxide and methane which are more harmful than CO₂ (Godfray et al., 2010; Levis & Barlaz, 2011).

Social impacts of food waste

The social effects of food waste are linked to the concepts of food security and food access. Food waste is challenging not only because of its environmental impacts but also for the ethics of wasting food in a world with remarkable food insecurity (Poças Ribeiro, Rok, Harmsen, Rosales Carreón, & Worrell, 2019; Ludovica Principato, 2018).

According to the FAO (2015b), nearly 800 million people around the world do not have sufficient access to food with around 3.1 million deaths in children reported annually as a result of malnutrition (Aamir, Ahmad, Javaid, & Hasan, 2018). Furthermore, in most Arab countries, malnutrition is more severe due to the current conflicts making millions of people unable to meet their basic food needs and these people cannot be offered adequate food security if food wastage is not explained and documented (Abiad & Meho, 2018). If only 25% of the wasted food can be saved, it could help feed 870 million severely malnourished people (Morone, Koutinas, Gathergood, Arshadi, & Matharu, 2019).

Food waste economic impacts

Other than the social and environmental effects, food waste also has monetary loss at both individual and national levels. It is estimated that the global cost of food waste amounts to nearly 2.6 trillion dollars annually (FAO, 2014; Queded, Marsh, Stunell, & Parry, 2013). Besides, food waste generates a cost not only related to the wasted product but also related to the production, transport and storage of the product. Consequently, the monetary cost is paid by different groups of actors including producers, traders, consumers and other operators in the food chain (Borma, 2017).

The previously stated consequences related to food waste are now widely recognized as primary barriers to global sustainability and should be avoided as far as possible. To mitigate the aforementioned effects, food waste generation must be controlled and managed; less food waste has been associated with fewer related adverse effects; by this, leading to an enhancement in the sustainability of the entire foodservice sector. In addition, food waste management and reduction positively impact the environment and is also associated with improved economic loss; it has been

demonstrated that for each one dollar spent for reduction of food waste there is a return of \$14 (Heikkilä, Reinikainen, Katajajuuri, Silvennoinen, & Hartikainen, 2016; L. Principato, Pratesi, & Secondi, 2018; Xue et al., 2017).

The amount of food waste is influenced by development level and industrialization and it varies greatly between countries. The (FAO, 2011), recognizes a large difference of one to ten in per capita waste respectively between developing and developed countries. In the developed world, pre-retail losses are low, food waste occurs primarily at consumption level, mostly driven by consumers' behaviors, attitudes, and values; thus, reducing food waste in the developed world is particularly challenging as it is closely related to individual behavior and cultural attitudes (Bond, Meacham, Bhunnoo, & Benton, 2013; Godfray et al., 2010; Parfitt, Barthel, & Macnaughton, 2010). In contrast, in the developing world, losses are attributed mainly to the lack of knowledge and investment in storage technologies and the absence of food-chain infrastructure. In India, approximately 35 to 40% of fresh products are being lost because neither retail outlets nor wholesale have cold storage commodities (Godfray et al., 2010). (Grethe, Dembélé, & Duman, 2011), have explained that low-income countries often experience food loss at early stages of the supply chain due to inadequate storing facilities and limited harvesting techniques, while medium- and high- income countries experience losses at later stages that result from consumer behavior and this is because people can simply afford to waste food.

Interest in the topic of food waste has increased worldwide, in Europe, following households' food waste, restaurants are the second source of food waste generation at the consumption level and this is also the case in Italy, with household food waste accounting for as much as 54% followed by 21% for restaurants wastes. The yearly

amount of food waste in Italy is estimated at 6.5 million tons and the water required in the agricultural sector to produce the wasted food is equivalent to 1200 billion liters of water and the carbon footprint of this waste quantity represents about 3% of the total Italian carbon footprint (Cicatiello, Franco, Pancino, & Blasi, 2016; Falasconi et al., 2019; L. Principato et al., 2018). Also, in the European Union, 89 million tons of food, equivalent to 173 kilograms of waste per person, is wasted every year while experts estimated that it might rise to 126 million tons by 2020 if enhancements are not implemented (Baig et al., 2018; Stenmarck et al., 2016). According to the United States Department of Agriculture (USDA), households and the foodservice sector including restaurants, canteens, fast food chains and cafeterias together, lost 39 billion kilograms of food in 2008 (Gunders & Bloom, 2017). The U.S. families and restaurants were shown to waste 39 million tons of food per year (Buzby, Hyman, Stewart, & Wells, 2011). In North America and Europe, the quantity of consumers' food waste generated per year is roughly 115 kilograms per person; around 1.3 G-tons of food waste were still edible at the time of disposal and this is equivalent to 81.25% of the total food waste (Petrescu-Mag, Petrescu, & Robinson, 2019). In Switzerland, the foodservice industry, including restaurants, was identified as the third-largest source of food waste, where the total losses from restaurant foods represent 18%, of which 13.5% are avoidable (Betz, Buchli, Göbel, & Müller, 2015). Across all restaurant in Pakistan, overproduction and plate waste were among the top three reasons for food waste (Aamir et al., 2018). In France, even with smaller portion sizes, the food waste generated at the restaurant level accounts for 14% of total food waste and still, research on food waste focus mainly on consumer behavior at home (Hamerman, Rudell, & Martins, 2018). In India, the proportion of food wasted represents one-third of the amount of food produced. Every

year, around 6.7 million tons of food is wasted, which accounts for a value of \$14 billion; it is a paradoxical situation that Indian restaurants are throwing away daily tons of food while so many Indians are dying from hunger (Jehangir, 2018). In industrialized countries, the volume of food wasted is almost equal to the entire food produced by Sub-Saharan Africa (FAO, 2015a). In Finland, Sweden and Germany, consumer food waste in the foodservice sector accounts for up to 55% of the total food wasted (Engström & Carlsson-Kanyama, 2004; Silvennoinen, Katajajuuri, Hartikainen, Heikkilä, & Reinikainen, 2014). In Finland only, approximately 79 million kilograms of food is wasted corresponding to 20% of all food produced and served in licensed restaurants (Silvennoinen, Heikkilä, Katajajuuri, & Reinikainen, 2015). On the other hand, in the United Kingdom, Australia and New Zealand wasted food is estimated at 8.3 million tons, 7.3 million tons and 224,000 tons, respectively (Reynolds, Geschke, Piantadosi, & Boland, 2015). In Australia, yearly, food waste expenses are estimated to reach \$20 billion and in New Zealand, the annual cost of food waste reaches approximately \$568 million (Goh & Jie, 2019; Reynolds et al., 2015). As for Malaysia, out of the 15,000 tons of wasted food, 3,000 tons are considered edible. This quantity usually increases during festive seasons by 15 to 20% (Dalilawati & Azwar, 2019).

As food waste represents a high economic cost and severe trouble for the restaurant industry, it is of great importance to initiate research that considers the issue of food waste generation out-of-home (Giorgi, 2013). Evidence-based approaches are needed to be developed to decrease food waste and improve food security and thus, decrease the adverse effect related to food waste. In Lebanon, no attempts have been taken to look into the challenges, drivers and associated determinants of food waste

generation while dining out. Understanding quantities, reasons, and patterns of food waste is essential for exploring strategies for food waste reduction (Wang et al., 2017).

CHAPTER II

FOOD WASTE GENERATION AMONG RESTAURANT CONSUMERS: DRIVERS AND DETERMINANTS

A. Introduction

Food wastage is a complicated problem that cannot be easily managed. It is manifested throughout all stages of the food supply chain from farm to fork. Researchers have classified the food lost and wasted into three main types: firstly, farm losses and waste which occur during agricultural production and harvesting; secondly, postharvest losses and waste happening during handling, storage, manufacturing, distribution and retail; and lastly, consumers' waste which take place at the foodservice sector level (out-of-home) and the household level (Aschemann-Witzel, 2016).

Interest in the topic of food waste has increased worldwide. Recently, a review by (Abiad & Meho, 2018) reported a ten-fold increase in research publications regarding this topic between 2007 and 2016. In the Arab world, research has also increased, but the publication rate is still minimal when compared to the world's overall publications about this topic. Besides, up to this point, international institutions such as the Food and Agriculture Organization (FAO) and the United Nations Environment Program (UNEP) have made assessments related to food waste in the US and the EU ignoring the Middle East and North African (MENA) region (Gustavsson et al., 2011). The importance of food waste reduction in the foodservice sector is of great interest as food is increasingly consumed out-of-home nowadays (Giorgi, 2013). (Heikkilä et al., 2016) highlighted that one-third of the population uses public food services daily. According to (Ozcicek-Dolekoglu & Var, 2019), increasing participation in the outdoor

working life, rapid urbanization, dietary transition, lifestyle changes and the spread of these changes globally are the main reasons behind the increasing consumption of food away from home. Also, consumers are spending more money on dining out than on groceries and this is mainly due to long working hours and lack of cooking skills (Hamerman et al., 2018). Besides, the foodservice sector has also expanded. It consists of different groups: pubs, restaurants, hotels, leisure venues, quick-service restaurants, staff canteens and dining halls of schools and hospitals (Ozcicek-Dolekoglu & Var, 2019). It is estimated that the foodservice sector generate 20 to 25% of food waste with plate waste as the most significant component (Ofei & Mikkelsen, 2011). Plate waste is defined as the amount of edible parts of the food served but has not been eaten and it is a common reason for food waste at the foodservice sector and consumer level (Ozcicek-Dolekoglu & Var, 2019). It is vital to control food waste generation in restaurants at the consumers' end; however, this can only be achieved once the issue has been acknowledged and recognized (Heikkilä et al., 2016).

Most of the studies on food waste at restaurants focus mainly on the quantity instead of the underlying causes of food waste generation. Besides, the available studies have only focused on food waste generation out-of-home in Western and European countries primarily while the information about the Arab world and the MENA region remains sparse (Abiad & Meho, 2018; Drabik, DeGorter, & Reynolds, 2019).

To effectively reduce food waste, a clear understanding of the drivers and determinants influencing consumers' behaviors and perceptions regarding food waste is essential. Besides, understanding the reasons and patterns of food waste generation is crucial for exploring strategies for food waste reduction (Wang et al., 2017). In the present study, we aim at identifying the drivers and determinants of food waste

generation while dining out at restaurants serving Mezza type/ Mediterranean-Lebanese food.

B. Materials and Methods

1. Questionnaire development

A questionnaire was developed to assess the drivers and determinants of food waste generation among consumers' dining out at restaurants serving local Lebanese food (Mediterranean Cuisine). Questionnaire, composed of 33 questions, was developed in English and translated to Arabic. The questionnaire was piloted on 50 participants to assess the readability and the average time needed for completion, after which minor modifications of language and keywords were made addressing cultural specificity. The questionnaire included three different sections. The first section (6 questions) covered the demographic characteristics of the participants including questions about gender, age, marital status, employment status and individual monthly income. The other two sections covered questions regarding attitudes and cultural relevant behaviors related to food waste as well as ethical and religious questions adopted from the "Belief into Action Scale – BIAC" and "The Centrality of Religiosity Scale – CRS". The study was approved for ethical compliance by the Institutional Review Board (IRB) at the American University of Beirut (AUB). It is worth noting that no personal identifiers were collected in order to ensure the anonymity of respondents and that the study was entirely voluntary.

2. Study population

A full list of restaurants serving Mezza/Mediterranean Lebanese food was compiled using the Zomato application, which operates in Lebanon. The restaurants

were then divided into three categories based on Zomato’s classification by average price for two people summarized in Table 1. This stratification was done to ensure that the random sampling yielded a sample with a diverse socio-economic background (assuming that price may attract different consumers). To ensure diversity between the various restaurant classifications, cluster sampling was adopted and the number of participants in each category was determined proportionally to the number of restaurants in that category. A purposive sample of 496 consumers aged between 18- and 60-years old dining out at different Lebanese restaurants located in the Greater Beirut Area were recruited between December 2018 and April 2019. One person per table, self-selected, was surveyed if the number of patrons at the table was six or less whilst two surveys were filled for tables having seven or more patrons; tables with 6 or less patrons represented 94.35% of the studied sample and tables with more than 7 consumers represented 5.65% of the studied sample. The sample characteristics are presented in Table 2.

Table 1 Restaurants classification based on average cost for two people as categorized by Zomato

Restaurant Classification (n of participants in each category)	Average cost for two people
Casual dining (146)	Less than LBP 50 000
Premium casual dining (273)	Between LBP 50 001 and LBP 120 000
Fine dining (77)	More than LBP 120 001

Table 2 Sociodemographic characteristics of study sample

Characteristics	n (Valid Percentage)
Gender	
Female	297 (59.87)

Male	199 (40.12)
Age	
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 (54.56)
Ever married	224 (45.44)
Employment Status	
Unemployed	65 (13.10)
Self-employed	99 (19.96)
Student	78 (15.73)
Employed	254 (51.21)
Monthly Income	
Less than USD 800	48 (9.68)
Between USD 801 and USD 1,600	101 (20.36)
Between USD 1,601 and USD 2,399	75 (15.12)
Between USD 2,400 and USD 4,499	60 (12.1)
More than USD 4,500	51 (10.28)
I don't know/ Refuse to answer	161 (2.46)

3. Food waste collection and measurement

At the end of the meal and following completion of the questionnaire, the plate food waste corresponding to the respondent's table was collected and weighed using a portable balance. Knowing that Mediterranean and Lebanese restaurants serve Mezza type foods, platters are usually shared. Accordingly, for each table an average waste quantity was calculated by dividing the total waste quantity by the number of patrons per table.

4. Statistical analysis

Stata version 14 was used for data analysis. Descriptive statistics were generated to summarize the study variables of interest as counts and percentages for the categorical variables and as means and standard deviations for the continuous variables. The effect of various drivers and determinants on consumers' food waste generation while dining out was estimated using a censored regression model, Tobit analysis. In the regression model, socio-demographic and work-related variables were all used as independent variables; refer to table 4 for the detailed list of the variables. The average food waste was used as the dependent variable. All variables that showed statistical significance in the simple model were included in the final multiple regression model as independent variables, in order to adjust for possible confounders. Expected values were calculated using margins, Tobit post estimation. All reported p-values were based on two-sided tests and were compared with a critical alpha level of 5%.

C. Results

1. Socio-demographic factors and food waste generation

Participants aged above 55 years waste significantly less food than younger adults aged between 18 and 24 years (p-value =0.03). In addition, participants who are single waste significantly more food than the ones who were classified as “ever married” (p-value=0.03). Food waste was also found to be higher in females as compared to males, in unemployed versus students and employees, the highest among self-employed participants, and higher in the category if people earning between USD 801 and USD 1,600 than the ones who earn less than USD 800; although findings were not statistically significant. The results of the regression analysis are shown in Table 3.

Table 3 Censored regression analysis of average food waste quantity on participants' characteristics

Drivers and Determinants	Coefficient	p-value	CI 95%		Margin*
Gender					
Female	0	0	0	0	110.28 ^A
Male	-28.82	0.12	-65.52	7.88	93.22 ^A
Age Categories					
18-24	0	0	0	0	113.27 ^B
25-34	-1.83	0.94	-47.21	43.56	112.12 ^B
35-44	-49.5	0.09	-106.32	7.33	84.49 ^{AB}
45-54	-15.23	0.62	-74.72	44.25	103.88 ^{AB}
55+	-94.4	0.03	-177.01	-11.8	62.73 ^A
Marital Status					
Single	0	0	0	0	115.02
Ever married	-40.86	0.03	-76.98	-4.73	90.68
Employment Status					
Unemployed	0	0	0	0	107.40 ^A
Self-employed	2.76	0.93	-61.18	66.70	109.09 ^A
Student	-15.51	0.65	-82.98	51.96	98.16 ^A
Employed	-9.25	0.75	-65.39	46.90	101.83 ^A
Monthly Income					
Less than USD 800	0	0	0	0	96.70 ^A
Between USD 801 and USD 1,600	29.96	0.40	-40.40	100.32	114.84 ^A
Between USD 1,601 and USD 2,399	6.75	0.86	-67.53	81.02	100.63 ^A
Between USD 2,400 and USD 4,499	-10.06	0.80	-87.84	67.72	91.01 ^A
More than USD 4,500	-7.25	0.86	-88.58	74.09	92.58 ^A

I don't know/ Refuse to answer	18.47	0.58	-47.83	84.78	107.68 ^A
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* Margin representing average waste quantity in grams per person per meal; margins sharing the same letter are not significantly different at the 5% level.

Note: Intercept estimates were omitted to improve display.

2. Drivers and determinants of food waste generation

The results of the regression analysis are shown in Table 4. Food waste was found to be higher among people having lunch, those consuming alcohol and those reporting that they always over order food (p-value= 0.05, p-value= 0.04 and p-value<0.001 respectively). Lower food waste quantities were found among people who were on a diet, non-smokers and people claiming that they always eat everything they ordered (p-value < 0.001, p-value= 0.02, p-value < 0.001 and p-value= 0.02 respectively).

Higher amount of food waste was found among individuals with normal weight (BMI 25 to 29 kg/m²), individuals who tend to share their meals and individuals claiming that food waste has a negative impact on the environment. However, lower food waste quantities were found among people who show interest in knowing the portion size before ordering, people who always ask for a take-home-box for the unfinished food, people expressing a feeling of guilt when they leave food in their plates, people claiming that they feel concerned about food waste generation and are willing to make an effort to reduce food waste, and people claiming that food waste has a negative impact on the economy; although findings were not statistically significant (Table 4).

The dining party also seems to affect the quantity of food waste generated. As shown in Table 5, when dining out alone, people tend to waste more food as compared

to people dining out with someone else. On the other hand, people dining out with their partner are more likely to waste food in comparison to people dining out with friends or family members. Finally, significant difference in the amount of food waste generated in the 3 types of restaurants was shown. Fine dining restaurants were linked to higher waste quantities as compared to casual dining and premium casual dining.

Table 4 Censored regression analysis of average waste quantity on the drivers and determinants of food waste generation

Drivers and Determinants	Coefficient	p-value	CI 95%		Margin*
BMI					
Normal weight	0	0	0	0	111.03 ^A
Under weight	-4.28	0.94	-115.40	106.85	108.39 ^A
Overweight	-33.79	0.12	-75.80	8.23	91.19 ^A
Obese	-38.60	0.25	-104.80	27.60	88.56 ^A
Dining out per week					
1 to 3 times	0	0	0	0	99.94
4 to 7 times	19.62	0.33	-19.69	58.94	111.84
Dining Party					
Alone	0	0	0	0	141.63 ^A
My partner	-24.78	0.64	-127.88	78.32	124.57 ^A
Family	-64.63	0.2	-162.59	33.34	99.58 ^A
Friends/Colleagues	-70.52	0.15	-167.09	26.05	96.16 ^A
Lunch vs. Dinner					
Lunch	0	0	0	0	116.15 ^A
Dinner	-36.01	0.05	-72.12	0.09	94.38 ^A
Diet					
No	0	0	0	0	114.67
Yes	-59.59	0.00	-98.01	-21.17	80.28
Smoking					
No	0	0	0	0	95.25
Yes	45.42	0.02	6.40	84.45	123.3
Hookah					

No	0	0	0	0	98.14 ^A
Yes	17.52	0.34	-18.42	53.46	108.60 ^A
Alcohol					
No	0	0	0	0	97.85 ^A
Yes	46.02	0.04	1.32	90.73	126.64 ^A
Eat everything ordered					
Never	0	0	0	0	163.01
Sometimes	-68.45	0.01	-120.39	-16.5	114.49
Always	-129.86	0	-175.73	-83.99	78.77
Meal sharing					
Never	0	0	0	0	76.52 ^A
Sometimes	47.22	0.19	-24.13	118.56	102.31 ^{AB}
Always	56.18	0.07	-3.77	116.12	107.72 ^B
Ask for half-portion					
Never	0	0	0	0	93.89 ^A
Sometimes	14.85	0.62	-43.29	73	102.52 ^A
Always	35.52	0.07	-2.71	73.75	115.27 ^A
Ask for take-home-box					
Never	0	0	0	0	104.35 ^A
Sometimes	13.87	0.57	-33.73	61.47	112.88 ^A
Always	-17.29	0.44	-60.81	26.24	94.26 ^A
Ask about serving size					
Never	0	0	0	0	113.90 ^B
Sometimes	-41.79	0.14	-97.14	13.56	89.20 ^{AB}
Always	-40.45	0.05	-81.12	0.22	89.94 ^A
Feel guilty to leave food in my plate					
Disagree	0	0	0	0	114.07 ^A
Neither agree nor disagree	-32.97	0.36	-102.89	36.95	94.28 ^A
Agree	-20.67	0.35	-63.88	22.55	101.41 ^A
Always over order food					
Disagree	0	0	0	0	81.18
Neither agree nor disagree	58.52	0.02	10.51	106.53	115.28 ^A
Agree	81.16	0	41.22	121.09	130.31 ^A
Concerned about food waste generation					
Disagree	0	0	0	0	128.08 ^A
Neither agree nor disagree	-55.24	0.13	-126.49	16.01	93.79 ^A

Agree	-44.81	0.07	-93.64	4.02	99.80 ^A
Food waste has a negative impact on the environment					
Disagree	0	0	0	0	98.09 ^A
Neither agree nor disagree	8.22	0.86	-84.35	100.79	102.92 ^A
Agree	10.64	0.69	-41.74	63.01	104.37 ^A
Food waste has a negative impact on the economy					
Disagree	0	0	0	0	109.97 ^A
Neither agree nor disagree	-24.06	0.63	-122.18	74.06	95.65 ^A
Agree	-11.02	0.73	-74.32	52.28	103.27 ^A
Effort to reduce food waste					
Disagree	0	0	0	0	108.81 ^{AB}
Neither agree nor disagree	46.67	0.25	-32.82	126.16	139.71 ^B
Agree	-18.88	0.56	-83.14	45.39	97.52 ^A
Restaurant Classification					
Casual dining	0	0	0	0	101.16 ^{AB}
Premium casual dining	-7.28	0.73	-48.11	33.56	96.9 ^A
Fine dining	46.79	0.1	-8.91	102.48	131.03 ^B

* Margin representing average waste quantity in grams per person per meal; margins sharing the same letter are not significantly different at the 5% level.

Note: Intercept estimates were omitted to improve display.

D. Discussion

By studying multiple food-related attitudes and behaviors and other determinants, the aim of the present study is to identify the drivers and determinants of food waste generation while dining out at Lebanese restaurants. Concerning socio-demographic factors, according to a study conducted by (Van Der Werf, Seabrook, & Gilliland, 2019), males tend to waste more food as compared to females; but, in our

study females were responsible for higher food waste quantities as compared with males. Our results can be explained by the fact that females usually tend to care more about their physical appearance and eat less, as compared to males, in order to maintain a balanced/restrictive diet leading to an increased wasteful behavior. The age of the person dining out is a factor that significantly influences food waste. According to (Bravi, Murmura, Savelli, & Viganò, 2019), “Millennials” generation represents the portion of the population that are most inclined to waste food, and it is the generation of youth and young adults born between 1982 and 2004. Furthermore, in the United Kingdom, people over the age of 65 waste significantly less in comparison to the rest of the population (Thyberg & Tonjes, 2016). Our findings, which suggests that young people aged between 18 and 34 years were responsible for the higher amount of food waste generated at restaurants, were in line with the previously mentioned studies. However, the claims that all youths and young adults waste more food would be misleading and it would be incorrect to accept that all members of this age group are to be held responsible (Bravi et al., 2019). The fact that single people tend to waste more food as compared to couples and married people can also be linked to the dining party. When dining out alone usually people tend to waste less food because they are in control of their food and ordering is more manageable when you are alone; however, our findings have revealed the opposite because of the fact that Lebanese restaurant offer a variety of mezza dishes and in order to satisfy your taste and appetite you cannot order one dish and thus more plates are ordered leading by this to higher probability of food waste generation. Besides, dining out with a partner was highlighted by a greater amount of food waste as compared to dining out with friends and family members and this could be explained by the fact that when you are around friends and family

members you feel more comfortable, limiting food loss by preventing friends and family from over ordering food. According to (Secondi, Principato, & Laureti, 2015), a negative association was found between employment status and food waste quantity. Unemployed people tend to waste less food as compared to people working full-time (Cecere, Mancinelli, & Mazzanti, 2014). Yet in our study, unemployed people were shown to waste more (107g/person/meal) when compared to employed people (102g/person/meal) and this could be due to the fact that unemployed people have more tendency to dine-out making them more prone to over order food for amusement purpose. Besides, self-employed people were shown to waste more food (109g/person/meal) as compared to employed people assuming that self-employed people earn more money and are less attentive to wasteful behaviors. Furthermore, when it comes to the individual monthly incomes, as highlighted by (Porpino, 2016), the literature is not consistent regarding the relation between food waste generation and the monthly income of an individual; some studies, show a negative relation between the income of the individual and the quantity of food waste generation (Cox et al., 2010); while others show the inverse (Stefan, van Herpen, Tudoran, & Lähteenmäki, 2013). In the present study, findings suggest no significant difference with regard to the monthly income of the individual and food waste generation.

Evidence suggests that socio-demographic characteristics such as gender, age, and employment status affect food provisioning practice. However, these factors, are modest predictors of food waste generation (Falasconi et al., 2019; Grasso et al., 2019; Koivupuro et al., 2012; Stancu, Haugaard, & Lähteenmäki, 2016). According to (Dagevos, 2005), the segmentation of consumers based on the recognized measures such as gender, age or income is no longer able to entirely explain behaviors, other

dimensions must be included into investigation. So, following this observation, and without ignoring the importance of demographic variables on food waste generation, other factors were studied along with some attitudes and behaviors related to food waste generation.

With regard to the diet plan, people following a restrictive diet or are watching their weight tend to pay more attention to what they eat so they usually never over order food and by this, they limit the quantity of food waste generation. This could be also an explanation for the higher amount of food waste found during lunch time as compared to dinner time; when dining out at night people tend to order less food and have a lighter meal limiting by this the quantity of food waste that can be generated. In terms of smoking, it appears that smoking is an influential factor. Due to acute suppression of appetite via actions of nicotine, smokers tend to eat less and waste more food contrary to non-smokers(Perkins, Sexton, DiMarco, & Fonte, 1994).

Observing practices of meal sharing and food ordering, consumers who claim to always share their meals with someone else tend to waste more food and this could be due to the fact that meal sharing increases the likelihood of ordering more plates in order to try different meals increasing by this the probability to generate more food waste. It is recognized that overconsumption indicates excessive use of products as a consequence of a mistaken belief that their use and accumulation are core cultural aspirations and keys to social status and personal happiness (Brown & Cameron, 2000). Consumers are generally waste averse, and the finding indicated that people who tend to throw less amount of food are those with greater intention not to waste food. In Denmark, attitudes towards food waste were positively linked to intention not to waste food: “ the more consumers believe that they should not waste food, the stronger their

intention not to waste food” (Bolton & Alba, 2012; Stancu et al., 2016) However, one limitation might be that it does not reflect real willingness; respondents might want to be seen as “good” and might answer that they will make an effort to reduce food waste. In terms of portion size, it appears that interest in knowing the portion size prior to ordering the meal is an influential factor. Serving big portions of food is one of the biggest factors that influences consumers’ leftovers. According to a study conducted in the UK, 2 out of 5 interviewed consumers stated that customization of portion sizes, price and various choices are solutions to reduce food waste, also they have mentioned that they would agree to eat smaller portions for a lower cost (WRAP, 2013). Besides, people interested in knowing the serving size tend to be more conscious about what they eat, consequently, they would order less food which results in a reduced wasteful behavior. When looking into the types of restaurants, fine dining restaurants were proven to account for the biggest amount of food waste generated by consumers assuming that people dining out at expensive restaurants earn more money and are more knee to waste food since they are not concerned about wasting their money.

One limitation to this study is that for feasibility reasons and knowing that Lebanese food is most of the time shared, we have filled one questionnaire per table and divided the amount of food waste by the number of people per table. This approach has shown to give an inaccurate representation of the entire table, especially when it comes to the personal behaviors.

E. Conclusion

To address the growing global crisis of the hospitality food waste an urgent need to effectively reduce plate waste is mandatory. As food waste cannot be considered as the outcome of a single behavior, it happens for various reasons, it is in

this light that the current study aims to highlight the drivers and determinants of food waste generation while dining out. Our results reported that variables such as gender, age, marital status, diet restriction, and other factors affected food waste volume. Behaviors such as meal sharing, over ordering food and smoking were shown to increase food wastage. Also, reporting an interest in knowing the serving sizes prior to ordering food, claiming to always eat everything you have ordered and willingness to make an effort to reduce food waste highlighted a reduced wasteful behavior among consumers. The complexity and magnitude of the food waste problem call the action for multiple interventions, both private and public, with the purpose of reducing and preventing the issue (Ludovica Principato, 2018). Waiters could be trained to help people in managing their ordering behavior. Also, they can take the initiative of asking the consumer to take doggie bag for the unfinished food. Also, a framework that can be used for the prevention and management of food surplus and food waste is the “food waste hierarchy” which recommends a priority order from least preferred option “disposal” to most preferred option “prevention” (Table 2.5) (Gharfalkar, Court, Campbell, Ali, & Hillier, 2015; Papargyropoulou, Lozano, K. Steinberger, Wright, & Ujang, 2014).

Table 5 The food waste hierarchy stages’ definitions

Stages	Definition
Prevention	Prevent avoidable food waste generation throughout the supply chain and avoid surplus food generation throughout food production and food consumption
Re-use	Re-use surplus food for human consumption for people affected by poverty, through food banks and redistribution networks
Recycle	Recycle food waste via composting Recycle food waste via animal feed
Recovery	Treat unavoidable food waste and recover energy
Disposal	Dispose unavoidable food waste into engineered landfill with landfill gas utilization system in place, only as the last option

Least preferred option ↓

CHAPTER III

THE EFFECT OF RELIGION AND RELIGIOSITY ON FOOD WASTE GENERATION AMONG RESTAURANT CLIENTELE

A. Introduction

Arabs are known to be generous in hospitality; the provision of food is a gesture of greeting to visitors. Guests are often fed with enormous quantities of food even if a family has little to offer. In Arab culture, a person who tries to conserve food is viewed as an inhospitable and a miser (Abiad & Meho, 2018). With such traditions, the Gulf Cooperation Countries were classified among the world's top food wasters (Baig et al., 2018). The level of food waste in the KSA is as high as in other high-income countries, with 427 kilograms of food waste annually per capita. Saudi Arabia has been ranked among the top 25 countries for food waste. On a daily basis, Saudis waste up to \$35 million worth of food equivalent to \$13 billion per year. As part of their culture, Saudis set up sumptuous food tables during weddings, Eid festivals, parties or even informal get-togethers where wasting food is indispensable. Of the food served in the public events, 70% goes to waste and with such rituals, it is expected that food waste may rise by 17.5 million tons by 2020 in KSA (Baig et al., 2018; Roewe, 2013). Based on the Food Sustainability Index (FSI), Lebanon is ranked as 48 out of 67 countries included in the FSI in terms of food waste and loss with an overall score of food loss and waste equal to 64.5 over 100 ("Food Sustainability Index," 2018).

There is evidence that food choices are widely influenced by religion, with the effect of religion on food consumption depending on the way in which believers tend to follow the teaching of the different types of religion (Bonne, Vermeir, Bergeaud-

Blackler, & Verbeke, 2007). Many religions forbid some types of food (e.g. non-ritually slaughtered meat and pork in Islam and Judaism, or beef and pork in Buddhism and Hinduism) except for Christianity that has no food taboos (Bonne & Verbeke, 2006). Thus, Christians are more prone to waste food because of the food choice freedom given to them. However, in the Bible, the Christian was clearly asked to waste no food, and this was highlighted in the following verse:

When they were filled, He said unto His disciples, gather up the fragments that remain, that nothing be lost. [John 6:12]

According to (Abiad & Meho, 2018) Islam prohibits wastage in every aspect of life, not only with regards to food waste but whether it is in energy, time or others. And this is clarified in the following verses of the Holy Quran:

O you who believe! Do not make unlawful the wholesome things which God has made lawful for you, but commit no excess for God does not Love those given to excess. [Quran 5:87]

It is He Who has brought into being gardens, the cultivated and the wild, and date-palms, and fields with produce of all kinds, and olives and pomegranates, similar (in-kind) and variegated. Eat of their fruit in season, but give (the poor) their due on harvest day. And do not waste, for God does not love the wasteful. [Quran 6:14]

Lebanon is a country with cultural diversity and various religious beliefs; it is a mosaic of various religious segments with 18 officially recognized religious groups and three major religions: Islam, Christianity, and Druze presenting an important opportunity for exploring the role of religion and religiosity on food waste generation while dining out in Lebanon. Identification by religious affiliation in Lebanon is not merely a function of

individual preference and a reflection of religious involvement. Instead, one's religion often determines social and political identification meaning that one might be identified as Christian or Muslim without really being a follower of that religion. Thus, the importance of also looking into "religiosity" which is the level of religious involvement. The aim of this study is to assess the effect of religion and religiosity on food waste generation while dining out in Lebanese restaurants.

B. Material and Methods

1. Study design and population

A purposive sample of 496 consumers dining out at different Lebanese restaurants located in the Greater Beirut area were interviewed. The greater Beirut Area includes the lower parts of the Caza of Metn, Baabda, Aley and Chouf in addition to Beirut. The study included only respondents over 18 and under 60 years of age. A list of restaurants serving Mezza/Lebanese food was obtained using the Zomato application which operates in Lebanon and three restaurant categories were created based on Zomato classification of average price for two people (Table 1). In order to ensure diversity between restaurants' classifications, the number of participants sampled from within each restaurant category was conducted proportionately. Sample characteristics are presented in Table 7.

Table 6 Sociodemographic characteristics of study sample

Characteristics	n (Valid Percentage)
Gender	
Female	297 (59.87)
Male	199 (40.12)
Age	
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 (54.56)
Ever married	224 (45.44)
Employment Status	
Unemployed	65 (13.10)
Self-employed	99 (19.96)
Student	78 (15.73)
Employed	254 (51.21)
Monthly Income	
Less than USD 800	48 (9.68)
Between USD 801 and USD 1,600	101 (20.36)
Between USD 1,601 and USD 2,399	75 (15.12)
Between USD 2,400 and USD 4,499	60 (12.1)
More than USD 4,500	51 (10.28)
I don't know/ Refuse to answer	161 (2.46)
Religious Belief	
Christian	325 (65.52)
Druze	14 (2.82)
Muslim	109 (21.98)
Other	48 (9.68)

2. Data collection

Data collection comprised of a face-to-face interview with the individual dining, and food waste measurement. Firstly, the interviewer took the consent of the restaurant's manager to approach consumers while dining out. Next, the interviewer approaches the consumers and explains the purpose of the study, its procedure and confidentiality. After completing the questionnaire, the interviewer waits for the consumers to finish eating and if agreed by the manager, the waiter collects the remaining food in a plastic bag and the leftovers are measured in grams using a portable balance. If the manager of the restaurant does not agree to collect the leftovers for weighing, the interviewer approximates the food waste quantities using a visual serving size guide. Knowing that Lebanese restaurants serve Mezza type foods, the platters are always shared and by this, for each survey, an average waste quantity is calculated by dividing the amount of food waste generated by the number of consumers at the table.

3. Questionnaire development

A questionnaire, composed of 33 questions, was developed in English, and translated to Arabic, to assess the attitudes and behaviors towards food waste generation among consumers' dining out at restaurants serving Mezza/Lebanese food. The questionnaire was piloted on 50 participants to assess the average time needed for completion and on average each survey took up to 20 minutes to be filled. The first section covered demographic characteristics of the participants, the second section included attitudes and cultural relevant behaviors related to food waste and the third section used for the present study included ethical and religious questions inspired from the "Belief into Action Scale – BIAC" and "The Centrality of Religiosity Scale – CRS".

Scoring instructions to determine the level of religiosity was conducted as per the “Belief into Action Scale – BIAC” and “The Centrality of Religiosity Scale – CRS” (Table 7).

Table 7 Religiosity level scoring for consumers dining out

Religiosity Level	Score over 50
Not Religious	0 to 20
Religious	21 to 38
Highly Religious	39 to 50

4. Analysis

a. Reliability

Internal consistency reliability was assessed using Cronbach’s alpha. Computed alpha for the scale measuring religiosity level used in the present study was 0.74, which is considered acceptable.

b. Statistical analysis

Following data collection, STATA version 14 was used for data analysis. Descriptive statistics were presented to summarize the study variables of interest as counts and percentages for the categorical variables and as means and standard deviations for the continuous ones. The effect of religiosity on consumers’ food waste generation while dining out was estimated by means of censored regression model, also known as Tobit analysis. In the regression model, socio-demographic and religion related variables including age, gender, marital status, employment status, monthly income and religious belief were all used as independent variables. Average food waste was used as the dependent variable. All variables that showed statistical significance in

the simple model were included in the final multiple regression model as independent variables, in order to adjust for possible confounders. Expected values were calculated using margins, Tobit post estimation. All reported p-values were based on two-sided tests and were compared with a critical alpha level of 5%.

C. Results

1. Religious belief and food waste generation

Our results suggest that Christian diners tend to waste less as compared to Druze and Muslim diners, although observed differences were not statistically significantly at the 5% (table 8).

2. Religiosity and food waste generation

Being highly religious reduce the probability of wasting food highlighting by this a reduced wasteful behavior among highly religious people. When observing the margins, people classified as “not religious” tend to waste more food (108g/person/meal) as compared to “highly religious” people (55g/person/meal). However, our results show no significant deference between the “not religious” and “religious” group. Additionally, an individual who reports that her/his relationship with God is her/his number one priority in life tends to waste less food (98g/person/meal) as compared to people who claim to have other priorities in life such as friendships, career, health, independence, financial security, etc. who, on average, waste 105g/person/meal (p-value = 0.60).

Table 8 Censored regression analysis of average waste quantity on participants' religion and religiosity

Drivers and Determinants	Coefficient	p-value	CI 95%		Margin*
Religious Belief					
Christian	0	0	0	0	98.38 ^A
Druze	38.02	0.48	-67.62	143.66	121.94 ^A
Muslim	33.76	0.13	-10.3	77.82	119.16 ^A
Other	-2.93	0.93	-65.28	59.41	96.68 ^A
Number one priority					
All other answers	0	0	0	0	105.06 ^A
Relationship with God	-11.28	0.60	-53.48	30.93	98.38 ^A
Religiosity					
Religious	0	0	0	0	103.29 ^A
Not religious	7.72	0.69	-29.81	45.25	107.97 ^A
Highly religious	-97.15	0.09	-208.20	13.90	54.84

* Margin representing average waste quantity in grams per person per meal; margins sharing the same letter are not significantly different at the 5% level.

Note: Intercept estimates were omitted to improve display.

D. Discussion

The present study examined whether religious belief along with religiosity affects the quantity of food waste generated while dining out. The finding of our study suggests that Muslim people waste more as compared to Christian although such acts do not support the teachings of Islam, where Muslims are asked to share excess food with the poor. Despite the fact that Muslim peers' faith prohibits the waste of food, the odds of wasting food among Muslims were higher as compared to Christians and Druze. Our results could be explained by the fact that in Lebanon, religious affiliation is merely a status or social identity; one's religious belief could not determine his involvement level. Even if one identifies himself/herself as Muslim, this does not necessarily classify him/her as a follower of that religion and the person might not be following the teaching

of the Quran. Thus, another factor to look into is religiosity which goes beyond one's religion at birth and is defined by the level of involvement or practice of the basic beliefs of the religion (Ghandour, Karam, & Maalouf, 2009).

As suggested by (Vitell, Paolillo, & Singh, 2005), religiosity is known to have an effect on human attitudes and behavior. Even though in the present study religiosity scale is not validated within the Lebanese context and did not show to be a significant predictor of food waste generation, the fact that it actually correlated with alcohol consumption ($p= 0.02$) speaks with its external nomological validity (Ghandour et al., 2009). Results have shown an inverse association between measures of religiosity and food waste generation while dining out; “non-religious” people were shown to waste double the amount of food when compared to “highly religious” people. Our results are in line with the fact that religiosity level goes beyond one's religious affiliation. In addition, individuals who report that their relationship with God is their number one priority in life were less likely to waste food. However, one limitation that might have affected the significance of our findings could be that the answers do not reflect the individuals' real priority; respondents might choose the answer to be seen as “believers” in front of their peers, family members or even the interviewer. It is worth noting that cases of answers changing were observed.

A limitation to this study is the sampling method used. Knowing that one person per table was filling the questionnaire this person could not be representative of all. You might dine out with people who do not share the same religion/religiosity level as yours; thus, the food waste quantity generated per table will not necessarily reflect the amount of food wasted by the person filling the questionnaire.

E. Conclusion

Reducing food waste represents a “triple win”: it can alleviate hunger, it can save money for companies, farmers and people, also it can save land, water and reduce the worldwide greenhouse gas emissions and therefore, climate change impacts.

Keeping this in mind, the reduction of food waste has been recently included in the Sustainable Development Goals (SDGs) supported by the UN and adopted by the member states with the aims of protecting the planet, ending poverty and ensuring wealth for all. Particularly, the 12th SDG titled “Ensure sustainability consumption” includes the food waste matter in its 3rd target: “by 2030, halve per capita global food waste at retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses” (Ludovica Principato, 2018; UN, 2015).

Understanding quantities, reasons, and patterns of food waste is essential for exploring strategies for food waste reduction. As stated by (Morone et al., 2019), food waste is a complex phenomenon that can be affected by numerous variables at the same time.

Thus, without ignoring the importance of different behaviors, attitudes and demographic variables, the present paper investigated the effect of religion and religiosity on food waste generation among consumers while dining out. Results suggested that Christians people waste less food as compared to Druze and Muslim peers. However, recognizing that in Lebanon one’s religious affiliation is mostly a social status, religiosity was found to be a better indicator with a negative association between the level of religiosity and the amount of food wasted.

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