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Attitudes and behaviors shaping household food waste generation: Lessons from Lebanon

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ABSTRACT

Background: Food consumption and wastage behavior varies across cultures, which warrants investigations in various countries and locations of different income levels. To date, information on the attitudes and behaviors of households in developing countries regarding food waste is scarce. The objective of this study is to assess the household attitudes and behaviors that determine food waste in Lebanon for a better understanding and for tailoring community based interventions.
Methods: A questionnaire, composed of 3 sections and 27 questions, was developed to assess the attitudes and behaviors towards food waste in Lebanese households. A convenient sample of 1264 households from the five governorates of Lebanon was interviewed in 2016 and 2017. The variable "*eat everything prepared*" was used as a proxy for food waste. The effect of various socio-demographic and behavioral factors on household food waste generation across urban and rural areas in Lebanon was estimated by means of a Logistic regression, using STATA.
Results: Socio-demographic variables such as employment, education, number of members in the household and income affected food waste volume. Behaviors such as eating out frequently and buying best offers were shown to increase food wastage. Also, beliefs such as feeling guilty decreased food waste generation. Rural households contributed less to food waste generation compared to urban areas.
Conclusion: Households contribute significantly to a country's food waste problem through their behavior and beliefs. Our findings showed that various household characteristics and food-related behaviors, attitudes toward recycling and other beliefs affected food waste generation in urban and rural communities of a developing country. Future research is still needed to better understand determinants of food waste at the household level in developing countries.

1. Introduction

The rapid population growth is considered the main reason for increased demand on food, putting a growing pressure on food security. Food loss and waste are important contributors to the latter (Yildirim et al., 2016). Food loss is related to the decrease in edible food mass at the production, postharvest and processing stages, while food waste is the food lost at the level of retailers and consumers (Parfitt et al., 2010). According to a report by the United Nations Environment Programme (UNEP) and the World Resources Institute (WRI), one-third of all the food produced worldwide is wasted or lost on annual basis and half of the food wasted is at the level of households (Jorissen et al., 2015), which place significant impacts on the environment and food security (Williams et al., 2012).

Appearance and taste expectations, socio-economic status, shopping attitudes, insufficient knowledge, errors in packaging, and health misconceptions about leftovers are all factors that affect food waste (Aschemann-Witzel et al., 2015). Also, there is increasing evidence that households contribute significantly to the food waste issue through their behavior and beliefs (Community, 2011; Sharp et al., 2010); (Evans, 2012); (Koivupuro et al., 2012); (Stefan et al., 2013). Research has shown that food consumption and wastage behavior varies across cultures, which necessitate examining it in different populations of various income-levels.

When it comes to Lebanon, it belongs to the group of upper

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middle-income countries (World Bank, 2018). In 2010, the waste generation rate in Lebanon varied from around 0.8 kg per person per day (kg/p/d) in rural areas to around 1.1 kg/p/d in urban areas, with a national weighted average estimated at about 1.0 kg/p/d and a total of 1.6 million tons of waste produced in Lebanon. Its majority is organic (varying between 50 and 55% in urban and rural areas respectively), while the rest mainly includes recyclables. It is characterized by its high moisture content, often exceeding 60% (MOE et al. (2011); Sweepnet, 2014; MOE et al. (2011)). Lebanon does not have a solid waste management plan, and this came to prominence in 2015 after litter piled up on the streets of Beirut. In many areas, burning garbage is the practice, and residents living nearby reported health problems (Human Rights Watch, 2017).

In addition to the huge capital investment that is required to improve waste management, social and behavioral factors at household level could decrease the volume of waste given that food waste behavior is the last step in the household food provisioning process (Stancu et al., 2016). Thus, there is a need to better understand household determinants of food waste to develop effective preventive measures. To date, information on the attitudes and behaviors of households in developing countries regarding food waste is scarce. The objective of this study is to assess the household attitudes and behaviors that determine food waste in Lebanon for a better understanding and for tailoring community based interventions. In specific, it aims to present and discuss the influences of several socio-demographical, behavioral and attitudinal factors on the generation of food waste in Lebanese households.

2. Methods

2.1. Questionnaire development

A culturally specific questionnaire in Arabic language, composed of 3 sections and 27 questions, was developed using ease-to-understand terms. It was piloted to assess the readability and the average time needed for completion. The first section (19 questions) covered demographic characteristics of the participants. It included questions about gender, role of the respondent in household, educational level of the respondent, residence area and size, combined household monthly income, person in charge of food grocery shopping, amount of money usually spent on food, number of household members, and frequency of grocery shopping from minimarkets and supermarkets for food and non-food items. The other two sections (8 questions, in addition to sub-questions) included attitudes and culturally relevant behaviors related to food waste.

2.2. Study population

A convenient sample of 1264 households from the five governorates of Lebanon was interviewed in 2016 and 2017 by trained interviewers from the American University of Beirut (AUB) and the Lebanese American University (LAU). The interviewer asked about the person in charge of food preparation or supervision of the preparation. If the selected person was not at home, a follow-up, up to one time, was conducted before declaring a non-response. Furthermore, the interviewer explained the objectives of the survey, ensured the anonymity and confidentiality and obtained the consent of the participants. The face-to-face interview took approximately 20 min. Out of the surveyed participants, 250 were given seven diary sheets that they had to fill on a daily basis over a period of a week. In order to ensure the geographical representation of the survey, the number of households to be interviewed in the eight electoral districts of the city was determined in proportion to the number of registered voters in each.

This survey was approved for ethical compliance by the Institution Review Board (IRB) of AUB and the LAU. In order to ensure the anonymity of the respondents, no personal identifiers were collected. The study was completely voluntary, and participants were also informed that they can withdraw from the study at any time, or refrain from answering any question(s).

Sample characteristics are presented in Table 1.

2.3. Methodology and empirical strategy

The effect of various socio-demographic and behavioral factors was estimated by means of a Logistic regression, using STATA. Due to the absence of a variable that accounts for the quantity of food waste for all governorates, we looked for variables that could be an appropriate proxy for food waste. Among variables, three are considered to be possible substitutes: "*throw food when cook too much*", "*eat everything prepared*", and "*use leftovers in anyway*". To test whether these are fitting alternatives, we conducted a simple OLS regression of weight on each of the mentioned variables in the 7-day diary sample formed of 250 households. The two variables "*throw food when cook too much*" and "*use leftovers in anyway*" showed no correlation with weight, whereas regression of weight on "*eat everything prepared*" revealed a negative significant coefficient. Results of the OLS regression are presented in Table 2.

Based on this result, we decided to use the variable "*eat everything prepared*" as a proxy for food waste. Since total weight is inversely related to "*eat everything prepared*", any increase in this variable will be interpreted as a decrease in the amount of food wasted. The variable "*eat everything prepared*" will be then used as a

Table 1
Characteristics of the surveyed participants.

Characteristics		Percentages
Gender	Male	14.2
	Female	85.8
The person in charge of food shopping is	Employed/Self-employed	54.4
	Unemployed	45.7
Highest level of education in household	Elementary/Intermediate/ Vocational	27.4
	Secondary/High school	43.0
	University	26.7
	Refuse to answer	2.9
Surface area of residence	<100m2	6.9
	100–140m2	46.9
	>140m2	46.2
What is the combined monthly income of all persons living in your household?[a]	<LBP1,200,000	17.8
	LBP1,201,000-LBP2,400,000	28.6
	>LBP2,400,000	42.3
	Don't know/Refuse to answer	11.2
Total number of people in household	1 occupant	1.6
	2-3 occupants	27.8
	>3 occupants	70.7
Place where usually eat meals	Mainly at home	45.1
	Partly at home, partly out	30.9
	Partly at home, partly out	19.5
	Mainly eating out/only eating out	4.5
Prepare different dishes each day	Sometimes at most	38.4
	Frequently/Regularly	61.6
Feeling guilty when throw food away	Disagree/Neither	11.7
	Agree	88.3
Buy special offers	Disagree/Neither	40.1
	Agree	59.9
Parcticipate in recycling program if payed	Yes	85.8
	No	9.9
	Don't know/Refuse to answer	4.3
Like to get more info on recycling	Yes	65.4
	No	26.4
	Don't know/Refuse to answer	8.2

[a] 1 USD is equal to 1500 Lebanese Pounds.

Table 2
Regression of "total weight' on "eat everything prepared" results.

Total weight	Coefficient	Robust Standard Errors	P > t
Eat everything prepared			
Sometimes at most	–	(base)	–
Frequently/Regularly	−2.233**	0.862	0.010
Constant	7.015	0.680	0.000
Model fit			
Prob > F	0.010		
R-squared	0.026		
Root MSE	6.616		
Observation	250		

*p < 0.10; **p < 0.05; ***p < 0.010.

dependent variable which takes values of 1 if the respondent marked "Frequently/Regularly" and 0 if the respondent marked "Sometimes at most". Since it is a binary variable, we chose to model the micro-data collected on food waste using a logit model. The logit model of the binary dependent variable *"eat everything prepared" (eatall)* with *k* regressors denoted *x* is:

$$Pr(eatall = 1|x_1, x_2, \ldots, x_k) = \frac{1}{1 + e^{-\beta_0 - \sum_k \beta_k x_k}}$$

Through an iterative procedure, and starting with a large list of explanatory variables, logit model was conducted and variables that achieved statistical significance with at least 90 percent confidence were selected to reach a working model (see Table 3).

3. Results

3.1. Determinants of food waste at a household level

In terms of model estimates, households in rural areas show higher tendency to eat all food prepared in comparison to those in urban areas. This means that rural households contribute less to food waste generation. Furthermore, employment status shows significant effect at 10 percent level *eatall*. The sign of the coefficient suggests that being employed/self-employed reduces the probability of *eatall* and hence increases the likelihood of wasting more food.

Acquiring secondary or high school as the highest level of education increases *eatall* in comparison to having reached only elementary/intermediate/vocational levels. Moreover, a household that has university graduates has twice the likelihood of eating everything prepared in comparison to a household that has secondary/high school as the highest level of education. In terms of the influence of number of householders on food waste generation, estimates suggest that the higher the number of occupants, the lower the probability of eating everything prepared, and the higher is food wastage. Another variable included in the model that acts as a contributor to food waste is the place where usually an individual eats his meals. Our results suggest that the more a person eats out of his home, the more he would be wasting food. An individual who prepares different dishes each day "frequently/regularly" compared to "sometimes at most", shows a higher probability to eat everything prepared. An individual who reports a feeling of guilt when throwing food is more likely to eat everything prepared, which reflects a reduced wasteful behavior. This appears to be true but in a lower magnitude (almost half) for those who think of ways to use leftovers. Additionally, the coefficient of "Buy special offer" is significantly negative, suggesting that those who buy more special offers tend to waste more food. Finally, when investigating respondents' perception towards recycling programs, a significant impact of incentives on the participation in such programs was found. Estimates suggest that participating in a recycling program if getting payed has approximately twice the effect of liking to get more recycling related information on food waste generation.

Table 3
Model estimation results for the Logit analysis.

Eat everything prepared	Coefficient	Robust Standard Errors	P > z
Area			
Urban	–	(base)	–
Rural	0.626***	0.171	0.000
Employed/Self-employed			
No	–	(base)	–
Yes	−0.266*	0.142	0.061
Highest level of education in household			
Elementary/Intermediate/Vocational	–	(base)	–
Secondary/High school	0.381**	0.168	0.024
University	0.622***	0.218	0.004
Total number of people in household			
1 occupant	–	(base)	–
2-3 occupants	−1.653***	0.645	0.010
>3 occupants	−1.609***	0.639	0.012
Place where usually eat meals			
Mainly at home	–	(base)	–
Partly at home, partly out	−0.711***	0.172	0.000
Partly at home, partly out	−1.200***	0.221	0.000
Mainly eating out/only eating out	−1.289***	0.376	0.001
Prepare different dishes each day			
Sometimes at most	–	(base)	–
Frequently/Regularly	1.571***	0.144	0.000
Feeling guilty when throw food away			
Disagree/Neither	–	(base)	–
Agree	0.745**	0.225	0.001
Think of ways to use leftovers			
Disagree/Neither	–	(base)	–
Agree	0.408**	0.164	0.013
Buy special offers			
Disagree/Neither	–	(base)	–
Agree	−0.336**	0.146	0.021
Participate in recycling program if payed			
Yes	–	(base)	–
no	0.736***	0.255	0.004
Don't know/Refuse to answer	1.565	0.585	0.007
Like to get more info on recycling			
Yes	–	(base)	–
no	−0.299*	0.165	0.069
Don't know/Refuse to answer	0.770	0.332	0.020
Constant	0.529	0.706	0.454
Model Fit			
Log pseudolikelihood	−665.020		
Prob > chi2	0.000		
Pseudo R2	0.187		
Observation	1264		

*p < 0.10; **p < 0.05; ***p < 0.010.

4. Discussion

The present study examined how household characteristics and food-related behaviors affected food waste generation in urban and rural communities of a developing country. Quested et al. (Quested et al., 2013a) call this bundle of behaviors the "behaviors that influence food waste" to highlight that it is not one but rather multiple behaviors that affect generation of food waste at a household level.

In terms of location, our household sample in rural areas showed significantly less food waste generation compared to urban households. To our knowledge, there are no comparative studies between rural and urban areas in terms of household food waste generation in developing countries or other countries in the region. One meta-analysis showed no significant difference in food waste between rural and urban samples collected in the USA from 1995 to

2003 (Thyberg et al., 2015). Another study done in a northern district of Austria reported significantly higher "proportion of preparation residues and avoidable food waste" in urban compared to rural zones (Lebersorger and Schneider, 2011). our results could be explained by the fact that residents of Lebanese rural areas tend to be more religious; thus, they avoid wasting food and instead, they donate leftovers. Furthermore, it is very cultural in rural area to share/invite over cooked food with neighbors or visitors, which decreases indirectly food waste.

Concerning socio-demographic characteristics, being self-employed or employed reduced the probability of *eatall* and hence increased the likelihood of wasting more food. This could be due to the fact that full timers have less available time to prepare food or focus to acquire awareness on food waste (Qi and Roe, 2016). Also, assuming that employed and self-employed earn more money than unemployed, our results are in line with the fact that lower income households generate little leftover, while higher income households are not as concerned for handling food leftovers (Abeliotis et al., 2016). On the other hand, the literature is not consistent regarding the relation between food waste and income (Porpino, 2016). Some studies, similar to ours, showed a positive relation, between the income of the family and food waste (Stefan et al., 2013), while others showed an inverse relation (Cox et al., 2010), and some studies could not identify any relation between the 2 variables(Bolaane and Ali, 2004; Quested and Johnson, 2009; Quested et al., 2013b)

In terms of educational level, it appears that education is an influential factor that helps in the reduction of food waste. In our study, acquiring secondary or high school as the highest level of education in comparison to having reached only elementary/intermediate/vocational levels significantly decreased food waste generation. Moreover, a household that has university graduates has twice the likelihood of eating everything prepared in comparison to a household that has secondary/high school as the highest level of education. This could be explained by the higher level of awareness that the advanced education offers (Qi and Roe, 2016). Consistently, a recent study done in Egypt showed that having a university degree is inversely related to food waste generation when compared to secondary education or illiterates (Abdelradi, 2017). In an attempt to explain this relation, Abeliotis et al. (2016) reported that increased education levels affect knowledge related to reading food labels which in turn decreases food waste.

Our results, showing a positive relation between the number of householders and the food waste volume, are in line with the literature, (Tucker and Farrelly, 2016). Abdelradi (2017) reported that in Egypt, households of 6–8 people produce on average 600 g more of food waste per day compared to households of 3–5 people. It may be that the more house occupants, the more food is left after cooking.

Regarding respondents' opinions and beliefs, individuals who report a feeling of guilt when throwing food are more likely to eat everything prepared, which reflects a reduced wasteful behavior. A study in the USA with a large sample (Qi and Roe, 2016) similarly showed that participants who expressed feeling guilty about throwing food, would generate less food waste. Also, in another regional study conducted in Greece, in response to the question '*To which extent are you concerned when your household throws away food?*', the large majority (90%) reported that they do care (Abeliotis et al., 2014). indeed, consumer's behavior is affected by his/her moral characteristics (Stancu et al., 2016). For instance, for food waste behavior, feeling guilty or bothered because one has thrown food affects negatively the quantity thrown away (Brook, 2007; Hamilton et al., 2005; Stefan et al., 2013). However one limitation for this type of question might be that it does not reflect the real feeling: respondents might want to be seen as "good" and might answer that they feel guilty when they throw food.

Observing practices related to food preparation, use of leftovers, and dining out practices, results suggested that the more a person eats out of his home, the more he would be wasting food at home. One counter-intuitive result is associated with the "preparation of different dishes each day" variable. An individual who prepares different dishes each day "frequently/regularly" compared to "sometimes at most" shows a higher probability to eat everything prepared, thus throwing less food. Comparing our findings to a certain extent with a previous study in which, contrary to our findings, the main generators of food waste were cooking and buying too much food (Lyndhurst et al., 2007), we could say that the variety of cooked meals or heterogeneity might lead to a decrease in food waste generation.

Food waste appears to be decreased but in a lower magnitude (almost half) for those who think of ways to use leftovers. Planning routines could potentially contribute to stronger leftovers reuse routines (Stancu et al., 2016).

Concerning shopping practices, it is well established that planning and creating a shopping list is considered to be effective in reducing food waste at the household level (Sharp et al., 2010). According to (Stefan et al., 2013), planning in advance, such as meal planning and consistent list making, decreases food waste generation. On the other hand, individuals might be attracted to "*buy special offer*" especially given the economic situation in developing countries like Lebanon. Our results suggest that those who buy more special offers tend to waste more food. In fact, buying special offers is one of the features of excessive purchasing that is believed to be one of the main contributors to food waste (Beretta et al., 2013; Ganglbauer et al., 2013; Koivupuro et al., 2012; Lyndhurst et al., 2007; Stefan et al., 2013).

Finally, when investigating respondents' perception towards recycling programs, we find a significant impact of incentives on the participation in such programs. Estimates suggest that participating in a recycling program, if getting payed, has approximately twice the effect of liking to get more recycling related information on food waste generation. However, asking about recycling willingness might have some limitations given that respondents might want to seem "good citizen".

4.1. Policies implications and strategies to decrease food waste at household level

Lebanon still faces several complex food challenges based on the latest Food Sustainability Index (FSI) (Food Sustainability Index, 2017). Similar to other Arab countries, Lebanon has high food waste and loss compared to other countries in the world; as it ranks 32 out of 34 countries included in the FSI in terms of food loss and waste, and 31 out of 34 as overall FSI score. These alarming figures create an utmost urgent need to decrease food waste at a national level. The government has a crucial role in decreasing food waste through policies and interventions. Such policies can be very complex and need to address all aspects of the food chain to be efficient (Chalak et al., 2016). Nevertheless, some of the policies have to tackle the consumer at a household level. For example, in Egypt, a national policy to cap the amount of government subsidized bread purchased per individual using smartcards, decreased significantly bread wastage. Other countries, such as Jordan, are now considering Egypt's strategies (Food Sustainability Index, 2017).

Household food wastage is extensively explained by several behavioral models (Stefan et al., 2013) and our results are in line with these theories, therefore this study can set the stage for actions to decrease food waste at the household. Based on our findings, intervention strategies should aim at raising awareness

regarding the issue of food waste, coupled with motivating individuals to decrease it. Also, increasing education related to household routines such as meal planning, storage, preparation and mainly re-using the left overs, should be taken into consideration while designing strategies. This can be achieved through awareness campaigns on TV and other media using effective simplified, culturally relevant messages. Furthermore, education of the consumer to reduce food waste by providing practical tools like recipes from leftovers, shopping planning and lists, cooking proper portion sizes using measurement instruments, and optimizing the use of fridges and freezers would minimize food waste. The “love food hate waste” campaign has been one of the most successful campaigns in reducing food waste at a household level and is a great example for the aforementioned interventions (*The impact of Love Food HateWaste*, 2017). Alternatively, efforts can be focused on changing the consumer's attitudes to intentionally decrease food waste, especially when feeling guilty or having religious reasons not to throw food. Also, working at the grassroots level of local communities to redistribute and redirect food leftovers to direct resident neighbors in need or through NGOs such as food banks will decrease the amount wasted.

On another note, collaboration with private actors in the food chain, and regulations through governmental policies tackling the marketing and the use of “best buy” offers would decrease food waste and help the household control impulsive buying.

5. Conclusion

Lebanon has been witnessing a severe garbage crisis. To address this growing problem, there is an urgent need to decrease food waste at the household level. It is in this light that the current study aims to highlight the issue at the household level that can be addressed to decrease food waste. Our results reported that variables such as employment, education, number of members in the household and income affected food waste volume. Behaviors such as eating out frequently and buying best offers were shown to increase food wastage. Also, beliefs such as feeling guilty decreased food waste generation. Various community-based interventions using simple educational material can tackle the beliefs and attitudes of households by increasing awareness regarding planning and preparation of food and use of leftovers. A limitation of the type studies like ours is that they are based on self-reported behavior and, as recent research indicates, households tend to underestimate their food waste. Nevertheless, self-reported behavior studies remain a valuable tool to study environmental behavior.

Future research is still needed to better understand determinants of food waste at the household level in the Lebanese community. The direction of future research can be toward developing proposed intervention strategies and testing their effect on minimizing food waste.

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