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Behavioral approach to food consumption and waste production: A quasi-experimental study

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Abstract:

BACKGROUND: Approximately one third of the food produced in the world for human consumption was wasted.

OBJECTIVES: This study aimed to determine the effect of intervention on behavior of food consumption and waste production in the restaurants of Shahid Beheshti University of Medical Sciences.

MATERIALS AND METHODS: In this quasi-experimental study, 233 students of public health school were selected as intervention group, and 233 students of medical school were selected as control group. The food wastage was weighed in both "Sabz" and "Medical" restaurants for a week. Based on training needs of the samples, teaching methods and programs were implemented in the intervention group for a month. The clients of both restaurants were followed 4 weeks after the intervention. The food waste was weighed after 4 weeks. Data were analyzed using SPSS software version 16 and statistical tests (Wilcoxon, Chi-squared, McNemar, and Mann–Whitney tests).

RESULTS: The results obtained from Wilcoxon test showed that, the means of awareness, attitude, and behavior were significantly improved after the intervention in the intervention and control groups ($P < 0.001$). After the intervention, according to the number of served foods, it was expected that the weight of food wastage to be 341.37 kg/week, but this figure was reduced to 224.98 kg/week after the intervention.

CONCLUSIONS: This study has confirmed the effectiveness of implementation of interventions on enhancement of knowledge, attitude, and behavior of people about consumption of food and amount of wastage. The authors suggest that to investigate sustainability of effect of intervention on behavior of food consumption and wastage production, this study could be implemented in different and longer time intervals after the end of project.

Keywords:

Behavior change, intervention, leftovers, waste management

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Introduction

The primary sources of food waste are the household cooking, stores, places of purchase and sale, restaurants, and other places where food is stored, cooked, or processed.[1,2] Food waste is growing along with modern consumption habit which is associated with the consumers' wasteful behavior, attitudes, and practices.[3] The majority of food waste (considered here as food that can no longer be consumed by humans) originates at consumer level with 60% of it seems to be avoidable.[4] The wastage of food in its edible state is a paramount issue which is embedded within economic, environmental, and societal issues of inequality, food insecurity, and hunger.[3] Within higher education institutions in particular, mitigation of food waste is important to meet a targeted 83%

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reduction in emissions by 2050.[5] Overall, consumers are a vital player in addressing the creation, reduction, and ultimate prevention of food waste.[6] The most efficient means of mitigating food waste are to focus on preventative actions within the waste hierarchy.[7] Annually, an average of one-third or one-fourth of food products is wasted in the form of waste materials and garbage.[8] On the other hand, more than one-sixth of the world's population (about 1 billion people) are suffering from malnutrition and about one-third of them suffer from hunger and poor nutrition during fetal and neonatal period, which could be the cause of one-third of child mortality at the developing countries.[9] The amount of food waste produced at the industrial countries is about 670 million tons and in the developing countries is about 630 million tons.[10]

The rate of waste disposal in Iran is estimated to be around 20 million tons/year.[11] Statistics have revealed that about 30% of foods in Iran are wasted. The value of this amount of wastage is estimated about 5–8 billion dollars.[12] In this regard, the portion of red meat and chicken is more than 300.000 tons/year, which are removed from the value cycle in the form of wastages in the process of production and consumption.[13] In consuming bread, people of Iran are among the most consumptive people of the world. Per capita, the consumption of bread at the world is equal to 25 kg and this value in Iran is 6 times more than world average.[12]

Public places such as schools, universities, barracks, offices, and organizations are important in terms of frequency of the number of food consumers and in terms of low cost paid for food (subside). In other words, environments such as universities play key role in guaranteeing reduction of the volume of food wastage.[14]

Mirosa *et al*. emphasize the research gap on consumers' food waste behavior in restaurants, and investigated customers' values and behavior regarding plate waste at a university restaurant.[15]

Looking at consumer behavior, attitudes, and norms it is possible to determine factors that drive food waste.[16] If people at these places are exposed to behavioral change interventions, they may transfer the knowledge to their families and friends and in other words, they could act as ambassadors of changing behavior in regard to food waste production. A study shown, the more the information of people about importance and value of natural resources, the more they participate in the preventative programs.[17] On the other hand, a study shown, taking educational intervention could result in reduction of food waste production by households.[18]

It is noteworthy that in Iran, all universities and many schools, army places (barracks), offices, and organizations have a restaurant, so interventional programs can significantly reduce the amount of food waste. Since there are not many studies and research done in Iran to measure the effects of interventions on food consumption behavior (FCB) and waste management in university restaurants, this study was conducted to determine the effect of intervention on FCBs and the production of wastage in restaurants of Shahid Beheshti University of Medical Sciences, Tehran, Iran.

Materials and Methods

Study design

This is a quasi-experimental study that was conducted on a population consisted of all clients, staffs and students of Sabz and Medical school restaurants. Data collection was carried out between April and September 2016. The sample size was calculated based on the formula $n_1 = n_2 = (z_{1-\alpha} + z_{1-\beta})\ S^2/\Delta^2 = 233$considering a drop rate of 10%. Finally, 466 samples ($n = 233$ in each group) were considered for this study. The randomized multi-stratified sampling method was used in this study. From all schools of Shahid Beheshti University of Medical Sciences, schools of public health and medicine were randomly selected. The optimal size of each cluster was estimated to be 233. Selection of the schools, allocation to either the intervention or control group, and the formation of cluster were all carried out randomly.

Inclusion and exclusion criteria

The inclusion criteria in this study were; going to the Sabz or Medical restaurant, and being interested in taking part in the study. The exclusion criteria included; not willing to continue participating in the study, being absent from classroom, and not completing the questionnaire fully.

Tool, validity, and reliability

Data collection tool in this study was a researcher-made questionnaire with four parts:

Part A: Demographic variables

Including nine items (age, gender, marital status, economic status, living in dormitory, history of digestive system disease, and the method of food consumption).

Part B

This section consisted of 47 items related to FCBs as well as knowledge, attitudes, and performance. Knowledge: Contain 30 items: The answers of true, no idea, and false get respectively points 2, 1, and 0 (e.g., production of food wastage through using water and destruction of water resources … [a] direct correlation, [b] reverse correlation, [c] no correlation, [d] I do not know). The items relevant to attitude include 10 items and are pointed in form of Likert 3-point scale (agreed, no idea,

disagreed) and are pointed with points 1–3 based on the direction of the item (e.g., in my opinion, food wastage of restaurants is reasonable: [1] agreed, [2] no idea, [3] disagreed). In the part related to items of behavior, 7 items are considered in the form of 4-Point Likert scale (always, sometimes, rarely, and never) and with points 0–3 (e.g., due to my need, I ask the food server to increase or decrease amount of my food: [1] always, [2] sometimes, [3] rarely, and [4] never).

To determine the validity of questionnaire, face, and content validity was used. For this purpose, first the questionnaire was prepared (using related sources such as texts, books, and articles) and then, 8 experts in this field evaluated the questionnaire to determine its validity. According to the opinions and suggestions of experts, some changes were made to the initial questionnaire and the final version was used for the purpose of data collection. To test the content validity of quantitative studies, content validity ratio (CVR) and content validity index (CVI) were used (CVR = 0.85 and CVI = 0.82). The estimation of reliability of the questionnaire was carried out on 10 people using test-retest (with interval of 2 weeks) methods. The internal consistency of (r = 0.75) was used in the awareness part and Cronbach's alpha in the attitude part was (0.7) and (0.72) in the behavior part.

Intervention

Training of prerequisite

Before the intervention, required training regarding the collection, separation, and weighing of total wastage of bread and food per day were given to the personnel of Sabz and Medical restaurants. At this stage, the bread, food, yogurt and buttermilk, and salad dishes were collected and placed separately in special containers. At the end of each day, the wastage of bread and food was weighed by scale.

The main areas of intervention

The pre-test was given to both intervention and control groups through the questionnaire. Pre-test results helped to do an educational need analysis and determine the educational methods (educational package). Furthermore, the contents of pamphlet, messages, and posters were determined in accordance with the attendants' learning power using credible scientific sources and field specialists' comments. The target behaviors as well as educational methods were also taken into account. The content was taken from credible sources of the Ministry of Health Education complemented by what community needs to know about FCBs and waste management. After the pre-test, the initial data were collected and analyzed. The content, behavioral goals, educational materials, and physical changes of food serving places were set based on the findings of pre-test. In the next step, the total food wastage of both Sabz and medical restaurants were measured over a week period and it average was estimated for both restaurants. The intervention conducted 1 month and follow-up was conducted 2 months after the training. In general, interventional program consisted of two main domains as bellow:

Individual interventions

The education course was held for the experimental group (all clients of Sabz restaurant) in the forms of pamphlet, poster, and leaflets. For this purpose, each client received a pamphlet with the food. The messages were displayed on the tables, and posters and leaflets were installed at right places to be clearly seen by the clients. Moreover, the staffs in Sabz restaurant were trained to keep the foods warm in the dishes by placing them on hot water and prevent early serve of food that makes it cold. Moreover, the catering staffs of Sabz restaurant were trained to keep the food warm in hot water containers and avoid the early serve of the meals, which causes the food to go cold. Furthermore, they were trained to help the clients about the amount food they consume (i.e., asking them how much food they consume) [Table 1, items of 1, 2, 3, 4, 6, and 8].

Environmental interventions

Coordination was made with the schools and permission was obtained for students to use staff's glaciers and freezers for food storage, as well as microwave to re-heat the stored foods. In addition, the university officials were asked to make physical changes in the restaurant environment, such as adding containers for remained foods, installing containers of boiling water under the dishes to keep foods warm until the end of the dining hours, turning the breads into smaller pieces before serving it, and getting permissions to offer food according to students' demands [Table 1, Items of 5, 7, and 8].

Data analysis

One month after the beginning of intervention, the total food wastage of Sabz and Medical university restaurants was measured during the week days and then, the mean value of food waste estimated per week was compared to the mean value of waste in a week before the intervention. It should be mentioned that to adjust the confounding factors, types of served foods in test days were controlled through entry system of the restaurant. The data were collected from the students in control and intervention groups 1 month after the intervention by a questionnaire in the form of self-report. Then, they were analyzed by SPSS software (V.16.0, SPSS Inc., Chicago, IL, USA) using frequency distribution diagrams and Wilcoxon, Chi-squared, McNemar, and Mann–Whitney tests. The $P < 0.001$ was considered as significance difference ($P < 0.001$). In the analysis, demographic

Table 1: The schedule of health promotion program to prevent food wastage

Educational method		Educational content
1. Presenting pamphlets	No 1: Hungry beside food	The effects of hunger, food losses and waste statistics, human, economic, social, cultural and environmental impacts on food waste
	No 2: Do you know how to reduce wastage of food in the restaurant?	Adjusting the amount of food based on appetite
		Considering the enough time to meals
		Carefully choose the kind of food
		Pouring the extra food in prepared dishes
		Taking bread according to food type and level of appetite
		Avoid to receive that portion of food we don't want
		Taking the extra food
		Offering friends to share food
		The way of reuse of food materials
2. Installing posters	No 1: Amount of food wastage	
	No 2: Mortality of children caused by malnutrition	
	No 3: Relationship of amount of food wastage and the hungry people	
3. Leaflets	No 1: Cultural and social damages of wastage	
	No 2: Food wastage and its importance	
	No 3: Impacts of food wastages on the natural environment	
	No 4: The relationship between food wastage and food security	
4. Training food servants	Do not serve the food before the request of person	
	Cooperate with people about the amount of demanded food	
	If clients have no tendency to receive a portion of food, do not put that in the dish	
5. Placing hot water in beneath of food dish		
6. Writing some messages in the place of putting bread		
7. Embedding special dishes to put the extra portion of food before eating		
8. Face to face consultations while eating food by the peers on the tables		

variables (different between the two groups) were considered as covariates. Kolmogorov–Smirnov test, and drawing histograms and P-P Plots indicated that variables of awareness, attitude, and behavior of students did not follow a normal distribution. Therefore, for the purpose of data analysis, nonparametric tests were used. Moreover, because of the tilted data distribution, median, and interquartile range (IQR) were used. IQR is the interval between quarter 1 and 3 and shows 50% of median of the data. Scores of awareness, attitude, and behavior were changed into the scale of 100 and it was used in the calculations.

Ethical considerations

The ethical considerations of this work include; obtaining permission from the authorities of restaurants and Shahid Beheshti University of Medical Sciences, obtaining informed consent from the participants, ensuring the voluntarily participation in the study, and preserving the principle of anonymity in the questionnaires. The participants were trained how to weigh food wastage and this could not affect their behavior. Moreover, the educational intervention was implemented on the control group too (medical restaurant), using posters, pamphlets, and leaflets. The study on which these data analyses are based was approved by the Ethical Board Committee of Shahid Beheshti University of Medical Sciences (Code of ethics: IR.SBMU.PHNS.REC.1394.541).

Results

The sample size was estimated to 233 individuals in the intervention group and 233 individuals in the control group. As samples were narrowed down (due to the lack of participation of students in classes or filling the questionnaire without ID code) in the post-test, number of samples was declined to 208 individuals (89% responding) in the intervention group and 211 individuals (89% responding) in the control group. The mean age range of the participants was 20.93 years. In terms of gender, 96.5% of the participants were female and 30.5% were male. Furthermore, 9.8% of them were married and 90.2% were single, with 42.8% of them living at the dormitory and 14.4% having history of digestive system diseases. In terms of economic status; 53.8% of the participants were in good economic level; 38% in middle economic level; 2.2% in weak economic level; and 5.3% were in excellent economic level.

After implementing the McNemar test, it was found that, there was a significant difference in the intervention group in terms of serving food style before and after the intervention, but this difference was not significant in the control group [Table 2].

The results of Wilcoxon test showed that, the mean value of awareness, attitude, and behavior after

the intervention was significantly different from pre-intervention time in the intervention and control group ($P < 0.001$). To analyze the effectiveness of intervention in the intervention group compared to the control group, the difference in the values of awareness, attitude, and behavior before and after the intervention were estimated per group and the differences between the two groups were compared using Mann–Whitney test. Mann–Whitney test revealed that, the two groups were different from each other in terms of values of awareness, attitude, and behavior 1 month after the educational intervention ($P < 0.001$), [Table 3].

As shown in Table 4, in the intervention group, the food wastage per person was decreased from 116 g before the intervention to 76 g after the intervention (40 g/person). In the control group, this amount was reduced from 158 g/person to 155 g/person (3 g/person). In the intervention group, the value of bread wastage was 8.5 g/person before the intervention, which was decreased to 4.28 g after the intervention. In the control group, the value was increased from 6.8 g/person in post-test to 9.9 g/person in pre-test (it means that, it has been increased to 45.6 g). Before the intervention, weight of the food wastage of Sabz restaurant per week was estimated to be 382.37 kg. After the intervention, according to the results of pre-test and number of served foods, it was expected that the weight of food wastage would be 341.37 kg/week. However, this value was decreased to 224.98 kg/week as a result of the intervention. In other words, the food wastage per week was reduced to 116.39 kg [Table 4].

Discussion

In this study, in addition to implementing educational intervention for the intervention group, some changes

Table 2: Response to questions on serving food in both groups before and after intervention

Question	Experimental group		*P*	Control group		*P*
	Before	After		Before	After	
1. Is food served hot in restaurant you go?						
Yes	158 (76.7)	184 (89.3)	0.001	177 (84.3)	179 (85.2)	0.98
No	48 (23.3)	20 (9.7)		32 (15.2)	31 (14.8)	
2. Is food poured in plate before you ask for?						
Yes	93 (45.1)	23 (11.2)	<0.001	105 (50)	104 (49.5)	0.93
No	113 (54.9)	183 (88.8)		104 (49.5)	106 (50.5)	
3. Have the personnel cooperation while serving food?						
Yes	147 (71.4)	188 (91.3)	<0.001	144 (68.6)	140 (66.7)	0.35
No	59 (28.6)	18 (8.7)		65 (31)	69 (32.9)	

Table 3: Central and dispersion Indexes of knowledge, attitude, and behavior scores in both groups before and after intervention

	Before intervention		1 month after intervention		*P**	Variation		*P***
	Mean±SD	Median (IQR)	Mean±SD	Median (IQR)		Mean±SD	Median (IQR)	
Knowledge								
Experimental	75.2±11.42	78.33 (70-83.33)	96.82±3.17	96.66 (95-100)	<0.001	21.67±11.91	20 (13.33-26.66)	<0.001
Control	78.17±8.62	80 (73.33-85)	80±8.8	81.66 (75-86.66)	<0.001	1.83±5.62	1.66 (0-5)	
Attitude								
Experimental	71.43±16.43	75 (60-85)	95±5.94	95 (90-100)	<0.001	23.56±17.11	20 (10-35)	<0.001
Control	69.85±18.08	70 (55-85)	75.11±15.92	77.5 (65-86.25)	<0.001	5.26±12.94	0 (0-10)	
Behavior								
Experimental	63.84±17.71	66.66 (52.38-76.19)	85.2±9.88	85.71 (80.95-91.66)	<0.001	21.35±19.24	19.04 (9.52-33.33)	<0.001
Control	63.33±18.45	66.66 (52.38-76.19)	65.21±16.13	66.66 (52.38-76.19)	<0.001	1.88±8.92	0 (0-4.76)	

SD=Standard deviation, IQR=Interquartile range. *Comparison test result before and after the intervention in each group (Wilcoxon test). ** Comparison of behavioral changes between experimental and control groups (Mann-Whitney test)

Table 4: Comparison of food wastage weight in experimental and control groups before and after intervention

Variable	Before intervention	After intervention	Variation percent
Experimental group			
Weight of food wastage per person (g)	116	76	−35
Weight of bread wastage per person (g)	8.5	4.28	−49.6
Control group			
Weight of food wastage per person (g)	158	155	−1.9
Weight of bread wastage per person (g)	6.8	9.9	−45.6

were also to the environment and the method of serving food, for example, the food kept warm on a container of hot water. According to the survey of clients, this method had a positive effect. In a study conducted by Engström and Carlsson-Kanyama on the Sweden's food industry, serving food with appropriate temperature could reduce the food wastage.[14] Moreover, as a result of training the restaurant staff, the food was not placed in dishes at the presence of clients and this could be important from two aspects: first, people could adjust the amount of food they want to eat and second, this could prevent serving cold food.

The results of this study showed that after the intervention, the information and awareness of participants regarding the food consuming behavior and the amount of waste production had increased compared to the control group. This showed the effectiveness of intervention in enhancing the awareness of clients and personnel of Sabz restaurant about the FCB and wastage production rate. The study conducted by Gutiérrez-Barba and Ortega-Rubio showed that training families about the FCB and amount of wastage production could be efficient and the awareness of participants was increased significantly.[19] Another study conducted by Quested *et al*., (2016) on families showed that, educational intervention could increase the information of family members about the wastage of food.[18] If people's awareness is based on awakening information, it could direct their behavior. To create continuous change in behavior or to ensure the continuing of the behavior, it is logical to create awareness and trend.[14] A study conducted by Gutiérrez-Barba *et al* showed that awareness and environmental concerns could affect consumption, so that with the increase in awareness and environmental concerns, consumption would be controlled.[19] Moreover, the study conducted by Painter *et al*., showed that, any increase in the awareness on environmental and economic complications of food wastage could be affective factor in reducing the wastage of food.[17]

In addition, training FCB played a key role in creating positive attitude in clients of Sabz restaurant. A study conducted by Rasti and Khadivi in a boarding high school concluded that, changes in the attitude and behavior of students and authorities could prevent wastage of food.[20] Other studies have confirmed the results of the present study.[21-24]

The results of this study showed that after the intervention, the scores of participants' behavior significantly increased in the intervention group compared to the control group. The study conducted by Gutiérrez-Barba and Ortega-Rubio showed that behavior of families could be changed as a result of interventions.[19] Moreover, the study conducted by Quested *et al*. showed that implementing the interventions could reduce waste production of families.[18] Gaining more information about the amount of food wastage allows authorities to have realistic goals about the amount of food waste reduction.[17] Attitude and behavior of consumers play a key role in determining the amount of food wastage in households.[25] A study conducted by Painter *et al*. showed that, if the report of amount of food wastage causes concern for the authorities, personnel, and students, it could be a starting point in reducing the amount of food wastage.[17] In a study conducted in 2006 in the U.K., 90% of consumers claimed that their imagination about wastage of food materials was very low or almost zero.[25] The results obtained from this study showed that after the intervention, behavior of the participants in the intervention group improved significantly compared to the control group. The results obtained by Gutiérrez-Barba and Ortega-Rubio showed that production of food waste before the workshop was about 1.3 days, which increased to 3.7 days after the workshop and training.[25] Moreover, Quested *et al*. showed that educational intervention could reduce the waste production in households.[18] The awareness, attitude, and behavior of samples in the control group were also significantly differed in post-test compared to pre-test and the reason for that could be the large sample size and the effect of pre-test.

According to the main findings of this study, the measures taken to reduce the food wastage have been not only based on the perceptions and self-reporting of respondents, as well as weighing the food wastage. In the intervention group, the amount of food wastage per person was decreased from 116 g in pre-test to 76 g in post-test as a result of the intervention, and the bread wastage was reduced from 8.5 to 4.28 after the intervention. Similar results were obtained by Gutiérrez-Barba and Ortega-Rubio, as they observed that the amount of waste production of families after educational workshop was reduced compared to the control group.[19]

Limitations

Self-reporting in the data collection procedure can be considered as one of the limitations of this study. However, the use of this method in such studies is inevitable and may lead to a bias of "researcher-desired report" by the audience, and over estimation in some segments. In this study, anonymous questionnaires were used to minimize such bias.

Conclusions

One of the most important factors in waste management at the universities is the degree of students and staff's

participation. One of the main methods to achieve this is to increase public interest and the participation of students and staff in recycling programs and to improve the awareness and attitude of individuals toward this issue. This could be addressed by planning and university meetings. This study has confirmed the effectiveness of interventions in increasing the awareness, attitude, and behavior of people about food consumption and amount of waste production. The strengths of this study could be that, environmental and educational interventions could form a health promotion program, which could lead to the effectiveness of plans. Moreover, in this study, the behavior was analyzed using two forms of self-report and real-time records. The results of this study could be used to reduce food waste production at universities, restaurants, dormitories, and other centers. The authors are suggested to investigate sustainability of interventions used to change the behavior of food consumption and wastage production. This study could be implemented in different and longer time intervals after the end of project.

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Conflicts of interest

There are no conflicts of interest.

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