Original Article

# Visual Cues and Food Intake: Distortion Power of Plate and Spoon Size on Overweight and Obese University Staff

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## Abstract

**Background:** This study was designed to evaluate the effect of the size of plate, spoon, and fork on food and energy intake during a meal in obese or overweight staff. **Methods:** This was a crossover randomized controlled trial that was conducted on 40 obese or overweight clerical staff of the university. The staff was invited to have lunch randomly, receiving either a large or a small set of plate, spoon, and fork. Washout period was 3 weeks, and the participants were then invited to have lunch in a second intervention period and received opposite sizes of dishes compared to the first period sizes. The meal was composed of roasted chicken (kebab), cooked rice, vegetable salad, dairy drink, and soda. Changes in food intake between large and small utensils (plate, spoon, and fork) were analyzed with paired *t*-test. **Results:** Rice intake using small or large eating utensils was different ($P$ = 0.02). But total energy intake was not different. The Pearson correlation test demonstrated a positive and significant correlation between rice consumption and waist-to-hip ratio ($P$ = 0.02). Soda ($P$ = 0.02), carbohydrate ($P$ = 0.01), and total energy intake ($P$ = 0.03) were negatively correlated with the age of the participant. **Conclusions:** It seems that only the amount of grain products consumption changes with changing in dishware size with no significant effect on total energy intake. It is recommended that the independent effect of visual cues on food intake for foods with different textures be investigated in future studies.

**Keywords:** *Cooking and eating utensils, eating, overweight*

## Introduction

Obesity and overweight have been the hot topics in health and medicine from the beginning of humanity to date. In 2014, 39% of adults were overweight and 13% were obese worldwide.[1] Today, 12.6–38.5% of Iran's population are overweight or obese.[2] Apart from common weight management methods, lifestyle change strategies are still leading the effort to deal with this problem.[3] It seems that people are under the impression that environmental factors nudge them toward altering their food choices.[4] Portion size affects food and energy intake and can be one of the leading causes of excess weight. Even a slight change in portion size leads to significant changes in calorie intake, which may lead to long-term weight loss or obesity.[5] The most feasible and effective way to control portion sizes remains a concern. Controlling meal size in humans is motivated by myriad direct and indirect complicated factors. Some direct external cues are characteristics of the food itself such as food components, a variety of food items, pleasurable items around the eater, characteristics of eating environment (watching TV, eating with others, and social facilitations), and characteristics of the consumer. After all, the specific effect of genetic variation in humans in terms of their reactions to external eating cues is undeniable.[6] Among the external cues that can influence food intake greatly, food container size is considered important these days.[7,8] Recent studies on Western foods did not show any significant changes in calorie intake with dish size changes.[7,9-12] Surprisingly, people would consume more vegetables and vegetable salads when they received larger plates, and recent studies on Western foods did not show the use of small plates as an effective strategy for reducing total energy intake.[13] In a recent study on normal-weight New Zealand Europeans, plate size had significant effects on estimated satiation and estimated food intake.[14] Despite the negative results of



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studies so far, the role of dish size on food consumption when serving Eastern foods, with their unique and different characteristics, is unknown.[14] Furthermore, there is a lack of studies targeting the effect of dishware size on calorie intake in Iran. Therefore, this study aimed to evaluate the effect of plate size on food intake of overweight Iranian men and women. The second objective of this study was to evaluate the relation of personality with food intake.

## Methods

### Study design and population

This was a randomized controlled trial with crossover design to evaluate the effect of dishware size on food intake in overweight and obese people. Fifty overweight and obese staff of Ahvaz Jundishapur University of Medical Sciences recruited in the study [Figure 1].

Inclusion criteria were as follows: age between 19 and 50 years, body mass index ≥25 kg/m$^2$, good mental and physical health (according to annual medical check-up of university staff), and no comorbidities of overweight and obesity such as high blood pressure, asthma, and cardiovascular disease. Exclusion criteria were as follows: women who were premenopausal or postmenopausal, athletic people who exercised regularly, people who followed any kind of therapeutic or weight management diet, those following any lifestyle or eating habit modification program or social network, people who were on medication for weight loss over past month or taking any medicine, metabolic or gastrointestinal disease, and drug or alcohol abuse.

### Ethical consideration

Informed written consent was obtained from all participants and the Ethical Committee of Ahvaz Jundishapur University of Medical Sciences approved this study (IR.AJUMS.REC.1394.392). The study protocol conformed to the ethical guidelines of the 2008 Declaration of Helsinki, and it has been registered in the Iranian Registry of Clinical Trials (IRCT2016041516123N7).

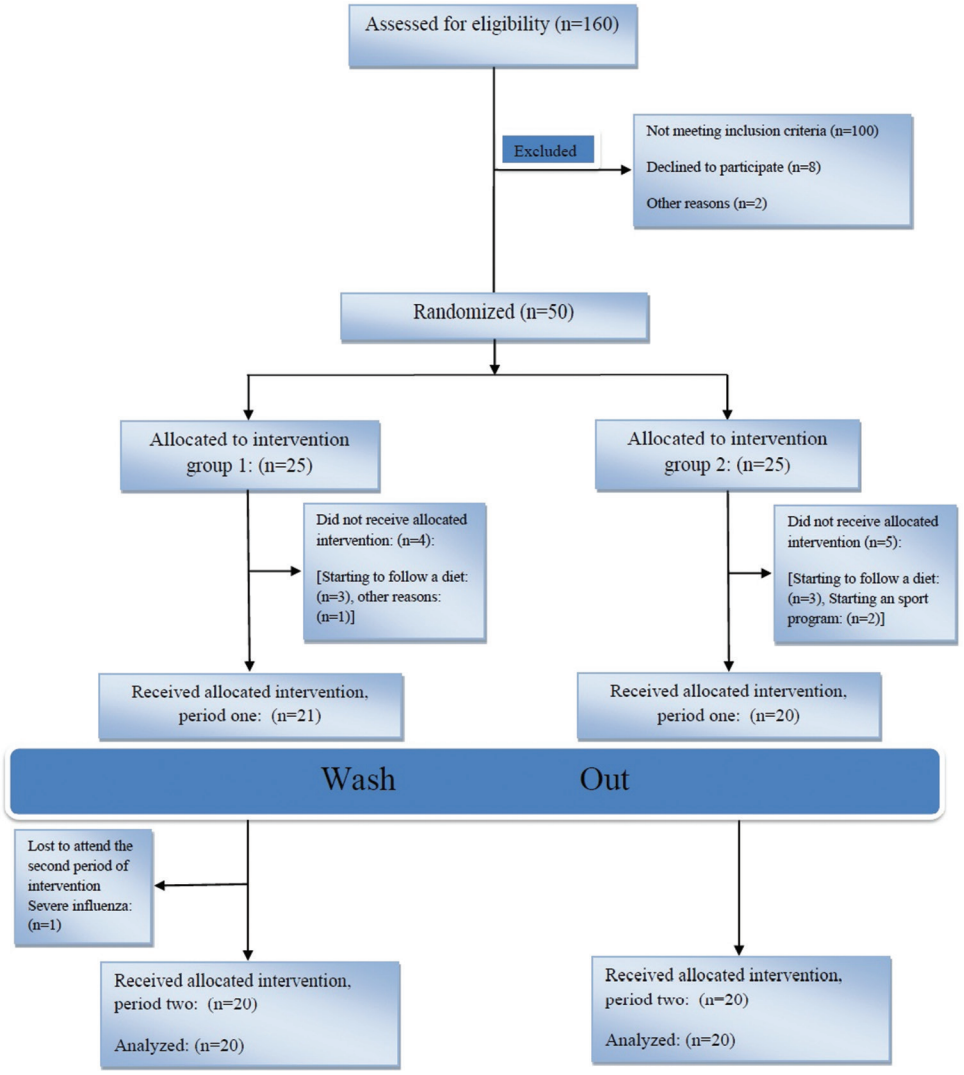


**Figure 1: Flow chart for staff enrollment, randomization, and retention**

### Randomization

Participants were randomly allocated into two groups, which is illustrated in Figure 1. We used the block allocation method to classify participants of both groups in each of the intervention periods. In line with this randomization method, all participants were assigned to nine blocks.

### Intervention

In the first intervention period, one group received a small-sized plate, spoon, and fork and large dishware in the second period; and the other group received a large plate, spoon, and fork in the first period and the small-sized dishes in the second period.

### Measures

Data collection was performed by a trained interviewer using a valid questionnaire. The information obtained included sociodemographic data and food dislikes. Before the intervention session, subjects underwent anthropometric measurements including body weight with digital scale (Seca 761, Germany), height with mechanical measuring tape (Seca 206, Germany), and waist and hip circumference with ergonomic circumference measuring tape (Seca 201, Germany), and scales were calibrated at the beginning of every day. Also, the Dutch Eating Behavior Questionnaire[15] was used to investigate eating behaviors of the participants (valid and reliable for use in Iran).[16,17]

In the first intervention period, subjects were invited to have lunch at the "dining hall" of the university. The walls and flooring of this hall were covered with white materials, and chairs and dining tables were also in white color. Each person had own table on the intervention day, with his/her own foods and dishware on the table. Besides the main course, they could have food additives such as salt, pepper, and sour orange juice for flavoring the food. Each individual's dishware consisted of two same-sized spoons and forks, one plate, and a glass. The characteristics of large eating utensils were as follows: a stainless steel spoon with a capacity of 15 mL and fork of the same length and weight, white ceramic plate of 25 cm in diameter, and 120-mL transparent glass. The characteristics of small eating utensils were as follows: a 5-mL stainless steel spoon and fork of the same length and width, 120-mL transparent glass, and plate of 19.5 cm in diameter. Both sizes (small and large) of forks and spoons were of the same material, design, thickness, and company, and the dining plates in both sizes were also of the same material, color, and thickness and were purchased from a single company.

The lunch packages were similar in the two intervention periods in terms of quality, quantity, and serving temperature and consisted of 270 g of barbecued chicken breast (seasoned with onion, saffron, and lime juice), 600 g of steamed rice with saffron and two medium-sized barbecued tomatoes as optional side dish, and 430 g of vegetable salad with 42 g mayonnaise sauce in two individual packs. These portion sizes were chosen wisely as they are all 1.5 times the normal portion sizes in Iran's restaurants.

Besides every lunch package, the participants could find two kinds of drinks and mineral water. Two bottles of soda (each contained 300 ± 50 mL) and two bottles of dairy drink, called Dough on the Iranian menu (each contained 270 ± 40 mL), were provided for each person. The main dish (chicken kebab with rice and one tablespoon of vegetable oil) had 1365 kcal in total.

In the beginning and on completion of each intervention session, each person's food container was weighed. The quantity of food consumed from each item (rice, chicken, salad, mayonnaise, and drinks) was determined according to the formula below:

(Food quantity in the main container) − [(Plate with remains-empty plate) + (Food remains in the food container)].

The measuring instrument for drinks (dairy drink and soda) was a measuring glass, and volume was reported in milliliters. The scale for measuring solid foods was a digital kitchen scale (A548, Turkey) with ± 5 g error, and each item was weighed twice for more accuracy.

### Statistical analysis

All statistical analyses were performed using STATA version 14 (STATA, College Station, TX, USA) and SPSS version 16.0 (SPSS Inc. SPSS for Windows, Chicago, 2007). All main outcomes of the study relating to two intervention periods were entered into STATA, and analysis showed that these effects were not significant. STATA was used to evaluate "period effect," "treatment effect," and "carryover effect."

Data are presented as mean (±SD) and frequency (%) for continuously and categorically distributed variables, respectively. The statistical significance level was set at a two-tailed type I error of 0.05 and deviation from a normal distribution was examined by calculating skewness and using the Kolmogorov–Smirnov test.

The Chi-square test was used to evaluate categorical variables and paired *t*-test and independent *t*-test (or nonparametric equivalents tests) for comparison within the group and between groups, respectively.

## Results

We recruited 50 participants and 40 participants completed the study. The reasons for dropout are presented in Figure 1. The mean age of participants was 39 ± 6.98 years and 29 (72.5%) participants were

female. Seventy-five percent were married (30 subjects), and 15% of participants had high school diploma, 22.5% had an associate's degree, 45% had a bachelor's degree, and 17.5% had a master's degree. The mean body mass index of participants was 30.14 ± 3.71 kg/m$^2$, and mean waist and hip circumference were 93.25 ± 10.61 and 110.45 ± 7.47 cm, respectively. With regard to the physical activity of participants, median metabolic equivalent was 475 (955.1–210.1) min/week.

As shown in Table 1, except for rice consumption difference in large and small utensils (plate, spoon, and fork), which was significant ($P$ = 0.02), none of the outcomes of this intervention was significantly different in the two study periods (different dish sizes).

Exploring the relations between characteristics of food intake and health-related variables by using the Pearson correlation tests showed some significant associations. A negative relationship between age and soda intake, total energy intake and total calories from carbohydrates was observed. Also, a negative relationship between total calories from fats and waist-to-hip ratio (WHR) and positive relationship between rice intake and WHR was found. Protein intake had no relationship with age or WHR [Table 2].

Relationships between characteristics of food intake and Dutch Eating Behavior test demonstrated a positive correlation between salad consumption and emotional eating with diffuse emotions ($r$ = 0.39, $P$ = 0.02) and emotional eating ($r$ = 0.35, $P$ = 0.03). Also, mayonnaise intake was negatively correlated with restraint eating ($r$ = −0.41, $P$ = 0.01). Protein percent of total calories was correlated positively and significantly with restraint eating ($r$ = 0.32, $P$ = 0.05).

## Discussion

This study was designed to evaluate the effect of dishware size on food intake among Iranian participants. The experimental data are rather controversial, and there is no general agreement about the effect of visual cues (especially plate or food container size) on food and energy intake. Most studies in the field of nutrition and food science have only focused on western foods and desserts (ice cream and sweets), and to the best of our knowledge, this is the first time that Eastern foods went through examination.

The results of this study showed that there was only a significant difference in rice intake but no significant difference in calorie intake between small and large dishware. Except for some kinds of food consumption (such as vegetables), plate size was not one of the effective environmental cues that alter calorie intake, and some studies provide support for these findings.[7,12,18-20] Surprisingly, in the study by Shah *et al*., people consumed more vegetables when they got bigger plates but the total calorie intake was not different between two plate sizes.[12] van Kleef *et al*. similarly examined the effect of the size of bowls containing pasta on serving behavior and food consumption (large-sized bowl vs. medium-sized bowl). The results showed that individuals served themselves 77% more pasta when receiving a bigger bowl and that this overeating was not related to the eating senses such as tastiness or notability.[7] This result is same as our result because we found more rice consumption. In an interesting study, Sharp and Sobal examined people's conceptualization and sensitivity toward plate size, food portions, and meal composition.[21] Based on their results, university students were asked to draw their desired portion size for dinner on paper plates of two different sizes.

**Table 1: Comparison of characteristics of food intake between small and large utensils (plate, spoon, and fork)**

| Variable | Small utensils ($n$=40) Mean±SD or mean rank | Large utensils ($n$=40) | $P$ |
|---|---|---|---|
| Rice (g) | 206.8±71.7 | 235.4±86.3 | 0.02*,# |
| Chicken kebab (g) | 162.4±65.8 | 158.1±68.7 | 0.65* |
| Vegetable salad (g) | 155±110.3 | 156±105.8 | 0.94* |
| Mayonnaise (g) | 13.3 | 16.8 | 0.71** |
| Soda (mL) | 7.1 | 9.3 | 0.19** |
| Dough (dairy drink) (mL) | 15.1 | 14.7 | 0.13** |
| Food quality (score) | 11.5 | 9.8 | 0.60** |
| Food quantity (score) | 9.5 | 10.6 | 0.99** |
| Eating durance (min) | 18.1 | 19.2 | 0.31** |
| Energy intake (calorie) | 775.1±249.6 | 783.7±249.7 | 0.77* |
| Protein percent of total calories | 0.3±0.1 | 0.3±0.1 | 0.34* |
| Carbohydrate percent of total calories | 0.4±0.1 | 0.4±0.1 | 0.39* |
| Fat percent of total calories | 0.3±0.1 | 0.3±0.1 | 0.88* |
| Protein intake (g) | 60.8±21.7 | 59.9±23 | 0.79* |
| Carbohydrate intake (g) | 75.1±32 | 78.7±31.5 | 0.32* |
| Fat intake (g) | 23.9±10.9 | 23.6±9.5 | 0.82* |

*Normal distributed variable (paired $t$-test), **Not normal distributed variables (Wilcoxon test), #$P$<0.05

**Table 2: Relationship between food intake and age and anthropometric measurements**

| | Age | Waist-to-hip ratio |
|---|---|---|
| Consumed rice | $r$=-0.41 | $r$=0.38 |
| | $P$=0.01* | $P$=0.02* |
| Soda | $r$=-0.37 | $r$=−0.12 |
| | $P$=0.02* | $P$=0.48 |
| Energy intake | $r$=-0.34 | $r$=0.24 |
| | $P$=0.03* | $P$=0.14 |
| Fat percentage of total calories | $r$=0.20 | $r$=-0.39 |
| | $P$=0.23 | $P$=0.02* |
| Carbohydrate percentage of total calories | $r$=-0.38 | $r$=0.25 |
| | $P$=0.02* | $P$=0.12 |
| Protein percentage of total calories | $r$=0.21 | $r$=0.11 |
| | $P$=0.20 | $P$=0.50 |

*Significant relationship

They draw significantly more vegetables on bigger plates, while the amount of main food on the two plates was not different. Despite two studies that support this idea about vegetable consumption and conception, we did not find any significant difference between two sizes of the plate in vegetable salad consumption. The reason may be the type of vegetable. We served a cold vegetable salad, while those other studies talked about "vegetables" that could be served warm or cold, possibly affecting the appetite of the eater.

Food intake and food container have been investigated in different aspects. In a study by Marchiori *et al*., participants were served M&M candies in two different containers (large and small) while they watched a TV show.[22] The results showed that they ate significantly more candy with the large-sized container. It is evident that participants may have been distracted by the TV show and ate more, while in our study, we controlled environment distractors such as noises or visual distractors, so participants could concentrate on the portion sizes. Also, we allowed eaters to take as much food as they wanted by giving them an empty plate, but Marchiori *et al*. gave an intentional amount of candy in a container and people had no choice but to take candies out of the container. For a rational conclusion, it seems that people should have complete permission and access to food and container at the same time.

Studies about spoon size are scarce. A study by van Ittersum and Wansink on 85 nutrition experts who were served ice cream showed a 14.5% increase in consumption when the spoon size was increased by 50% (2 vs. 3 oz) with an insignificant trend, and this result was irrespective of the size of the bowl.[10]

### Strength and limitations

To the best of our knowledge, there is no published study investigating the effect of dishware size on Eastern food intake. The most powerful aspect of this study was its crossover design, which makes it powerful and effective. Also, the effects of "within-patient" confounders were omitted and we could have samples absolutely matched. Some limitations of the present study should be acknowledged. The food amount for each participant was determined as 1.5 times more than common portion sizes in Iranian restaurants. It would be better if people could freely choose the food amount by presenting food as self-service with huge food amounts. Also, we examined the effect of two different sizes of dining dishes and spoon and fork all in one package and did not investigate spoon, plate, and fork sizes separately. This could have precluded any conclusions regarding utensils' effect alone.

Moreover, while the cultural characteristics of participants were one of the important factors to affect food intake, it was not considered and investigated in this study. Surprisingly, a unique study by Peng *et al*. on 570 people from different cultures showed that cultural differences can have an impact on perception of food portion as a function of plate size. They showed that manipulations of the plate size had no effect on the expected fullness or the estimated food intake of western candidates such as Canadians and New Zealanders but not of Chinese and Korean.[23]

## Conclusions

It seems that only the amount of grain products consumption changes with changing in dishware size with no effect on total energy intake. It is recommended that the independent effect of visual cues on food intake for foods with different textures be investigated in future studies.

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### Conflicts of interest

There are no conflicts of interest.

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