Clinical and Experimental Health Sciences

The Estimation of Standard Portion Sizes Using Food Photographic Booklet Among University Students in Turkey

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ABSTRACT

Objective: To examine estimation of standard portion size and, the influence of different food plates on the estimation of food portion size, using photograph booklet in students.

Methods: The sample consisted of 300 students, aged 18-35 years old from different academic departments. The student's general characteristics were asked by using a questionnaire, and anthropometric measurements were taken. Students were asked to select the standard portion sizes of each food from a photographic booklet, which was developed by the researchers. Dietary guidelines for Turkey were used for assessing the quantity of standard portion size of foods of a photographic booklet (1).

Results: The findings of the present study indicate that the food group which the most students provided the accurate estimation was protein foods (36.0%), pursued by grains (35.1%), dairy (29.2%), fruits and vegetables group (28.9%). The most and the least accurate estimated foods were found boiled potato (64%) and cheese (3.7%), respectively. The percentages of the accurate estimation of standard portion size for five foods (meatball, meat cubes, shredded chicken, egg, yogurt) in 24 foods were higher in females than men ($p<0.05$). There was no significant relationship between various plate sizes and shape with the perception of standard portion size.

Conclusion: It was found that many students were unable to identify the correct photo that represented a standard portion size. Future studies are needed to validate the food atlas for use in the Turkish population.

Keywords: Portion size estimation, food photographs, standard portion size.

1. INTRODUCTION

In recent years, nutrition scientists have stated that there is a need for research in portion size estimation because the perception of the correct amount of portion sizes of food consumed is an important factor for analyzing nutrient intake (2). Assessment of dietary intake with self-report methods such as dietary diaries, 24-h recall, and food frequency questionnaire, rely on the individual's ability to recall their amount of food intake. For this reason, the major sources of errors occur in the assessment of the portion size of food consumption (3, 4). Methods that have been used to reduce measurement error and help individuals to express amounts of food intake include portion-size models, food models, and photographs (5). Photographs have different advantages in comparison with three-dimensional models like being easily copied, including a wide range of different kinds of foods and it is easy for questionnaires to carry them (6). For this reason, food photographs are usually used in dietary surveys to help estimate portion size (7). As food habits differ between the countries and within, the food photographs used in a dietary study should represent the most important local food items and dishes of the area (6).

The photographs, which show a range of portion sizes, are beneficial for estimating portion sizes, and using such photographs can reduce the misclassification of subjects. Also, it was indicated that age, sex, body mass index were potentially important confounders in the perception of portion size (5). Small errors were seen in using photographs and virtual portion sizes. The findings supported that a food photographic atlas is a valid tool for estimating portion sizes in nutritional epidemiological studies. Different factors may influence these three elements, such as food variety, dishware size, number of various portion sizes and their arrangement in the food photograph booklet, size of photographs, and camera angle (8). The effect of dishware size on the serving behavior of an individual is significant (9). Since 1960, the size of the average dinner plate has increased by 36% (8). Based

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on some studies, a positive correlation was seen between dishware size or plate and the amount of food consumption portion (10-13). Recently, obesity has been rapidly increasing and, has become a major health problem worldwide. Epidemiological data suggest that obesity and lifestyle changes lead to increased incidence of chronic diseases such as cardiovascular diseases, cancer, osteoporosis, high blood pressure, and obesity (14,15). Higher energy consumption due to increasing portion size is associated with higher prevalence of overweight or obesity (16). In this regard, to prevent overweight/obesity, estimating the amount of food intake and measuring the portion size seem necessary. The aim of this study was to assess the estimation of standard portion size and analyze the effect of the dishware on the estimation of food portion size in the students of Hacettepe University.

2. METHODS

2.1. Subjects and Data Collection

This cross-sectional study was conducted on Faculty of Economics and Administrative Sciences and Faculty of Engineering at Hacettepe University, during the fall of 2014 and spring 2015 semesters (October 2014-February 2015) to to assess the perception of standard portion size in students. The sample size was calculated by G-Power analysis program and determined as at least 270 students with β=0.3 and α=0.05 and 80% power. Three hundred students (male: 138, 46.2%; female: 162, 54%), aged 18-35 years, who volunteered to participate in the study. The inclusion criteria for the participants were to be healthy students and not to be following a special diet. Participants with any chronic diseases and eating disorders were excluded. Also, pregnant women were excluded. Data were collected through face-to-face interviews. The questionnaire consisted of two parts, including general information and 35 food photographs of 24 foods (milk, yogurt, cheese, meatball, meat cubes, chicken, shredded chicken, baked beans, egg, French fries, boiled potato, boiled green pea, boiled spinach, apple, orange, banana, strawberry, watermelon, bread, rice, pasta, cornflakes, tomato soup, pizza) for estimating the standard portion size of typical Turkish foods. To determine the standard amounts of foods, Dietary guidelines for Turkey were used (1). Students were asked to estimate standard portion sizes of each food using a photographic booklet which was developed by the researcher. Some anthropometric measurements were taken. The body weights were measured to the nearest 0.5 kg with a portable scale. Height, waist, and hip circumferences were measured to the nearest 0.1 cm with a fiber-glass tape. The students wore minimal clothing without shoes during measurements (16). Body mass index (BMI; kg/ m^2) was calculated for each subject. The cut-off points for BMI were defined as 18.5–24.9 kg / m^2 for normal weight and 25–29.9 kg m^2 for overweight according to the World Health Organization (WHO) standards (17). According to WHO recommendation optimal cut-off points for waist circumference were 94 for men and 80 for women; 94-102 cm in men and 80-88 cm in women is associated with an increased risk of metabolic complications and the risk is significantly increase with ≥102 cm in men and ≥88 for women. Also, the waist-hip ratio cut-off points recommended by WHO expert consultation to detect obesity were ≥ 0.9 and ≥ 0.85 for men and women, respectively (18). The cut-off points for waist to height ratio according to Ashwell et al, were defined as; <0.4 take care, 0.4 – 0.5 no increased risk, ≥0.5 and <0.6 'increased risk' and ≥0.6 'very high risk' (19).

Ethical approval was endorsed by Hacettepe University Ethics Committee with B.30.2.HAC.016969557-238 number on 20.10.2015. The participants of this study have confirmed the Informed Consent Form statements.

2.2. Design of the Photographic Booklet

2.2.1. Food selection

The food items were selected among some popular foods which daily consumed in Turkish population (milk, yogurt, cheese, meatball, meat cubes, chicken, shredded chicken, baked beans, egg, French fries, boiled potato, boiled green pea, boiled spinach, apple, orange, banana, strawberry, watermelon, bread, rice, pasta, cornflakes, tomato soup, pizza). It has been noted that foods were selected from different food groups. The participants were asked to select the photo reflecting one portion of a food from different photos shown for each food

2.2.2. Food digital photographs

To reflect the various amount of food intake, photos from three or four different portion sizes were taken. To determine portion size amounts; a coefficient equal to 1 was assessed as medium portion size, the small portion was calculated by multiplying the medium portion size by 0.5. The large portion size was calculated by multiplying the medium one by 1.5, while the extra-large was calculated by multiplying the large portion by 1.5. All foods and beverages were prepared in the kitchen and subdivided into three or four different weighed portions in accordance with previous computed. In the following, they placed on white dining plates, bowls, and glasses against a white background, and photographed from the same angle using a digital camera (Canon SX200IS Power Shot). As the photos were taken with the same angle camera and distance the photographs were demonstrated the unique frame. In the first form, photos were arranged side by side with the paint program, coded by numbers and each portion identified by alphabetical capital letters (A, B, C, and D), and then printed in color. To avoid response bias, actual weights of portions were not shown in photographs. The weights of portion size were indicated at the end of the photograph booklet. The photographs, which were presented to the selection of students, were evaluated with two forms: 1. In 24 food photographs, foods were weighted in different

amounts and were presented in the same size of dishware to examine the knowledge of standard portion size (Figure 1.A) ; 2. In 11 food photographs, foods were weighed in the same amount but presented in different sizes of plates (small (19 cm), medium (23 cm), large (28 cm) diameter) and different dishware (soup plate, bowl, glass) to examine the influence of dishware size in estimating standard portion size (Figure 1.B). For assessing the quantity of standard portion size of foods, Dietary guidelines for Turkey were used (1).

2.3. Data Analysis

Statistical evaluation of results was performed using IBM SPSS 22 package program in the Windows operating system to calculate the frequency, percentage, average, and standard deviation according to gender. The data normality was assessed by Kolmogorov-Smirnov test. The number and percentage of participants with correct estimation for standard portion size were calculated for each portion size foods. The percentages of correct and incorrect estimation of standard portion size of foods were compared for gender using the χ2-test, with 95% confidence.

3. RESULTS

The general characteristics of the subjects are demonstrated in Table 1. The average age of students was 21.5 years old that was found similar in males and females. The percentages of normal BMI (18.5-24.99 kg/m2) were 69.6% and 71.6% in men and women, respectively. 17.7 % of the total samples were overweight, and a further 1.7 % of them were obese. We found that 13.7% of men had a waist circumference ≥94 cm, and 20.4% of women had a waist circumference ≥80 cm. Also, 13.8 % of men (WHR ≥ 0.9) and 7.4% of women (WHR ≥ 0.85) demonstrated central adipose tissue distribution. The percentages of males and females with central obesity according to the waist-to-height ratio (WHtr >0.5) were 31.2 % and 13.0%, respectively.

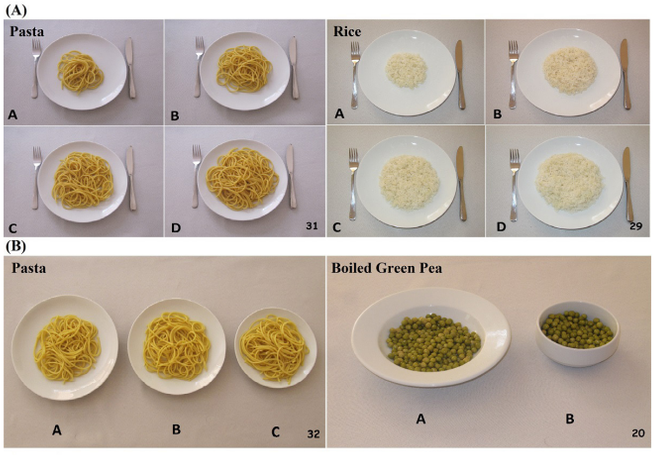

Figure 1. *(A) Different amount of food in same plate (B) Same ammount of food in different dishwares*

Table 1. *General characteristics and anthropometric measurements of students*

	Male (n:138) Mean ±SD	Female (n:162) Mean ±SD
Age (year)	21.9 ± 3.0	21.0 ±2.2
Height (cm)	177.2 ± 6.0	163.7 ± 5.9
Weight (kg)	74.5 ±10.6	57.3 ± 9.2
BMI(kg/m²)	23.9 ± 3.0	21.3 ± 2.8
Waist circumference (cm)	84.8 ± 9.4	74.2 ±9.0
Waist/hip ratio	0.86 ± 0.05	0.77 ± 0.05
Waist/height ratio	0.48 ± 0.05	0.45 ± 0.05
BMI classifications*		
<18.5	1 (0.7)	29 (17.9)
18.5-24.99	96 (69.6)	116 (71.6)
25.0-29.9	37 (26.8)	16 (9.9)
≥ 30	4 (2.9)	1 (0.6)
Waist classifications*		
<94	119 (86.2)	-
94-102	13 (9.4)	-
≥102	6 (4.3)	-
<80	-	129 (79.6)
80-88	-	21 (13.0)
≥88	-	12 (7.4)
Waist/hip ratio classifications*		
<0.9	119 (86.2)	-
≥ 0.9	19 (13.8)	-
<0.85	-	150 (92.6)
≥0.85	-	12 (7.4)
Waist/height ratio classifications*		
<0.4	4 (2.9)	15 (9.3)
0.4-0.5	91 (65.9)	126 (77.8)
0.5-0.6	40 (29.0)	18 (11.1)
>0.6	3 (2.2)	3 (1.9)

Correct estimation of the standard portion size of 24 typical Turkish foods shown in Table 2. The food group that the most students provided the accurate estimation, was for protein group (36.0%), followed by grains/ starches (35.1%), dairy (29.2%), and fruits and vegetables (28.9%) (Figure 2). The food item for which most of the participants provided the accurate estimation was boiled potatoes (64.0%), followed by meat

cubes (55.3%). The most and the least food item which students estimated the accurate portion size was yogurt (47.3%) and cheese (3.7%) from the dairy group, cube meat (55.3%), and chicken (13.7%) from the protein group, boiled potato (64.0%), and orange (5.0%) from fruit and vegetable group, cooked rice (40.0%) and cornflakes (19.3%), respectively.

Among 24 foods, there were significant gender differences in the estimation of portion size of 5 foods ($p<0.05$). The female students came done to an accurate estimation compare with the male students, to appraisal of the standard portion size for meatball ($p < 0.001$), meat cubes ($p <0.001$), shredded chicken ($p < 0.01$), egg ($p < 0.001$), yogurt ($p<0.05$). Only for cornflakes, males provided the correct estimation of standard portion size comparison to females ($p<0.05$). The proportion of female students in estimating of standard portion size of foods, were higher than male students.

The standard portion size estimation of the same amount of some foods in different plate size and dishware are shown in Table 3 and Table 4. In estimating the same amount of foods, which were offered in three sizes of plates (meatball, chicken, shredded chicken, French fries, rice, and pasta), the majority of students were selected medium-sized plates. For the same amount of yogurt in glass and bowl, 74.0% of the students were chosen the yogurt showed in the bowl as standard portion size. In tomato soup, 66.7% of students had preferred the bowl as standard portion size. The differences in selecting dishes were statistically significant ($p< 0.01$).

Table 2. *Correct estimation of standard portion size of typical Turkish food*

	Male (n=138)	Female (n=162)	Total (n=300)	
Variables	N (%)	N (%)	N (%)	p
Dairy				
Milk (225g)	39 (28.3)	35 (21.6)	74 (24.7)	0.183
Yogurt (225g)	55 (39.9)	68 (42.0)	123 (41.0)	0.031*
Cheese (60g)	5 (3.6)	6 (3.7)	11 (3.7)	0.710
Protein Foods				
Meat ball (100g)	37 (26.8)	77 (47.5)	114 (38.0)	0.000*
Meat cubes (100g)	49 (35.5)	117 (72.2)	166 (55.3)	0.000*
Chicken (100g)	22 (15.9)	19 (11.7)	41 (13.7)	0.290
Shredded chicken (100g)	44 (31.9)	77 (47.5)	121 (40.3)	0.006*
Baked beans (130g)	42 (30.4)	54 (34.6)	98 (32.7)	0.447
Egg (50g)	34 (24.6)	73 (45.1)	107 (35.7)	0.000*
Vegetables				
French fries (90g)	47 (34.1)	58 (35.8)	105 (35.0)	0.752
Boiled potato (150g)	86 (62.3)	106 (65.4)	192 (64.0)	0.576
Boiled green pea (150g)	50 (36.2)	77 (47.5)	127 (42.3)	0.061
Boiled spinach (200g)	49 (35.5)	68 (42.0)	117 (39.0)	0.252
Fruit				
Apple (150g)	12 (8.7)	6 (3.7)	18 (6.0)	0.070
Orange (150g)	9(6.5)	6 (3.7)	15 (5.0)	0.264
Banana (150g)	24 (17.4)	32 (19.8)	56 (18.7)	0.601
Strawberry (150g)	31 (22.5)	37 (22.8)	68 (22.7)	0.938
Watermelon (150g)	34 (24.6)	49 (30.2)	83 (27.7)	0.302
Grains and Starches				
Bread (50g)	43 (31.2)	55 (34.0)	98 (32.7)	0.607
Rice (90g)	52 (37.7)	68 (42.0)	120 (40.0)	0.479
Pasta (90g)	45 (32.6)	68 (42.0)	113 (37.7)	0.095
Corn flakes (30g)	35 (25.4)	33 (14.2)	58 (19.3)	0.015*
Tomato soup (200g)	45 (32.6)	62 (38.3)	107 (35.7)	0.307
Pizza (100g)	41 (29.7)	42 (25.9)	83 (27.7)	0.465

**Significant differences between categories defined at P < 0.05. Using chi-square test*

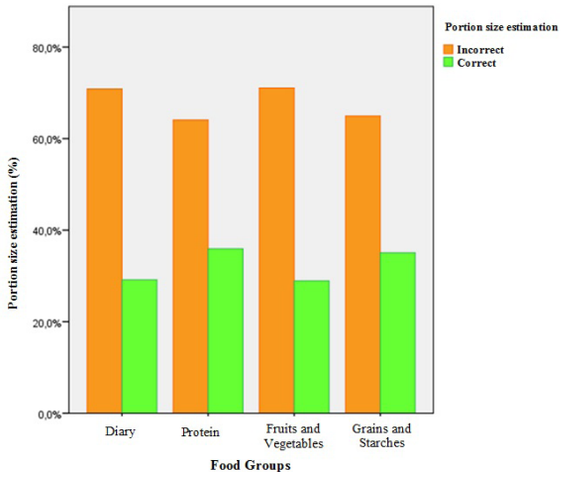

Figure 2. *Estimation of standard portion size of food groups*

Table 3. *Estimation of standard portion size in order to the same amount of foods in different plate size*

Foods (standard portion size)	Plate size n (%)			
	Small	Medium	Large	p
Meat ball (100g)	62 (20.7)	155 (51.7)	83 (27.7)	0.000*
Chicken (100g)	43 (14.3)	158 (52.7)	99 (33.0)	0.000*
Shredded chicken (100g)	61 (20.3)	163 (54.3)	76 (25.3)	0.000*
French fries (100g)	88 (29.2)	129 (43.0)	83 (27.7)	0.002*
Rice (90g)	82 (27.3)	131 (43.7)	87 (29.0)	0.001*
Pasta (90g)	88 (29.3)	134 (42.7)	78 (26.0)	0.000*

**Significant differences between categories defined at P < 0.05. Using chi-square test*

Table 4. *Estimation of standard portion size in order to the same amount of foods in different dishware*

Foods (standard portion size)	Dishware	n (%)	p
Yogurt (225g)	Bowl	222 (74.0)	0.000*
	Cup	78 (26.0)	
			0.000*
Tomato soup§ (200g)	Bowl	200 (66.7)	
	Plate	100 (33.3)	

**Significant differences between categories defined at P < 0.05. Using chi-square test*

4. DISCUSSION

Portion-size estimation is the main factor for assessing dietary intake for managing weight and subsequently managing chronic diseases. In this study, we found that the knowledge of students in estimation of standard portion sizes of foods from food photographs was poor. We found gender differences in the estimation of portion sizes of five foods (meatball, meat cubes, shredded chicken, egg, yogurt). We did not find any statistically differences between different plate sizes and dishware with the estimation of food portion size.

Studies, which examine the accuracy of portion size estimation have reported contradictory results. While in the study of Naska (20), about 53% of participants and in the study of Nikolić (21) about 60.3% (44.3–82.9%) of participants selected the correct portion size from food photographs. In this study, we found that many students were unable to identify the photo that represented a standard portion size. According to the results of this study and previous studies (16, 22,23), the low percentages of accurate estimation, approved that estimating portion size is a challenging task for participants.

The findings of the present study indicate that the food group which the most students provided the accurate estimation was protein foods (36.0%), pursued by grains (35.1%), dairy (29.2%), fruits and vegetables group (28.9%). In this study, the food photographs which most students gave the correct answer was for the standard portion size of boiled potato (64.0%), followed by meat cubes (55.3%). In an earlier study, Choi et al. (24) were evaluated the estimation of the energy content of standard portion size among students and reported that the estimate of the calorie content was correct for grains/starches (25.6 %), followed by dairy products (22.5%) and protein foods (15.6%). Another study (25) showed that the most accurate estimated food groups were dairy products (48%) grains/starches (37.5%), and fruits (22.6%), respectively. Venter et al. (26) stated that more than 80.0% of correct answers were for estimating of standard size of foods, which were presented as solid pieces (sausage, fried fish, apple, and dumplings). On the other hand, the least correct responses (<60.0%) were provided for fairly amorphous foods like soft porridge, lamb and beans, cooked cabbage, and margarine spread on bread. In one study, portion sizes of rice, collard green, and cookies were largely estimated correctly (14). Lillegaard et al. (27) showed that the highest correct responses were for mashed potatoes, pizza, meat, sauce, salad, and cornflakes, while the lowest percentages of correct answers for both portion size of fat-spread bread and French fries. Also, we found that while the largest error in rates of portion size estimation occurred for cheese, orange, and apple, the smallest error occurred for boiled potato and meat cubes. However, Nelson et al. (28) reported that the most and the least error in estimating portion size were for mashed potato and cornflakes, respectively.

The study showed that gender is a major factor in portion size estimation and compared with women, men usually have inaccurate portion size estimation (29). In addition, previous studies indicated that males prefer larger portion sizes of foods than females (30,31). However, Pfrimer et al. (32) showed that there were no significant differences in the

accuracy of perception of portion sizes for different genders. In this study, compared with men, a high rate of women perceived the correct standard portion size for meatball, meat cubes, chicken, egg, bread, cooked rice, pasta, tomato soup, and pizza. Only for cornflakes, men provided the correct estimation of standard portion size compared with women. Gender differences in portion size estimation can be related to the truth that men had higher nutrient requirements and tend to consume more foods in comparison with women (33-35). On the other hand, women are more interested in nutrition-related issues and have more concern about their body weight which can be the result of estimating correct portion size (35,36). The shape and color of foods and the size of the plate on which foods are presented are important factors that affect the perception of the portion size of food. We observed that the majority of students were selected medium-sized plates (Figure 1.B) in the estimation of the same amount of foods (meatball, chicken, shredded chicken, French fries, rice, and pasta) which were offered in 3 sizes of plates. In this study, more selection of medium-sized plates can be contributed to being the middle plate in the photograph. For the same amount of yogurt in glass and bowl, 74.0% of the students chose yogurt in the bowl as standard portion size. In the present study, the usual presentation form of yogurt in the bowl may be the reason for choosing the yogurt in the bowl as the standard portion size. More than half of the students selected a bowl as a standard portion size instead of the plate for tomato soup, also its presentation form in restaurants can be effected to select bowl as a standard one. While some studies (15, 37,38) reported that plate size did not have any effect on the perception of food portion size. On the other hand, other studies (9-13, 39) showed that increasing plate size leads people to eat more food. One study has presented that half of the study participants notified that they tended to eat until they 'clean their plates'. Thus, the tendency means consuming the entire portion available on the plate as a result of visual signaling of a 'clean plate' and not just being satisfied with a smaller quantity (12). Van et al. (9) demonstrated that increasing the size of dishware can encourage an individual to eat at least 50 more calories a day that causes a five-pound increase in weight each year. One study indicated that participants who served themselves cereal in a larger bowl ate 30% more cereal and underestimated their portion size by 14% compared with those given smaller bowls (40). Wansink et al. (11) reported a similar relationship between glass size and amounts of drinking beverages. Another study indicated that in comparison with wide glasses, tall and slender glasses cause to consume more quantity of beverages (41). In this study, we showed that many students were unable to correctly identify the photo that represented a standard portion size. Also, we did not find a significant relationship between different dishware size and shape with the perception of standard portion size. So, training programs and policies should be planned and implemented for university students to improve knowledge of standard portion size as an important factor in preventing the most important health problem, obesity.

5. CONCLUSION

In conclusion, our finding in this study showed that the students have poor portion size estimation skills from food photographs. We found gender differences in the estimation of some foods portion sizes. We could not determine any statistically differences between various dishware and perception of food portion size. The food photographic booklet can be a useful tool to assess the quantification of foods during dietary assessment. So, university students should have education with food-portion tools which is an effective way to enhance estimation skills to improve the accuracy of dietary assessment. Also, Future studies are needed to validate the food atlas for use in the Turkish population.

Author contributions

N.A collected the data, analyzed and interpreted the results, wrote the manuscript. N.R designed the research and had primary responsibility for final content. All authors reviewed the manuscript rigorously and approved the final version submitted for publication.

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