Nutrition Research and Practice 2016;10(5):524-529

http://e-nrp.org

Effect of plate size on meal energy intake in normal weight women

Aylin Ayaz[1*§], Asli Akyol[1*], Cansu Cetin[1] and H. Tanju Besler[2]

[1]Department of Nutrition and Dietetics, Faculty of Health Sciences, Hacettepe University, Sıhhiye, Ankara 06100, Turkey
[2]Eastern Mediterranean University, Faculty of Health Sciences, Department of Health Management Famagusta, North Cyprus Mersin 10, Turkey

BACKGROUND/OBJECTIVES: Use of smaller plates to control food intake is a commonly recommended strategy for restricting energy intake, despite conflicting results. Therefore, the aim of this study was to examine whether or not three different sizes of plates influence energy intake during a multi-itemed buffet meal in normal weight women.
SUBJECTS/METHODS: This was a cross-over study conducted on 37 female participants aged 19-25 years with normal BMI levels. Participants were recruited from Hacettepe University and the surrounding community. On experimental days, participants ate a standard breakfast and were then randomly assigned to eat lunch using a small (19 cm), medium (23 cm), or large (28 cm) diameter plate. Visual analogue scale (VAS) scores on sensory and satiety outcomes were measured for all meals. Energy and macronutrient intakes during lunch were recorded.
RESULTS: There was no evidence that use of a smaller plate size reduced energy or specific macronutrient intake during the free choice lunch meal. Multiple visits to the serving table were not associated with energy or macronutrient intake. Plate size did not affect VAS scores during the test days.
CONCLUSIONS: Plate size did not influence energy intake, meal composition, or palatability in normal weight women during a multi-itemed open buffet lunch. Studies in natural settings at the population level are needed to clarify current outcomes.

Nutrition Research and Practice 2016;10(5):524-529; doi:10.4162/nrp.2016.10.5.524; pISSN 1976-1457 eISSN 2005-6168

Keywords: Plate size, obesity, energy intake, satiety response

INTRODUCTION

A large body of evidence has established that lifestyle and environmental factors contribute to development of obesity [1-5]. One environmental factor that has contributed to the development of obesity is overeating, which can result in excess energy intake [6,7]. Over the last 30 years, the number of meals eaten outside the home, commercial portion sizes, and both domestic and external dishware sizes have increased [8,9]. Over time, excess energy intake increases body fat stores and induces weight gain in healthy individuals, and this trend has been implicated in increased prevalence of overweight and obesity as a result of increased energy consumption [10,11]. In order to combat this worrying observation, efficient strategies are required to improve and regulate healthy eating habits [7].

There is a common opinion that visual cues can influence the accurate perception of the served food amount [12]. According to this phenomenon, the Delboeuf illusion may play a role in determination of energy intake since it generates an illusion of the perceived size of one object related to another [13]. Hence, identical food quantities appear smaller when served on a relatively large plate, resulting in increased energy intake. In this context, dietary guidelines suggest using smaller plates to avoid overeating and to control portion sizes [14,15].

It is important to establish an evidence-based set of data before making recommendations regarding plate size and energy intake. There have been several studies that indicate use of smaller plates may influence the amounts of food consumed in children [16] and adults [17,18]. However, a number of studies reported no effect of plate size on food intake [19-21]. The inconsistent outcomes of these studies point to the necessity of additional research to better elucidate the influence of various plate sizes.

Serving manner may have a deterministic effect on observed outcomes. For example, multi-item buffet meals have been shown to be more effective in inducing overeating compared to restricted-item meals [22]. The current food environment also introduces a variety of options and allows participants to make additional choices [23-25]. In addition, studies measuring the impact of plate size on energy intake through multi-item buffet meals should take into account the number of visits and food intake during each visit [21], as limited food intake is detected only during the first visit when using smaller plates. This information may be translated into further interventions.

In the present study, the main aim was to examine energy and macronutrient intakes of 'normal' eaters in the context of

This study is funded by Scientific Research Projects Coordination Unit of Hacettepe University, number 5272.
§ Corresponding Author: Aylin Ayaz, Tel. 90-312-305-10-94, Fax. 90-312-309-13-10, Email. baylin@hacettepe.edu.tr
Received: February 15, 2016, Revised: June 9, 2016, Accepted: June 10, 2016
* These two authors contributed to this work equally.

three different plate sizes during a multi-item buffet meal. Macronutrient compositions of the consumed meals were also measured to determine whether or not plate size influences intake of a specific macronutrient. Subjective sensations of sensory and satiety outcomes are influenced by external factors and are related to subsequent food intake [26]. Although few studies have measured the relation between plate size and subjective sensations of sensory outcomes to date [20,21], measurement of this parameter is important to define the link between plate size and satiety. Therefore, the second aim of the study was to measure participants sensory and satiety outcomes by VAS.

SUBJECTS AND METHODS

Subjects

Forty female subjects were recruited from Hacettepe University and the surrounding community through poster advertisement. Inclusion criteria included women in good health between the ages of 19-25 who were non-smokers, not dieting and not diagnosed with any metabolic disease, not professional athletes, and possessing no food allergies or extreme dislikes for specific foods. Each subject signed an informed consent document before the study. None of the participants were taking medications known to affect appetite or weight regulation. Regular breakfast, snack, and lunch consumption was an additional inclusion criterion for participants. Subjects having extreme dislikes for specific foods were also excluded. Subjects were excluded if they scored > 9 on a Beck depression scale and had a measured Body Mass Index (BMI) < 18 or > 25 kg/m^2. Participants body weight, height, and body compositions were measured (Jawon XScan Plus). Since the menstrual cycle may affect appetite ratings, experiment days were arranged at two weeks before menstruation for all participants.

Ethical approval was confirmed on 21 January 2015 by the Non-Interventional Clinical Researches Ethics Board of Hacettepe University (GO15/25-02).

Study design

This was a cross-over study conducted at the Nutrition Laboratory in the Faculty of Health Sciences, Hacettepe University, Ankara, Turkey. The study was carried out on three separate days, with one week to two weeks of washout period between each study day. On each test day, participants were randomly assigned to eat lunch using a small (19 cm), medium (23 cm), or large (28 cm) diameter plate. Plates used in the study are shown in Fig. 1. Participants were informed that the topic of the research was to examine their energy intakes on different test days and were not given any detailed information about plate size.

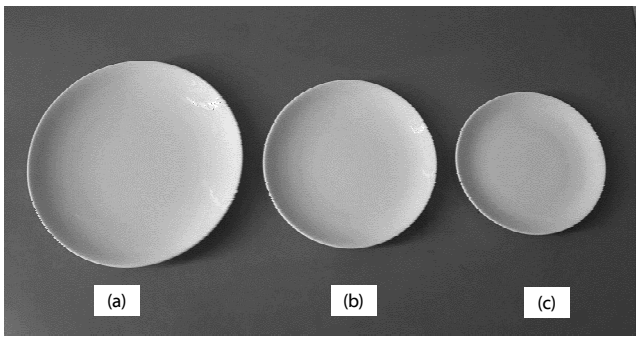

Fig. 1. (a) Large (28 cm), (b) medium (23 cm), and (c) small (19 cm) plates used in the study

Experimental protocol

The experimental protocol of this study used the European consensus on postprandial studies evaluating appetite measures and eating behaviour [27]. On experiment days, participants arrived at 08.00 h after fasting for 12 h and left at 14.00 h. A breakfast meal including two thin slices of wholemeal bread (50 g), a slice of cheese (30 g), and a cup of tea was served at 08.00 h. Participants were asked to consume the full breakfast within 15 min. Further food or beverage intake was not allowed until the open buffet lunch. At 12.00 h, an *ad lib* buffet-style lunch was served. Throughout the study, participants were in the same room and were allowed to read or use laptops throughout the experiment. Physical activity and social interaction were limited. Subjects were not allowed to see how much other subjects consumed. Energy and macronutrient intakes of subjects were measured by weighing the amounts of food and drinks consumed and converting these values into energy (kcal) and macronutrients based on the manufacturer's labelling.

VAS

Subjects were informed on how to fill out VAS forms. VAS was used to assess hunger, satiety, prospective food consumption, amount of food they could consume, and desire for sugary foods throughout the study period. Appetite ratings were recorded on 100 mm visual analogue scales (VAS) with words anchored at each end describing the extremes of a unipolar question (for instance, for hunger: "I am not hungry at all"/"I have never been more hungry", for satiety: "I am not sated at all"/"I have never been more sated", for prospective food consumption: "I cannot consume any food at all"/"I have never wanted to consume food that much", for desire for sugary snack: "I do not want to consume a sugary snack at all"/"I have never wanted to consume a sugary snack that much", for amount of food: "I can only have a small amount of food"/I can eat a large amount of food" [28]. VAS scores were measured before breakfast and until the end of the study for 23 times in total.

Open buffet lunch

The *ad libitum* open buffet lunch consisted of a variety of meatballs, cocktail sausages, potato crockets, a variety of pastries, nuggets, cherry tomatoes, cucumbers, apples, bananas, pudding, bread, soft drinks, and water. The serving table was a separate dining table at a moderately close distance where the subjects sat. On each test day, same amounts and types of foods were served, and the buffet items were identical. Same portion sizes, serving cutlery, and serving bowls were used on the test days. The subjects were instructed to have lunch until comfortably satisfied and allowed to refill their plate whenever they wanted.

Statistical analyses

Data were analysed using the Statistical Package for the Social Sciences (SPSS) version 22 (SPSS Inc., Chicago, IL, USA). The primary outcome of this trial was to assess the effect of plate sizes on energy and macronutrient intakes. The secondary outcome variables were subjects' VAS scores. For the primary outcome, data were analysed using one-way ANOVA. VAS data on subjective sensations of sensory indicators was analysed using a two-way repeated measures ANOVA. Subjects and test day were included in the procedure, in addition to the plate size/time interaction. Data on the area under the curve (AUC) for VAS were obtained using GraphPad Prism version 6 (Graphpad Software Inc., La Jolla, CA, USA). Data were given as mean ± standard error of mean unless otherwise stated. $P < 0.05$ was considered statistically significant.

RESULTS

Subjects

From a total of 40 participants, three women were excluded during screening due to having a BMI over 25 kg/m^2. The remaining 37 subjects completed the study successfully, and all subject data were analysed for each test meal. Participants were 22.93 ± 2.83 (mean ± SD) years of age, weighed 61.69 ± 12.15 kg with a BMI of 22.93 ± 2.17 kg/m^2, and had a waist circumference of 77.89 ± 10.85 cm.

VAS scores

Fig. 2 shows VAS rated hunger, satiety, prospective food consumption, amount of food that could be consumed, and desire for sugary foods. Baseline values did not differ between test days ($P > 0.05$). VAS scores indicated that both breakfast and lunch significantly influenced hunger and fullness ($P < 0.05$). However, plate size did not affect VAS scores during the test days ($P > 0.05$). No interaction was detected between test meal and time. In addition, AUC data of VAS scores did not exhibit a significant difference between the groups (Table 1) ($P > 0.05$).

Energy and Nutrient Intakes

Energy and macronutrient intakes during the open buffet lunch are shown in Table 2. There was no evidence suggesting that use of a smaller plate size reduced energy or specific

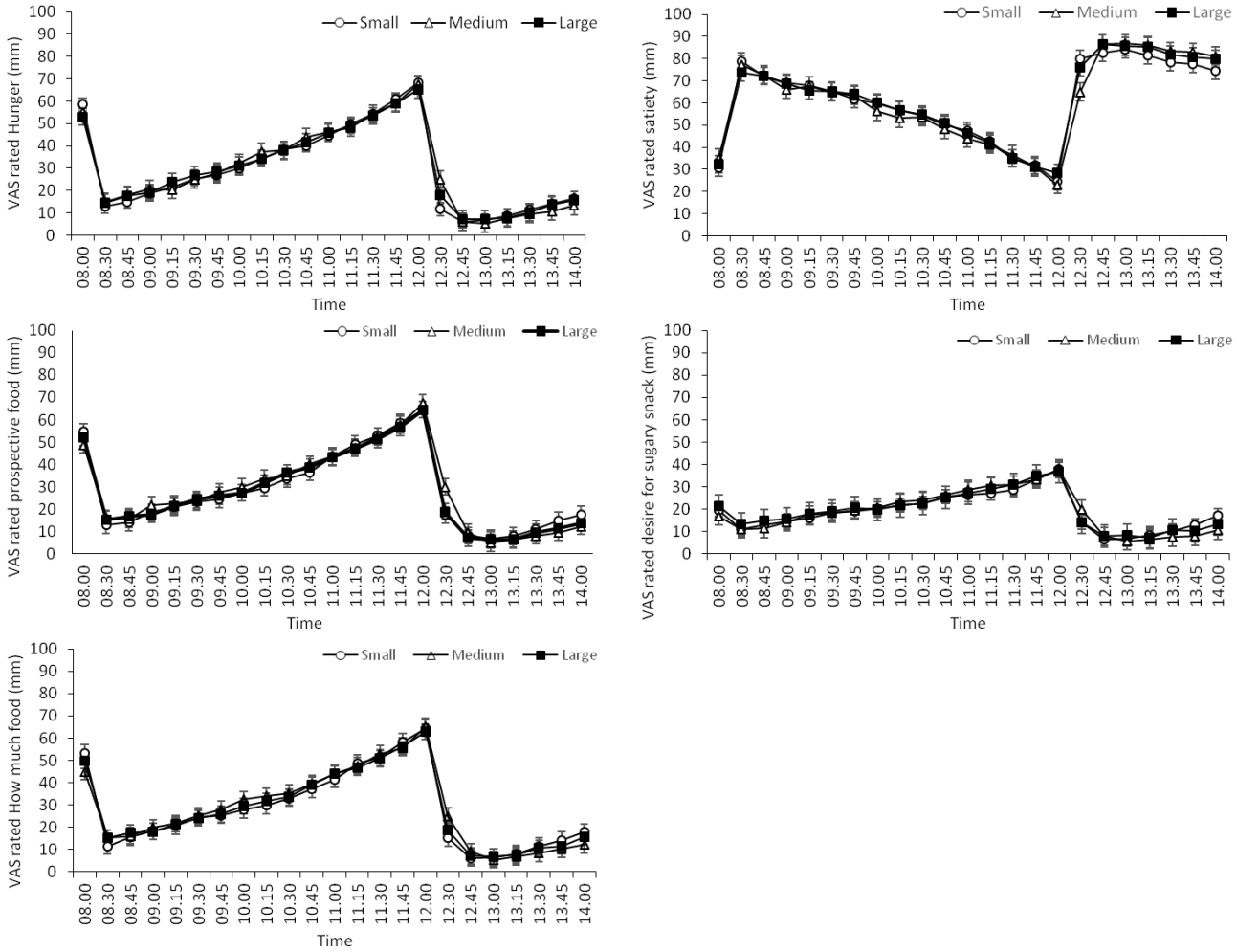

Fig. 2. Mean VAS scores (± SEM) during the three test days, n = 37. Small indicates 19 cm plate, medium indicates 23 cm plate, and large indicates 28 cm plate. A light breakfast was served at 08.00 h, immediately after recording baseline VAS scores. Lunch was served at 12.00 h. There were no statistically significant differences among the groups ($P > 0.05$).

Table 1. Area under curve (AUC) data of VAS scores

VAS questions	Plate sizes		
	Small (19 cm)	Medium (23 cm)	Large (28 cm)
Hunger	176.4 ± 17.15	183.2 ± 19.30	178.6 ± 167.28
Satiety	366.4 ± 39.84	364 ± 36.84	371.9 ± 38.26
Prospective consumption	170.3 ± 16.25	178.1 ± 16.89	169.0 ± 17.45
Amount of food that could be consumed	168.4 ± 16.56	175.2 ± 16.27	169.9 ± 18.96
Desire for sugary snack	114.8 ± 12.74	116.3 ± 12.74	117.2 ± 13.82

Mean VAS scores (± SEM) during the three test days, n = 37. There were no statistically significant differences between treatments (P> 0.05).

Table 2. Energy and macro nutrient intake during the open buffet lunch meal

	Plate sizes		
	Small (19 cm)	Medium (23 cm)	Large (28 cm)
Energy intake at 1st visit (kcal)	949.77 ± 50.98	929.95 ± 50.52	965.23 ± 54.72
Energy intake at 2nd visit (kcal)	234.79 ± 41.97	326.88 ± 42.19	263.94 ± 59.13
Total energy intake (kcal)	1,017.27 ± 51.96	1,088.03 ± 53.08	1,015.77 ± 55.64
Carbohydrate intake at 1st visit (g)	78.66 ± 5.01	78.38 ± 5.26	77.58 ± 5.43
Carbohydrate intake at 2nd visit (g)	17.31 ± 4.18	29.04 ± 4.70	23.79 ± 8.27
Total carbohydrate intake (g)	83.72 ± 5.36	92.32 ± 5.84	82.59 ± 5.21
Protein intake at 1st visit (g)	26.49 ± 1.53	25.07 ± 1.64	26.83 ± 1.70
Protein intake at 2nd visit (g)	5.89 ± 0.75	7.59 ± 1.13	6.41 ± 1.50
Total protein intake (g)	28.17 ± 1.49	28.70 ± 1.55	28.12 ± 1.72
Fat intake at 1st visit (g)	58.07 ± 3.28	56.31 ± 2.92	28.44 ± 3.42
Fat intake at 2nd visit (g)	16.23 ± 2.81	19.01 ± 2.93	15.69 ± 3.16
Total fat intake (g)	62.71 ± 3.37	65.57 ± 3	61.58 ± 3.66

Mean VAS scores (± SEM) during the three test days, n = 37. Data on 2nd visits to serving table consists of n = 17 participants for small, n = 15 participants for medium, and n = 16 participants for large plates.
There were no statistically significant differences among the groups (P> 0.05).

macronutrient intake during the study days (P > 0.05). In the current study, participants were allowed to refill their plates by visiting the serving table as much as they wanted. Of the 37 participants, 17, 15, and 16 revisited the serving table a second time and consumed additional food on small, medium, and large plate days, respectively. As seen in Table 2, first, second, and total amounts of energy and nutrient intakes were not influenced by plate size (P > 0.05). Serving table was not visited more than twice throughout the study.

DISCUSSION

This study shows that alteration of plate size during a multi-item buffet lunch did not influence energy consumption in normal weight women allowed to eat freely. In the current study, we aimed to assess normal weight women since the main objective of the study was to evaluate women with no dietary restrictions or concerns regarding food preferences, portions, or meal composition. It was expected that participants having healthy body weights would make spontaneous choices reflective of their natural life experiences. Being overweight or obese may trigger motivational and emotional drives in food preference and consequently may result in altered nutritional behaviours [29]. A recent review also indicated the necessity of such experiments in controlled environments [27]. Therefore, the study population in the current experiment consisted of individuals of normal body weight.

Although a smaller plate size is a recommended strategy for food intake control and body weight maintenance in individuals who are healthy and overweight [14,15,30,31] lack of support for the recommendation to use a smaller plate to control food intake has been reported by other studies [20,21,32,33]. The conflicting results observed in these studies may be attributable to differences in study populations, serving manner of meals, and study design. However, explaining the observed outcomes through these parameters appears to be highly complex. Furthermore, different characteristics of study populations between these studies can be considered as a deterministic factor. Some of these studies were conducted on individuals who were overweight, whereas others included individuals of normal body weight. Since obesity may be associated with altered eating behaviours [34], comparison of these two groups in plate size studies should be done differently.

It appears that composition of served meals is considered as a potential explanation for the observed outcomes. Shah *et al.* [20] used a single item lunch and suggested that the outcomes could be partially explained by the low fat content of this meal, as consumption of foods with higher fat content was found to be related with a greater effect on energy intake [17]. In contrast, similar to our findings, Yip *et al.* [21] introduced a palatable buffet lunch meal and did not observe any significant differences between the test days. It is shown that multi-item buffet meals encourage overeating [35]. Therefore, individuals eating from smaller plates tend to use multiple plates during multi-item buffet meals.

As indicated by Robinson *et al.* [36] and Yip *et al.* [21], direct

measurement of multiple plates used by participants during the test days is required in order to distinguish exact calories between multiple visits to the buffet. For the first time, the current study measured all consumed calories in each visit to the buffet, and results indicate that there were no significant differences between the test days when first, second, or total visits to the buffet were taken into account. Interestingly, our data show that only half of the subjects visited the buffet more than once. Hence, in light of our results, it can be suggested that the lack of significant effects of different plate sizes on energy intake is not associated with allowing participants to visit the serving table more than once.

Another factor that influences the energy intake may be the social setting of the meal. [37,38]. One study investigating the role of social effects along with plate size showed that participants who ate with an acquaintance had a higher energy intake than those who ate with a stranger, but only when using small plates [32]. Researchers observed a significant effect of smaller plates on energy intake according to social setting [17,39]. On the other hand, one study failed to exhibit a significant effect of plate size on energy intake when analysed in a singular environment [20]. Although the participants in current study may have been acquaintances, social interaction was limited, and thus the precise role of this situation is unknown. Therefore, the effect of this social environment on the observed outcomes remains unclear. Future studies focusing on the interaction between social effects and energy intake through different dishware sizes are still needed.

The Delboeuf illusion explains the relationship between plate size and perceived amount of food based on the effects of inner and outer plate diameters on food portions and plate borders, respectively [40]. As a result, a larger plate creates a larger circle, making food portions appear to be smaller due to the contrasting effect of the circle. It is suggested that this effect can actually be more pronounced when serving singular components such as snacks since other forms of foods, especially meals, are not always in a circular shape [30]. Indeed, people may be prone to pile up their plates in these situations, resulting in increased food liking and food intake [41]. This may be another explanation for the non-significant outcomes regarding different plate sizes and energy intake in this study.

The effect of plate size on energy intake is important, but its effect on meal composition is also a crucial factor. Some of the studies investigating the role of dishware size on food consumption also examined the macronutrient patterns of consumed meals [21,33] but did not a report a significant effect on composition. Our study supports these findings concerning carbohydrate, protein, or fat intake being similar between test days as well as additional plates having no effect on these outcomes individually or in total. Despite these findings, a study by Libotte *et al.* [30] showed that although plate size had no significant effect on total meal energy, a large plate was associated with higher vegetable intake. Future studies should focus on the interaction between plate size and distinct food groups.

Outcomes of this study were obtained from short-term data. It is well known that long-term portion control may be effective in reducing food intake, thus preventing overeating [42]. Secondly, this experiment was conducted in a laboratory where participant's usual eating habits might be influenced due to the different environment. Therefore, future studies should perform similar research under natural settings. Finally, this study excluded male subjects to limit the confounding effect of sex differences on eating behaviours [43,44]. The sample size and recruitment limitation to female subjects restricts generalisation of these findings.

In conclusion, plate size did not influence energy intake, meal composition, or palatability in normal weight women during a multi-itemed open buffet lunch. Multiple visits to the serving table were not associated with energy or macronutrient intake in the present study. Although a systematic review and meta-analysis also showed that plate size did not exert a strong influence on food intake [36], the recommendation of using a smaller plate size for control of food intake should not be ignored until studies conducted within natural settings at the population level reveal outcomes.

CONFLICT OF INTEREST

The authors declare no potential conflicts of interests.

REFERENCES

1. Lifshitz F, Lifshitz JZ. Globesity: the root causes of the obesity epidemic in the USA and now worldwide. Pediatr Endocrinol Rev 2014;12:17-34.
2. Levitsky DA, Pacanowski CR. Free will and the obesity epidemic. Public Health Nutr 2012;15:126-41.
3. Cawley J, Meyerhoefer C. The medical care costs of obesity: an instrumental variables approach. J Health Econ 2012;31:219-30.
4. Pearson N, Biddle SJ. Sedentary behavior and dietary intake in children, adolescents, and adults. A systematic review. Am J Prev Med 2011;41:178-88.
5. Popkin BM, Adair LS, Ng SW. Global nutrition transition and the pandemic of obesity in developing countries. Nutr Rev 2012;70:3-21.
6. Young LR, Nestle M. Reducing portion sizes to prevent obesity: a call to action. Am J Prev Med 2012;43:565-8.
7. Sofer S, Stark AH, Madar Z. Nutrition targeting by food timing: time-related dietary approaches to combat obesity and metabolic syndrome. Adv Nutr 2015;6:214-23.
8. Nielsen SJ, Popkin BM. Patterns and trends in food portion sizes, 1977-1998. JAMA 2003;289:450-3.
9. Piernas C, Popkin BM. Food portion patterns and trends among U.S. children and the relationship to total eating occasion size, 1977-2006. J Nutr 2011;141:1159-64.
10. Mattes R. Energy intake and obesity: ingestive frequency outweighs portion size. Physiol Behav 2014;134:110-8.
11. Pedersen SD, Kang J, Kline GA. Portion control plate for weight loss in obese patients with type 2 diabetes mellitus: a controlled clinical trial. Arch Intern Med 2007;167:1277-83.
12. English L, Lasschuijt M, Keller KL. Mechanisms of the portion size effect. What is known and where do we go from here? Appetite 2015;88:39-49.
13. van Ittersum K, Wansink B. Plate size and color suggestibility: the Delboeuf Illusion's bias on serving and eating behavior. J Consum Res 2012;39:215-28.

14. Center for Nutrition Policy and Promotion (US). How Much Are You Eating?: Putting the Guidelines into Practice. Home and Garden Bulletin No. 267-1. Washington (D.C.): Center for Nutrition Policy and Promotion, U.S. Department of Agriculture; 2002.
15. NHLBI Obesity Education Initiative Expert Panel on the Identification, Evaluation, and Treatment of Obesity in Adults (US). Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults. Bethesda (MD): National Heart, Lung, and Blood Institute; 1998.
16. DiSantis KI, Birch LL, Davey A, Serrano EL, Zhang J, Bruton Y, Fisher JO. Plate size and children's appetite: effects of larger dishware on self-served portions and intake. Pediatrics 2013;131:e1451-8.
17. Wansink B, van Ittersum K, Painter JE. Ice cream illusions bowls, spoons, and self-served portion sizes. Am J Prev Med 2006;31:240-3.
18. Wansink B, van Ittersum K. Portion size me: plate-size induced consumption norms and win-win solutions for reducing food intake and waste. J Exp Psychol Appl 2013;19:320-32.
19. Penaforte FR, Japur CC, Diez-Garcia RW, Hernandez JC, Palmma-Linares I, Chiarello PG. Plate size does not affect perception of food portion size. J Hum Nutr Diet 2014;27 Suppl 2:214-9.
20. Shah M, Schroeder R, Winn W, Adams-Huet B. A pilot study to investigate the effect of plate size on meal energy intake in normal weight and overweight/obese women. J Hum Nutr Diet 2011;24: 612-5.
21. Yip W, Wiessing KR, Budgett S, Poppitt SD. Using a smaller dining plate does not suppress food intake from a buffet lunch meal in overweight, unrestrained women. Appetite 2013;69:102-7.
22. Wiessing KR, Xin L, McGill AT, Budgett SC, Strik CM, Poppitt SD. Sensitivity of ad libitum meals to detect changes in hunger. Restricted-item or multi-item testmeals in the design of preload appetite studies. Appetite 2012;58:1076-82.
23. Rolls BJ, Rowe EA, Rolls ET, Kingston B, Megson A, Gunary R. Variety in a meal enhances food intake in man. Physiol Behav 1981;26: 215-21.
24. Rolls BJ, Rowe EA, Rolls ET. How sensory properties of foods affect human feeding behavior. Physiol Behav 1982;29:409-17.
25. Mattes R, Foster GD. Food environment and obesity. Obesity (Silver Spring) 2014;22:2459-61.
26. Herman CP, Polivy J. External cues in the control of food intake in humans: the sensory-normative distinction. Physiol Behav 2008;94:722-8.
27. Blundell J, de Graaf C, Hulshof T, Jebb S, Livingstone B, Lluch A, Mela D, Salah S, Schuring E, van der Knaap H, Westerterp M. Appetite control: methodological aspects of the evaluation of foods. Obes Rev 2010;11:251-70.
28. Flint A, Raben A, Blundell JE, Astrup A. Reproducibility, power and validity of visual analogue scales in assessment of appetite sensations in single test meal studies. Int J Obes Relat Metab Disord 2000;24:38-48.
29. Provencher V, Jacob R. Impact of perceived healthiness of food on food choices and intake. Curr Obes Rep 2016;5:65-71.
30. Libotte E, Siegrist M, Bucher T. The influence of plate size on meal composition. Literature review and experiment. Appetite 2014;82: 91-6.
31. Mechanick JI, Kushner RF, Sugerman HJ, Gonzalez-Campoy JM, Collazo-Clavell ML, Spitz AF, Apovian CM, Livingston EH, Brolin R, Sarwer DB, Anderson WA, Dixon J, Guven S; American Association of Clinical Endocrinologists; Obesity Society; American Society for Metabolic & Bariatric Surgery. American Association of Clinical Endocrinologists, The Obesity Society, and American Society for Metabolic & Bariatric Surgery medical guidelines for clinical practice for the perioperative nutritional, metabolic, and nonsurgical support of the bariatric surgery patient. Obesity (Silver Spring) 2009;17 Suppl 1:S1-70.
32. Koh J, Pliner P. The effects of degree of acquaintance, plate size, and sharing on food intake. Appetite 2009;52:595-602.
33. Rolls BJ, Roe LS, Halverson KH, Meengs JS. Using a smaller plate did not reduce energy intake at meals. Appetite 2007;49:652-60.
34. Ernst B, Wilms B, Thurnheer M, Schultes B. Eating behaviour in treatment-seeking obese subjects - Influence of sex and BMI classes. Appetite 2015;95:96-100.
35. Brondel L, Romer M, Van Wymelbeke V, Pineau N, Jiang T, Hanus C, Rigaud D. Variety enhances food intake in humans: role of sensory-specific satiety. Physiol Behav 2009;97:44-51.
36. Robinson E, Nolan S, Tudur-Smith C, Boyland EJ, Harrold JA, Hardman CA, Halford JC. Will smaller plates lead to smaller waists? A systematic review and meta-analysis of the effect that experimental manipulation of dishware size has on energy consumption. Obes Rev 2014;15:812-21.
37. Herman CP. The social facilitation of eating. A review. Appetite 2015;86:61-73.
38. Hetherington MM. Cues to overeat: psychological factors influencing overconsumption. Proc Nutr Soc 2007;66:113-23.
39. Wansink B, Cheney MM. Super bowls: serving bowl size and food consumption. JAMA 2005;293:1727-8.
40. McClain AD, van den Bos W, Matheson D, Desai M, McClure SM, Robinson TN. Visual illusions and plate design: the effects of plate rim widths and rim coloring on perceived food portion size. Int J Obes (Lond) 2014;38:657-62.
41. Parizel O, Sulmont-Rossé C, Fromentin G, Delarue J, Labouré H, Benamouzig R, Marsset-Baglieri A. The structure of a food product assortment modulates the effect of providing choice on food intake. Appetite 2016;104:44-51.
42. Rolls BJ. What is the role of portion control in weight management? Int J Obes (Lond) 2014;38 Suppl 1:S1-8.
43. Asarian L, Geary N. Sex differences in the physiology of eating. Am J Physiol Regul Integr Comp Physiol 2013;305:R1215-67.
44. Robinson E, te Raa W, Hardman CA. Portion size and intended consumption. Evidence for a pre-consumption portion size effect in males? Appetite 2015;91:83-9.