RELATIONSHIP BETWEEN FOOD PORTION SIZE AND FOOD INTAKE: A REVIEW

RELAÇÃO ENTRE TAMANHO DA PORÇÃO DE COMIDA E INGESTÃO ALIMENTAR: UMA REVISÃO*

Alline Gouvea Martins Rodrigues[1]

Rossana Pacheco da Costa Proença[2]

Abstract

The relationship between food portion size and food intake is discussed in this study. Articles in ScienceDirect, Scopus, SciELO and MEDLINE/PubMed databases, as well as the references of the articles identified, were searched in Portuguese and English, with no time limitation, using the following key words: "portion size" or “plate/dish weight" conjugated to "restaurant", "meal", "food choice", "behavior food "energy density", "food consumption" and/or “food intake”. Based upon the results of this literature research, it is possible to claim that food portion size is an important determinant of food intake so often, regardless of age, sex, nutritional status, perceptions of hunger and satiety or compensation. Experimental studies demonstrate that the effects of larger food portions sizes are positively associated with increase in food intake. When purchasing ready-to-eat foods, the intake of food portion sizes greater than the energy requirements are related to the perception of food portion size in relation to the perception of value of money. It follows that, once selected larger portion sizes, it is likely that a passive increase in intake occurs, and this effect could last for several days, changing eating habits. These changes may be related to an inadequate nutritional status and higher risk of overweight/obesity and chronic-degenerative diseases.

Key words: Appetite Regulation. Feeding Behavior. Food Habits.

Resumo

Este texto discute a relação entre tamanho da porção de comida e ingestão alimentar. Foram pesquisados artigos nas bases de dados ScienceDirect, Scopus, SciELO e Medline/PubMed, bem como nas referências dos artigos identificados, utilizando-se, sem limitação temporal, em português e inglês, as palavras-chave: “tamanho da porção” ou “peso do prato” conjugado a “restaurante”, “refeição”, “escolha alimentar”, “comportamento alimentar” “densidade energética”, “consumo alimentar” e/ou “ingestão alimentar”. Com base nos resultados da pesquisa bibliográfica, é possível afirmar que o tamanho da porção de comida é importante determinante da ingestão alimentar, de modo muitas vezes independente de idade, sexo, estado nutricional, percepções de fome e saciedade ou compensação. Estudos experimentais demonstram que a oferta de maiores porções de comida associa-se positivamente a aumento da ingestão alimentar. Quando da aquisição de alimentos prontos para o consumo, a ingestão de porções de comida superiores às necessidades energéticas

relaciona-se com a distorção da percepção do tamanho desta porção em relação à percepção do valor do dinheiro. Conclui-se que, uma vez selecionadas porções alimentares maiores, é provável que ocorra um aumento passivo na ingestão, sendo que tal aumento pode perdurar por vários dias, alterando as práticas alimentares. Essas alterações podem estar relacionadas a um padrão nutricional inadequado e maiores riscos de sobrepeso/obesidade e doenças crônico-degenerativas.

Palavras-chave: Regulação do Apetite. Comportamento Alimentar. Hábitos Alimentares.

INTRODUCTION

Discussing food choice, Sobal & Bisogni (2009) consider that it is a multifactorial, complex and dynamics process that: (1) involves events and experiences throughout life that establish a path marked by transitions, turning points, conveniences and distinct contexts; (2) is influenced by cultural ideals, personal factors, available resources, socio-demographic determinants and contexts; and (3) corresponds to a system through which personal values are developed for each decision on feeding, and negotiations are set in search of equilibrium. In this system, food and the situations in which it operates are classified, and the strategies and routines concerning these practices are revised and formulated.

Furst et al. (1996) point out that this process incorporates not only decisions based on conscious reflection, but also those that are automatic, habitual and subconscious. A survey of American adults of various socioeconomic levels estimated that most people make 14 conscious decisions daily, and more than 220 unconscious decisions on food choices (WANSINK; SOBAL, 2007; WANSINK, 2010). Thus, a dynamic process occurs before every eating moment, culminating in the development of individual strategies to determine what, how much, when and with whom to eat (FURST et al., 1996; JOMORI; PROENÇA; CALVO, 2008; SOBAL; BISOGNI, 2009; STROEBELE; CASTRO, 2004; WANSINK, 2010).

In relation to the influences inherent in food, it is observed that changes in consumption can be detected due to sensory characteristics such as color, temperature and odor, and mainly due to the size of food portions (KELLY et al., 2009; STEENHUIS; VERMEER, 2009; STROEBELE; CASTRO, 2004).

Given these assumptions, this text discusses the relationship between portion size of food and eating habits.

METHOD

Information search was carried out by non-systematic review of articles found in electronic databases (ScienceDirect, Scopus, SciElo, Medline/PubMed and CAPES) without time limitation, as well as consulting reference lists of the identified articles. The following terms were searched in both Portuguese and English: “portion size” or “weight of the plate” along with “restaurant”, “meal”, “food choice”, “eating behavior”, “energy density”, “food consumption” and/or “food intake” and also the association of these terms with: “body weight”, “overweight” and “obesity”. We appealed to the logical operators “AND”, “OR”, and “NOT” to combine the descriptors and terms used to trace publications.

In the analysis of publications, information was grouped so as to identify relationships between food portion size and food intake. The research was not guided by the numerical concern to ensure proportional representation of the findings for a qualitative analysis. Thus, emphasizing the focus on studies related to the object of research, similar articles were discarded and books were consulted.

PORTION SIZE AND EATING BEHAVIOR

Food portion size is an important determiner of food intake, regardless of age, sex or nutritional status (DILLIBERTI et al., 2004; ELLO-MARTIN; LEDIKWE; ROLLS, 2005; FISHER et al., 2007; FLOOD; ROE; ROLLS, 2006; KELLY et al., 2009; KRAL; ROE; ROLLS, 2004; RAYNOR; WING, 2007; ROLLS; MORRIS; ROE, 2002; ROLLS et al., 2004a; 2004b; ROLLS; ROE; MEENGS, 2006; 2007; STEENHUIS; VERMEER, 2009; WANSINK; KIM, 2005; WANSINK; PAINTER; NORTH, 2005). The increase in portion sizes

Increase in portion sizes can significantly facilitate increased food intake (STROEBELE; CASTRO, 2004). There is a current consensus that, in the United State, the size of food portions has increased significantly over the last decades, what is confirmed by some studies to be discussed here.

According to Young & Nestle (2002), it is estimated that in the United States the trend of increased portion sizes began in the 1970s, with a peak in later decades. This increase was particularly significant for products consumed in dining out. For example, the portions of sandwiches, chips and soft drinks sold in restaurants in 2002 by American fast-food chains are two to five times larger than its original standard in 1970.

Nielsen & Popkin (2003) conducted a survey of nationally representative data from 63,380 individuals aged two years and older, in order to determine trends in the size of servings consumed by Americans, by meal site and food type. The authors found that between 1967 and 1993, increases in portion sizes for snacks, desserts, soft drinks, chips, sandwiches, pizzas and Mexican food were significant both at home and outside. Such increments caused a caloric increase in portion size, from 49 to 133 calories. The authors also pointed out that the comparison between food at home and outside, both in fast-food establishments and in restaurants showed highest increases in portion sizes in fast-food establishments and lowest in the restaurants.

It is suggested that the relationship between increase in portion sizes and increased energy consumption is independent of age and starts early, even during childhood. An experimental study showed that, from the age of four, it is possible to see changes in energy intake due to the increased portions served in the United States (ELLO-MARTIN; LEDIKWE; ROLLS, 2005).

A retrospective study conducted by McConahy et al. (2002), with a sample of 2,139 American children showed that the size of portions consumed by children aged one to two years was similar for the vast majority of foods in the last twenty years. The intake of children with four or more years was strongly related to the portion sizes. With the general increase of portion sizes, there was an increment of body mass in all subgroups of children aged four or more years; however, this event was not found in children younger than three years.

Several experimental studies conducted in the United States and United Kingdom, published between 2004 and 2009, showed increased food intake resulting from the increase in portion size, among people of both sexes, but with different ages and nutritional status. In these studies, food intake was independent of factors such as sex, age, nutritional status, perception of hunger before meals and satiety after food intake or higher compensation. As compensation for intake, the authors understand the act of adjusting the portion size consumed during a given period, in response to the previous consumption of larger or smaller portion than usual (ROLLS; ROE; MEENGS, 2006; 2007; KELLY et al*.,* 2009). Thus, when adjustment occurs in response to eating a larger portion size than usual, the individual shrinks the portion to be eaten in one or more subsequent meals. Or rather, in response to eating a smaller portion size than usual, one increases the size of the portion in one or more subsequent portions.

In general, studies investigated portions offers between 100% and 200%, reaching up to 500% larger than the standard portion size. They showed that food

intake increases by offering large portions in at least 30%. In addition, studies that used the largest portions, even among individuals who did not eat the portion offered full, showed hihger increases in food intake (DILLIBERTI et al., 2004; ELLO-MARTIN, LEDIKWE´; ROLLS, 2005; FISHER et al., 2007; FLOOD; ROE; ROLLS, 2006; KELLY et al., 2009; KRAL; ROE; ROLLS, 2004; RAYNOR; WING, 2007; ROLLS; MORRIS; ROE, 2002; ROLLS et al., 2004a; 2004b; ROLLS; ROE; MEENGS, 2006; 2007; STEENHUIS; VERMEER, 2009; WANSINK; KIM, 2005; WANSINK; PAINTER; NORTH, 2005). The schematic summary of the studies is presented in table 1.

According to a study by Rolls et al. (2004b) with 75 adults, increasing the portion sizes of single preparations, such as sandwiches, is responsible for a significant increase in energy intake. In the study, a sandwich was served, on alternate days, for all participants, who were told to eat as much as desired. The sandwich portion sizes were 15, 20, 25 and 30 centimeters on each day. Although changes in hunger and satiety were not identified, before and after every snack, men ate 56% more calories (355 kcal), and women 31% (159 kcal) when served with the 30 cm portion, as compared with the initial portion of 15 cm.

The increase in caloric intake is even greater if the increase in portion size is associated with a higher energy density. Kral, Roe & Rolls (2004), in a study using a “before and after” type design, in which each participant is his own control, assessed during six weeks, once a week, the intake of three different portions (500, 700 and 900 grams) and two energy densities (1.2 and 1.7 kcal). Participants consumed 56% more calories when served the largest portion and higher energy density than when they were offered smaller portion and lower energy density. Despite this substantial difference in caloric intake, there were no changes in hunger and satiety ratings before and after each subsequent intake or compensation.

A study conducted by Ello-Martin, Ledikwe & Rolls (2005) showed that increases in portion sizes were positively correlated with increased intake during a meal, also influencing the total daily energy consumption, since the participants did not compensate the higher consumption with less food intake at subsequent meals.

Moreover, research shows that the effects of exposure to larger portion sizes may last for several days (KELLY et al., 2009; ROLLS; ROE; MEENGS, 2006; 2007). In a study designed “before and after” type, all participants were offered food to be eaten in two periods of 11 consecutive days, separated by an interval of two weeks. In the second period, the portions were 50% larger than those distributed in the first period. The authors observed, in the second period, an increase in caloric intake, on

average, of 25% among women and 14% among men, when compared to the first period. Due to the increased portion size, the individuals increased their intake in 423 kcal per day, totaling an excess intake of 4,636 calories in 11 days of analyses.

It is suggested that the acquisition and intake of more food portions than the energy needed may be influenced by the perception of money value and portion size.

Perception of money value is understood as the relation between quantity purchased and amount paid. Larger portions are often sold at relatively lower prices; in other words, more units for lower unit price or larger packs at relatively lower costs may encourage the purchase of these goods (STEENHUIS; VERMEER, 2009). Denney-Wilson et al. (2009), in a study on high energy density foods among 2,719 Australian adolescents, found that the convenience and perception of money value corresponded to stronger associations with fast food consumption among boys.

Authors argue that a distortion in the perception of food portion sizes may occur when individuals assimilate larger portions than those considered normal in the context in which they live and thus do not realize that the portion size eaten usually overcomes this size perceived as normal. One must consider that larger portions have become commonplace and therefore consumers find it difficult to select quantities of food that are appropriate for their weight and activity level. In addition, the labels of food products do not always have clear information on portioning. This information often refers to smaller portions, and it seems they have been recommended so as to mask the caloric content and real allowance of a package, which implies difficulties in understanding what is actually being ingested.

Terms such as small, medium and large in packs can be interpreted in different ways, which certainly reflect in the amounts ingested (STEENHUIS; VERMEER, 2009). Many people interpret the package as a single portion and are not aware that a package may contain several portions (PELLETIER et al., 2004). Finally, some evidence suggests that people are served larger portions when using larger dishes and utensils (WANSINK; CHENEY, 2005; WANSINK; VAN ITTERSUM; PAINTER, 2006); however, these results are still controversial (KOH; PLINER, 2009).

Given the perception of the messmates on the size of food portions, qualitative study conducted by Willemijn, Steenhuis & Seidell (2010) in the Netherlands showed that the participants consider that food portions of various products have increased in recent decades, and that they are currently higher than necessary. In addition, they reported difficulty in self-regulating eating larger food portions. Yet, they found that money value is important when buying larger food portions and offer proportionally

lower prices. The products often referred were chocolate bars, candies, soft drinks, chips, popcorn, and the increased availability of restaurants where people can eat at will for a fixed price.

CONCLUSION

We conclude that, once selected larger food portions, because of the principles of perception of the value of money and / or distortion of the portion, it is likely to happen an intake passive increase. This unconsciously increased food intake may last several days, and change previous eating habits. Those changes may be related to an inadequate nutritional status and higher risks of overweight / obesity, and chronic-degenerative diseases.

ACKNOWLEDGEMENTS

To the Coordination for Improvement of Higher Education Personnel / Postgraduate Studies Support Program (PROF-CAPES).

REFERENCES

DENNEY-WILSON, E.; CRAWFORD, D.; DOBBINS, T. et al. Influences on consumption of soft drinks and fast foods in adolescents. *Asia Pacific Journal of Clinical Nutrition*, v. 18, p. 447-452, 2009.

DILIBERTI, N.; BORDI, P.L.; CONKLIN, M.T. et al. Increased portion size leads to increased energy intake in a restaurant meal. *Obesity Research*, v. 12, p. 562-568, 2004.

ELLO-MARTIN, J.A.; LEDIKWE, J.H.; ROLLS, B.J. The influence of food portion size and energy density on energy intake: implications for weight management. *American Journal of Clinical Nutrition*, v. 82, p. 236S–241S, 2005.

FISHER, J.O.; ARREOLA, A.; BIRCH, L.L. et al. Portion size effects on daily energy intake in low-income Hispanic and African American children and their mothers**.** *American Journal of Clinical Nutrition*, v. 86, p. 1.709-1.716, 2007.

FLOOD, J.E.; ROE, L.S.; ROLLS, B.J. The effects of increased beverage portion size on energy intake at a meal. *Journal of the American Dietetic Association*, v. 106, p. 1984-1990, 2006.

FURST, T.; CONNORS, M.; BISOGNI, C.A. et al. Food choice: a conceptual model of the process. *Appetite*, v. 26, p. 247-265, 1996.

JOMORI, M.M.; PROENÇA, R.P.C; CALVO, M.C.M. Determinantes de escolha alimentar. *Revista de Nutrição*, Campinas, v. 21, p. 63-73, 2008.

KELLY, M.T.; WALLACE, J.M.; ROBSON, P.J. Increased portion size leads to a sustained increase in energy intake over 4 d in normal-weight and overweight men and women. *British Journal of Nutrition*, v. 102, p. 470-477, 2009.

KOH, J.; PLINER, P. The effects of degree of acquaintance, plate size, and sharing on food intake. *Appetite*, v. 52, p. 595-602, 2009.

KRAL, T.V.E.; ROE, L.S.; ROLLS, B.J. Combined effects of energy density ad portion size on energy intake in women. *American Journal of Clinical Nutrition*, v. 79, p. 962-968, 2004.

McCONAHY, K.L.; SMICIKLAS-WRIGHT, H.; BIRCH, L.L. et al. Food portions are positively related to energy intake and body weight in early childhood. *Journal of Pediatrics*, v. 140, p. 140-340, 2002.

NIELSEN, S.J.; POPKIN, B.M.Patterns and trends in food portion sizes, 1977–1998. *Journal of the American Medical Association*, v. 289, p. 450-453, 2003.

PELLETIER, A.L.; CHANG, W.W.; DELZELL, J.E. et al. Patients' understanding and use of snack food package nutrition labels. *Journal of the American Board of Family Medicine*, v. 17, p. 319-323, 2004.

RAYNOR, H.A.; WING, R.R. Package unit size and amount of food: Do both influence intake? *Obesity*, v. 15, p. 2.311-2.319, 2007.

ROLLS, B.J.; ROE, L.S.; KRAL, T. et al. Increasing the portion size of a packaged snack increases energy intake in men and women. *Appetite*, v. 42, p. 63-69, 2004a.

ROLLS, B.J.; ROE, L.; MEENGS, J.S. et al. Increasing the portion size of a sandwich increases energy intake. *Journal of the American Dietetic Association*, 104:367-372, 2004b.

ROLLS, B.J.; ROE, L.S.; MEENGS, J.S. Larger portion sizes lead to sustained increase in energy intake over 2 days. *Journal of the American Dietetic Association*, v. 106, p. 543-549, 2006.

_____. The effect of large portion sizes on energy intake is sustained for 11 days. *Obesity*, v. 15, p. 1535-1543, 2007.

ROLLS, B.J.; MORRIS, E.L.; ROE, L.S. Portion size of food affects energy intake in normal-weight and overweight men and women. *American Journal of Clinical Nutrition*, v. 76, p. 1207-1213, 2002.

SOBAL, J.; BISOGNI, C.A. Constructing food choice decisions. *Annals of Behavioral Medicine*, v. 38, p. 37-46, 2009.

STEENHUIS, I.H.M.; VERMEER, W.M. Portion size: review and framework for interventions. *International Journal of Behavioral Nutrition and Physical Activity*, v. 6, p. 1-10, 2009.

STROEBELE, N.; CASTRO, J.M. Effect of Ambience on Food Intake and Food Choice. *Nutrition*, v. 20, p. 821-838, 2004.

WANSINK, B. From mindless eating to mindlessly eating better. *Physiology and Behavior*, v. 100, p. 454-463, 2010.

WANSINK, B.; VAN ITTERSUM, K.; PAINTER, J.E. Ice cream illusions. Bowls, spoons, and self-served portion sizes. *American Journal of Preventive Medicine*, v. 31, n. 240-243, 2006.

WANSINK, B.; CHENEY, M.M. Super bowls: Serving bowl size and food consumption. *Journal of the American Medical Association*, v. 293, p. 1727-1728, 2005.

WANSINK, B.; KIM, J. Bad popcorn in big buckets: Portion size can influence intake as much as taste. *Journal of Nutrition Education and Behavior*, v. 37, p. 242-245, 2005.

WANSINK, B.; PAINTER, J.E.; NORTH, J. Bottomless bowls: Why visual cues of portion size may influence intake. *Obesity Research*, v. 13, p. 93-100, 2005.

WANSINK, B.; SOBAL, J. Mindless eating: the 200 daily food decisions we overlook. *Environment and Behavior*, v. 39, p. 106-123, 2007.

YOUNG, L.R.; NESTLE, M. The contribution of expanding portion sizes to the US obesity epidemic. *American Journal of Public Health*, v. 92, p. 246-249, 2002.

---

[1] M.Sc. in Nutrition and member of the Núcleo de Pesquisa de Nutrição em Produção de Refeições, Santa Catarina Federal University (UFSC). Felowship owner from CAPES.
[2] Professor of the Departament of Nutrition and head of the Núcleo de Pesquisa de Nutrição em Produção de Refeições, Santa Catarina Federal University (UFSC).

Correspondência / *Correspondence*
Rossana Pacheco da Costa Proença
UFSC – Universidade Federal de Santa Catarina
CCS - Centro de Ciências da Saúde, PPGN – Programa de Pós-Graduação em Nutrição
Campus Universitário – Trindade
88040-900 – Florianópolis, SC, Brasil
E-mail: rossana@mbox1.ufsc.br

*Article based on the dissertation project: "Estado nutricional, indicadores sociodemográficos e escolha alimentar de comensais em restaurantes por peso", at the Programa de Pós-Graduação em Nutrição da Universidade Federal de Santa Catarina como requisito para Qualificação de Mestrado, Florianópolis, 2009. Financing: Programa de Pós-Graduação em Nutrição/UFSC – Programa de Fomento à Pós-Graduação (PROF)/ Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES).

Received on: 14/2/2011
Aproved on: 15/3/2011

Authors (year)	Study design	Sample	Age (years or age group)	Relevant results for this study
Rolls, Roe & Meengs (2006)	Experimental study designed "before and after" type, with three different portion sizes of food (standard, 150%, 200%)	32 people	19-45	Increase of energy intake by the increased size of the offered portion, for all food groups, between 335-530 kcal/day among women, and 504-812 kcal/day among men. No intake compensation in two days of exposition to larger portions.
Kelly et al. (2009)	Experimental study, randomized, designed" before and after" type, with two different portion sizes of food and beverages (standard, increased)	43 people	Adults	Increase of energy intake by the increased size of the offered portion of 10% for women and 17% for men. Little evidence of intake compensation in four days of exposition to larger portion sizes.
Rolls, Roe & Meengs (2007)	Experimental study designed "before and after" type, with two different portion sizes of food (standard, 150%)	23 people	20-40	Increase of energy intake of 423 kcal/day, by the increased size of the offered portion, for all food groups, except fruits and vegetables. No intake compensation in 11 days of exposition to larger portions
Diliberti et al. (2004)	Experimental study designed "before and after" type, with two different portion sizes of food (standard, 152%)	180 people	Adults	Increase in energy intake of 172 kcal, and of 43% with a offer of portion of 152%.
Fisher et al. (2007)	Experimental study designed "before and after" type, with different portion sizes of pasta with cheese, apple juice, rice, chicken, cracker and cereal (standard, 200%)	58 children and their mothers	Children and adults	Increase in energy intake in approximately 270 kcal (21%) in mothers, and about 180 kcal (23%) in children, by increased offered portion in a period of 24 hours.
Flood, Roe & Rolls (2006)	Experimental study designed "before and after" type, with two different portion sizes of beverage (standard, 150%)	33 people	18-45	Increase in energy intake of beverages in approximately 10% in women and 26% in men, by the increase in the offered portion. There was no alteration/compensation in food intake.
Kral, Roe & Rolls (2004)	Experimental study designed "before and after" type, with three different portion sizes of Italian pasta (standard, 140% and 180%) and two energy densities (1.25 and 1.75 kcal/g)	39 mulheres	20-45	Increase in energy intake of 221 kcal (56%) when served with larger portion size and energy density. There was no systematic difference in the evaluations of hunger and satiety after energy intake, nor intake compensation in the subsequent meal.
Raynor & Wing (2007)	Experimental study comparing the independent effects of package size or quantity of food, through four groups: two unit package sizes (small	28 people	18-30	Unit size of package in food intake was not observed. A 100% increase in the quantity of offered food led to an increased energy intake of 2,246 kcal (81%) in three days.

	and large) x two quantities (small and large) of chips, cheese snacks, cookies and candies			
Rolls, Morris & Roe (2002)	Experimental study with four different portion sizes of pasta with cheese (standard, 125%, 150%, 200%)	51 people	21-40	Progressive increase in energy intake with increase in offered portion sizes of, respectively, 12% (64 kcal), 19% (105 kcal) and more than 30% (161 kcal) in portions 125%, 150% and 200% larger than the standard one. A resposta ao tamanho da porção não variou de acordo com características de sexo ou estado nutricional.
Rolls et al. (2004a)	Experimental study designed "before and after" type, with five different portion sizes of chips (standard, 150%, 204%, 357%, 507%)	60 people	20-45	Increase in energy intake of 184 kcal for women and 311 kcal for men when a larger portion size was offered. No intake compensation in the short term.
Rolls et al. (2004b)	Experimental study designed "before and after" type, with four different portion sizes of sandwich (standard, 134%, 167%, 200%)	75 people	20-45	Increase in energy intake of 31% for women (159 kcal) and 56% for men (355 kcal) when offered the larger portion size. There was no systematic difference in evaluating hunger and satiety after increase in energy intake.
Wansink & Kim (2005)	Experimental study with four groups: two unit sizes of package (standard and 200%) x two types (fresh and withered) of popcorn	158 people	Adultos	Increase in energy intake when a larger portion is served,both for fresh and withered popcorn of, respectivlely, 45% and 34%.
Wansink, Painter & North (2005)	Experimental study with two groups: normal bowl with soup x experimental bowl with soup with auto-recharge not perceived by the messmate	54 people	18-46	Participants who were unknowingly taking a bowl with self-recharge consumed 73% more soup and did not believe they had consumed more, nor felt more satisfied than those who took bowls without self-recharge. Consumption was not altered but the nutritional status of the participants.

Table 1 – Experimental studies on the influence of food portion sizes in food intake