MISS GOELE AERTS (Orcid ID : 0000-0002-8876-6064)

Article type : Original Article

Do depicted suggestions of portion size on-pack impact how much
(un)healthy food children consume

Goele Aerts* (goele.aerts@kuleuven.be)

Tim Smits (tim.smits@kuleuven.be)

Institute for Media Studies, KU Leuven, Parkstraat 45, 3000 Leuven, Belgium

Acknowledgments

The authors analyzed and interpreted the data, they wish to thank Msc. Janne Vandeveldde and Charlotte Vertessen for collecting de data. This research was made possible and supported by a grant [grant number: G078815N] from the Flemish Fund for Scientific Research (FWO).

Corresponding author: Goele Aerts

Institute for Media Studies
Faculty of Social Sciences, KU Leuven
Parkstraat 45 (PO box 3603)
B-3000 Leuven (Belgium)
Phone: +32 16 32 01 87
Fax: +32 16 32 04 97
E-mail: goele.aerts@soc.kuleuven.be

This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/ijcs.12503

This article is protected by copyright. All rights reserved.

Abstract

In previous decades portion and pack sizes of many foods tended to increase while, more recently, some foods started to downsize. These changes in actual portion sizes typically get coverage but less attention is given to the suggested portion sizes for multi-serving food packages, and to what the impact is of depicted portion sizes on-pack. Using two studies with a mixed experimental design among young children, this paper examines the effects of depicted suggestions of portion size manipulation (regular vs large – “large” corresponds to how brands typically depict portions). Both studies used a 2 x 2 x 2 cross-over design, with suggested portion size and food type as within- and order as between-subjects manipulation. In Study 1, we used snacks (grapes and chocolate nuts). In Study 2, we compared two bread spreads (chocolate and cheese). In both studies, we found that children ate more when presented with the larger depiction of the suggested portion size compared to the regular one. In Study 1, however, we found that children consumed more calories from the chocolate nut than the grape snack, while children did eat more grams of this healthier grape snack. We also showed that consumption in grams only differed between portion sizes when given grapes, which might be due to a possible ceiling effect of chocolate nut consumption. In Study 2, we also found a main effect for spread type as children ate more of chocolate compared to cheese spread. Our results indicate that this subtle on-pack cue is persuasive. Moreover, policy makers but also marketers could use these insights to stimulate healthy eating in children.

Keywords: Depicted portion size; food and nutrition; front-of-pack marketing; environmental cue; young children; food consumption

Introduction

As children grow older, the environment begins to affect their food decisions and consumption behavior (Preston, 2016). Children will be socialized by environmental cues, such as package and portion sizes, to adopt adult-like attitudes about food and food consumption (Hill and Peters 1998; Young and Nestlé 2012). With regard to food consumption, we have come to expect large portion sizes (Young and Nestlé 2002), which is evident from the amount of super-sized food items and depicted serving sizes on-pack available in the supermarket. Marchiori, Papies, and Klein (2014) suggested that portion sizes are used as anchor quantities, such that consumers take the size of the portion as a reference amount. Larger than normal portion sizes have become “consumption norms” (Wansink and Chandon 2014), leading them to overestimate what is an adequate portion size (Nielsen and Popkin 2003). The availability of these larger package and portion sizes is one of the more elusive factors believed contributing to the increase in dietary intake, which results in escalating rates of overweight and obesity (Chandon 2013; Zlatevska et al. 2014). For instance, the duplication of package sizes has translated into a 18% to 25% increase in intake for many meal related foods, such as spaghetti and a 30% to 45% increase for many snack-related foods (Wansink 1996). Especially children seem to be affected by size perceptions, as quantity information on labels is hard to process (Chandon 2013; Viswanathan et al. 2005).

It has earlier been demonstrated that also children’s perceptions and expectations about food are influenced by packaging. Most of the research about on-pack food marketing directed to children has focused on the use of persuasive cues, such as endorsers, that impact children’s attitudes and preferences (Smits et al. 2015). Recently, Aerts and Smits (2018) showed in a content analysis that children are often exposed to various food marketing cues on-pack in supermarkets usually to promote unhealthy foods.

Food marketing directed to children mainly includes unhealthy foods that contain lots of sugar and exceed the daily recommended amounts of fat and salt (Botha et al. 2008). These foods often use persuasive appeals with peripheral cues which may mislead children or even their parents to ignore possible negative effects (Kim et al. 2016). Children also prefer sugary foods above the healthier ones (Liem and De Graaf 2004), and they show stronger activation of brain regions associated with reward while eating it (van Meer et al. 2016). Till now, prior research about marketing effects on children's eating behavior mainly focused on the impact of (unhealthy) meals, particularly focusing on (sugary) cereals (Harris et al. 2009; Schwartz et al. 2008). Next to cereals, a large part of children eats white bread (or alternatives poor in fibre) with 75% using sugary spreads on their bread (Huybrechts et al. 2008). Moreover, over 25% of preschoolers' energy intake comes from snacks nowadays (Piernas and Popkin 2010). We should thus also study the impact of marketing effects on the consumption of these foods.

Apart from the (un)healthiness of products themselves, the dosage of these products also plays a role (Young and Nestlé 2012). Several studies already showed the effect of larger serving sizes and food type on children's consumption (e.g., Small et al. 2013). Lab experiments typically demonstrated that children consumed significantly more when served a larger portion-size, and when energy-density was high. Aerts and Smits (2017) also showed that children consumed more of snacks offered in larger packaging, moreover, a stronger package size effect was found for sugared snacks than for less sugared snacks. Such an effect even seems to exist with the mere suggestion of portion sizes using an on-pack visual cue. Neyens, Aerts, and Smits (2015), for instance, demonstrated that manipulated image-serving sizes (small vs larger pictorials) on cereal boxes influenced children's consumption.

The goal of this paper is to examine how such depicted suggestions of a portion size (i.e. suggested serving) on food packages influences food intake among children. Although prior research already demonstrated the impact of portion and package size effect on

children's consumption, conceptual replication of these effects are needed. Moreover, the impact of a depicted suggested serving size on the front of a pack has not been investigated, while it is often used as a subtle marketing cue by food producers. A quick look around the supermarket's food aisles or one's home stock of packaged foods quickly confirms this. For instance, cookie packages often show more than just one cookie. Other subtle visual cues pertaining to serving size are thought to impact eating as food selection is mainly guided by the visual system (Linné et al. 2002; Wansink and van Ittersum 2003), and the "first taste is always with the eyes" (van der Laan et al. 2011).

In two studies, we look at the impact of depicted on-pack portion sizes. We hypothesize (Hypothesis 1) that children would consume more when the depicted portion size is large rather than normal. In the first study we test this with a snack, while in the second study we test this with regard to spreads applied by children preparing their own slices of bread. Prior studies also revealed increases in energy intake among young children for more energy dense foods (Leahy et al. 2008). We can expect children to consume more of less healthy foods (Hypothesis 2). In the first study, we check if children eat more of the less healthy chocolate nut snack than the healthier grape snack. In the second study, we check if children eat more of the less healthy chocolate spread than the cheese spread on their first and total amount of slices of bread. Till now, prior results revealed inconsistencies in portion size effects by food type, the basis of which remains unclear (see Fisher and Kral 2008). Does a suggested portion size cue depicted on-pack generate stronger consumption effects for unhealthy foods? Therefore, we aim to explore possible interaction effects between suggested portion size and food type (Research question). We controlled for the effects of age, gender, BMI z-score, overall liking of the food and feelings of hunger. Finally, we discuss potential policy solutions that should limit the contribution of food packaging to the global obesity epidemic among young children.

Study 1

Methods

A 2 x 2 x 2 mixed experimental design, similar to Looney and Raynor's (2011) design, was used: with suggested portion size (regular vs. large) and snack type (grapes vs. chocolate nuts) as within- and order as a between-subjects manipulation. Suggested portion size and snack type were manipulated within-subjects, presentation-order was manipulated between-subjects to counterbalance spurious effects due to presentation order. We opted for this crossover design because it levels out interindividual differences that should otherwise be included as covariates. As a result, such a design typically has a higher power such that smaller sample sizes can be tolerated. We conducted this experiment in a controlled school environment. Recruitment began by distributing letters in primary schools to parents who had children within the age range of four to seven years old. Of the 47 participating children, there were 29 girls (61.7%) and 18 boys (38.3%), the average age was about seven years old ($M = 6.60$; $SD = 0.61$). Their ages ranged from six till eight years old.

For each session, children were provided a snack (healthy vs. less healthier) during breaks at school. Children had a maximum of 10 minutes to consume the snack, but could leave the table during the 10 minutes when they had eaten as much as they wanted. The procedure was filmed to control for unexpected circumstances. After the last session, the children were debriefed and could give any comment they might have. The institutional review board of (anonymous for peer review) reviewed and approved all procedures.

See-through packaging with a front-of-pack sticker was used (see Figure 1). Four different stickers with a suggestion of portion size manipulation were created. The sticker showed a hand holding the packaged snack, and was manipulated in the same manner as in the study of Versluis, Papies, and Marchiori (2015). "Taste this tasty snack" was written on

the sticker next to the depicted hand holding the snack. As the healthy snack type we opted for dark red grapes. This snack contains 72kcal/100g, 13.3gsugar/100g, and 0.3gfat/100g. As the less healthy and more sugared snack we opted for chocolate nuts (nuts covered with chocolate), this snack type has the same size and somewhat the same color as the grapes. This snack contains 555kcal/100g, 47gsugar/100g, and 35gfat/100g, which is much higher in kcal, sugar and fat than the healthier grapes. The regular portion front-of-pack sticker, showed a hand with 20 chocolate nuts (which is similar to 100g) or 20 grapes (+-160g), which are normal or appropriate sizes for snacks. The large sized portion manipulation consisted of 40 chocolate nuts (which is similar to 200g) or 40 grapes (+-320g). All packages contained 200 grams of grapes or chocolate nuts.

Consumption of the snacks was measured in grams, this was done by subtracting pre- from post-snack weight. Covariates were age, gender, BMI, liking of the snacks, and feelings of hunger. BMI was measured by dividing the children's body weight by the square of their height. BMI criteria differ between children and adults, with childhood criteria based on percentiles rather than absolute scores. Prior literature suggests that children are considered overweight from the 85th percentile (Barlow and Committee 2007). Liking of the grape and chocolate nut snack was measured at the last session only, with a three-point cartoon Likert-scale ranging from 'not tasty' (1) to 'very tasty' (3) (Birch, 1979). Hunger was measured before each session with a series of three cartoon drawings developed by Birch (Birch and Fisher 2000), ranging from 'not hungry' (1) to 'very hungry' (3).

Results and discussion

The mean BMI of the participants was 15.43 ($SD = 1.55$). The BMI cut-offs for underweight and overweight were set at 13.86 and 16.67 in our sample (BMI 15th and 85th percentile), respectively. About 15% of the participants were underweight ($N = 7$), about 15% of them were overweight ($N=7$) and the remaining 70% had a normal weight ($N = 33$, with a

score between 13.86 and 16.67). Moreover, by using the international cut off point of BMI (Cole et al. 2000) we note that only one girl with the age of six and three boys with the age of seven are overweight (BMI 25 kg/m²). None of them is seen as obese (BMI 30 kg/m²). In terms of likeability, children liked the grape snack ($M = 2.76$; $SD = 0.50$) as much as the chocolate nut snack ($M = 2.85$; $SD = 0.34$; $t(92) = -1.028$, $p = .307$). Both were liked more than the scale's neutral midpoint (grapes: $t(46) = 10.34$, $p < .001$; chocolate nuts: $t(46) = 16.94$, $p < .001$). The average value of hunger across all sessions was 2.69 ($SD = 0.46$), which significantly exceeded the scale midpoint ($t(46) = 10.25$; $p < .001$).

A repeated measures ANOVA was used to test for the hypothesized main effects and the potential interaction effect (see Figure 2). A significant main effect of suggested portion size appeared on the amount of consumed snacks ($F(1,46) = 6.61$, $p = .013$, $\eta_p^2 = .13$), confirming Hypothesis 1. Children consumed more when the on-pack stickers suggested a large portion ($M = 67.50$; $SD = 36.81$) compared to a regular one ($M = 60.04$; $SD = 33.20$). Second, we also found a main effect for snack type ($F(1,46) = 73.79$, $p < .001$, $\eta_p^2 = .62$). Children ate significantly more of the healthy snack ($M = 91.81$; $SD = 51.13$) than the less healthy snack ($M = 35.73$; $SD = 18.88$), which contradicts Hypothesis 2. Exploring our research question, we also found an interaction-effect ($F(1,46) = 9.66$, $p = .003$, $\eta_p^2 = .17$). Paired-samples t-tests indicated that when children were offered grapes, they ate significantly more when the depicted portion was large ($M = 99.23$; $SD = 51.21$) compared to regular ($M = 84.38$; $SD = 51.04$), $t(46) = 3.738$, $p = .001$). In contrast to the grapes, depicted portion size did not affect consumption when children were presented with chocolate nuts: they did not eat significantly more when the suggestion was large ($M = 35.76$; $SD = 22.40$) compared to regular ($M = 35.70$; $SD = 15.36$), $t(46) = .018$, $p = .986$. As an answer on our research question, we found that snack intake only differed significantly between regular and large portions when children were given grapes. This could be because of a ceiling effect in the

chocolate nut consumption condition, where children in both condition maybe ate just until a similar level of satiety was reached.

To explore the counterintuitive effect of snack type, we also took a closer look at our data. When analyzing snack intake expressed in kcal, there was again a main effect for snack type on kcal intake, but in the opposite direction as children consumed more of the chocolate nuts than the grapes in kcal ($F(1,46) = 148.41, p < .001, \eta_p^2 = .76$). We also see that the previous found interaction disappears when analyzing the data in terms of calories ($F(1,46) = 0.29, p = .006, \eta_p^2 = .01$).

None of the covariates age, gender, BMI z-score, liking of the grape snack, liking of the chocolate nut snack and feeling of hunger were significant ($F < 1$), but the portion size effect lost significance. These findings should, however, be interpreted with care given the small sample size that limits the degree of reliable variability in the covariate measures.

Study 2

Methods

In this study we again used a 2 x 2 x 2 cross-over design. We manipulated on-pack depictions of suggested portion size (regular vs. large) and spread type (cheese spread vs. chocolate spread) within-subjects and presentation-order of these stimuli was manipulated between-subjects. The final sample consisted of 24 children, of which 13 were girls (54.2%) and 11 were boys (45.8%). The average age of the participating children was about six years old ($M = 5.62; SD = 0.92$). The youngest participant was five and the oldest seven years old.

Slices of bread together with bread spread in individual jars were served per child. A sticker with a serial number was given that corresponded to the serial number provided on every child's plate, knife and jar to guarantee anonymity. Children ate at tables in the dining area of the school one day a week for four weeks (four sessions), and were told a new brand

wanted to sell bread spreads on the Belgian market. The children were led to believe they were test subjects who had to taste the products of the new brand. They got 30 minutes to breakfast during every session. The procedure and cover story were similar to Study 1.

Jars were filled with 200grams of spread. Four different on-jar labels were created differing in depicted type of spread and thickness of the layer of spread. The cheese spread used, was Philadelphia Nature Light and contains 152kcal/100g, 5gsugar/100g, and 11gfat/100g. The chocolate spread we used, was Nutella and contains 549kcal/100g, 57gsugar/100g, and 32gfat/100g. As the cheese spread is lower in kcal, sugar and fat we consider it as the healthier spread type, and chocolate spread as the less healthy type. To the best of our knowledge, spread types have not yet been studied from a childhood consumption perspective. Spread types' depicted portion sizes are often exaggerations and thus could influence children following the same line of reasoning from above. Both spread types were offered in plain packaging (i.e. jars) with only a sticker added that showed a generic product category label and a slice of bread with a serving suggestion (see Figure 3). The regular sized spread manipulation depicted a slice of bread with 15grams of spread as this equals a serving size on the nutrition table of a well-known brand for chocolate spread (i.e. Nutella). The large sized spread manipulation was 73grams of spread on the depicted slice of bread. This amount is based on an estimate of how much this brand visually suggests on the front of their jars, and is about 5 times as much as suggested on the nutrition label. For the cheese spread similar serving sizes were depicted on the experimental jars.

The measurements were the same as in Study 1: we measured how much the children consumed by subtracting pre- from post-spread weight in grams. The first dependent variable was the amount of spread on the first slice, and the second variable was the total amount of spread used on all given slices of bread. Each time a child spread a slice of bread, the jar was

weighed again and the remaining weight was listed separately for each child. Covariates were age, gender, BMI, liking of spreads, and feelings of hunger.

Results and discussion

The participating children had a mean BMI of 15.86 ($SD = 1.61$). About 13% of the children in our sample were overweight ($N = 3$, BMI 85th percentile) and about 13% of them were underweight ($N = 3$, BMI 15th percentile). The BMI cut-offs for underweight and overweight were set at 14.61 and 18.19. About 74% of the children had a normal weight ($N = 18$, with a score between 14.61 and 18.19). We again used the international BMI cut off point table of Cole and colleagues (2000) to see if the children are overweight (BMI 25 kg/m^2) or obese (BMI 30 kg/m^2) compared to the reference population. None of the children were obese, however, two five-years old boys, one six-years old boy, one seven-years old boy, and one seven-years old girl were seen as overweight. In terms of likeability, children indicated they liked the chocolate spread ($M = 2.75$; $SD = 0.61$) more than the cheese spread ($M = 2.00$; $SD = 0.83$; $t(46) = -3.560$, $p = .001$), with chocolate spread exceeding the neutral 2 score ($t(23) = 6.04$, $p < .001$). The average value of hunger across all sessions was 2.29 ($SD = 0.47$), which implies the children were rather hungry ($t(23) = 3.04$, $p = .006$).

To test the effects of suggested portion size manipulation and front-of-jar depicted type of bread spread on intake, we performed again a *repeated measures ANOVA analysis* with amount of spread on the first slice of bread (see Figure 4a) and total amount of spread (see Figure 4b) as dependent variables. A significant main effect of suggested portion size appeared on the amount of consumed spread ($F(1, 23) = 8.10$, $p = .009$, $\eta_p^2 = .26$). Children ate significantly more spread on the first offered slice of bread when exposed to a large serving suggestion ($M = 9.94$; $SD = 6.38$) than to a regular one ($M = 7.63$; $SD = 5.20$). Concerning the total amount of consumed spread, however, the main effect of suggest portion

size did not reach significance ($F(1,23) = .74, p = .398, \eta_p^2 = .03$). Children did not eat significantly more spread on the total amount of consumed slices when suggested portion size was large ($M = 25.48; SD = 16.33$) than regular ($M = 22.92; SD = 20.85$), thus we only found partly confirmation for Hypothesis 1. This could be due to the fact that the first taste is always with the eyes (van der Laan et al. 2011), therefore visual cues on-pack would guide food selection. Moreover, the total consumption shows great variability, thus limiting the possibility of significant effects in a small sample size.

Spread type, however, had main effects on both the amount of spread on the first ($F(1,23) = .827, p = .009, \eta_p^2 = .26$) and the total amount of slices ($F(1,23) = 19.38, p < .001, \eta_p^2 = .46$). Children ate significantly more chocolate spread ($M = 10.42; SD = 5.96$) on the first offered slice than cheese spread ($M = 7.15; SD = 5.62$). In total, they also ate significantly more chocolate spread ($M = 34.92; SD = 24.91$) than cheese spread ($M = 13.48; SD = 12.27$), which confirms Hypothesis 2. Overall, children consumed more of the less healthy chocolate spread, confirming the “innate sweet spot” children are supposed to have (Botha et al. 2008). Related to our research question, no interaction-effect was found between suggested portion size and spread type to predict the amount of spread on the first slice ($F(1,23) = 0.18, p = .677, \eta_p^2 = .01$), or the total amount of spread ($F(1,23) = 0.21, p = .651, \eta_p^2 = .01$). Prior research already highlighted the inconsistency concerning the impact of portions size by food type (Fisher and Krall 2008), future research should continue to investigate interaction effects.

The same *repeated measures ANOVA* analysis was carried out with the addition of the covariates age, gender, BMI z-score, liking of cheese spread, liking of chocolate spread and feeling of hunger to test whether these variables influence the impact of suggested portion size and spread type on the amount of spread consumed on the first slice and in total. None of

them had an effect on consumption ($F < 1$). The inclusion of these covariates also rendered the main effects and interaction effect of our independent variables insignificant, but these results should be interpreted with care given the small sample size.

General discussion

The findings of both studies showed that children consumed more when presented with a packaging containing a larger depicted suggested portion size compared to a regular one. Our research is the first to demonstrate the effect of this subtle on-pack cue and gives new insights in the serious concern for children's eating behavior, in which food marketing plays a major role. Till now, only few studies looked at the impact of servings on the consumption among young children, which could be a factor that contributes to childhood obesity and could even lead to type 2 diabetes (Colapinto et al. 2007). Thus, serving large portion sizes could have a rather small effect in the short-term but could cause obesity in the long-term (Ebbeling et al. 2002).

The findings of both studies in this paper are also limited in some respects. A first limitation of this paper is that only short-term effects were measured. Moreover, no study to date has examined the long-term sustainable effects of portion size on children's energy intake, weight status, or health over time. Longer-term studies could show how individual susceptibility and food characteristics (e.g., palatability, exposure, etc.) influence portion size effects. Second, although previous studies have frequently reported the impact of portions and serving sizes, future studies should also look at other food types affecting food intake as we found evidence for the impact on healthy snacking. Third, the findings might not be generalized as we only looked at the impact on young children's consumption. Future studies should investigate if front-of-pack cues also have an effect on adults' consumption. A recent meta-analysis found that consumption increases by 22% when serving size doubles

(Zlatevska et al. 2014), and this effect was significantly larger for adults than for children under 10. Prospective research should assess from which age children become aware of subtle cues' purposes. Lastly, a major limitation is that children might be influenced by classmates as they consumed together in the same dining room at school. Future experiments in a more natural setting are needed.

This paper highlights the need for improvement in snacking and breakfast habits among preschoolers in order to prevent diet-related diseases in our future adult population, and to produce a more healthful diet. Moreover, it is important that young children are served appropriate portions by their parents and that parents get portion education or training interventions (Small et al. 2014) as parents serve portions they learn to be appropriate for their child, moreover they should serve by their desire for a healthy child with a balanced diet (Kairey et al. 2018). Regulations are needed to increase children and parents' awareness of health risks arising from overconsumption.

Figure Legends

Fig. 1 Front-of-pack sticker manipulations in Study 1.

*1) Regular size grape snack condition 2) Regular size chocolate nut snack condition
3) Large size grape snack condition 4) Large size chocolate nut snack condition*

Fig. 2 The effect of suggested portion size and snack type on snack consumption in grams.

Fig. 3 Front-of-pack sticker manipulations with jars in Study 2.

*1) Regular size chocolate spread condition 2) Regular size cheese spread condition
3) Large size chocolate spread condition 4) Large size cheese spread condition.*

Fig. 4a The effect of suggested portion size and spread type on the consumption in grams of spread on the first slice of bread.

Fig. 4b The effect of suggested portion size and spread type on the consumption in grams of spread on the total amount of slices of bread.

References

- Aerts G, Smits T (2018) Child-targeted on-pack communications in Belgian supermarkets: associations with healthiness and type of brand. *Health Promot Int*. Advance online publication. <https://doi.org/10.1093/heapro/dax057>
- Aerts G, Smits T (2017) The package size effect: How package size affects young children's consumption of snacks differing in sweetness. *Food Qual Prefer* 60: 72-80. <https://doi.org/10.1016/j.foodqual.2017.03.015>
- Barlow S E, Committee E (2007) Expert committee recommendations regarding prevention, assessment, and treatment of child and adolescent overweight and obesity: summary report. *Pediatrics* 120(4): 164-192.
- Birch L L (1979) Preschool children's preferences and consumption patterns. *J Nutr Educ* 11: 189–192. [https://doi.org/10.1016/S0022-3182\(79\)80025-4](https://doi.org/10.1016/S0022-3182(79)80025-4).
- Birch L L, Fisher J O (2000) Mothers' child-feeding practices influence daughters' eating and weight. *Am J Clin Nutr* 71(5): 1054-1061. <https://doi.org/10.1006/appe.2001.0398>.
- Botha S, Fentonmiller K, Jennings C, Johnson M, Young K, Hipsley H. et al. (2008) Marketing food to children and adolescents. A review of industry expenditures, activities, and self-regulation. A report to Congress. <http://www.ftc.gov/os/2008/07/P064504foodmktingreport.pdf>.
- Chandon P (2013) How package design and packaged-based marketing claims lead to overeating. *Appl Econ Perspect* P 35(1): 7–31. <https://doi.org/10.1093/aepp/pps028>.
- Colapinto C K, Fitzgerald A, Taper L J, Veugelers P J (2007) Children's preference for large portions: Prevalence, determinants, and consequences. *J Am Diet Assoc*, 107(7): 1183–1190. <https://doi.org/10.1016/j.jada.2007.04.012>
- Cole T J, Bellizzi M C, Flegal K M, Dietz W H (2000) Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ* 320: 1240-1243. <https://doi.org/10.1136/bmj.320.7244.1240>
- Ebbeling C B, Pawlak D B, Ludwig D S (2002) Childhood obesity: public-health crisis, common sense cure. *The Lancet* 360(9331): 473-482. [https://doi.org/10.1016/S0140-6736\(02\)09678-2](https://doi.org/10.1016/S0140-6736(02)09678-2)
- Fisher J O, Kral T V (2008) Super-size me: Portion size effects on young children's eating. *Physiol Behav* 94(1): 39-47. <https://doi.org/10.1016/j.physbeh.2007.11.015>
- Harris J L, Schwartz M B, Brownell K D et al. (2009) Cereal FACTS: Nutrition and Marketing Ratings of Children's Cereals. New Haven, CT: Rudd Center for Food Policy and Obesity. <http://www.cerealfacts.org>. Accessed 15 December 2017.

- Hill J O, Peters J C (1998) Environmental contributions to the obesity epidemic. *Science* 280: 1371–1374. <https://doi.org/10.1126/science.280.5368.137>.
- Huybrechts I, Matthys C, Vereecken C, Maes L, Temme E H, Van Oyen H et al. (2008) Food intakes by preschool children in Flanders compared with dietary guidelines. *Int J of Env Res Pub He* 5(4): 243-257.
- Kairey L, Matvienko-Sikar K, Kelly C, Mckinley M, O'Connor E, Kearney P. et al. (2018) Plating up appropriate portion sizes for children: A systematic review of parental food and beverage portioning practices. *Obes Rev* (published online 29 August 2018). <https://doi.org/10.1111/obr.12727>.
- Kim H, Lee D, Hong Y, Ahn J, Lee K Y (2016) A content analysis of television food advertising to children: Comparing low and general- nutrition food. *Int J Cons Stud* 40(2): 201-210. <https://doi.org/10.1111/ijcs.12243>
- Leahy K E, Birch L L, Fisher J O, Rolls B J (2008) Reductions in entree energy density increase children's vegetable intake and reduce energy intake. *Obesity* 16(7): 1559–1565. <https://doi.org/10.1038/oby.2008.257>.
- Liem D G, de Graaf C (2004) Sweet and sour preferences in young children and adults. Role of repeated exposure. *Physiol Behav* 83: 421–429. <https://doi.org/10.1016/j.physbeh.2004.08.028>
- Linné Y, Barkeling B, Rössner S, Rooth P (2002) Vision and eating behavior. *Obesity* 10(2): 92-95. <https://doi.org/10.1038/oby.2002.15>
- Looney S M, Raynor H A (2011) Impact of portion size and energy density on snack intake in preschool-aged children. *J Am Diet Assoc* 111(3): 414-418. <https://doi.org/10.1016/j.jada.2010.11.016>
- Marchiori D, Papies E K, Klein O (2014) The portion size effect on food intake. An anchoring and adjustment process? *Appetite* 81: 108–115. <https://doi.org/10.1016/j.appet.2014.06.018>
- Neyens E, Aerts G, Smits T (2015) The impact of image-size manipulation and sugar content on children's cereal consumption. *Appetite* 95: 152–157. <https://doi.org/10.1016/j.appet.2015.07.003>.
- Nielsen S J, Popkin B M (2003) Patterns and trends in food portion sizes, 1977-1998. *Jama* 289(4): 450-453. <https://doi.org/10.1001/jama.289.4.450>
- Piernas C, Popkin B M (2010) Trends in snacking among U.S. children. *Health Affair* 29(3): 398–404. <https://doi.org/10.1377/hlthaff.2009.0666>.
- Preston C (2016) Pre- school children and marketing communications. *Int J Cons Stud* 40(5): 618-623. <https://doi.org/10.1111/ijcs.12307>

- Schwartz M B, Vartanian L R, Wharton C M, Brownell K D (2008) Examining the nutritional quality of breakfast cereals marketed to children. *J Am Diet Assoc* 108(4): 702-705. <https://doi.org/10.1016/j.jada.2008.01.003>
- Small L, Heather L, Vaughan L, Melnyk B, Mcburnett D (2013) A systematic review of the evidence: The effects of portion size manipulation with children and portion education/training interventions on dietary intake with adults. *Worldv Evid-Based Nu* 10(2): 69–81. <https://doi.org/10.1111/j.1741-6787.2012.00257.x>.
- Smits T, Vandebosch H, Neyens E, Boyland E. (2015) The persuasiveness of child targeted endorsement Strategies: A systematic review. In: Elisia L. Cohen (ed). *Communication Yearbook* 39, New Brunswick, N.J.: Routledge
- Versluis I, Papies E K, Marchiori D (2015) Preventing the pack size effect: exploring the effectiveness of pictorial and non-pictorial serving size recommendations. *Appetite* 87: 116-126. <https://doi.org/10.1016/j.appet.2014.12.097>
- van der Laan L N, De Ridder D T, Viergever M A, Smeets P A (2011) The first taste is always with the eyes: a meta-analysis on the neural correlates of processing visual food cues. *Neuroimage* 55(1): 296-303. <https://doi.org/10.1016/j.neuroimage.2010.11.055>
- van Meer F, van der Laan L N, Charbonnier L, Viergever M A, Adan R A, Smeets, P A (2016) Developmental differences in the brain response to unhealthy food cues: an fMRI study of children and adults. *Am J Clin Nutr* 104(6): 1515-1522. <https://doi.org/10.3945/ajcn.116.137240>
- Viswanathan M, Rosa J A, Harris J E (2005) Decision making and coping of functionally illiterate consumers and some implications for marketing management. *J Marketing* 69(1): 15-31. <https://doi.org/10.1509/jmkg.69.1.15.55507>
- Wansink B (1996) Can package size accelerate usage volume? *J Marketing* 60(3): 1–14. <https://doi.org/10.2307/1251838>.
- Wansink B, Chandon P (2014) Slim by design. Redirecting the accidental drivers of mindless overeating. *J Consum Psychol* 24: 413–431. <https://doi.org/10.1016/j.jcps.2014.03.006>.
- Wansink B, Van Ittersum K (2003) Bottoms up! The influence of elongation on pouring and consumption volume. *J Consum Res* 30(3): 455-463. <https://doi.org/10.1086/378621>
- Young L R, Nestlé M (2012) Reducing portion sizes to prevent obesity. *A J Prev Med* 43: 565–568. <https://doi.org/10.1016/j.amepre.2012.07.024>
- Young L R, Nestlé M (2002) The contribution of expanding portion sizes to the US obesity epidemic. *Am J Public Health* 92: 246–249. <https://doi.org/10.2105/AJPH.92.2.246>.
- Zlatevska N, Dubelaar C, Holden S S (2014) Sizing up the effect of portion size on consumption: a meta-analytic review. *J Marketing* 78(3): 140–155. <https://doi.org/10.1509/jm.12.0303>