

Larger Bowl Size Increases the Amount of Cereal Children Request, Consume, and Waste

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Objective To examine whether larger bowls bias children toward requesting more food from the adults who serve them.

Study design Study 1 was a between-subject design involving 69 preschool-age children who were randomized to receive either a small (8 oz) or large (16 oz) cereal bowl and were asked to tell researchers how much cereal they wanted for a morning snack. Study 2 was a within-subject design involving 18 school-age children at a summer camp who were given a small (8 oz) cereal bowl on one day and a large (16 oz) cereal bowl on another day and asked by a cafeteria server how much cereal and milk they wanted for breakfast. Hidden scales measured how much cereal and milk were served, consumed, and wasted. Body mass index was calculated at the end of the study.

Results In study 1, the young children requested almost twice as much cereal to eat when presented with the larger bowl compared with the smaller bowl. In study 2, the older children consumed 52% more and wasted 26% more when served in the larger bowl.

Conclusion A step toward potentially reducing overeating and waste would be for parents and adult caregivers to use smaller bowls for serving food to children. (*J Pediatr* 2014;164:323-6).

One way in which environmental factors can bias how much food people serve is by altering what they believe are appropriate consumption norms or serving sizes.¹ One such factor that has influenced intake in field studies is the size of bowls. Recent studies in homes and restaurants have shown that when adults serve themselves, they select an amount of food proportional to the size of the plate.² This is believed to partially be a function of visual illusion, such as the size-contrast illusion and the Delboeuf illusion.³ Although not all laboratory studies have found the same effect sizes,⁴ the strength of these findings in field situations raises the question of how bowl size biases the amount of food requested by young children when being served by adults.^{1,2}

A factor of increasing concern in childhood obesity is early habits or predispositions that lead to weight gain and obesity well before adulthood. The degree to which children's eating behaviors are biased by visual cues in their eating environment has not been widely examined. Piaget famously suggested that children are especially susceptible to visual illusions, but that their susceptibility decreases—although does not disappear—with age.⁵ Piaget's suggestion implies that a broad age range of children (3-10 years) would be susceptible to the effect of bowl size when serving food,⁶ and this has been shown to be even more pronounced with extroverted children.⁷ In contrast, if children ignored such cues such as the size of a bowl, then they might instead purely focus on the actual amount of food served and stop serving themselves when reaching what they consider an acceptable amount.

Although self-serving is important, how much a parent or caregiver serves the child might be even more relevant to childhood obesity.⁸ Frequently, younger children do not have the motor control to efficiently serve themselves without spilling. Up to a certain age, perhaps 8-10 years, parents or adults often serve the food, asking the child how much he or she wants during serving.^{9,10} It has been shown that adults are prone to the effect of bowl size and portion size when serving themselves,^{2,11} but what happens when the child directs the adult to serve? A question of practical relevance to parents, caregivers, and children is whether larger bowls or plates bias a child to request more food than they otherwise would. The purpose of the present study was to examine whether the size of cereal bowls similarly influences children of various body mass index (BMI) percentiles. We also examined whether any such overserving translates into overconsumption or food waste.

Methods

Study 1

After obtaining Institutional Review Board approval from Cornell University, children were given consent forms at their school to give to their parents. The consent form requested parents' permission—via signature—for their daughter or son to participate in a food study. Because of Institutional Review Board

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BMI Body mass index

concerns about choking hazards, the consent form stipulated that the child would not engage in actual consumption of foods, but would be asked his or her preference for the amounts of food presented. In this developmentally appropriate age range, parental approval was given for 69 of 81 children (50.0% female; mean age, 4.1 ± 0.65 years) to participate. Of the remaining children, 6 were absent from school on the day when permission slips were either handed out or collected, and 6 did not return with a signed slip. The racial distribution of the group was 78% Caucasian, 13% Asian, 5% African-American, and 4% Hispanic. The socioeconomic status and health insurance status of the children's families were not known.

To investigate whether children would request more food away-from-home food as a function of bowl size, a presweetened children's cereal was provided as a morning snack. A presweetened cereal was used because its nutritional profile makes it emblematic of away-from-home food and because it has high familiarity with children. The children were randomized to receive either a small (8 oz) or large (16 oz) cereal bowl, sizes shown to be commonly used in the home in a presurvey of a similar population. Previous research in this area has tended to use one bowl of a modest size and another bowl twice as large.²

Each child sat across a small table in the lunchroom from the researcher, who engaged in warm-up conversation. The conversation probed for the child's age, favorite color, and favorite activity at school, and covered the upcoming task. It was explained to children that researchers wanted to know how much cereal they would want for an upcoming morning snack. All children were tested between 8 a.m. and 10 a.m., and no parents were present.

Because mothers in a prestudy reported that they generally poured the cereal and milk for their child's breakfast, a similar approach was adopted, with the children served how much they said they wanted instead of risking accidental pours and spills. To be as precise as possible regarding the children's preferred cereal quantity, a premeasured scoop was used to pour a small amount of cereal (approximately 3-4 g) into the bowl, at which point the child was asked "Is that enough, or do you want more?" or "Do you want more, or is that enough?" The 2 versions of this statement were alternated each time the child was questioned. If the child said "more," then the researcher would add another 3-4 g to the bowl and again ask the child if that was enough or if he or she wanted more. This procedure continued as long as the child wanted more. If child said "enough," then the bowl was removed and its weight recorded, and the weight of the empty bowl was subtracted. Children did not subsequently eat the cereal—approval for the study was conditional on the children not consuming it—but were instead allowed to choose a small toy to keep in appreciation for helping.

After the study, trained researchers measured each child's height to the nearest 1/8" without shoes and weight using a calibrated scales. These height and weight measurements were transformed into BMI (kg/m^2) and then into an age- and sex-adjusted BMI percentile as stipulated by the Centers

for Disease Control and Prevention. One-third of the children were in the top BMI quartile for their age, and 2 children were in the top 2.5% of the distribution.

An independent-samples *t* test was applied using bowl size (large vs small) as a predictor of the amount of cereal requested. To examine whether the effect of bowl size on amount of cereal requested was attenuated by children's age, sex, or age- and sex-adjusted BMI percentile, 1-way ANOVA was performed, with age- and sex-adjusted BMI percentile, sex, and age as covariates.

Study 2

Study 2 addressed the limitations of study 1 and the robustness of the general effect by using a within-subjects longitudinal design to control for individual differences and by measuring intake and comparing it with the amount of food served. This longitudinal study was nested within a 4-week-long summer camp involving 18 children (66.7% female) with an average age of 8.3 years (range, 6-10 years) and who were in attendance for each of the 4 consecutive breakfasts served during the third week of camp, 2 of which were test breakfasts. (A total of 27 children were in the camp, but 9 children missed at least 1 of the 4 breakfasts and were not included in the study). In contrast to the study 1 group, which was primarily Caucasian, the study 2 group was 39% African-American, 28% Caucasian, 22% Hispanic, and 11% Asian. Given the criteria of the summer camp program, all of the children's families were known to be at or below the 20% poverty line.

During the 2 test days, a server affiliated with the cafeteria randomly assigned children to receive either a smaller bowl (8 oz) or a larger bowl (16 oz). The children were asked to indicate how much cereal and milk they wanted. Each day, "hidden" scales embedded in the tables, as well as remote sensors, measured how much cereal and how much milk each child was served. The quantity consumed and the quantity wasted were determined by subtracting the amount of cereal and milk remaining in the bowl at the end of breakfast. What was eaten was coded as consumed, and what remained in the bowl was coded as wasted. This test was repeated 2 days later, with the bowl size alternated; that is, a child who was given the small bowl on the first test was given the large bowl, and vice versa.

Results

In study 1, in general, children requested more cereal to be served when given a large bowl than when given a small bowl (46.1 ± 15.1 g vs 24.7 ± 14.9 g; $P < .001$). This difference represents an 87% increase in the amount of cereal requested for the large bowl. The average fill level in the small bowl was approximately 32%. The largest amount of cereal requested filled the bowl to approximately a 61% level, indicating that there was no ceiling effect with the smaller bowl.

After controlling for age, sex, and BMI, it was again found that children requested more cereal to be served in the large bowl than in the small bowl (47.3 ± 2.7 g vs 23.0 ± 2.7 g; $P < .05$). The effect of bowl size on requested amount of cereal

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