

## **Mothers' perceptions of portion size: are they fueling the child obesity epidemic?**

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### **Abstract**

What is driving the current obesity epidemic? A relatively new area of research is the study of portion sizes and energy density of foods served at home and in restaurants. The purpose of this report is to compare mothers' perceptions of appropriate portion sizes for young children with the guidelines published by the American Academy of Pediatrics (AAP). The picture card sort method was developed using photographs of various portion size options of 16 food and

beverage items commonly consumed by young children. For 15 of the 16 foods, low-income mothers (n = 87) selected larger portion sizes than recommended by the AAP for the 4-5 year old child. Four foods scored an energy density  $\leq 2.0$  kcal/g and a naturally nutrient rich score  $> 100.0$ : 2% milk, fresh carrots, cooked beans and orange juice. Our results highlight the need for further research exploring the potential obesogenic effect of increased portion sizes and varying energy densities on caloric intakes of children.

**Key words:** Portion size, young children, overweight, obesity, Latino

## Introduction

### *Obesity is an important public health problem.*

The number of overweight children in the US has tripled in the past 30 years (Hedley et al. 2004). Of particular concern are racial/ethnic disparities in the rates of pediatric overweight (Crawford et al. 2001). Pre-school aged Mexican-American children are more likely to be overweight (11 percent) than their non-Latino black (8 percent) or non-Latino white (10 percent) peers. The problem increases as children grow older. About 26 percent of Mexican-American boys, ages 6-11 years, are overweight, compared to 14 percent of non-Latino white boys (National Center for Health Statistics 2005).

Overweight and obesity disproportionately affect people living in low-income communities (Molarius et al. 2000) including those served by two Cooperative Extension programs: Expanded Food and Nutrition Education Program (EFNEP) and the Supplemental Nutrition Assistance Program—Education (SNAP—Ed). Obesity rates continue to rise in the US for all groups, but particularly for low-socioeconomic groups (Zhang and Wang 2004).

What is driving the obesity epidemic? A number of environmental factors are likely to be involved. A relatively new area of research is the study of portion sizes and energy density of foods served at home and in restaurants.

### *How and why have portions sizes changed?*

Eating out has become popular as family incomes have risen, 2-income families have increased, and fast food restaurants have multiplied (Kant and Graubard 2004). At the same time, portions of foods served at these fast food restaurants are 2 to 5 times larger than portions of those same foods served twenty years earlier in 1983 (Young and Nestle 2002). Between 1977 and 1996, portion sizes increased for salty snacks, desserts, soft drinks, fruit drinks, French fries, hamburgers, cheeseburgers and Mexican food at fast food restaurants and at home as well (Nielsen and Popkin 2003). A possible reason the restaurant industry can offer larger portions at “bargain prices” without harming the bottom line is that the cost of food ingredients are

relatively cheap compared to other inputs such as the labor to prepare or serve the food item (DiDomenico 1994; Neilson and Popkin 2003).

***What is the potential impact of larger portions on calorie intake?***

Consumers increasingly choose food outlets on the basis of portion sizes of food served (DiDomenico 1994), particularly in communities serving low-income families. To these consumers, supersized portions may seem like a “bargain.” One ounce of a supersized soft drink is just a few pennies, but these large portions also come with extra calories. A 64 ounce soda with ice contains about 720 kcal---nearly a third of the day’s recommended calories for many teenagers and adults.

***Do children eat more when served larger portions?***

To establish a link between child obesity and larger portion sizes, we would need to establish a relationship between portion sizes offered and average daily food intake. However, most of the work examining the influence of portion size on food intake has been done with adults. When portions of an entrée 43% larger than regular size were served at a cafeteria, customers ate the larger portion without noting the increased amount of food. Portion size had a significant effect on total caloric intake for both the entrée and the meal (Ello-Martin, Ledikwe and Rolls 2005). In another study, women served 3 meals a day did not compensate for the larger portions at one meal by eating smaller portions at the subsequent meal (Kral, Roe and Rolls 2004). Finally, researchers gave a group of adults bottomless bowls of soup. Participants eating from the self-refilling bowls ate more soup than those eating from normal soup bowls. Despite eating 73 percent more calories, they did not describe themselves as being more sated or full than other subjects (Wansinkj, Painter and North 2005). When eating increasingly larger portions, adults did not respond to corresponding levels of fullness, suggesting that hunger and satiety signals were ignored or overridden.

Do children do the same thing? In the one study available, researchers showed similar results for children. Portion size influenced food intake of 5 year old preschool children (Rolls, Engell and Birch 2000). These children ate more macaroni and cheese when served a larger portion. In fact, they ate the amount served to them—whether the amount was small, medium or large portions. With the availability of many foods in larger portions at home and in restaurants, it is not surprising that children are eating more food (Smiciklas-Wright et al. 2002).

***Do larger portions for children contribute to overeating every day and becoming overweight?***

In a cross-sectional analysis, McConahy et al. found that among preschool children in the US, the size of portions predicted average total energy intake for the day (McConahy et al. 2004). We

also know that heavier children with higher body mass index eat portions that are almost twice as large as those eaten by children with normal body weight at a given age (McConahy et al. 2002). As children learn to respond to environmental instead of internal cues for eating, large portion sizes may stimulate overeating and thus promote a gradual increase in body fat over time. Studies thus far have typically focused on a single meal or one day's total caloric intake.

### *Energy density as an indicator of diet quality*

An indicator of diet quality used to estimate healthier diets is energy density, defined as the amount of available energy per unit weight (Drewnowski 2003). Unlike portion size where the focus is quantity of food, with dietary energy density the issue is about quality of food. Foods such as lean meats, skim and lowfat milks, and fresh vegetables and fruit provide less energy per unit weight than do foods in these categories: fried foods such as fried chicken and French fries; snack foods such as potato and tortilla chips; sweets such as a candy bar, chocolates and cookies; and desserts such as cakes, pies and ice cream (Drewnowski et al. 1998). Whereas energy-dense foods tend to have few micronutrients, foods of low energy density tend to contain substantial vitamins and minerals in relation to their calorie content (Drewnowski 2007). Several studies have demonstrated that the energy density and nutrient density of diets in France (Andrieu, Darmon and Drewnowski 2006) and the United States (Townsend et al. 2009) are inversely linked.

In a recent Cooperative Extension study of a group of low-income women (n=112) in California, higher energy dense diets were associated with significantly lower intakes of dietary fiber, vitamin A, and vitamin C and with significantly higher intakes of total fat and saturated fat. These diets were less expensive than the lower energy dense diets of women in the study (Townsend et al. 2009).

### *Dietary energy density and caloric intakes*

Other researchers found that diets with higher energy density tend to be positively associated with total dietary energy intakes and with higher percent dietary energy from fat (Poppitt and Prentice 1996). High energy-dense diets are those higher in fried foods, snacks and desserts, whereas diets lower in energy density are higher in vegetables and fruit (Marti-Henneberg et al. 1999).

As a proposed mechanism, energy-dense diets have been reported to reduce satiety, and stimulate overeating and eventually weight gain. In experimental studies, energy-dense foods led to diminished satiation and satiety (Drewnowski 1998), so-called "passive overconsumption" of fats and sweets and higher energy intakes.

### *Current Study*

Our current report was part of a University of California Cooperative Extension study examining the relationship of past food insecurity and child feeding practices of low-income Latino and white mothers of children 4-5 years old (Kuyper 2005; Kuyper et al. 2006). In that study, mothers who had experienced past food insecurity as children described their desire to give their children foods they lacked in Mexico and larger portions of food (Kuyper et al. 2006).

The purpose of this current report is to compare these mothers' perceptions of appropriate serving sizes for young children with the American Academy of Pediatrics (AAP) recommendations. We calculated energy density as total calories per 100 grams of edible food product (Drewnowski 2003) and naturally nutrient rich scores for each of the 16 foods (Drewnowski 2005). We hypothesized that mothers' perceptions of appropriate portion sizes for young children of energy dense foods (ED > 2.0 kcal/g) and those with fewer micro nutrients (Naturally nutrient rich scores < 100.0) are larger than portion sizes recommended by the AAP. We hypothesized that portion sizes of foods with more micronutrients (Naturally nutrient rich scores > 100.0) would be smaller than recommended.

### **Methods**

#### *Interviews*

Interviews were conducted in five California counties [Amador, Calaveras, Tulare, San Joaquin, Solano] with Latino and white mothers (n = 87) recruited from low-income community sites. These sites included Special Supplemental Nutrition Program for Women, Infants and Children (WIC) clinics, Head Start programs and local health clinics. Demographic information was collected from each mother. The interviews were conducted in Spanish or English by 2 interviewers. The study was reviewed by the University of California, Davis, Institutional Review Board.

#### *Picture card sort*

During the interviews, the picture card sort method was used (Kuyper 2005). To assess Latino mothers' perceptions of appropriate serving sizes for young children, the researchers identified foods familiar to 4-5 year old children in the Latino community in California using previously collected 24-hour recalls, a household food pantry inventory, and a child food frequency questionnaire (Kaiser et al. 2004). The most commonly identified foods for children were selected. A graduate student and co-author (EMK) photographed different amounts of each of 16 food and beverage items in a standard size bowl or cup, capturing different portion sizes for each food. Except for the banana, all foods were photographed in at least four different quantities,

ranging from sizes smaller than those recommended by the Food Guide Pyramid for children aged 4-5, to quantities greater than the recommended serving sizes (U.S. Department of Agriculture). She also measured the weight and volume of each portion of each food. Portion sizes included sizes smaller and larger than that recommended by the Food Guide Pyramid for children aged 4-5 years (Kuyper 2005). The student converted the photographs, printed with the bowl at actual size, into a set of pictures to be sorted by the mothers during the interviews. An example of a photo food card series for canned fruit cocktail with 4 portion sizes is shown in Figure 1. When given the set of card sort photographs and the actual bowls and cups used in the photographs, each mother was asked to select the portion size that she considered most appropriate for a young child (4-5 years old). The mother was asked how much food should be considered to be the right amount for a 4-5 year old child. We made no attempt to determine if mothers' responses differed by the number of items served at the same time.

***Picture Card sort protocol.***

Interviewer: "I am going to show you pictures of different foods (show set of picture cards). The pictures show different quantities of each food."

Interviewer: "Does your child eat/drink \_\_\_\_\_? If you were feeding your child, how much \_\_\_\_\_ would you serve him or her (how much do you think the child should eat)?"

***Validity estimate.*** To validate this series of photographs for the picture card sort method, the mother's perception of appropriate portion size was compared with 24-hour recall data for her child with the mother using the same bowls and cups to calculate amounts for the 16 items. We found a marginally significant correlation ( $r=0.21$ ,  $p < 0.07$ ) between calories selected by the card sort method and energy intake of the children. Since most of the children were away from the parent and home during part of the day, the 24-hour recalls probably underestimated total energy intakes.

***Reliability estimate.*** Reliability of this method was also examined by repeating the procedure with the same mothers two weeks apart with a small sub-sample ( $n = 19$ ). The reliability coefficient was 0.59 for the fruit and vegetable items and 0.57 for the fast food items. Since interpretation of the reliability score depends on the range of ability of participants in the sample, sample size, and intended use, both coefficients were considered acceptable for this method given the small sample (Carmines and Zeller 1979).

***Food security.*** The Food Security of the household was assessed using the Spanish and English versions of the USDA 18-item Food Security Supplement (Bickel et al. 2000).

### *Comparison guidelines*

Guidelines from the American Academy of Pediatrics (AAP), referred to as the Feeding Guide for Children, were compared to the mothers' portion size selections (American Academy of Pediatrics 1999). These guidelines for the 4-6 year old age category include ½ to ¾ cup milk, ¼ cup cooked vegetables, a few pieces of raw vegetables, ½ cup fruit juice, ¼ cup canned fruit, ½ cup cooked cereal, 1 cup dry cereal, and 1- 2 ounces of meat. Four examples of the American Academy of Pediatrics recommended portion sizes for preschool children are shown in Figure 2. Because our study focused on younger children in this age range (4 to 5 year olds), we opted to compare the portion sizes selected by the mothers to the smaller portions when a range was provided.

### *Diet quality assessments using food energy density and naturally nutrient rich score*

Two measures of diet quality were assessed for each food. Energy density was calculated as the food energy in kcals per 100 grams of edible food product and as the naturally nutrient rich (NNR) score. The NNR is calculated using the average of 12 nutrients, expressed as % daily value, normalized by amount of food needed to supply 2000 kcal (Drewnowski 2005). The NNR is composed of two components: 1) the nine nutrients to encourage including vitamins A, C, and E, calcium, magnesium, iron, potassium, fiber and protein, 2) the three nutrients to limit including saturated fat, added sugar and sodium.

The University of California single check (√) is given to a food with an Energy Density score ≤ 2.0 kcal/gm or a NNR score ≥ 100/0. The University of California double check (√√) is given to a food meeting both criteria for diet quality: an Energy Density score ≤ 2.0 kcal/g and a NNR score ≥ 100/0.

## **Results**

All mothers in our sample identified their households as low-income [Table 1]. Their average age was 31 years, and the majority were originally from Mexico (74%). Although most families were food secure at the household level during the previous three months, 56% of the mothers reported having experienced some degree of food insufficiency with hunger during childhood (Kuyper et al. 2006).

Mothers reported larger than AAP recommended portions for 15 foods of the 16 popular children's foods in this study [Table 2]. The exception was the 1 cup dry cereal. The 16 foods included pizza, hamburger, macaroni with cheese, French fries, orange juice, banana, among others. Four visual examples of the mothers' perceptions of appropriate portion size for preschool children (4-5 years old) is shown in Figure 2. The caloric differences for portion sizes

include 150 additional calories for the larger portion of cheeseburger, 44 additional calories for the larger portion of chicken nuggets, and 276 additional calories for the larger portion of macaroni. Two of the foods (i.e., tortilla chips and cookie) were classified as “extras” and did not have an AAP recommendation. For our analysis, we considered zero as the desired intake for these “extras” for 4-5 year old children.

### ***Energy Density and NNR score***

The University of California single check ( $\surd$ ) was given to eight foods with Energy Density scores  $\leq 2.0$  kcal/g and to six foods with NNR scores  $\geq 100/0$ . The University of California double check ( $\surd\surd$ ) was given to four foods meeting both criteria for diet quality: an Energy Density score  $\leq 2.0$  kcal/g and a NNR score  $\geq 100/0$ . Those four foods were orange juice, carrots, cooked dry beans and low fat milk.

### **Discussion**

For the 87 low-income families in our study, mothers generally perceived large portion sizes to be appropriate for children ages 4 to 5 years. The portion sizes selected by the mothers for 15 of the 16 foods in this study were larger than those recommended by the AAP. The portions were overestimated for foods with high and low NNR scores. In other words, the mothers overestimated the recommended size for carrots just as they did for French fries and crackers. Also surprisingly, they overestimated for foods with high and low energy density scores. The mothers overestimated banana as well as chicken nuggets and pepperoni pizza.

Future research should investigate whether serving larger portions over time contributes to overweight in young children as well as what role is played by the energy density of the foods offered to children. For example, the child who consistently consumes an extra 100 calories a day by eating larger than recommended portions could easily gain unnecessary body fat that would accumulate year after year. As children grow, they begin to eat in response to external or environmental cues such as the presence of palatable food, the time of day and the social situation (Birch and Fisher 1995). Studies suggest that by the time children are older than 3 or 4 years, eating is no longer driven by hunger alone, but is influenced by many environmental factors (Birch et al. 1987). Increasing the portions served to 5 year olds increased the amount of food they chose to eat (Rolls, Engell and Birch 2000). This finding was not true for 3 year olds. Rolls and Birch speculate that during this preschool period, children's increased responsiveness to environmental cues in controlling food intake may be one factor contributing to the increase in the prevalence of child overweight (Rolls, Engell and Birch 2000).

Serving large portions to young children may be one aspect of an overall indulgent child feeding and parenting style. In a University of California Cooperative Extension study, researchers and

practitioners suggested that seasonal patterns of unemployment and food insecurity in Latino families may be associated with indulgent feeding practices during periods of full employment and increased income (Kaiser et al. 2002). Although most mothers at the time of this study appeared to be food secure, more than half reported having experienced hunger during childhood. Past experiences of food deprivation may also be associated with an indulgent or permissive feeding behaviors (Kuyper et al. 2006). A study in Mexico among middle-class families found that a permissive (i.e., less authoritarian) parenting style is associated with child overweight, especially in boys (Brewis 2003). A recent study in the U.S. among an ethnically diverse sample also reported that a permissive or indulgent parenting style doubles the risk of overweight in young children (Rhee et al. 2006).

A limitation of this study is that the AAP portion size recommendations are only available for a range of ages for children including children 4 to 6 years, but not specifically 4 to 5 years. We used the lower end of the recommended serving sizes for our target group 4-5 year old children. Additionally, some children accompanied their mothers to the interviews and we did not test the effect of the child's presence on his mother's responses. However, when parents were asked to sort the pictures, they did so very quickly minimizing potential effects of a child's presence. A limitation of the Card Sort method is that it does not differentiate between foods served alone and as part of a meal. Parents make that choice for themselves.

Our results highlight the need for further research exploring the potential effect of increased portion sizes and energy density on total energy intakes of children. Serving larger portions, particularly of high energy-dense foods, may promote the development of overweight among children. The AAP should widely publicize their recommendations; currently those recommendations are not easy to locate and identify. They are not available at no charge to parents on the AAP Web site. As a public service, the organization could distribute colorful portion size food posters to WIC locations and pediatrician offices throughout the country. Future studies should examine the influence of large portions being served by parents to children over longer periods of time to determine the possible effect of portion size on short- and long-term weight gain. In the interim, suggestions that Cooperative Extension professionals can recommend now to parents are offered in Table 3.

[Table 1. Demographic characteristics of study participants, low-income Latina mother-child pairs \(n = 87\)](#)

[Table 2. Comparison of 16 popular child food items: their corresponding energy density, Naturally Nutrient Rich score, American Academy of Pediatrics recommended portion sizes, mothers' perceived portion sizes for children 4-5 years and caloric differences.](#)

[Table 3. What can parents do now? Suggestions for Cooperative Extension professionals working with parents.](#)

[Figure 1. Using the picture card sort method, a food card photographic series of canned fruit cocktail with 4 portion sizes for estimation of mothers' perceptions of appropriate portion size for preschool children, age 4-5 years.](#)

[Figure 2. Four examples of American Academy of Pediatrics recommended serving sizes for preschool children and low-income mothers' perceptions of appropriate portion size for preschool children, age 4-5 years \(n = 87\).](#)

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