Serving portion size influences 5-year-old but not 3-year-old children's food intakes

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Americans have come to expect large portion sizes. This is evident from the number of "super-sized" and "value-sized" food items available in grocery stores and restaurants. Larger portion sizes could be contributing to the increasing prevalence of overweight among adults and children (1). An initial step in linking larger portion sizes to increased overweight would be to establish a relationship between portion size and food intake. To date, however, only a few empirical studies have systematically examined the influence of portion size on intake in adults (2-5) and to our knowledge there have been no studies in children.

During the early years of life, eating occurs primarily in response to hunger and satiety cues (6,7). By adulthood eating is also influenced by environmental cues such as presence of palatable food, time of day, and social context. As children develop and make the transition to an adult diet, they learn social and cultural conventions regarding food and eating, and are socialized to adopt adult eating behaviors and attitudes about food (8-12). Evidence suggests that by the time children are 3 or 4 years old, eating is no longer depletion driven but is influenced by a variety of environmental factors (13-15).

The prevalence of childhood overweight has increased dramatically in the past few years (16). These secular trends in overweight differ by age group: increases are relatively minimal for infants and toddlers but become more dramatic as children move through the preschool period. It is possible that during the preschool period children's increased responsiveness to the environmental cues controlling food intake may emerge as a factor that contributes to increased overweight. For children who have learned to be responsive to environmental cues, very large portion sizes may elicit overeating and, thus, promote weight gain. The purpose of this study is to examine the effects of portion size on children's food intake and to test the prediction that the effects of portion size on children's food intake will be greater for 5-year-old than for 3-year-old children.

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SUBJECTS AND METHODS

Subjects

Thirty-two preschool children, enrolled in 2 classrooms of a day-care program at the Pennsylvania State University Child Development Laboratory participated. In 1 class (8 boys and 8 girls) children had a mean age of 3.6 years (range=3.0 to 4.3 years); the other (6 boys and 10 girls) had a mean age of 5.0 years (range=4.3 to 6.1 years). Children were predominantly white (78% white, 6% Asian, 6% African-American, and 9% other). Parental consent was obtained before the children's participation in the study. All procedures were approved by the university's Human Subjects Review Board.

Procedure

Children participated in 3 sessions conducted at their usual lunchtime, in the usual lunch setting, on the same day of the week, once a week for 3 weeks. A lunch consisting of macaroni and cheese (Stouffer's, Solon, Ohio; 29 g carbohydrate, 16 g fat, and 13 g protein per 225 g serving, energy density=1.4 kcal/g) varying in portion size (small, medium, and large), carrot sticks (25 g), applesauce (118 g), and milk (328 g) was served to each child. Order of presentation of the different portions of macaroni and cheese was counterbalanced on the 3 test days within each class. Portions were selected that were larger than, smaller than, or about equal to the US Department of Agriculture recommended serving sizes (17). The 3-year-olds were offered portions of 150 g (⅔ c), 263 g (1⅙ c), and 376 g (1⅔ c), and the 5-year-olds received 225 g (1 c), 338 g (1½ c), and 450 g (2 c). All portions were presented in the same size bowl. All foods were weighed before and after lunch to determine the amount consumed. Before and after lunch, children's hunger was assessed using cartoon drawings of children with stomachs shaded to represent degree of fullness (empty, half full, and full). Children's liking of the macaroni and cheese was also assessed using cartoons with different facial expressions (18). Height (stadiometer, Shorr Productions, Olney, Md) and weight (electronic scale, Seca, Columbia, Md) were measured. Weight and height values were converted to percentiles using age-appropriate reference data (19).

Statistical Analysis

A χ^2 analysis was used to determine whether the ratings of hunger and liking differed by group or portion size. Results were considered significant at $P<.05$. Analysis of variance was used to assess the effects of age group and portion size on food intake. Because the interaction term was found to be significant, we examined differences between means within each group using a Bonferonni correction to maintain familywise α at 0.05 (17). Children's weight and height percentile, sex, and ratings for liking of macaroni were tested for covariance. All data were analyzed using SAS-PC for Windows (version 6.11, 1996, SAS Institute, Cary, NC).

RESULTS

Participant Characteristics

Children in the younger group were 98.5±1.4 cm tall and weighed 16.1±0.5 kg (mean±standard error). Children in the older group were 108.5±1.2 cm tall

and weighed 18.7±0.7 kg. Weight-for-height percentiles were similar between groups (67.1±3.4 and 60.8±3.8 for the younger and older children, respectively).

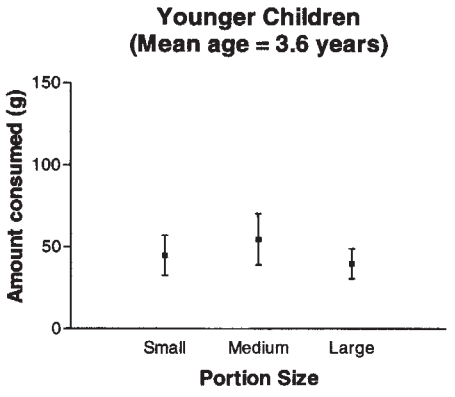
Hunger and Liking Ratings

Hunger ratings before the meal did not differ by age or condition. Liking ratings indicated that the children found the macaroni and cheese acceptable.

Food Intake

Older preschoolers consumed more macaroni and cheese when served the large portion (see the Figure) than when served the smaller portion ($P<.002$). In contrast, for younger children, portion size did not significantly affect food intake. Older children consumed 76.7±14.8 g, 100.7±18.7 g, and 122.7±21.6 g when served the small, medium, and large portions, respectively. Younger children consumed similar amounts across all 3 conditions (44.8±12.3 g, 54.6±15.8 g, and 39.6±9.2 g for the small, medium, and large portions, respectively).

Results were similar for total energy intake. The older children consumed a greater amount of energy when served the large portion ($P<.002$). Total energy intakes, including the macaroni and cheese, milk, applesauce, and carrot sticks, were 140±18.5 kcal, 155±22.3 kcal, and 146±18.2 kcal and 186±18.4 kcal, 227±28.8 kcal, and 258±35.4 kcal for the small, medium, and large portions for the younger and older children, respectively. Interestingly, the total weight of all foods consumed at lunch did not differ significantly across conditions (210±20.4 g, 219±22.0 g, 230±24.8 g, and 246±18.7 g, 289±27.9 g, 309±37.4 g for the small, medium, and large portions for the younger and older children, respectively). Sex of the child, liking rating, and weight and height percentile were not significant covariates.



Amount of macaroni and cheese consumed at lunch by portion size (g) for younger (n=16) and older (n=16) children. Means (±standard error) marked by different letters are significantly different at P<.002.

DISCUSSION

Our findings reveal that by the end of the preschool period, the amount of food offered influences children's food intake: 5-year-old children ate greater amounts when presented with larger portions. In contrast, food intakes of 3½-year-old children were not affected by portion size; their intake varied little across the portion size manipulation. This pattern of results is consistent with other findings indicating that as children develop, their food intake is increasingly affected by a variety of social, cultural, and environmental factors (8-14).

Several studies indicate that portion size can also affect the food intake of adults. In a study similar to that described here, Engell and colleagues (5) served adult participants 3 portions of macaroni and cheese on separate days. A significant linear relationship was found between portion size and intake, indicating that adults ate more macaroni and cheese when served larger portions. Previous research by Booth and colleagues (3) found similar results in that adults consumed more food when served portions 1½ times larger than a standard portion size. Further, larger portion sizes have been shown to increase intakes of both lean and obese adults (2).

Our results highlight the need to further explore the potential effect of increased portion sizes on food intakes, including the extent to which portion size may be implicated in the development of overweight. Future studies should examine the influence of large portion sizes on children's food intake over longer periods of time in order to determine the possible effect of portion size on long-term weight gain.

APPLICATIONS

- Environmental factors have an important role in shaping children's dietary intake in ways that can either promote or prevent the development of overweight. During the first 5 years of life, environmental factors become increasingly important determinants of intake; thus, these early years may provide a unique opportunity for interventions that reduce the risk of developing overweight.
- Anticipatory guidance designed to prevent the development of overweight in children should include clear information on appropriate portion sizes for children.
- Information on child feeding for parents and care providers should encourage child feeding practices that grant children a degree of autonomy in determining how much they eat, and discour-

age the use of practices that focus children on portion size as a determinant of intake, such as "cleaning up your plate."

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Overconcern about thinness in 10- to 14-year-old schoolgirls in Taiwan

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Eating disorders are common among young adult women in Western countries (1,2), but Eastern countries are also beginning to report eating disorders in their cultures (3,4). Research in Western society has indicated that eating disorders are especially prevalent during adolescence and early adulthood and that, most commonly, onset occurs around the age of 18 years (5). However, children as young as 9 years are concerned about and dissatisfied with their weight (6). Rosen and Gross (7) reported that by adolescence, 63% of girls, compared with 16% of boys, are trying to lose weight. Cooper and Goodyer (8) reported that more than 10% of 11-year-old girls and nearly 20% of 16-year-old girls are overly concerned about weight and body shape.

Most studies about weight concerns and perceptions have been conducted in Western countries. Relatively little is known about the occurrence and onset of eating disorders in Eastern countries. Wong and Huang (9) found a significant incongruity between perceived and actual body weight categories for female college students in Taiwan. Identification of behaviors that lead to the onset of eating disorders is critical to their prevention and early treatment.

Overestimation of body fatness and inappropriate body image (10), unrealistic weight goals (11), and misperception of body weight status (12) are major risk factors closely associated with onset of eating disorders. This study was designed to obtain data regarding desired body weight, satisfaction with body weight, self-perceived weight categories, and weight-loss practices of 10- to 14-year-old schoolgirls in Taiwan.

METHODS

Sample Selection

The study was conducted in a major city in Taiwan from January 1998 through December 1998. Eight hundred ninety 10- to 14-year-old girls attending elementary school were selected randomly. Subjects were selected by multiple-stage sampling in the order of schools, ages, and classes. The sample was a cross section of all public and private schools in this city. Name lists of children in selected classes were provided by schools. Informed consent was obtained from subjects and their parents. The study protocol was approved as ethical when reviewed by the Chungshan Medical and Dental College (Taichung City, Taiwan).

Instrument and Data Collection

A questionnaire contained items to collect data regarding body-weight perception, body-weight satisfaction, desired body weight, and intentional weight-loss experiences. Eight professionals in health-related fields evaluated the questionnaire for content, clarity, and construction of the questions. After the questionnaire was revised, 10 students from each age group participated in a pilot-test. After they completed the questionnaire, students were interviewed about clarity and relevance of each item. Minor revisions were made on the basis of comments and responses collected during the test.