Eating in the absence of hunger and overweight in girls from 5 to 7 y of age[1–3]

Jennifer Orlet Fisher and Leann L Birch

ABSTRACT

Background: Eating when exposed to large portions of palatable foods in the absence of hunger has been suggested to contribute to overweight.

Objective: This research evaluated whether young girls' eating in the absence of hunger was stable across a 2-y period in middle childhood, was associated with an increased risk of overweight, and could be predicted by parents' use of restriction in child feeding.

Design: The participants were 192 non-Hispanic white girls and their parents, assessed when the girls were 5 and 7 y of age. The girls' eating when exposed to palatable foods in the absence of hunger was measured after they consumed a standard lunch and indicated that they were no longer hungry.

Results: Eating in the absence of hunger showed moderate stability across the 2-y period for most of the girls. The girls who ate large amounts of snack foods in the absence of hunger at 5 and 7 y of age were 4.6 times as likely to be overweight at both ages. Parents' reports of restricting their daughter's access to foods at age 5 y predicted girls' eating in the absence of hunger at age 7 y, even when the girls' weight status and eating in the absence of hunger at age 5 y were controlled for.

Conclusions: This study provides the first evidence that young girls' eating in the absence of hunger may represent a stable phenotypic behavior of young overweight girls. In addition, these findings are consistent with previous work indicating that parents' restrictive feeding practices may contribute to this behavior. *Am J Clin Nutr* 2002;76:226–31.

KEY WORDS Overweight, restriction, child-feeding practices, eating behavior, hunger, girls

INTRODUCTION

In addressing the dramatic increases in child overweight noted over the past 2 decades (1–4), Hill and Peters (5) posit that "the culprit is an environment which promotes behaviors that cause obesity." In particular, exposure to large portion sizes of palatable energy-dense foods, particularly in the absence of hunger, is thought to contribute to overweight among children (5). A recent study by Rolls et al (6) illustrates that children become increasingly responsive to environmental cues, such as large portions of energy-dense foods, during the preschool years. They found that 2- to 3-y-old children ate roughly the same amount of a main course whether a regular or large portion was served, whereas 4- to 6-y-olds ate 60% more when the portion size was doubled. Although heightened responsiveness to environmental factors may constitute a normative aspect of development during early childhood, the extent to which children use such cues to initiate and terminate eating may indicate a behavioral susceptibility to obesity. It is unknown whether eating beyond fullness in response to the presence of palatable foods represents a phenotypic or characteristic behavior of overweight children.

Childhood is a focal period for understanding the causes of eating behaviors that may favor the development of overweight because environmental and social influences shape the acquisition of eating behaviors during this period (7). Individual differences in the behavioral controls of food intake are apparent during the preschool period, and they arise as genetic predispositions are modified via experience with food and eating. Preschool children vary in the extent to which they eat when exposed to palatable foods in the absence of hunger (8, 9). One study found a positive association between mothers' overeating in response to environmental cues (10) and their preschool-aged daughters' eating in the absence of hunger, suggesting a genetic or learned component to this behavior (8). Several other studies have found that parents' reports of restricting their child's access to foods increases intakes of those foods even in the absence of hunger (9, 11, 12). Taken together, these studies provide evidence that familial factors influence the extent to which environmental cues take precedence over children's own fullness.

The purpose of the present study was to evaluate whether young girls' eating in the absence of hunger showed evidence of tracking over a 2-y period, was associated with increased risk of

being overweight, and was associated with parents' reports of restriction in child feeding. Data are from an ongoing longitudinal project on the development of food-intake controls in young girls during middle childhood. We hypothesized that girls who ate relatively large amounts in the absence of hunger at 5 and 7 y of age would be heavier than girls who ate relatively small amounts at both ages.

SUBJECTS AND METHODS

General procedures

The girls visited the laboratory twice for 1-d "camp sessions," once during the summer before entry into kindergarten and again before entry into second grade, with ≈6 girls visiting the laboratory each day. Measurements of the girls' eating in the absence of hunger were part of a larger protocol involving interviews on a range of topics, including body esteem, parenting, physical activity, and peer relationships. Eating in the absence of hunger was measured after consumption of a standard lunch on the second visit. The girls' height and weight measurements were also obtained during their visits to the laboratory. The parents' height and weight measurements and their reports of restrictive child-feeding practices were obtained during a laboratory visit in which they completed a series of questionnaires on parenting, family life, and other psychosocial variables.

Participants

The participants were girls and their parents who were taking part in an ongoing longitudinal project on the development of food-intake controls during middle childhood. Eligibility criteria at the time of enrollment in the study specified that the girls were preschool eligible, lived with both biological parents, and did not have severe food allergies, chronic medical problems, or dietary restrictions affecting food intake. Families were recruited for participation through flyers and newspaper advertisements that described the study's focus as girls' nutrition, early experience, and development. Families with age-eligible female children within a 5-county radius also received mailings and follow-up phone calls. The study protocol was reviewed and approved by the Pennsylvania State University Institutional Review Board. Parents provided written consent for their own and their daughters' participation in the study.

At the time they were first measured, the girls (n = 196) were 5.4 ± 0.3 y of age ($\overline{x}$ ± SD). On average, the parents were in their mid-30s (mothers: 35.4 ± 4.8 y; fathers: 37.4 ± 5.4). Most fathers (97%) and almost two-thirds of mothers (63%) were employed, reporting an average of 45 h and 20 h/wk at work, respectively. Of the reported family incomes, 29% were <$35 000, 35% were $35 000–$50 000, and 36% were >$50 000. The parents were well-educated, with the mothers reporting 14.5 ± 2.3 y (range: 12–20 y) of education and the fathers reporting 14.7 ± 2.6 y (range: 12–20 y). Roughly one-half of the mothers (52%) and three-quarters of the fathers (76%) were overweight (as defined by body mass index [BMI; weight (kg)/height (m)^2] of >25 (13); mean BMI was 26.3 ± 5.5 for mothers and 28.1 ± 4.5 for fathers. Of the 196 families seen at the time of the first measurement, 2 fathers did not provide data. At the time of the second measurement, 5 families declined further participation and an additional 4 fathers declined participation, resulting in a sample of 191 girls (mean age: 7.3 ± 0.3 y), 191 mothers, and 186 fathers.

Measures

Parents' reports of restriction in child feeding

Parents' reports of restricting their daughters' access to foods were measured with the Restriction Subscale of the Child Feeding Questionnaire (14). This subscale contains 8 items measuring parents' attempts to control their daughters' eating by restricting access to foods, including the type and amount of food, and has response options of 1 (disagree) to 5 (agree). Item examples include "I have to be sure that my child does not eat too many high-fat foods" and "If I did not guide or regulate my child's eating, she would eat too many junk foods." Scores for the 8 items were averaged to create a total score for this scale. The internal consistency for the Child Feeding Questionnaire Restriction Subscale in this sample was 0.79 when the girls were age 5 y and and 0.84 when the girls were age 7 y. A parent score was created by taking the mean of the mothers' and fathers' scores, with possible mean item scores ranging from 1 to 5.

Girls' weight status

Height and weight measurements for determining BMI were obtained by a trained staff member following procedures described by Lohman et al (15). The girls were dressed in light clothing and were measured without shoes. Height was measured in triplicate to the nearest 0.1 cm with a stadiometer (Shorr Productions, Olney, MD). Weight was measured in triplicate to the nearest 0.1 kg with an electronic scale (Seca Corp, Birmingham, United Kingdom). Overweight among girls was scored as a dichotomous variable, with the 85th percentile for age- and sex-specific reference data as the cutoff point (16).

Girls' eating in the absence of hunger: free-access protocol

To minimize the influence of hunger on the girls' intake in the free-access session, each girl participated in a standard ad libitum lunch before the free-access session with 4–5 other girls of the same age. Each girl was provided with generous portions of bread (2 rolls, 56 g each), sandwich meat (4 slices at age 5 y and 6 slices at age 7 y, 28 g/slice), carrots (20 g), applesauce [120 mL (4 oz)], cheese (1 slice at age 5 y and 2 slices at age 7 y, 21 g/slice), cookies (2 medium, 16 g each), and milk [300 mL (10 oz)]. In addition, a subjective measure of hunger was obtained from each girl immediately after lunch, with the use of 3 figures depicting "hungry," "half-full," and "full." Girls who ate little before the free-access snack session or who indicated they were "hungry" or "half-full" after lunch were not included in the analyses.

Immediately after lunch, the girls were interviewed individually during the free-access session (8, 11). To determine the girls' preferences for the snack foods (data not shown), each girl was asked to rate small (2-bite) samples of 10 sweet and savory snack foods varying in fat, energy content, and sensory properties: popcorn (15 g), potato chips (58 g), pretzels (39 g), nuts (44 g), fig bars (51 g), chocolate chip cookies (66 g), fruit-chew candy (66 g), chocolate bars (66 g), ice cream (168 g), and frozen yogurt (168 g). Next, the girl was shown various toys and containers holding generous preweighed portions of the 10 snack foods. The girl was instructed that she could play with the toys or eat any of the foods while the experimenter did some work in the adjacent room. The experimenter then left the room for 10 min. When the experimenter returned, the girl was interviewed about whether her parents let her have the foods provided and how she felt about her eating (data not shown).

TABLE 1
Descriptive data for girls at ages 5 and 7 y[1]

	Age 5 y	Age 7 y[2]
Snack food intake (kJ)	522 ± 390 (0–1827)	709 ± 473 (0–2084)
n	165	181
BMI (kg/m²)	15.9 ± 1.5 (13.1–23.4)	16.6 ± 2.2 (12.5–24.3)
n	196	191
Parent restriction[3]	3.0 ± 0.6 (1.2–4.7)	2.8 ± 0.7 (1.0–4.6)
n	196	191

[1] $\bar{x}$ ± SD; range in parentheses. For snack food intake, n = 154 cases with complete data at ages 5 and 7 y.

[2] Significantly different from age 5 y, $P < 0.01$ (paired t test).

[3] Rated on a scale of 1–5, where 1 = disagree and 5 = agree.

To reduce measurement error in the girls' snack food intake in the absence of hunger, 31 of 196 cases were excluded at age 5 y and 10 of 191 cases at age 7 y for the following reasons: interviewer ratings indicated general behavioral difficulties throughout the interview day; interviewer ratings indicated that the girl did not seem comfortable or understand instructions during the 10-min period in which she was told she could play or eat; the girl ate less than a total of 1680 kJ (400 kcal) at breakfast, a midmorning snack, and the lunch preceding the snack food session.

Statistical analyses

Because we were primarily interested in distinguishing girls who ate little from girls who ate a lot in the absence of hunger, median splits were used to create low- (value = 0) and high-intake (value = 1) groups. This approach was chosen in favor of evaluating smaller differences in energy intake to take into account changes in the distribution of intakes across the 2-y period and the likely measurement error involved in assessing this behavioral construct 2 y apart in young girls seen in an artificial eating setting. Cohen's Kappa statistic was used to assess the stability or tracking of the girls' eating in the absence of hunger within individuals over both time points (17). Logistic regression was used to determine whether being overweight at both ages (value = 1) was predicted by having stable membership in either the low-intake (value = 0) or high-intake (value = 1) group. In addition, logistic regression with multiple predictors was used to determine the likelihood of having high intake in the absence of hunger at age 7 y (value = 1) on the basis of measures obtained when the girls were 5 y of age: parents' reports of restriction, girls' overweight, and girls' snack food intake in the absence of hunger (low or high group, where high = 1). SAS software (version 8.2; SAS Institute Inc, Cary, NC) was used for the statistical analyses.

RESULTS

Descriptive data for measurements obtained when the girls were 5 and 7 y of age

As shown in **Table 1**, parents' reports of using restrictive feeding practices were slightly lower when their daughters were 7 y of age than when their daughters were 5 y of age. The girls' mean BMI scores increased from age 5 to age 7 y. The girls' mean lunch intake before the free-access snack session and their snack food intakes during the free-access session increased from age 5 to age 7 y. Mean intake at the standard lunch before the free-

access snack session was 1558 kJ (372 kcal) and 1869 kJ (446 kcal) at ages 5 and 7 y, respectively, constituting ≈21% of the 4–6-y-old and 22% of the 7–10-y-old recommended dietary allowance for energy (18). The girls' snack food intake during the free-access session was 522 kJ (125 kcal) at age 5 y and 709 kJ (169 kcal) at age 7 y.

Categorizing snack food intake in the absence of hunger

Median splits were used to characterize the girls' snack food intake in the absence of hunger. The average snack food intakes for girls in the low-intake groups at ages 5 and 7 y were 206 ± 147 kJ (49 ± 35 kcal) and 319 ± 197 kJ (76 ± 47 kcal), respectively, corresponding to the consumption of 1–1.5 chocolate bar nuggets or fruit bars during the 10-min period and representing only 3–4% of the age- and sex-appropriate recommended dietary allowance for energy (18). Mean intakes for girls with high intakes in the absence of hunger at ages 5 and 7 y were 844 ± 281 kJ (201 ± 67 kcal) and 1100 ± 323 kJ (263 ± 77 kcal), respectively, corresponding to the consumption of 4–5 chocolate bar nuggets or fruit bars during the same period. Mean snack food intake in the high-intake group constituted ≈11 and 13%, respectively, of age- and sex-appropriate recommended dietary allowances for energy (18). When the girls' body weight was controlled for, mean intake at the standard lunch before the free-access snack session did not differ between girls with low snack food intakes and girls with high snack food intakes at age 5 y [1579 kJ (377 kcal) compared with 1663 kJ (397 kcal); $P = 0.21$] or age 7 y [1835 kJ (438 kcal) compared with 1945 kJ (464 kcal); $P = 0.15$].

Stability of eating in the absence of hunger from age 5 to age 7 y

As presented in **Table 2**, eating in the absence of hunger showed stability across time for the majority of girls ($\chi^2 = 16.3$, $P < 0.001$). Of girls who had low intakes in the absence of hunger at age 5 y, 64% also had low intakes at age 7 y. Similarly, 68% of girls who had relatively high snack food intakes in the absence of hunger at age 5 y also had high intakes at age 7 y. In other words, eating in the absence of hunger was a stable behavioral characteristic over the 2-y period for most girls.

Relation between eating in the absence of hunger and overweight

The percentages of girls who were overweight at ages 5 and 7 y were 23% and 25%, respectively, indicating that the prevalence of overweight in this sample was similar to current age- and sex-specific population estimates for overweight (3, 4, 19). Logistic regression was used to assess whether girls who ate high amounts of food in the absence of hunger at both ages were more

TABLE 2
Stability of girls' eating in the absence of hunger from age 5 to age 7 y[1]

	Age 7 y	
Age 5 y	Low intake	High intake
	%	
Low intake	64 [n = 50]	36 [n = 28]
High intake	32 [n = 24]	68 [n = 52]

[1] Data presented as percentage of girls in each category at age 5 y who fell in each category at age 7 y; n in brackets. Median splits were used to create low and high groups; eating in the absence of hunger was defined as having a high snack food intake after indicating a lack of hunger.

TABLE 3
Eating in the absence of hunger at ages 5 and 7 y as a predictor of girls' overweight[1]

Outcomes	Total sample size	Odds ratio (95% confidence limits)
Overweight at both ages ($n = 19$)[2]	102	4.6[3] (1.4, 15.2)
BMI above the median at both ages ($n = 44$)[4]	102	2.5[5] (1.1, 5.6)

[1] Eating in the absence of hunger was coded as a dichotomous variable, where high snack food intake at both ages = 1.

[2] BMI ≥ 85th percentile (16); coded as a dichotomous variable, where overweight at both ages = 1.

[3] $P < 0.01$.

[4] Girls' median BMI = 15.6 at age 5 y and 16.1 at age 7 y.

[5] $P < 0.05$.

likely to be overweight at both ages than were girls who ate little in the absence of hunger (**Table 3**). Girls in the high-intake group in the absence of hunger at ages 5 and 7 y were 4.6 times as likely to be overweight at both times as girls who ate little in the absence of hunger. Because relatively few girls were overweight at both ages ($n = 19$), we also evaluated the probability of being above the median BMI at both time points ($n = 44$) to increase the sample size in the target group. With this grouping, girls with high snack food intakes at both ages were ≈2.5 times as likely to have BMI values above the median at both time points as girls with low intakes.

Predicting eating in the absence of hunger at age 7 y on the basis of measured variables at age 5 y

Girls' overweight, eating in the absence of hunger, and parents' reports of restriction, each measured when the girls were 5 y of age, were used to predict eating in the absence of hunger at age 7 y. For each unit increase in the parents' reports of restriction in child feeding at age 5 y, the girls were 2.1 times as likely to eat in the absence of hunger at age 7 y after controlling for both the girls' BMI at age 5 y and their snack food intake in the absence of hunger at age 5 y (**Table 4**).

DISCUSSION

Because the dramatic increases in childhood overweight cannot be attributed to changes in the gene pool and hence genetic factors alone, there is a need to identify both contributing environmental factors and behavioral phenotypes for childhood overweight. The findings of the present research provide the first evidence that young girls' eating when exposed to large portions of palatable foods in the absence of hunger represents a stable behavioral risk factor for overweight. The parents' use of restrictive feeding practices when the girls were 5 y of age predicted eating in the absence of hunger at age 7 y, providing additional evidence for environmental effects on the developing controls of food intake in girls. In particular, these findings extend previous experimental and cross-sectional research that indicates that parents' use of restrictive feeding practices is not effective in limiting children's food intake and can actually promote children's consumption of the restricted foods, even in the absence of hunger.

Infants and children are responsive to the energy density of the foods they consume, illustrating the importance of internal hunger and fullness cues to self-regulate energy intake (20–24).

However, environmental factors play an increasingly important role in the development of eating behaviors throughout early childhood (7). For instance, preschool-aged children learned to initiate eating in a setting where they had become accustomed to eating, even in the absence of hunger (25). In another study, young children's ability to regulate energy intake was disrupted by focusing their attention on environmental cues, including the use of food rewards and drawing attention to the amount of food remaining on the plate (26). Similarly, a recent study by Rolls et al (6) found that although 2–3-y-old children's eating was not affected by increasing the portion size served at a meal, 4–5-y-olds increased their intake as portion size increased.

The findings of the present study are consistent with previous findings; the girls' mean snack food intakes at 5 [522 ± 390 kJ (125 ± 93 kcal)] and 7 [709 ± 473 kJ (169 ± 113 kcal)] y of age indicated that most girls ate something when presented with large portions of palatable foods, even though they had just indicated that they were not hungry. This research extends previous findings, however, by providing evidence that eating large amounts of food in the absence of hunger can be distinguished from a more normative tendency to show some responsiveness to environmental cues. In this study, girls who ate relatively large amounts of food in the absence of hunger at age 5 y were almost 4 times as likely to eat large amounts of food at age 7 y as girls who ate little in the absence of hunger at age 5 y. The girls who ate relatively large amounts of food in the absence of hunger at both ages were at increased risk of being overweight at both ages.

The fact that girls' eating in the absence of hunger was associated with overweight is noteworthy given that "supersize" food portions have become increasingly abundant in restaurants, supermarkets, and movie theaters. For instance, Young and Nestle (27) noted that movie sodas have increased from 360 mL (12 oz) to 600 mL (20 oz) in the past decade, and the largest adult size of soda has increased from 960 mL (32 oz) to 1320 mL (44 oz). The findings of the present study indicate, however, that "obesigenic" eating environments in which large portion sizes of energy-dense foods are present are necessary but not sufficient to promote overweight. Rather, the manner in which children initiate and terminate eating in such "obesigenic" environments may indicate a behavioral phenotype of girls who are highly susceptible to problems of energy balance.

From a developmental perspective, girls' eating in the absence of hunger may be problematic because it resembles disinhibited eat-

TABLE 4
Multiple logistic regression predicting girls' eating in the absence of hunger at age 7 y with the use of predictors measured at age 5 y[1]

Predictors at age 5 y	Odds ratio (95% confidence limits)
Girls' overweight[2]	2.5[3] (1.1, 6.1)
Girls' eating in the absence of hunger[4]	4.1[5] (2.0, 8.2)
Parental restriction[6]	2.1[3] (1.2, 3.8)

[1] Eating in the absence of hunger was coded as a dichotomous variable, where high snack food intake at age 7 y = 1; $n = 181$.

[2] BMI ≥ 85th percentile (16), coded as a dichotomous variable, where overweight = 1; $n = 154$.

[3] $P < 0.05$.

[4] Coded as a dichotomous variable with the use of median splits, where high snack food intake = 1; $n = 181$.

[5] $P < 0.01$.

[6] Continuous variable with possible mean item scores range from 1 to 5, where 1 = disagree and 5 = agree; $n = 181$.

ing patterns observed among adults (10). Disinhibited eating has been characterized as eating that occurs in response to factors other than hunger and satiety, such as the presence and smell of palatable foods or emotional states (eg, sadness or anxiety). This problematic eating behavior is associated with weight status and gain (28, 29), weight fluctuations (30), and binge eating in adults (31) and is thought to be produced, in part, by self-imposed rigid restrictions placed on eating (32, 33). In the present study, young girls' eating in the absence of hunger was associated with both overweight among the girls and parent-imposed restrictions on their eating.

The relation between parents' use of restriction and girls' eating in the absence of hunger extends experimental (12) and cross-sectional observational (11, 34) research indicating that restriction draws children's attention to restricted foods, increases selection and intake of restricted foods, and may even generate negative self-evaluation about eating restricted foods in young girls (9). In this sense, restrictive child-feeding practices may serve to establish young girls' responsiveness to external cues as controls of food intake, favoring the development of overweight (7, 35–37). It is likely, however, that the relation between parents' use of restriction and child weight status is bidirectional (34); parents may impose restriction in response to the child's eating behaviors or weight status, and restriction may, in turn, promote behaviors that contribute to overweight among children.

One recent study by Johnson (38) offers promising evidence that the extent to which children's eating is regulated by environmental factors, such as parents' restrictive feeding practices or the presence of palatable food, can be modified. In a pre-post test design of 25 preschool-aged children, Johnson found that children's ability to regulate energy intake was improved after 6 wk of training sessions in which children were focused on their own internal hunger and fullness cues during eating. Furthermore, although poor intake regulation was associated with their greater weight status and higher levels of problematic maternal eating behavior at the beginning of the study, these relations were not evident after the training-related improvements in children's intake regulation. Such work indicates that successful preventive and interventional efforts are contingent on identifying problematic eating behaviors of susceptible individuals and understanding the causes of those behaviors, particularly within the context of the family eating environment.

The findings of the present study provide evidence for environmental effects on child overweight, resulting from a heightened responsiveness to an "obesigenic" food environment in which a wide variety of energy-dense foods are readily available in large portions. In this study individual differences in young girls' eating in response to palatable foods in the absence of hunger were *1*) stable across time, *2*) associated with an increased risk of overweight, and *3*) predicted by parents' reports of restrictive feeding practices. This research also adds to a growing body of research indicating that restricting young children's access to food does not promote moderate intake of restricted foods. That overly restrictive feeding practices may not be effective, however, does not mean that structure in child feeding should be abandoned. Limit setting is an important part of child feeding and should be a focus of anticipatory guidance for parents. Alternatives to overly restrictive approaches, however, should be suggested. These include fostering dietary variety by offering children an array of healthy foods to reduce neophobia and promote acceptance, offering children portion sizes appropriate to their needs, and giving children structured choices regarding the types of foods consumed. Children should be encouraged to focus on their own hunger and fullness as a guide to when eating begins and ends.

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