Latina mothers' influences on child appetite regulation

Abstract

Parents influence child weight through interactions that shape the development of child eating behaviors. In this study we examined the association between maternal autonomy promoting serving practices and child appetite regulation. We predicted that maternal autonomy promoting serving practices would be positively associated with child appetite regulation. Participants were low-income Latino children—a group at high risk for the development of childhood obesity. A total of 186 low-income Latina mothers and their 4-5 year old children came to a laboratory on two separate days. On the first day, mothers and children chose foods for a meal from a buffet and were audio/videotaped so that maternal autonomy promoting serving practices could be later coded. On the second day, children completed the Eating in the Absence of Hunger (EAH) task to measure child appetite regulation. Mothers also completed the Child Eating Behavior Questionnaire (CEBQ) to measure other aspects of child appetite regulation (food responsiveness, satiety responsiveness, and emotional overeating). Maternal autonomy promotion during serving was assessed using seven separate measures of child and maternal behavior. Principal components analyses of these serving measures yielded three components: allows child choice, child serves food, and mother does not restrict. Consistent with hypotheses, maternal autonomy promoting serving practices (i.e., allows child choice and does not restrict) were negatively associated with maternal reports of child food responsiveness and emotional overeating (CEBQ). The results for the EAH task were more complex—mothers who were autonomy promoting in their serving practices had children who ate the most in the absence of hunger, but this linear effect was moderated somewhat by quadratic effect, with moderate levels of autonomy promotion during serving associated with the greatest child EAH.

- 1 **Keywords:** Eating in the Absence of Hunger, Children's Eating Behavior Questionnaire,
- 2 appetite regulation, Head Start, feeding behaviors, preschoolers

1 Introduction

2 Poor self-regulation of eating in children (i.e., an imbalance between energy intake and
3 expenditure) increases the risk of childhood obesity (Frankel et al., 2012). Child appetite self-
4 regulation refers to the child's ability to regulate hunger, satiation (i.e. processes and feelings
5 leading to the termination of eating), and satiety (i.e. processes and feelings that increase the time
6 between eating and decrease the amount subsequently consumed) (Blundell, 1991). While most
7 children appear to possess an inborn ability to self-regulate food intake in responses to the
8 energy content of foods consumed (Birch & Fisher, 1998), some children show poor patterns of
9 self-regulation.

10 Compensation trials have been used observationally to assess the extent to which children
11 compensate for energy consumed as first course preloads during a subsequent *ad libitum* meal
12 (Johnson & Birch, 1994). The Eating in the Absence of Hunger (EAH) task (Fisher & Birch,
13 1999) has also been used successfully to evaluate satiety where children's intake of palatable
14 foods is measured following a meal eaten to fullness. More recently, dimensions of child appetite
15 have been assessed by caregiver report using the Children's Eating Behavior Questionnaire
16 (Wardle, Guthrie, Sanderson, & Rapoport, 2001; CEBQ) which assesses eight aspects of young
17 children's appetite including food responsiveness, emotional overeating, and satiety
18 responsiveness. In general, poorer appetite regulation in children has been associated with higher
19 body weight. In several studies, children with higher levels of body fat showed poorer
20 compensation for energy consumed as a first course preload (a drink offered twenty minutes
21 before a meal) by failing to adjust their intake at the subsequent meal (e.g., Faith et al., 2012;
22 Johnson & Birch, 1994; Kral et al., 2012), although this sometimes varied as a function of child
23 sex. Moreover, in cross-sectional studies, compensation was usually poorer among older children
24 (Cecil et al., 2005; Johnson & Taylor-Holloway, 2006). Similarly, studies of children between

the ages of 3 and 18 show that heavier children consume greater amounts of energy in the absence of hunger (Butte et al., 2007; Fisher & Birch, 1999, 2002; Fisher et al., 2007; Francis & Birch, 2005; Hill et al., 2008; Moens & Braet, 2007; Shoemaker et al., 2010), although this has sometimes varied by child sex. As with the compensation task, older children ate more in the absence of hunger than younger children (Fisher & Birch, 2002; Francis & Birch, 2005; Fisher et al., 2007; Kral et al., 2012). Caregiver reports of child food responsiveness, emotional overeating, and enjoyment of food are positively associated with child BMI, whereas reports of satiety responsiveness are negatively associated with child BMI. Thus, children who showed poor regulation of appetite based on maternal reports are at greater risk of having a higher BMI and/or becoming overweight/obese (Carnell & Wardle, 2008; Dornoff, Miller, Kaciroti, & Lumeg, 2015; Frankel et al., 2014; Gardner, Sapienza, & Fisher, 2015; Gross, Fox, Rudser, Foy, & Kelly, 2016; Mallan, Liu, Mehta, Daniels, & Magarey, 2013; Santos et al., 2011; Sleddens, Kremers, & Thijs, 2008; Spence, Carson, Casey, & Boule, 2011; Viana, Sinde, & Saxton, 2008; Webber, Hill, Saxton, Van, & Wardle, 2009).

Many factors may influence child appetite regulation. One such factor is parent feeding. Johnson and Birch (1994), for example, observed that parents who reported greater use of control over feeding had children who were observed to have more imprecise caloric compensation. These findings suggested that parental control may diminish children's attendance to internal appetite cues and diminish children's self-regulation of appetite. These findings are consistent with self-determination theory, which proposes that child self-regulation is best encouraged when parents provide autonomy support which also supports a child's internal motivation (Grolnick & Ryan, 1989; Ryan & Deci, 2000). Highly controlling feeding practices may interfere with child self-regulation and lead to external motivation.

Research in the area, however, has shown that the relationship between child appetite regulation and feeding is complex. The most consistent findings come from studies of restriction and child appetite regulation: two involving the CEBQ (Gregory, Paxton, & Brozovic, 2010; Webber, Cooke, Hill, & Wardle, 2010), and two involving EAH (Fisher & Birch, 1999; Birch, Fisher, & Davison, 2003). These studies found that high maternal restriction was associated with poorer child appetite regulation. The other results depended upon how child appetite regulation was measured. The only study examining feeding practices and child responses in compensation trials (Johnson & Birch, 1994) found that highly controlling feeding (a combination of restriction and pressure to eat) was associated with poorer child appetite regulation. Studies using the CEBQ have found that both the highly controlling feeding practice of pressure to eat and the low-controlling, autonomy promoting practices of modeling and monitoring were positively associated with better child appetite regulation (Farrow, Galloway, & Fraser, 2009; Gregory et al., 2010; Haycraft & Blissett, 2012; Powell, Farrow, & Meyer, 2011; Webber et al., 2010). Finally, one study found that indulgent feeding style predicted poorer regulation (Frankel et al., 2014), whereas another reported a curvilinear relationship (Jansen, Mulken, & Jansen, 2007) such that moderate levels of parent restriction were associated with the lowest child EAH.

Most of the studies in the feeding literature have relied on maternal self-report questionnaires to assess feeding. Self-report measures have numerous limitations (Grotevant & Carlson, 1989; Holden & Edwards 1989; Kerig, & Lindahl, 2001) and these feeding questionnaires only examine a limited range of parent behaviors. It is important that multiple methods be used to assess various aspects of feeding before conclusions can be drawn about feeding and child appetite regulation.

Given the inconsistencies found in the literature on feeding and child appetite regulation, the present study was designed to further explore this question using observational methods. Given that previous research has targeted middle class European or European American families, we chose to focus on a Latino population in the U.S. because of their higher risk of childhood obesity (Ziol-Guest & Kalil, 2012). The present study examined autonomy promoting serving practices during observations of mothers' behavior at the beginning of a meal—when they served their child at a buffet. This was an excellent setting for observing maternal autonomy about what and how much to eat. Based upon the findings and hypotheses of Fisher and Birch (1999), Johnson and Birch (1994), and self-determination theory (Grolnick & Ryan, 1989; Ryan & Deci, 2000), we predicted that maternal autonomy promoting serving practices would be associated positively with child appetite regulation.

Methods

Participants

Participants were one hundred and eighty-six Latina mothers and their 4-5 year-old children recruited from Head Start centers in a large urban city in southeast United States. For mothers with more than one child in the 4-5 year age range, one child was randomly selected to participate in the project. Head Start is a preschool program that serves low-income families with the goal of increasing school readiness. The study was reviewed and approved by the Institutional Review Board at the Baylor College of Medicine. The purpose of the study was explained to parents in the language of their choice and written consent was obtained before participation. Child verbal assent was secured as well. Parents were told that the purpose of the research was to study the development of children's eating behaviors. Parents were aware that they were being videotaped and provided written consent for audio/videotaping.

1 *Procedures*

2 Mothers and their children were part of a larger study examining child self-regulation and
3 parental influences on child self-regulation. Each mother and her child came into the laboratory
4 on two separate days. On day one, the mother and child chose foods from a standard buffet meal
5 and were audio/videotaped so that maternal autonomy promoting serving practices could be
6 coded later. On day two, the child completed the EAH task. Mothers also completed the Child
7 Eating Behavior Questionnaire along with a number of other questionnaires. Mothers completed
8 the questionnaires in our laboratory with staff members available to assist should they have
9 problems with literacy; however, most mothers needed little assistance. Height and weight
10 measures were taken on the child. All observed tasks were conducted in either English or
11 Spanish, depending on preference (77% were conducted in Spanish) and audio/videotaped using
12 unobtrusive cameras placed in the laboratory rooms.

13 *Measures*

14 *Demographics.* Information gathered from the demographic questionnaire included the
15 mother's country of origin, age, education level, marital status and if the mothers were
16 employed. Also, the questionnaire asked about child age, sex, and if the child was born in the
17 United States.

18 *EAH.* The EAH task, developed by Fisher and Birch (1999), consisted of presenting the
19 child with palatable foods and toys. Before the task, staff members made sure that the child was
20 full by giving him/her a standard meal accounting for 40% of daily food requirements. The 40%
21 calculation was based on the Estimated Energy Requirements (EER) of 4 to 5 year old children
22 at a sedentary physical activity level (Dietary Reference Intakes: Essential Guide to Nutrient
23 Requirements, 2006). After the meal, the staff member showed the child pictures of three

1 stomachs (empty, half full, and full) and asked him/her which one best matched the child's own
2 stomach (to ensure that the child was full). After confirming fullness, the staff member provided
3 the child with a set of palatable foods: chips, fruit chew candy, pretzels, sherbet, ice-cream,
4 chocolate bars, and chocolate chip cookies. The foods were weighed before giving them to the
5 child, and the child was left by him/herself in the room for ten minutes. The child was told he/she
6 could play with the toys and eat as many of the snacks as he/she wanted. After ten minutes, the
7 staff member returned and removed the food. The food was later weighed. Using food intake
8 weights, in conjunction with manufacturer's information on the nutritional content of foods,
9 energy (kcal) eaten in the absence of hunger was calculated. Evidence of validity has been
10 provided through positive associations with child weight status in multiple studies (Butte et al.,
11 2007; Fisher & Birch, 1999, 2002; Fisher et al., 2007; Francis & Birch, 2005; Hill et al., 2008;
12 Moens & Braet, 2007; Shoemaker et al., 2010).

13 *Children's Eating Behavior Questionnaire (CEBQ)*. Three subscales of the CEBQ were
14 used to measure child appetite regulation (Wardle et al., 2001). Food responsiveness referred to
15 how responsive the child was to food and eating (e.g., "My child is always asking for food," "If
16 given the chance, my child would always have food in his/her mouth," "Given the choice, my
17 child would eat most of the time"). Satiety responsiveness referred to child responsiveness to
18 feelings of fullness (e.g., "My child gets full up easily," "My child leaves food on his/her plate at
19 the end of a meal," "My child gets full before his/her meal is finished"). Emotional overeating
20 referred to eating when experiencing negative emotions or boredom (e.g., "My child eats more
21 when anxious" "My child eats more when annoyed") (Wardle et al., 2001). Lower levels of
22 satiety responsiveness and higher levels of food responsiveness and emotional overeating have
23 been associated with child weight status (Carnell & Wardle, 2008; Dornoff et al., 2015; Frankel

et al., 2014; Gardner et al., 2015; Gross et al., 2016; Mallan et al., 2013; Santos et al., 2011; Sleddens et al., 2008; Spence et al., 2011; Viana et al., 2008; Webber et al., 2009). Responses were scored on a 1 to 5 scale (never to always). Factor structure, test-retest reliability, and internal consistency were described in a sample of predominately white families in the United Kingdom (Wardle et al., 2001). The CEBQ has been used successfully in multiple samples of ethnically diverse children (Dornoff et al., 2015; Frankel et al., 2014; Gardner et al., 2015; Gross et al., 2016; Mallan et al., 2013; Santos et al., 2011; Viana et al., 2008). Coefficient alphas were adequate in the current sample (0.68 for satiety responsiveness; 0.79 for food responsiveness; and 0.69 for emotional overeating). Higher scores on satiety responsiveness reflected higher child appetite regulation; higher scores on food responsiveness and emotional overeating reflected poorer child appetite regulation.

Buffet meal. The mother and her child participated in a buffet meal in a laboratory setting. Mothers were told to “help yourself and your child to the food from the cart” and told that they “can have whatever they’d like.” They were told to eat with their child “so he/she feels comfortable eating in the room and eat as you normally do at home.” The room was equipped with a dining table and chairs as well as a sofa, rug, small desk table and chair, and floor length drapes to replicate a home setting. The meal consisted of penne pasta noodles, tomato sauce, meat flavored sauce, rolls, salad, salad dressing, carrots, broccoli, corn, applesauce, peaches, butter, parmesan cheese, pudding cups, and cookies. Both milk and water were also provided. The meal consisted of 3,304 calories. Foods were provided in serving dishes nearby the table with dish lids and wrappers removed so that all foods were exposed and visible to the mother and child. Mothers were told that light and regular versions of some foods were available (e.g. salad dressings). The meal officially began when the staff member left the room or when the family

1 began to serve themselves—whichever came first. Families were given 40 minutes to complete
2 the meal. For those who did not complete the meal in 40 minutes, a five minute warning was
3 given. After the five minutes, the staff member removed the food from the room.

4 *Anthropometrics.* Child height and weight measurements were taken by trained staff
5 following procedures described by Lohman, Roche, and Martorell (1988). Children were dressed
6 in light clothing and asked to remove their shoes. Height and weight were measured in duplicate
7 to assure accuracy; the two scores were averaged. Scores were converted to age- and sex-
8 specific BMI z-scores using the revised 2000 growth charts from the Centers for Disease Control
9 and Prevention (Kuczmarski, Ogden, & Guo, 2002).

10 *Videotape coding*

11 An observational coding system was developed for the current study to measure maternal
12 autonomy promotion when serving the child at the buffet meal. As shown in Table 1, every time
13 the mother and/or child put a food on the plate (and also when the mother did not allow the child
14 to have a food), seven aspects of the interaction were coded: 1) whether the child decided if the
15 food went on the plate; 2) whether the food ended up on the on plate; 3) whether the child served
16 the food on the plate or table or the child served the food with the mother's help; 4) whether the
17 child decided how much was served; 5) whether the child held the plate or the child held plate
18 with mother's help; 6) whether the mother restricted the food from child (not restricting was
19 autonomy promoting); and 7) whether the mother served the food against the child's wishes or
20 tried to change the child's mind. The second column in Table 1 reflects the options coded for
21 each serving practice (e.g. Mom, child, both). Autonomy promotion usually was defined by the
22 'child' response (see column three in Table 1), but in two cases (who served the food and who
23 held the plate), 'child or both' designated autonomy promotion because the physical set up of the

1 buffet made it difficult for the children to perform these tasks by themselves. Two bilingual
2 undergraduate students coded 34 of the 186 videotapes independently for reliability purposes.
3 Percent agreement ranged from 63 percent to 100 percent with a mean of 83 percent. The values
4 used in the analyses were, for each of the measures, the proportion of coded interactions where
5 the autonomy supportive response was coded. For example, if 10 interactions were coded and in
6 six cases the child decided how much food would be served, the value for the measure “Who
7 determined how much food was served” would be 0.60.

8 *Statistical Analyses*

9 All statistics were run using the Statistical Package for the Social Sciences (SPSS,
10 Version 20.0, Chicago, IL). Statistical significance was set at p -value <0.05 . Descriptives were
11 run on all variables and examined to determine distributions. To reduce the number of observed
12 variables, a principal components analysis with varimax rotation was run on the seven maternal
13 autonomy promoting serving practices. Variables that loaded on each serving practice
14 component were standardized and averaged to create component scores. Bivariate correlations
15 were run on the variables in the study. Four linear regression analyses were run—one set for
16 each dependent variable (i.e., Food Responsiveness, Satiety Responsiveness, Emotional
17 Overeating, and EAH). The independent variables were the covariates of child sex and child age
18 in months; the three maternal autonomy promoting serving scores; and the autonomy promoting
19 serving scores squared (to assess whether quadratic effects were significant). Interactions with
20 child sex were examined as well (both for the linear and quadratic effects), but since only 1 of 24
21 was significant (the number that would be expected by chance alone), these analyses are not
22 presented below.

Power analyses. For factor analysis, it is recommended that the subject to item ratio should be at least 5:1 (Gorsuch, 1983) to 10:1 (Nunnally (1978). A sample size of 186 participants and 7 items exceeded the minimum 10:1 ratio. Given a sample size of 186, an alpha of 0.05, and 8 predictors in the multiple regression analysis (the regression analysis in this current study which required the largest sample size), Gpower showed there was adequate power (80%) to detect a small effect (Cohen's effect for the f statistic=0.08) (Faul, Erdfelder, Buchner, & Lang, 2009). The sample size of 186 also met several general rules of thumb for regression analysis (Green, 1991; VanVoorhis & Morgan, 2007). Therefore, there was adequate power to conduct the proposed analyses with the sample size of 186.

Results

Sample Characteristics

About an equal number of boys and girls participated. Most of the mothers were born outside of the United States, predominantly in Mexico. Sixty percent of the mothers were married and seventy-six percent did not work outside of the home. Sixty-five percent of the mothers had a high school education or less. Finally, ninety-six percent of the children were born in the United States and forty-seven percent were overweight or obese. Sample characteristics are presented in Table 2.

Descriptive Statistics

Descriptive statistics were examined for all of the variables to ensure that there was sufficient variability for the analyses. Ranges, means, and standard deviations for the observed maternal serving practices and child appetite regulation measures are shown in Table 3. Examination of the scree plot in the principal components analysis for observed maternal serving practices variables suggested there were three serving practice components which accounted for

72% of the variance: Child Serves, Does Not Restrict, and Allows Choice. Variable loadings for each component are given in Table 4. Variables that are bolded in the table were standardized and then averaged together to create the three component scores. For example, the “Child Serves” score was calculated by standardizing and averaging together the scores for “Who served the food?”, “Who determined how much food was served?”, and “Who held the plate?”

Correlations among Autonomy Promoting Serving Practices, Child Appetite Regulation, and Child Age, Sex, and BMI

As shown in Table 5, mothers were more likely to allow choice with girls compared to boys and more likely to restrict their boys. Mothers reported that boys had higher food responsiveness and emotional overeating than girls, although boys and girls did not differ on child BMI z. Mothers of older children were more likely to let the child serve themselves. Older children ate more in the absence of hunger. Child BMI z had several correlates as well. Mothers with children at a higher weight status showed lower restriction during serving (i.e. allowing children to have a particular food). Children at a higher weight status were observed to consume greater energy in the absence of hunger, and were reported by their caregivers to have greater food responsiveness and less satiety responsiveness.

Examining the correlations within domains showed that maternal reports of food responsiveness were correlated with maternal reports of satiety responsiveness (negative) and emotional overeating (positive). EAH was not correlated with any of the maternal report measures of child appetite regulation. In examining maternal autonomy promoting serving practices, mothers who allowed their children choices were less likely to restrict children’s choices, thus allowing food to end up on the plate. Mothers who gave their children choices (Allows Choice) reported that their children showed low levels of emotional eating. Further,

those who were observed to show lower levels of restriction (i.e., Does Not Restrict) reported that they had children who showed low levels of food responsiveness and low levels of emotional overeating.

Multiple Regressions Predicting Child Appetite Regulation

Of the four regressions run to predict child appetite regulation from maternal autonomy promoting serving practices, three showed significant effects—all except for satiety responsiveness, $F(8, 176) = .961, ns$. The results of the significant regressions are presented in Table 6. Because EAH showed a significant quadratic effect, both the linear and quadratic predictors are presented in Table 6. For the two regressions not showing significant quadratic effects, the equations with only the linear predictors are presented in the table. As shown in Table 6, boys showed poorer appetite regulation than girls as indicated by higher levels of maternal reports of food responsiveness and emotional overeating, and greater EAH. Older children were also observed to consume greater amounts of energy in the absence of hunger. For the two significant CEBQ scales (food responsiveness and emotional overeating), mothers who did not restrict their children reported that their children had better self-regulation. As shown in Figure 1, children whose mothers were high on allowing the child to serve were most likely to eat in the absence of hunger, but this was qualified somewhat by a significant quadratic effect, with moderate values associated with the most kilocalories consumed.

Discussion

The purpose of the present study was to examine the relationships between low-income Latina's mothers' autonomy promoting serving practices and child appetite regulation. The serving situation was chosen because it was an excellent context in which to observe maternal autonomy promotion or a lack thereof (e.g., giving the child choices about what foods to eat,

controlling quantities, restricting food choices). Three aspects of maternal autonomy granting were studied: allowing the child choice, allowing the child to serve, and a lack of restriction. The degree to which the findings were consistent with our hypotheses (i.e., that maternal autonomy promoting serving practices would be positively associated with child appetite regulation) varied as a function of the way child appetite regulation was measured. The findings based on maternal reports (using the CEBQ) were consistent with the hypotheses. Although maternal reports of satiety responsiveness was not associated with maternal promoting serving practices, mothers who allowed their children choices (simple correlations) and did not restrict their children's eating (correlations and regressions) reported that they had children who were least likely to be food responsive and/or to emotionally overeat. This is consistent with other studies showing that restriction is positively correlated with maternal reports of food responsiveness (Gregory et al., 2010; Webber et al., 2010) and emotional overeating (Haycraft and Blissett, 2012). Therefore, by using autonomy promoting serving practices, these mothers may have been encouraging appetite regulation in their children. Alternatively, children who were more food responsive and tended to overeat may have required greater maternal restriction. Longitudinal research is needed to evaluate the directionality of such effects.

In contrast to the maternal report data, the results for EAH were in the opposite direction of what was predicted: mothers who were autonomy promoting in their serving practices had children who ate the most in the absence of hunger. This effect, however, was qualified somewhat by a quadratic effect, with moderate levels of autonomy promotion associated with the highest levels of EAH. Self-determination theory (Grolnick & Ryan, 1989; Ryan & Deci, 2000) posits that external pressure will lead to extrinsic motivation and poor self-regulation. The finding that low autonomy promoting mothers having children with better appetite regulation

1 was unexpected. It could be, however, that allowing children to serve themselves at a buffet
2 with several high calorie snacks (i.e., cookies and pudding cups) may have been an indicator of
3 indulgent feeding which may encourage child overeating in other settings (see Fisher, Birch,
4 Zhang, Grusak, & Hughes, 2013).

5 Besides identifying some maternal correlates of child appetite regulation, the present
6 study identified a number of sex differences. Specifically, mothers of girls gave their girls more
7 choices and were less likely to use restriction than mothers of boys. This is consistent with the
8 findings of Moens, Braet, and Soetens (2007) who found in an observational study of older
9 children that parents of boys exercised more control over their boys at mealtime than parents of
10 girls. Regarding child behavior, boys ate more in the absence of hunger, and mothers reported
11 that boys showed greater food responsiveness and emotional overeating. These findings are
12 consistent with a number of studies showing sex differences in child eating behavior: Sleddens
13 and colleagues (2008) found that boys showed higher levels of emotional eating than girls, and
14 three studies reported greater EAH in boys than girls (Fisher et al., 2007; Hill et al., 2008; Remy,
15 Issanchou, Chabanet, Boggio, & Nicklaus, 2015) found that boys ate more in the absence of
16 hunger. Several interpretations of the sex differences found are possible. Girls, for example, may
17 have developed better eating self-regulation as a result of their mothers' autonomy promoting
18 serving practices. Alternatively, mothers of boys may have been forced to use more controlling
19 behavior toward their children (i.e., fewer choices and more restriction) in response to their boys'
20 poor self-regulation.

21 As found in previous studies (Carnell & Wardle, 2007; Leung et al., 2014), it appears that
22 maternal reports of child appetite regulation and EAH may measure relatively independent
23 aspects of appetite regulation. In the present study, although both maternal reports of the self-

1 regulation of eating and EAH were associated with child obesity and EAH was positively
2 correlated with child age, none of the correlations between the maternal reports and the EAH
3 were significant. However, the correlation between scores on the EAH task and maternal report
4 of emotional overeating in the current study was $r = .13$, $p < .08$, similar in size to the significant
5 correlation found by Leung and colleagues (2014) in their larger sample, $r = .15$.

6 The results of this study should be considered in light of its limitations. First, the
7 correlational, cross-sectional design makes it impossible to determine the direction of effects. For
8 example, alternative explanations may explain some of our results—mothers of children with
9 high food responsiveness and/or emotional eating may have been more restrictive and given their
10 child fewer choices because these mothers were worried that their child would put too many
11 unhealthy foods on the plate. Future longitudinal and experimental studies should more directly
12 examine the direction of effects. Second, we only examined maternal autonomy promoting
13 practices during serving. Although an excellent setting to observe autonomy promotion, it is
14 possible that different associations would be found if other maternal behaviors during the meal
15 had been observed. Third, mothers were observed during only one meal—observing interactions
16 at home over several days may have provided different results. Finally, the sample consisted of
17 low-income Latina mothers and their children—the results could differ for middle income
18 families or families of other ethnicities.

19 Despite these limitations, this study has several strengths compared to previous research
20 in this area—a large sample was employed, observational methods were used to assess maternal
21 autonomy promotion, and mixed methods (parent-report and observation) were used to assess
22 child appetite regulation. Finally, an understudied population was studied—one at a high risk for
23 childhood obesity.

1 The results of this study establish associations of maternal autonomy promoting serving
2 practices and child appetite regulation. Although most of the findings were consistent with our
3 hypotheses (i.e., that maternal autonomy promotion would be associated with child appetite
4 regulation), the results for the EAH task were the opposite of what was expected. This makes it
5 difficult to make recommendations for parent education or intervention at this point. Given the
6 non-significant relationships between EAH and the maternal report measures of child appetite
7 regulation, additional research on these assessments need to be conducted to better understand
8 what these individual differences represent. Furthermore, longitudinal studies with more detailed
9 assessments of both maternal behavior and child eating need to be conducted to further
10 understand child eating patterns that contribute to the development of childhood obesity. Results
11 of such studies would contribute greatly to the development of intervention and prevention
12 programs to address the problem of childhood obesity.

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Table 1. **Description of codes used to assess maternal autonomy promoting serving practices**

Variable	Coding Option	Autonomy Response
Who decided which food goes on the plate?	Mom, Child, Both	Child
Did the food end up on the plate?	Yes, No	n/a
Who served the food?	Mom, Child, Both	Child or Both ^a
Who determined how much food was served?	Mom, Child, Both	Child
Who held the plate?	Mom, Child, Both	Child or Both ^a
Did the mother restrict the child?	Yes, No	No
Was the food served against child's wishes and/or did the mother try to change the child's mind?	Yes, No	No

^a”Child” or “both” responses were coded as autonomy promoting for these questions because the physical set up of the buffet made it difficult for children to perform these tasks by themselves.

1 Table 2. **Characteristics of the sample (n = 186)**

Parent sex- female	100.0%
Child sex - female	47.6%
Parent age, mean in years (SD)	31.48 ^a (6.49) ^b
Child age, mean in years (SD)	4.34 ^a (0.48) ^b
Education of parent	
High school diploma or less	64.7%
Some college or more	35.3%
Employment status, currently employed	23.5%
Marital status	
Married	60.0%
Never Married	14.5%
Widowed, separated, divorced	25.5%
Parent immigrant status	
Born in the U.S.	21.4%
Born in Mexico	60.4%
Born in Central America	16.6%
Born in another country	1.6%
Child immigrant status	
Born in the U.S.	96%
Child BMI categories	
Normal (<85 th percentile)	52.9%
Overweight (85 th to <95 th percentile)	20.9%
Obese (≥95 th percentile)	26.2%

2 ^aMean; ^bStandard Deviation

1 Table 3. **Descriptive statistics on maternal autonomy promoting serving practices and self-**
2 **regulation measures**

Maternal Autonomy Promoting Serving Practices (Proportion of Interactions that Were Autonomy Promoting)	Range	Mean	SD
Who decided which food goes on the plate?	0-1	0.58	0.23
Did the food end up on plate or table?	0.33-1.00	0.86	0.12
Who served the food?	0-1	0.16	0.22
Who determined how much food was served?	0-1	0.13	0.20
Who held the plate?	0-1	0.12	0.26
Did the mother Not restrict the child?	0.08-1.00	0.85	0.16
Was the food Not served against child's wishes and/or did the mother try to change the child's mind?	.33-1.00	0.92	0.13
Self-Regulation Measures			
Eating in the Absence of Hunger (kilocalories consumed)	0-445	117.51	97.79
Food Responsiveness (CEBQ) (5 point scale)	1-5	2.21	0.85
Satiety Responsiveness (CEBQ) (5 point scale)	1-5	2.84	0.65
Emotional Overeating (CEBQ) (5 point scale)	1-4	1.68	0.63

3
4 Note: SD = Standard Deviation; CEBQ = Child Eating Behavior Questionnaire

1 Table 4. Components and variable loadings from a principal components analysis of the
2 seven observational measures of maternal autonomy promotion during serving
3

Maternal Autonomy Promoting Serving Practices (proportions of interactions)	Child Serves	Does Not Restrict	Allows Choice
Who decided which food goes on the plate?	.23	.27	.76
Did the food end up on plate or table?	.02	.91	.05
Who served the food?	.75	-.03	.15
Who determined how much food was served?	.81	.13	.04
Who held the plate?	.79	-.05	-.09
Did the mother NOT restrict the child?	.01	.91	.06
Was the food NOT served against child's wishes and/or did the mother NOT try to change the child's mind?	-.10	-.09	.88

4

1 Table 5. Correlations among maternal autonomy promoting serving practices, child appetite regulation, and child sex, age, and
2 weight status (n = 186)

	Female	Child Age in Months	Child BMI z	Allows Choice	Child Serve	Does Not Restrict	EAH kcal	Food Respon- siveness	Satiety Respon- siveness
Child Age in Months	.05								
Child BMI z	-.04	.08							
Allows Choice	.20**	.03	.08						
Child Serves	.04	.15*	.02	.10					
Does Not Restrict	.16*	-.10	.14*	.16*	.07				
EAH kcal	-.12	.34**	.21**	.01	.07	-.04			
Food Respon- siveness	-.23**	.01	.15*	-.12	-.08	-.22**	.07		
Satiety Respon- siveness	.03	.06	-.24**	-.07	.13	.08	.02	-.29**	
Emotional Overeating	-.23**	.06	.03	-.16*	.08	-.24**	.13	.58**	.00

3 EAH = Eating in Absence of Hunger
4 * Correlations significant at the 0.05 level (2-tailed)
5 ** Correlations significant at the 0.01 level (2-tailed)

1 Table 6. Significant linear regressions predicting appetite regulation from child covariates and observed maternal autonomy
 2 promoting serving practices

	CEBQ Food Responsiveness (5 point scale)			CEBQ Emotional Overeating (5 point scale)			EAH (Kcals consumed)		
R ²	0.10			0.12			0.17		
F(Model)	F(5,179) = 3.81**			F(5,179) = 4.81**			F(8,177) = 4.54**		
Independent Variables	B	SE	Beta	B	SE	Beta	B	SE	Beta
Female (covariate)	-0.32*	0.12	-0.19*	-0.23*	0.09	-0.18*	-33.32*	14.00	-0.17*
Child age in months (covariate)	0.00	0.01	0.02	0.00	0.01	0.04	6.32**	1.32	0.34**
Child Serves	-0.06	0.08	-0.05	0.09	0.06	0.11	30.25*	14.28	0.25*
Does Not Restrict	-0.16*	0.07	-0.17*	-0.13**	0.05	-0.19**	2.90	9.31	0.03
Allows Choice	-0.06	0.08	-0.06	-0.08	0.06	-0.11	1.94	9.66	0.02
Child Serves ²	-- ^a				-- ^a		-16.49*	6.84	-0.28*
Does Not Restrict ²	-- ^a				-- ^a		0.00	6.81	0.00
Allows Choice ²	-- ^a				-- ^a		-2.24	6.33	-0.03

3 EAH = Eating in Absence of Hunger

4 * Significant at the 0.05 level; ** Significant at the 0.01 level; ns = non-significant

5 ^aNote: Regression weights and standard errors are not presented for the quadratic terms for the analyses of food responsiveness or
 6 emotional overeating because none of these quadratic terms were significant. Therefore, these terms were dropped from the equations
 7 and the regressions rerun with only the linear predictors (the most parsimonious solutions).

Figure 1. Total kilocalories consumed during the EAH task as a function of percentile on the “child serves” scores^a

^aChild Serves Score is the sum of the standardized proportions that each of the following codes occurred: Who served the food? Who determined how much food was served? Who held the plate?