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Pressuring and restrictive feeding styles influence infant feeding and size among a low-income African-American sample

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Abstract

The prevalence of overweight among infants and toddlers has increased dramatically in the past three decades, highlighting the importance of identifying factors contributing to early excess weight gain, particularly in high-risk groups. Parental feeding styles, the attitudes and behaviors that characterize parental approaches to maintaining or modifying children's eating behavior, are an important behavioral component shaping early obesity risk. Using longitudinal data from the Infant Care and Risk of Obesity Study, a cohort study of 217 African-American mother-infant pairs with feeding styles, dietary recalls and anthropometry collected from 3-18 months of infant age, we examined the relationship between feeding styles, infant diet and weight–for-age and sum of skinfolds. Longitudinal mixed models indicated that higher pressuring and indulgent feeding style scores were positively associated with greater infant energy intake, reduced odds of breastfeeding and higher levels of age-inappropriate feeding of liquids and solids while restrictive feeding styles were associated with lower energy intake, higher odds of breastfeeding and reduced odds of inappropriate feeding. Pressuring and restriction were also oppositely related to infant size with pressuring associated with lower infant weight-for-age and restriction with higher weight-for-age and sum of skinfolds. Infant size also predicted maternal feeding styles in subsequent visits indicating that the relationship between size and feeding styles is likely bidirectional. Our results suggest that the degree to which parents are pressuring or restrictive during feeding shapes the early feeding environment and, consequently, may be an important environmental factor in the development of obesity.

Introduction

A growing literature highlights the role of parental feeding styles, the attitudes that characterize parental approaches to maintaining or modifying children's eating behavior and

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the quality of interaction during feeding [1, 2], and feeding practices, the strategies parents use to direct child eating, in the development of child overweight and obesity [2, 3]. Based on typologies of general parenting styles [4] and defined by the degree of parental demandingness and responsiveness shown during feeding [1], feeding styles shape the early feeding environment since young children depend both on parents' and caregivers' choices of the types and amounts of foods offered and also on their responses to child hunger and satiety cues [5, 6]. Controlling (pressuring or restrictive) feeding practices may contribute to the development of overweight by disrupting the development of children's self-regulation of food choice and energy intake [2] and encouraging overeating or eating in the absence of hunger when the restriction is removed [7]. Recently there has been some disagreement about the role of controlling practices in the development of overweight [8, 9], with some studies finding either no association [9, 10] or a protective relationship between restriction and overweight [11, 12]. The majority of this research however has relied on cross-sectional or infrequent longitudinal assessment and has not been able to assess whether restriction is a cause of or response to child size [3, 13, 14].

Although much of the literature has focused on the use of controlling feeding practices, research among ethnically diverse samples has increasingly identified the importance of feeding styles in shaping child dietary composition, energy intake and overweight [1, 15]. Hughes and colleagues [1] , for example, found that African-American and Hispanic children whose parents had an indulgent feeding style, characterized by low levels of parental control and high parental responsiveness, tended to have higher BMI z-scores than those whose parents had an authoritarian feeding style (characterized by high levels of parental control and low responsiveness to child preferences). An authoritative feeding style, characterized by high parental demandingness and high responsiveness, has also been linked to greater fruit and vegetable intake among African-American and Hispanic preschoolers [15]. Conversely, uninvolved or indulgent feeding styles have been linked to reduced intake of fruit, vegetables, 100% fruit juice and dairy foods among ethnically-diverse Head Start participants [16]. This research underscores the need to examine the role of feeding styles in shaping more proximal outcomes such as dietary composition and intake and the development of overweight.

Current research has primarily focused on preschool or school-aged children. However, caregiver feeding styles and associated feeding practices are likely to affect energy intake and child weight prior to the preschool years [17-19]. Breastfeeding in the first year of life shapes subsequent maternal control over feeding [18] and controlling feeding practices established by the end of the first year of life appear to persist into toddlerhood [11]. Less is known about how parental feeding styles during infancy may influence overfeeding or entrain infant eating behavior, especially among populations at high risk for obesity. Prospective, longitudinal data are needed to establish the causal role of parental feeding styles on the development of obesity from infancy.

In this paper, we examine the effects of feeding styles on diet and infant weight and adiposity longitudinally from 3 to 18 months of age in a sample of first-time, low-income African American mothers and their infants using the Infant Feeding Style Questionnaire, a validated scale assessing caregiver feeding behaviors and beliefs [19]. Feeding styles have been variously described as the emotional context within which specific types of feeding interactions take place [20, 21] and more broadly as parental attitudes regarding feeding and styles of interacting with children around food [3] and feeding practices as the particular behaviors parents use to achieve their feeding goals [5]. However, there is considerable overlap in the use of terms in the literature and, as Blissett [20] describes in her review of these terms, it is often particularly unclear what separates a feeding practice from a feeding style. Based on theoretical work on feeding domain-specific parenting styles [22], we define feeding styles as *both* parents' general philosophy about feeding and interactions with their children around feeding *and* the associated practices they use to direct their children's eating behavior. We assessed four potential pathways (Figure 1) linking feeding styles to infant size, testing: 1) the direct effect of feeding styles on infant weight and adiposity; 2) the direct effect of feeding styles on infant diet (energy intake, breastfeeding and age-inappropriate feeding of solids and liquids); 3) the indirect effect of feeding styles on size through their influence on infant diet; and, since the association between feeding styles and infant size is likely reciprocal, 4) the effect of infant size on maternal feeding styles.

Methods

Sample

The study sample includes first-time African-American mothers participating in the Infant Care, Feeding and Risk of Obesity Study, an observational cohort study of characteristics associated with the risk of developing obesity within the first two years of life [19, 23, 24]. Mothers were aged 18-35 years and recruited from WIC clinics in central North Carolina. Mother-infant pairs were excluded if the infant was born before 35 weeks gestation or had an illness or condition that might affect appetite, feeding or growth, such as Down syndrome, epilepsy, cleft lip or palate, cerebral palsy, failure to thrive, mental retardation or severe food allergies.

Mothers and infants were followed with in-home visits when infants were 3, 6, 9, 12 and 18 months of age. Two hundred and seventeen pairs participated at the 3-month baseline visit. At each home visit, interviewer-administered questionnaires, dietary recalls and anthropometry were collected. Mothers were asked to report infant birthweight, infant diet (e.g. breastfeeding), child care patterns (e.g. use of daycare), and socio-demographic characteristics. The protocol was approved by the School of Public Health Institutional Review Board at the University of North Carolina at Chapel Hill.

Feeding styles

The Infant Feeding Style Questionnaire (IFSQ) [19]was used to assess maternal feeding style at the 3, 6, 9, 12, and 18 month visits. The IFSQ is a validated instrument that includes 39 items addressing maternal beliefs regarding infant feeding, 24 items measuring feeding behaviors for all infants and an additional 20 questions regarding solid feeding behaviors for infants above the age of 6 months. Our previous work [19] emphasized the importance of measuring each of the traditionally assessed feeding styles- 1) *laissez-faire* (LF), in which the parent does not limit infant diet quality or quantity and shows little interaction with the infant during feeding; 2) *pressuring/controlling* (PR), in which the parent is concerned with increasing the amount of food the infant consumes, adds cereal to the infant's bottle to increase intake or promote sleeping through the night, and uses food to soothe the infant; 3) *restrictive/controlling* (RS), in which the parent in which the parent is concerned with decreasing the amount of food the infant consumes, limits the infant to healthful foods, and limits the quantity of food consumed; 4) *responsive* (RP), in which the parent provides structure while remaining attentive to child hunger and satiety cues and monitors the quality of the child's diet and 5) *indulgent* (IN), in which the parent does not set limits on the quantity or quality of food consumed- through smaller sub-constructs representing substantive domains (e.g. restrictive with respect to amounts vs. quality of the diet). Consequently, we measure the effects of these five styles through 13 sub-constructs validated through confirmatory factor analysis in our previous work. These sub-constructs and example items are presented in Table 1.

Scores were created for each of these 13 sub-constructs by calculating the mean score for the items loading on that factor following our validated protocol [19]. Behaviors were scored from 1 to 5 representing response options 'never', 'seldom', 'half of the time', 'most of the time', and 'always'. Belief items were scored from 1 to 5, representing 'disagree', 'slightly disagree', 'neutral', 'slightly agree', and 'agree'. Construct scores were considered missing when an item response was missing on sub-constructs with 2 or 3 items or when more than 1item was missing on sub-constructs with 4 or more items. If only one item was missing in sub-constructs with ≥ 4 items, the sub-construct score was calculated without that item. Cronbach's alpha coefficients were calculated for the 13 IFSQ sub-constructs at each time point in this sample (range: 0.33-0.89). All but 7 of the 65 tested subscales exceeded the 0.60 threshold considered adequate for internal consistency [25].

Infant Diet Assessment

Infant dietary intake data were collected at 3, 6, 9, 12 and 18 months and analyzed using Nutrition Data System for Research software (NDS; version 2005 developed by the Nutrition Coordinating Center (NCC), University of Minnesota, Minneapolis, MN). Food types and energy intakes from non-breastmilk liquids and solids were estimated from three 24-hour recalls. One recall was conducted during an in-home visit, where food models and pictures were used to aid in the estimation of portion sizes. Two subsequent telephone recalls were collected on random, nonconsecutive days within a 2-week interval after the home visit. To ensure accuracy, recalls were collected by interviewers trained to use the software by a NDS-R™ certified staff member of the Clinical Nutrition Research Unit (CNRU) at the University of North Carolina at Chapel Hill. Training included instruction in the use of the multiple-pass format to collect food details, preparation and ingredients. Interviewers reviewed and followed up on records with missing foods, unrealistic quantities or supplement use. Approximately 40 infant foods, including jarred baby foods and cereals, were not in the database and were added to the CNRU digital food library. This protocol was similar to that used in the Feeding Infants and Toddlers Study (FITS) [26] and has been shown to produce similar patterns of intakes compared to 3-day weighed food records in infants [27]. Mean daily energy intake from non-breastmilk liquids and solids was generated by the NDS software and averaged over the 3 recalls. Because of the difficulty of estimating the quantity of breastmilk consumed by mixed-fed infants [28], we did not estimate the energy contribution of breastmilk.

Diet histories were also collected at each visit, asking mothers whether they were currently breastfeeding or to recall the age they had stopped if cessation occurred between visits and whether they had given their infants specific foods in the months between visits. These diet histories were used to define breastfeeding status and age-inappropriate feeding. Because of the low levels of exclusive and full-breastfeeding in this sample, breastfeeding status was coded as yes when mothers reported providing any breastmilk at the time of the home visit or any of the 3 NDS recalls (if breastfeeding status was missing from the diet history). Age-inappropriate feeding of liquids and solids (inappropriate feeding) was based on AAP (American Academy of Pediatrics) guidelines for optimal feeding [29]. Using these guidelines, feeding was considered inappropriate if the infant received: at 3 months, any liquids or solids except for breastmilk or formula; at 6 months, cow's milk or soy milk instead of human milk or formula, or juice, meat, eggs, cheese, junk food (such as potato chips, corn chips, or cheese puffs), fast food (such as french fries, chicken nuggets, burgers or pizza) or sweets (such as cookies, cakes, pies, or ice creams); at 9 months, cow's milk or soy milk, junk food, fast food or sweets; and at 12 or 18 months, flavored milks, junk food, fast food, or sweets.

Infant Anthropometry

Infants were measured at each home visit by trained study personnel using standard techniques. Infant weight was measured on a digital scale (Tanita BD-585 Digital Baby Scale) to the nearest 10gm. Recumbent length was measured to the nearest 0.1 cm by a two-person team, using a portable length board (O'Leary Length Board). All anthropometrics were done in triplicate and their mean was used in analysis.

The main outcome variables of interest were infant weight-for-age z-scores (WAZ) and the sum of 3 skinfolds (subscapular, triceps and abdominal). WAZ was calculated using the CDC/NCHS 2000 growth reference [30]. Alternate analyses were conducted using dichotomized measures of these variables, with high infant weight defined as a WAZ > 90^{th} percentile of the CDC/NCHS reference (above 90^{th}%ile WAZ). High infant fatness was represented as a sum of skinfold >90^{th} percentile (above 90^{th}%ile Sumsf) of the sample age- and sex-specific skinfold distribution following Slining et al 2010 [23]. We assessed WAZ for comparability with the only other longitudinal study of feeding styles and size in infancy [11, 17] and with measures available from birth to test for an association between size at birth and feeding styles at 3 months. Recent research has documented that WAZ is similarly predictive of obesity and adiposity at 3 years of age when compared to weight-for-height Z-score (WHZ) [31]. Skinfold thickness was included because feeding styles have been linked to fat mass in older children [12], and skinfold thickness measures are highly correlated (R^2=0.94) with direct measures of body fat assessed through dual-energy X-ray absorptiometry [32].

Infant Activity

Infant activity was included in analyses of the association between infant diet and size outcomes given the documented relationship between activity measures and size in this sample [24]. Infant activity was assessed at each home visit through the activity level score from the Infant Behavior Questionnaire-Revised (IBQ-R) [33]. The IBQ-R activity scale consists of 16-items characterizing maternal perception of infant gross motor activity including limb movement, squirming and locomotor activity. A higher score on this scale, which ranges from 1-7, indicates a more active infant. Previous research in this sample documented adequate internal consistency for the activity subscale (Cronbach's alpha >0.60) at each visit [24].

Statistical Analysis

All statistical analysis was performed with STATA software (version 10; STATA Corporation, College Station, TX). Descriptive statistics were calculated for feeding styles, anthropometrics, dietary intake data and select sociodemographic characteristics. Concurrent associations between feeding style and dietary (Figure 1: Path A) and anthropometric (Figure 1: Path C) outcomes and between dietary intake and infant size (Figure 1: Path B) were assessed through longitudinal random effects models. To address temporality and support causality, a second set of lagged longitudinal models was fit with feeding style or feeding behavior at one visit predicting size at the next visit. Because we hypothesized that the association between feeding style and infant size may be bidirectional, lagged longitudinal models were used to test whether infant size at one visit significantly predicted maternal feeding styles at the next visit (Figure 1, Path D). Concurrent and lagged longitudinal logistic regression models were used to test for an association of feeding styles with high WAZ and sum of skinfolds (above the 90^{th} percentiles).

To test whether the inclusion of only non-breastfed infants in models using mean energy intake biased our findings, we compared the models described above with those: 1) excluding the 49 infants breastfed at 3 months from Paths A-D and 2) including the energy intake from non-breastmilk foods and liquids for breastfed infants in Paths A and B, a dummy variable indicating breastfeeding status and an interaction term between the main effect (feeding style and mean energy intake, respectively) and breastfeeding status to test whether the association differed by breastfeeding status. Neither the dummy variable nor the interaction term was significant in adjusted models and the estimate of the association between feeding style and energy intake or energy intake and WAZ, respectively, did not differ from initial models.

Confounding was assessed through *a priori* change in estimate criterion (change in main effect coefficient of >10%) while effect modification was examined through testing interaction terms with likelihood ratio tests. Models predicting infant size were adjusted for sex, age at measurement, infant activity level, and birthweight, while models predicting infant diet were adjusted for infant sex, visit, maternal age, education and marital status. Infant weight-for-height z-score (WHZ) was also included in Path A models testing the association between sub-construct scores and mean energy intake to control for the higher energy needs of larger infants. Maternal obesity was not an effect modifier or confounder in any pathway model and was not included in analysis. Mediation by infant diet of the relationship between feeding styles and size outcomes was tested by comparing unadjusted and diet-adjusted models. Dichotomous breastfeeding and inappropriate feeding diet measures were included in models with all infants while mean energy intake was limited to models with non-breastfed infants. Mediation of the association between feeding styles and infant size by diet was tested in the longitudinal models by including the infant diet variables into the full Path C models and seeing whether the association between feeding styles and size were completely accounted for by diet. A reduction of the feeding style coefficient to non-significantly different from zero was considered evidence for complete mediation while a reduction in the absolute size of the feeding style coefficient, though still significantly different than zero, and a significant mediator variable were considered evidence for partial mediation following MacKinnon and colleagues [34].

Results

Sample Descriptives

Sample sociodemographic characteristics, maternal and infant anthropometry and infant diet are presented in Table 2. Mean WAZ scores were above the 50th percentile of the 2000 CDC/NCHS reference standards for the first 3 visits and at the 50th percentile at the 12 and 18-month visits. The percentage of infants with WAZ above the 90th percentile decreased, ranging from 21.7% at 3 months to 10.1% at 18 months. Similarly, sum of skinfolds decreased slightly over time, although triceps and subscapular skinfold thicknesses remained relatively high in comparison to NHANES-III reference data [23].

Longitudinal models controlling for repeated measures across mothers indicated that feeding styles changed with infant age. Laissez faire diet-quality, restrictive diet quality, responsive satiety and pressuring soothing scores decreased significantly with infant age while laissez-faire attention, pressuring to finish and all indulgence scores increased (Table 3).

Path A: Feeding Style Scores and Infant Diet

Feeding styles were significantly associated with measured infant diet, including infant energy intake, odds of breastfeeding and likelihood of inappropriate feeding (Table 4). In non-breastfed infants, higher maternal scores for pressuring to finish, pressuring with cereal and indulgent coaxing were associated with a higher average daily energy intake controlling for infant age, sex, weight-for height- z score and the random effect of subject. Conversely, higher restrictive with diet quality scores were associated with lower daily energy intake.

Because energy intake could only be accurately assessed in non-breastfed infants, we explored how feeding styles related to breastfeeding and inappropriate feeding of solids and liquids. Pressuring to finish, pressuring with cereal and all indulgence sub-construct scores remained significantly independently associated with reduced odds of breastfeeding after adjustment for maternal education, age and marital status. The restrictive diet quality sub-construct was the only feeding style measure associated with increased odds of breastfeeding in adjusted analysis.

The results of longitudinal logistic regression models indicated that odds of age-inappropriate feeding were significantly higher in mothers who had higher pressuring with cereal scores controlling for maternal and infant covariates. Conversely, higher restrictive diet quality and responsive to satiety sub-construct scores were associated with significantly reduced risk of inappropriate feeding. Adjustment for maternal and infant covariates did not alter these results.

Path B: Infant Diet and Size

In models of concurrent feeding and infant anthropometrics, mean caloric intake among non-breastfed infants was inversely associated with WAZ (Table 5). Breastfeeding was marginally associated with higher WAZ (p=0.06) and sum of skinfolds (p=0.07), controlling for infant sex, age, birthweight and activity level. In lagged models, inappropriate feeding was associated with higher WAZ score in the next visit. None of the feeding variables significantly predicted concurrent or future risk of being above the 90th percentile for WAZ or sum of skinfolds.

Path C: Feeding Styles and Infant Size

Only the controlling feeding styles, pressuring and restrictive, were significantly associated with infant size outcomes (Table 6). In concurrent models of feeding styles and infant size, higher pressuring to finish scores were associated with lower WAZ while higher pressuring with cereal scores were associated with lower infant skinfolds. These sub-constructs were also associated with infant size at the next visit in lagged models; higher pressuring to finish scores predicted lower WAZ at the next visit while higher pressuring with cereal scores predicted lower sum of skinfolds. In lagged models, restrictive diet quality scores were associated with higher WAZ at the next visit. Restrictive amount scores were inversely associated with WAZ at the next visit, though this result did not reach statistical significance (p=0.07).

Similar results were obtained from models predicting dichotomous >90th%tile for WAZ and sum of skinfolds variables. As in continuous models, higher pressuring to finish scores were associated with reduced odds of being >90th%ile for WAZ in the visit and higher pressuring with cereal scores were associated with reduced odds of being >90th%ile for sum of skinfolds in both concurrent and lagged models.

Mediation by infant diet variables was tested in all of the above models. Only pressuring with cereal showed evidence for partial mediation with a reduction in the effect size for the main effect of pressuring with cereal on sum of skinfolds when breastfeeding was included in the model, such that the inclusion of breastfeeding attenuated the effect of pressuring with cereal score on sum of skinfolds.

Path D: Testing for Reverse Causality

Lagged size measures were associated with feeding style measures at the next visit, providing evidence for a bidirectional relationship between feeding styles and infant size (Table 7). Higher infant WAZ was associated with lower pressuring to finish scores and marginally with responsive satiety (p=0.06) and indulgence coaxing (p=0.09) scores. Larger size measures, excluding being above the 90th%ile WAZ, were associated with lower responsive satiety scores while above the 90th%ile WAZ was associated with lower restrictive diet quality scores. The effects of birth weight on feeding style at 3 months were tested in separate cross-sectional regression models and no significant results were found (results not shown).

Discussion

We found significant and contrasting effects of pressuring and restriction on infant dietary and anthropometric outcomes in longitudinal analysis across the first 18 months of life. Pressuring was positively associated with greater infant energy intake, reduced odds of breastfeeding across visits, higher levels of inappropriate feeding and lower infant WAZ; restriction, on the other hand, was associated with lower energy intake, higher odds of breastfeeding across visits, reduced odds of inappropriate feeding, higher WAZ and larger sum of skinfolds. While a large extant literature links parental feeding practices to child eating behaviors and child weight [3], this study extends this literature by examining the impact of feeding styles in infancy, a particularly important time for the development of eating behaviors and future obesity risk. Our longitudinal analysis of the associations between feeding styles, habitual diet, and weight and adiposity over the first 18 months of life further lends empirical support to interpretations from previous cross-sectional studies that maternal feeding style is both a response to and predictor of child size [reviewed in: 35].

The finding that pressuring is associated with more potentially detrimental infant diets (higher energy intake, reduced odds of breastfeeding and higher odds of inappropriate feeding) is consistent with previous research in older children where pressure to eat has been linked to the “problematic” intake of sweets, snacks and fast foods among German preschoolers [36] and higher energy intake and snack food consumption in Australian 5- and 6-year olds [9]. Similarly, our finding that higher levels of pressuring are associated with smaller concurrent infant size aligns with much previous research [10, 11, 14, 37] across multiple ethnic groups, where this association has been interpreted as a reflection of maternal attempts to increase the intake of smaller children due concerns about their small size and dietary adequacy [13, 37]. Infant size was also inversely associated with pressuring scores in the next visit, supporting the interpretation from previous cross-sectional studies that pressuring is likely a response to small infant size [13, 37]. That higher levels of pressuring were associated with lower, not higher, WAZ at the next visit suggests that higher pressuring is maintained because infants remain small at the next visit. Our findings that mothers of smaller infants are more likely to use pressuring styles and that higher pressuring is associated with greater infant energy intakes and more inappropriate feeding raise the concern that pressuring may lead to overfeeding as mothers attempt to increase the weight of smaller infants[14]. The potential long-term effects of this strategy may be obesogenic as infants become children who are less able to regulate their food intake [6].

Our finding that higher restrictive with diet quality scores are associated with better infant diets (lower energy intake, higher odds of breastfeeding and lower odds of inappropriate feeding) during infancy differs from previous research among predominately white, preschool-aged children. While parental restriction is associated with increased intakes [2, 38] eating in the absence of hunger and preference for forbidden foods [7] in older children, among our younger age group, who have limited opportunity to eat foods not provided by caregivers, maternal restriction of diet quality has a positive impact on infant diet. Higher restrictive diet quality scores are associated with less age-inappropriate feeding and, consequently, less reported feeding of snack foods, fast foods and other age- inappropriate foods and liquids. Restriction in this age group may be more comparable to the "covert" control described by Ogden and colleagues [8] as a type of restriction that is not apparent to the child, involves managing the types of foods that are available in the home and social environment, and has beneficial consequences for child weight. Interestingly, our two measures of restriction did not have the same effect on infant weight. Restriction with diet quality was associated with higher subsequent WAZ, a result seen in some [2, 38] but not all longitudinal studies among infants [11] and older children [11, 12]. Restriction with the amounts infants and toddlers are fed, on the other hand, was marginally associated with lower infant WAZ in the next visit. The opposing effects of the two separate sub-constructs of restriction (diet quality and amount) underscore the importance of using finer-grained feeding domains and highlight the need for further conceptual work to more fully understand restriction in infants and young children.

Paradoxically, we found that higher levels of restriction are associated with better infant diets, better infant diets are associated with larger infant size and larger infant size is associated with reduced levels of restriction in subsequent visits. Previous research among low-income, African-American mothers has documented that larger infants are viewed as healthier and as evidence of successful parenting [39]. Thus, mothers in our sample may feel less concerned about subsequently restricting foods among infants they view as growing well due to their larger size. Mothers' perceptions of children's size and concerns about future risk of under- or overweight have been shown to mediate the association between feeding styles and size [13, 14]. Weight concerns may play a similar mediating role in infancy.

Unlike much previous research, we were able to examine the effects of maternal feeding style on infant energy intake and diet in a non-laboratory setting. Yet, the relationship between infant diet and size was not straightforward in our analysis. While inappropriate feeding is associated with higher subsequent WAZ as expected, higher energy intake is associated with lower concurrent WAZ. This finding is unlikely to be due to the exclusion of breastfed infants from models of mean energy intake. Incorporating the energy derived from non-breastmilk substances for breastfed infants and an interaction term between breastfeeding status and energy intake did not alter reported results. In separate models assessing the association between breastfeeding and infant size, breastfeeding status was only marginally associated with higher WAZ and higher sum of skinfolds. There was no evidence for biased maternal reporting of infant diet; reported energy intakes either above or below estimated requirements were not significantly associated with infant size. Our use of two different measures, 24-hour recalls and diet histories, at each of the visits provided detailed information about infant diet, and the collection of three 24-hr recalls collected on non-consecutive days, two of which were administered separately from the IFSQ, may have ameliorated bias introduced by maternally-reported measures of diet. Further, these paradoxical results are similar to those of Baird and colleagues [40] who found that infants with diets most similar to feeding guidelines, with diets composed of fresh fruits and vegetables, home-prepared foods and breastmilk, gained weight and skinfold thicknesses more rapidly from 6 to 12 months than infants with the highest intakes of breads, snacks and processed foods. The role of other factors such as genetics, energy expenditure or the feeding practices of other caregivers in mediating size throughout infancy require further exploration.

While the Infant Care Study provides the unique opportunity to explore the multiple pathways linking feeding styles to diet and size longitudinally in infancy, it also presents some limitations. A potential limitation stemming from the wealth of available data is that our use of 13 sub-constructs of feeding styles and multiple diet and size measures increased the number of tests performed and our risk of type 1 error. However, the consistency of the results for the pressuring and restrictive feeding styles in each of the tested pathways lends support to the documented findings. The generalizability of our results to other ethnic groups remains unknown, but many of the factors that characterize this sample, such as low levels of breastfeeding and high levels of overweight, may be similar across low-income populations and may more broadly influence both maternal feeding styles and feeding practices.

The study of feeding styles remains an active, evolving of area of research and definitions continue to be refined to more clearly distinguish feeding practices from the emotional context engendered by feeding styles [21]. Nonetheless, we believe that the IFSQ constitutes an advance in the measurement of infant feeding and has the potential to clarify some of the existing confusion over what distinguishes feeding practices and styles on the ground. Developed based on developmental psychology theory on parenting styles [4, 22] and previous work on feeding practices [5], the IFSQ measures both *parental beliefs and attitudes* about child feeding (i.e. "it is important that a parent decides how much an infant should eat" or "it is okay for a child to walk around while eating") and their associated *feeding practices* (i.e. restricting children's access to junk food and adding cereal to the bottle) across a number of feeding domains. Consequently, the IFSQ has the potential to push the literature forward to examine the constellation of infant feeding beliefs and practices that underlie the creation of the emotional context in which feeding practices are expressed and feeding socialized. Future research is warranted to more fully capture the emotional context associated with these IFSQ-derived feeding styles.

Despite the fact that this sample was designed to capture a population at high-risk for the development of overweight and obesity, we found very few significant effects of feeding styles or diet on the risk of being above the 90th percentile for WAZ or sum of skinfolds. This may stem from the relatively high sample attrition rate; only 64% of the sample (n=139) remained at the 18-month visit. Despite the best efforts of study personnel to contact participating mothers, the instability of this relatively young, low-income sample made follow-up difficult. The main variables of interest, infant weight status, sum of skinfolds, and maternal feeding styles, did not differ at 3 months age among those lost to follow-up. While caution is needed in interpreting these results due to the relatively small number of infants (n=14) above the 90th percentile of WAZ at 18 months, the relatively high skinfold measures in this sample [23] and the low-income and overweight/obese status of their mothers clearly put these infants at risk and, suggest that we may need to look longer term to see effects of feeding style and infant diet on the development of overweight/obesity.

Conclusion

This study explores the longitudinal relationship between feeding styles, diet and size during infancy, an important period for the development of eating behaviors. We find that pressuring is associated with more detrimental infant diets that would presumably lead to greater risk for overweight and, at the same time, smaller infant size. Conversely, restriction is associated with both better infant diets and also larger infant size. These results suggest that the association between maternal feeding styles and infant size is unlikely to be unidirectional; rather, maternal feeding styles may both influence feeding practices and infant size, may also be responsive to infant size. This dyadic interaction between maternal feeding styles and infant size may be important to consider in interventions aimed at stemming early obesity risk.

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References

1. Hughes SO, Power TG, Orlet Fisher J, Mueller S, Nicklas TA. Revisiting a neglected construct: parenting styles in a child-feeding context. Appetite. 2005; 44:83–92. [PubMed: 15604035]
2. Faith MS, Scanlon KS, Birch LL, Francis LA, Sherry B. Parent-child feeding strategies and their relationships to child eating and weight status. Obes Res. 2004; 12:1711–22. [PubMed: 15601964]
3. Ventura AK, Birch LL. Does parenting affect children’s eating and weight status? Int J Behav Nutr Phys Act. 2008; 5:15. [PubMed: 18346282]
4. Baumrind D. Current patterns of parental authority. Developmental Psychology Monographs. 1971; 4:1–103.
5. Birch LL, Fisher JO, Grimm-Thomas K, Markey CN, Sawyer R, Johnson SL. Confirmatory factor analysis of the Child Feeding Questionnaire: a measure of parental attitudes, beliefs and practices about child feeding and obesity proneness. Appetite. 2001; 36:201–10. [PubMed: 11358344]
6. Johnson SL, Birch LL. Parents’ and children’s adiposity and eating style. Pediatrics. 1994; 94:653–61. [PubMed: 7936891]
7. Fisher JO, Birch LL. Restricting access to palatable foods affects children’s behavioral response, food selection, and intake. Am J Clin Nutr. 1999; 69:1264–72. [PubMed: 10357749]
8. Ogden J, Reynolds R, Smith A. Expanding the concept of parental control: a role for overt and covert control in children’s snacking behaviour? Appetite. 2006; 47:100–6. [PubMed: 16682098]
9. Campbell K, Andrianopoulos N, Hesketh K, et al. Parental use of restrictive feeding practices and child BMI z-score. A 3-year prospective cohort study. Appetite. 2010; 55:84–8. [PubMed: 20420869]
10. Powers SW, Chamberlin LA, van Schaick KB, Sherman SN, Whitaker RC. Maternal feeding strategies, child eating behaviors, and child BMI in low-income African-American preschoolers. Obesity (Silver Spring). 2006; 14:2026–33. [PubMed: 17135620]
11. Farrow CV, Blissett J. Controlling feeding practices: cause or consequence of early child weight? Pediatrics. 2008; 121:e164–9. [PubMed: 18166535]

12. Spruijt-Metz D, Lindquist CH, Birch LL, Fisher JO, Goran MI. Relation between mothers' child-feeding practices and children's adiposity. Am J Clin Nutr. 2002; 75:581–6. [PubMed: 11864866]
13. Webber L, Hill C, Cooke L, Carnell S, Wardle J. Associations between child weight and maternal feeding styles are mediated by maternal perceptions and concerns. Eur J Clin Nutr. 2010; 64:259–65. [PubMed: 20087383]
14. Gregory JE, Paxton SJ, Brozovic AM. Pressure to eat and restriction are associated with child eating behaviours and maternal concern about child weight, but not child body mass index, in 2-to 4-year-old children. Appetite. 2010; 54:550–6. [PubMed: 20219609]
15. Patrick H, Nicklas TA, Hughes SO, Morales M. The benefits of authoritative feeding style: caregiverfeeding styles and children's food consumption patterns. Appetite. 2005; 44:243–9. [PubMed: 15808898]
16. Hoerr SL, Hughes SO, Fisher JO, Nicklas TA, Liu Y, Shewchuk RM. Associations among parental feeding styles and children's food intake in families with limited incomes. Int J Behav Nutr Phys Act. 2009; 6:55. [PubMed: 19678947]
17. Farrow C, Blissett J. Does maternal control during feeding moderate early infant weight gain? Pediatrics. 2006; 118:e293–8. [PubMed: 16882774]
18. Fisher JO, Birch LL, Smiciklas-Wright H, Picciano MF. Breast-feeding through the first year predicts maternal control in feeding and subsequent toddler energy intakes. J Am Diet Assoc. 2000; 100:641–6. [PubMed: 10863566]
19. Thompson AL, Mendez MA, Borja JB, Adair LS, Zimmer CR, Bentley ME. Development and validation of the Infant Feeding Style Questionnaire. Appetite. 2009; 53:210–21. [PubMed: 19576254]
20. Blissett J. Relationships between parenting style, feeding style and feeding practices and fruit and vegetable consumption in early childhood. Appetite. 2011; 57:826–31. [PubMed: 21651932]
21. Hughes SO, Power TG, Papaioannou MA, et al. Emotional climate, feeding practices, and feeding styles: an observational analysis of the dinner meal in Head Start families. The international journal of behavioral nutrition and physical activity. 2011; 8:60. [PubMed: 21663653]
22. Costanzo PR, Woody EZ. Domain-Specific Parenting Styles and Their Impact on the Child's Development of Particular Deviance: The Example of Obesity Proneness. Journal of social and clinical psychology. 1985; 3:425–445.
23. Slining M, Adair LS, Goldman BD, Borja JB, Bentley M. Infant overweight is associated with delayed motor development. J Pediatr. 2010; 157:20–25 e1. [PubMed: 20227724]
24. Slining MM, Adair L, Goldman BD, Borja J, Bentley M. Infant temperament contributes to early infant growth: A prospective cohort of African American infants. Int J Behav Nutr Phys Act. 2009; 6:51. [PubMed: 19656377]
25. DeVillis, R. Scale Development: Theory and Applications. Thousand Oaks, CA: Sage Publications; 1991.
26. Ziegler P, Briefel R, Clusen N, Devaney B. Feeding Infants and Toddlers Study (FITS): development of the FITS survey in comparison to other dietary survey methods. J Am Diet Assoc. 2006; 106:S12–27. [PubMed: 16376627]
27. Fisher JO, Butte NF, Mendoza PM, et al. Overestimation of infant and toddler energy intake by 24-h recall compared with weighed food records. Am J Clin Nutr. 2008; 88:407–15. [PubMed: 18689377]
28. Stuff JE, Nichols BL. Nutrient intake and growth performance of older infants fed human milk. The Journal of pediatrics. 1989; 115:959–68. [PubMed: 2585235]
29. Kleinman, R., editor. American Academy of Pediatrics CoN. Pediatric Nutrition Handbook. 6. Elk Grove Village, IL: American Academy of Pediatrics; 2008.
30. Ogden CL, Kuczmarski RJ, Flegal KM, et al. Centers for Disease Control and Prevention 2000 growth charts for the United States: improvements to the 1977 National Center for Health Statistics version. Pediatrics. 2002; 109:45–60. [PubMed: 11773541]
31. Taveras EM, Rifas-Shiman SL, Belfort MB, Kleinman KP, Oken E, Gillman MW. Weight status in the first 6 months of life and obesity at 3 years of age. Pediatrics. 2009; 123:1177–83. [PubMed: 19336378]

32. Schmelzle HR, Fusch C. Body fat in neonates and young infants: validation of skinfold thickness versus dual-energy X-ray absorptiometry. Am J Clin Nutr. 2002; 76:1096–100. [PubMed: 12399284]
33. Gartstein M, Rothbart M. Studying infant temperament via the Revised Infant Behavior Questionnaire. Infant Behavior and Development. 2003; 26:64–86.
34. MacKinnnon D, Fairchild A, Fritz M. Mediation Analysis. Annu Rev Psychol. 2010; 58:593–614.
35. Farrow C, Blissett J, Haycraft E. Does child weight influence how mothers report their feeding practices? International journal of pediatric obesity : IJPO : an official journal of the International Association for the Study of Obesity. 2011; 6:306–13.
36. Kroller K, Warschburger P. Associations between maternal feeding style and food intake of children with a higher risk for overweight. Appetite. 2008; 51:166–72. [PubMed: 18342396]
37. Carnell S, Wardle J. Associations between multiple measures of parental feeding and children's adiposity in United Kingdom preschoolers. Obesity (Silver Spring). 2007; 15:137–44. [PubMed: 17228041]
38. Faith MS, Berkowitz RI, Stallings VA, Kerns J, Storey M, Stunkard AJ. Parental feeding attitudes and styles and child body mass index: prospective analysis of a gene-environment interaction. Pediatrics. 2004; 114:e429–36. [PubMed: 15466068]
39. Bentley M, Gavin L, Black MM, Teti L. Infant feeding practices of low-income, African-American, adolescent mothers: an ecological, multigenerational perspective. Soc Sci Med. 1999; 49:1085–100. [PubMed: 10475672]
40. Baird J, Poole J, Robinson S, et al. Milk feeding and dietary patterns predict weight and fat gains in infancy. Paediatr Perinat Epidemiol. 2008; 22:575–86. [PubMed: 19000296]

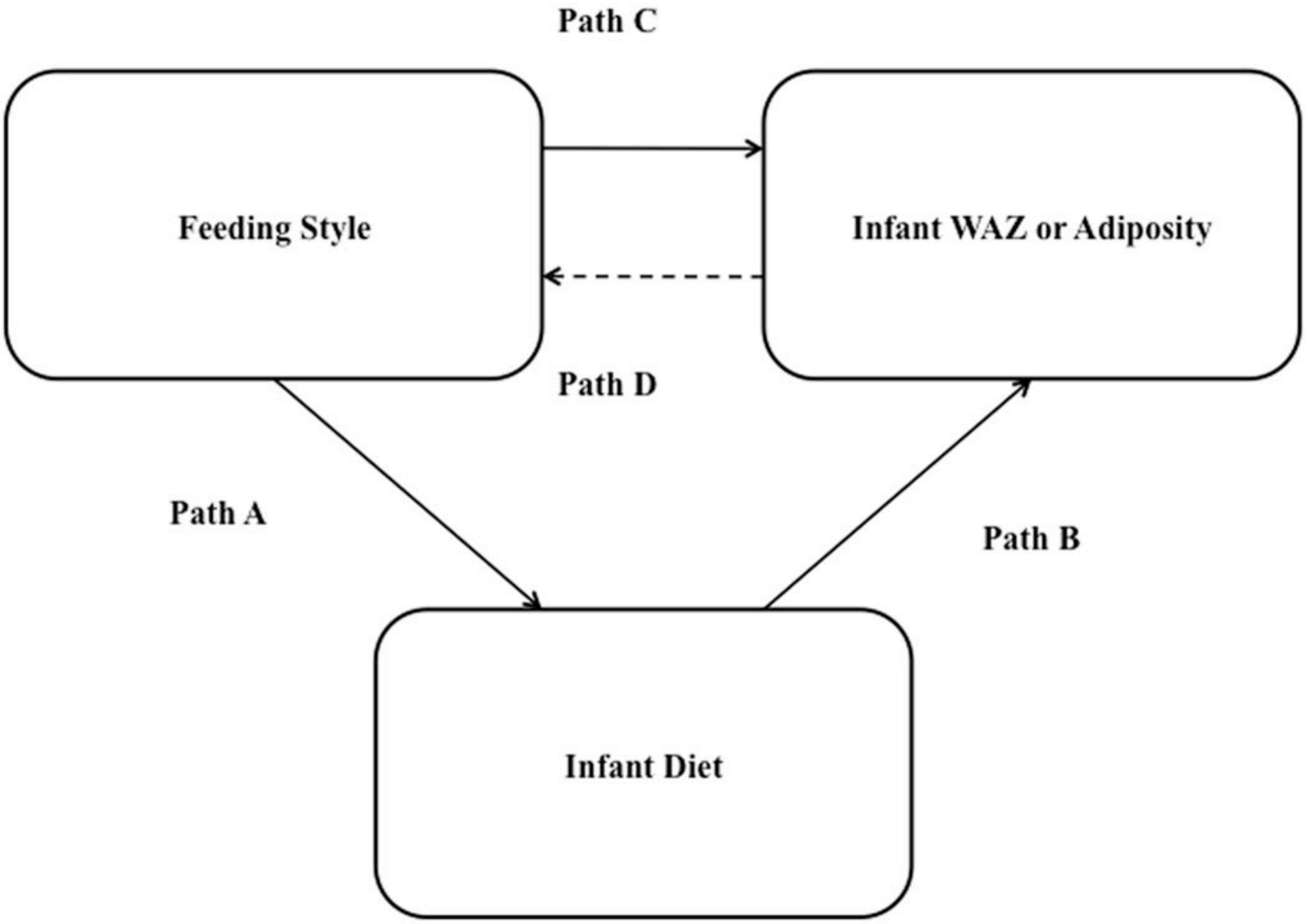

Figure 1.
Conceptual model of the relationship between maternal feeding styles, infant diet, and infant size

Table 1

Infant Feeding Style Questionnaire Constructs and Sample Items

Feeding Style	Constructs	Item Type	Sample Items[a]
LF[b]	Attention	Behavior	When [my child] has a bottle, I prop/propped it up.
LF[b]	Attention	Belief	I think it is okay to prop an infant's bottle.
LF	Diet Quality	Behavior	I keep track of what food (child) eats[c].
LF	Diet Quality	Belief	A toddler should be able to eat whatever he/she wants for snacks.
PR	Finish	Behavior	I try to get [child] to finish his/her food.
PR	Finish	Belief	It is important for a toddler to finish all the food on his/her plate.
PR	Cereal	Behavior	I give/gave [child] cereal in the bottle.
PR	Cereal	Belief	Cereal in the bottle helps a child sleep through the night.
PR	Soothing	Behavior	When [child] cries, I immediately feed him/her.
PR	Soothing	Belief	The best way to make an infant stop crying is to feed him/her.
RS	Amount	Behavior	I carefully control how much [child] eats.
RS	Amount	Belief	It is important for parents to have rules for how much a toddler eats.
RS	Diet Quality	Behavior	I let [child] eat fast food[c].
RS	Diet Quality	Belief	A toddler should never eat fast food.
RP	Satiety	Behavior	[Child] lets me know when he/she is full.
RP	Satiety	Belief	A child knows when he/she is full.
RP	Attention	Behavior	I talk to [child] to encourage him/her to drink formula/breastmilk.
RP	Attention	Belief	It is important to help or encourage a toddler to eat.
IN	Permissive	Behavior	I allow child to watch TV while eating if he/she wants.
IN	Permissive	Belief	Toddlers should be allowed to eat desserts/sweets if they want.
IN	Coaxing	Behavior	I allow child to watch TV while eating if he/she gets enough.
IN	Coaxing	Belief	Toddlers should be allowed to eat desserts/sweets to make sure they get enough.
IN	Soothing	Behavior	I allow child to watch TV while eating to keep him/her from crying.
IN	Soothing	Belief	Toddlers should be allowed to eat desserts/sweets to keep them from crying.
IN	Pampering	Behavior	I allow child to watch TV while eating to keep him/her happy.
IN	Pampering	Belief	Toddlers should be allowed to eat desserts/sweets to keep him/her happy.

[a]Sample items include a belief and behavior item from each construct.

[b]Feeding styles are abbreviated: LF=laissez-faire, PR=pressuring, RS=restrictive, RP=responsive and IN=indulgent.

[c]Item is reverse-coded.

Table 2

Descriptive characteristics of participating mothers and infants at the 3-18 month visits

	Birth n(%)/ mean ± SD	3-month visit n(%)/mean ± SD	6-month visit n(%)/ mean ± SD	9-month visit n(%)/ mean ± SD	12-month visit n(%)/ mean ± SD	18-month visit n(%)/ mean ± SD
Maternal characteristics						
Total n		217	166	168	154	139
Age (*years*)		22.67 (3.81)				
Education (>*hs graduate*)		90 (42.7)				
Single mother		190 (88.8)				
BMI <25		63 (29.0)				
BMI 25-29.99		58 (26.7)				
BMI >30		96 (44.2)				
Infant characteristics						
Female		116 (53.5)	86 (51.8)	85(50.6)	83 (53.9)	73 (52.5)
Age (*months*)		3.24 ± 0.31	6.36 ± 0.51	9.37 ± 0.47	12.63 ±0.72	19.3 ± 2.56
Gestational age (*weeks*)	39.48 ± 1.46					
Birthweight (*kg*)	3.23 ± 0.48					
Weight-for-age Z score		0.58 ± 0.96	0.36 ± 1.04	0.12 ± 1.02	-0.02 ± 1.07	-0.03 ± 1.08
Weight-for-length Z score		0.58 ± 1.00	0.59 ± 1.11	0.55 ± 1.10	0.47 ± 1.10	0.32 ± 1.06
Length-for-age Z score		-0.02 ± 0.90	0.10 ± 0.91	0.10 ± 0.87	0.06 ± 0.87	0.09 ± 0.95
Over 90%ile WAZ		47 (21.7)	32 (19.4)	22 (13.2)	17 (11.2)	14 (10.1)
Sum of skinfolds (*mm*)		25.36 ± 4.72	25.66 ± 5.79	24.72 ± 6.13	23.66 ± 6.16	22.60 ± 4.31
90^{th} %ile Sum of skinfolds (*male*)		30.13	32.47	31.13	31.40	27.73
90^{th} %ile Sum of skinfolds (fe*male*)		32.00	32.53	30.93	29.93	30.33
Mean calorie intake (*kcal*)		710.30 ± 192.75	787.99 ± 187.51	920.38 ± 228.56	1092.23 ± 405.36	1328.03 ± 371.82
Any breastfeeding	148 (69.2)[a]	49 (22.6)	24 (14.6)	19 (11.4)	8 (5.3)	3 (2.2)
Inappropriately fed		167 (78.0)	53 (32.1)	39 (23.8)	52 (34.9)	35 (32.1)
Activity level		4.11 ± 0.82	4.69 ± 0.77	4.84 ± 0.73	5.47 ± 0.72	5.38 ± 0.78

[a]Figure represents breastfeeding initiation

Table 3

Changes in feeding style scores with infant age

	Overall FS score[a] mean ± SE	Change in score[b] β (p)
LF attention[c]	2.15 ± 0.05	0.01 (0.04)
LF diet quality	3.05 ± 0.05	-0.01 (0.004)
RS amount	3.69 ± 0.06	-0.002 (0.65)
RS diet quality	3.21 ± 0.05	-0.04 (<0.001)
RP satiety	4.49 ± 0.04	-0.005(0.06)
RP attention	3.54 ± 0.06	0.003 (0.47)
PR finish	2.14 ± 0.05	0.04 (<0.001)
PR cereal	2.77 ± 0.06	-0.004 (0.34)
PR soothe	2.18 ± 0.06	-0.01 (0.01)
IN permissive	1.82 ± 0.05	0.12 (<0.001)
IN coaxing	1.23 ± 0.05	0.03(<0.001)
IN soothe	1.27 ± 0.04	0.01 (<0.001)
IN pampering	1.34 ± 0.04	0.02 (<0.001)

[a] Average feeding style score across all visits

[b] Coefficient from longitudinal models predicting feeding style score by infant age controlling for repeated individual measures

[c] Feeding styles are abbreviated: LF=laissez-faire, PR=pressuring, RS=restrictive, RP=responsive and IN=indulgent

Table 4

Feeding Style Scores and Infant Diet

Feeding Style[a]	Mean Energy Intake[b] *β(p-value)*	Odds of Breastfeeding[c] *Adj OR (95% CI)*	Odds of Inappropriate Feeding[c,d] *Adj OR (95% CI)*
LF attention	3.82 (0.82)	0.56 (0.29-1.10)	1.00 (0.77-1.31)
LF diet quality	-17.29 (0.36)	1.0 (0.50-2.00)	0.87 (0.66-1.14)
RS amount	-2.58 (0.85)	0.78 (0.50-1.23)	1.01 (0.83-1.24)
RS diet quality	-36.31 (0.03)	2.99 (1.70-5.37)	0.69 (0.52-0.91)
RP satiety	-5.52 (0.81)	1.71 (0.70-4.22)	0.66 (0.46-0.94)
RP attention	9.87 (0.47)	1.13 (0.70-1.82)	0.88 (0.71-1.10)
PR finish	31.14 (0.05)	0.29 (0.34-0.61)	1.04 (0.80-1.35)
PR cereal	32.84 (0.02)	0.45 (0.27-0.74)	1.30 (1.04-1.63)
PR soothing	19.35 (0.18)	1.78 (0.98-3.23)	1.05 (0.84-1.32)
IN permissive	18.28 (0.34)	0.31 (0.14-0.68)	0.99 (0.73-1.35)
IN coaxing	42.51 (0.01)	0.15 (0.44-0.54)	0.84 (0.60-1.18)
IN soothing	11.21 (0.65)	0.17 (0.05-0.60)	0.91 (0.61-1.36)
IN pampering	11.64 (0.61)	0.19 (0.06-0.60)	0.87 (0.60-1.27)

[a] Feeding styles are abbreviated: LF=laissez-faire, PR=pressuring, RS=restrictive, RP=responsive and IN=indulgent.

[b] Results from longitudinal regression model of effect of a 1-unit increase in feeding style score on energy intake, controlling for infant (sex, whz and visit) and maternal (education, marital status and age) characteristics.

[c] Adjusted longitudinal logistic model of effect of a 1-unit increase in feeding style score on feeding behavior, controlling for infant (age, sex) and maternal (education, marital status and age) characteristics.

[d] Age-inappropriate feeding of liquids and solids is based on AAP (American Academy of Pediatrics) guidelines for optimal feeding and is considered inappropriate if the infant received: at 3 months, any liquids or solids except for breastmilk or formula; at 6 months, cow's milk or soy milk instead of human milk or formula, or juice, meat, eggs, cheese, junk food (such as potato chips, corn chips, or cheese puffs), fast food (such as french fries, chicken nuggets, burgers or pizza) or sweets (such as cookies, cakes, pies, or ice creams); at 9 months, cow's milk or soy milk, junk food, fast food or sweets; and at 12 or 18 months, flavored milks, junk food, fast food, or sweets.

Table 5

Concurrent and lagged models of infant and size from 3 to 18 months[a]

	Infant Anthropometric Outcome			
Infant Diet	WAZ[b] β (p)	> 90th%ile WAZ[c] OR (95% CI)	Sumsf β (p)	>90th%ile Sumsf OR (95% CI)
Concurrent Models				
Mean calories[d]	-0.10 (0.01)[e]	0.83 (0.68-1.02)	-0.11 (0.10)	0.92 (0.77-1.09)
Inappropriate feeding	0.05 (0.22)	1.26 (0.60-2.64)	-0.10 (0.73)	0.73 (0.37-1.46)
Breastfeeding	0.14 (0.07)	1.06 (0.30-3.69)	1.07(0.06)	2.69 (0.88-8.20)
Lagged Models				
Mean calories[d]	-0.07 (0.08)[e]	1.03 (0.84-1.28)	0.01 (0.89)	1.02 (0.85-1.22)
Inappropriate feeding	0.11 (0.01)	1.45 (0.57-3.71)	0.24 (0.48)	0.65 (0.27-1.48)
Breastfeeding	-0.001 (0.99)	0.75 (0.17-3.30)	0.85 (0.17)	4.41 (1.14-16.98)

[a]Models control for infant age sex, age, birthweight and activity. Outcome variables are abbreviated WAZ: CDC/NCHS weight-for-age Z-score, Sumsf: continuous sum of skinfolds measure, >90th%ile WAZ: above the 90th percentile for the CDC/NCHS weight-for-age Z-score, >90th%ile sumsf: above the 90th percentile for age- and sex-adjusted sample sum of skinfold measure.

[b]Beta coefficient and p-value from longitudinal regression models

[c]Odds ratio and 95% confidence interval from longitudinal logistic models

[d]Coefficient reflects the effect of a 100 calorie increase on the outcome. Models restricted to non-breastfed infants.

[e]Models additionally control for significant interaction between mean calories and activity

Table 6

Concurrent and lagged models of feeding style and infant size from 3 to 18 months[a]

	Infant Anthropometric Outcome[b]							
	WAZ β (p)[d]		>90th%ile WAZ OR (95% CI)[e]		Sumsf β (p)		>90th%ile Sumsf OR (95% CI)	
Feeding Style[c]	*Concurrent*	*Lagged*	*Concurrent*	*Lagged*	*Concurrent*	*Lagged*	*Concurrent*	*Lagged*
LF attention	0.06 (0.13)	0.03 (0.48)	1.13 (0.59-2.16)	1.79 (0.79-4.05)	-0.19 (0.50)	-0.11 (0.73)	0.88 (0.50-1.54)	0.71 (0.32-1.60)
LF diet quality	0.05 (0.23)	0.03 (0.47)	0.98 (0.50-1.91)	1.02 (0.41-2.53)	-0.39 (0.15)	0.06 (0.85)	0.63 (0.34-1.17)	1.21 (0.60-2.43)
RS amount	0.003 (0.92)	-0.06 (0.07)	1.09 (0.66-1.80)	0.95 (0.51-1.76)	-0.10 (0.61)	-0.22 (0.35)	1.04 (0.68-1.60)	0.64 (0.36-1.14)
RS diet quality	0.05 (0.19)	0.07 (0.04)	1.02 (0.57-1.81)	0.76 (0.38-1.53)	-0.11 (0.63)	0.09 (0.73)	1.08 (0.67-1.76)	0.57 (0.29-1.10)
RP satiety	-0.003 (0.94)	0.004 (0.94)	0.71 (0.29-1.76)	0.91 (0.30-2.75)	-0.51 (0.16)	-0.08 (0.84)	0.79 (0.39-1.62)	1.44 (0.52-3.97)
RP attention	-0.01 (0.66)	-0.02 (0.62)	0.97 (0.57-1.64)	0.71 (0.37-1.38)	0.01 (0.98)	-0.21 (0.38)	0.94 (0.61-1.44)	1.06 (0.63-1.84)
PR finish	-0.10 (0.008)	-0.10 (0.02)	0.59 (0.30-1.17)	0.41 (0.17-0.99)	-0.37 (0.18)	-0.27 (0.40)	0.55 (0.31-1.01)	0.92 (0.30-1.30)
PR cereal	-0.01 (0.58)	-0.03 (0.36)	1.09 (0.64-1.86)	1.13 (0.59-2.20)	-0.44 (0.04)	-0.64 (0.01)	0.60 (0.38-0.95)	0.52 (0.28-0.97)
PR soothing	0.02 (0.58)	0.001 (0.98)	0.75 (0.42-1.34)	0.95 (0.46-1.99)	-0.01 (0.96)	-0.27 (0.33)	1.05 (0.64-1.75)	0.89 (0.47-1.71)
IN permissive	0.04 (0.33)	0.07 (0.16)	1.80 (0.85-3.81)	1.32 (0.54-3.21)	-0.04 (0.88)	0.07 (0.85)	0.98 (0.51-1.89)	1.05 (0.45-2.46)
IN coaxing	-0.05 (0.14)	-0.03 (0.43)	0.46 (0.14-1.49)	0.52 (0.12-2.19)	-0.25 (0.33)	-0.05 (0.85)	0.94 (0.45-1.98)	0.78 (0.24-2.51)
IN soothing	0.02 (0.96)	-0.003 (0.96)	0.56 (0.19-1.63)	0.47 (0.11-1.99)	-0.24 (0.60)	-0.34 (0.49)	1.02 (0.41 -2.53)	0.32 (0.08-1.33)
IN pampering	-0.02 (0.63)	-0.05 (0.36)	0.64 (0.24-1.67)	0.43 (0.11-1.64)	-0.63 (0.09)	-0.66 (0.15)	0.75 (0.32-1.78)	0.66 (0.20-2.15)

[a]Models control for infant sex, age and birthweight

[b]Outcome variables are abbreviated WAZ: CDC/NCHS weight-for-age Z-score, >90th%ile WAZ: above the 90th percentile for the CDC/NCHS weight-for-age Z-score, Sumsf: continuous sum of skinfolds measure , >90th%ile Sumsf: above the 90th percentile for age- and sex-adjusted sample sum of skinfold measure.

[c]Feeding styles are abbreviated: LF=laissez-faire, PR=pressuring, RS=restrictive, RP=responsive and IN=indulgent

[d]Beta coefficient and p-value from longitudinal regression models

[e]Odds ratio and 95% confidence interval from longitudinal logistic models

Table 7

Lagged models of infant size and subsequent feeding styles from 3 to 18 months[a]

	Feeding Style Outcomes[b]												
Anthropometric Measures[c]	**LF attention**	**LF diet quality**	**RS amount**	**RS diet quality**	**RP satiety**	**RP attention**	**PR finish**	**PR cereal**	**PR soothing**	**IN permissive**	**IN coaxing**	**IN soothing**	**IN pampering**
WAZ β (p)	0.04 (0.28)	-0.04 (0.24)	-0.002 (0.97)	-0.03 (0.37)	-0.05 (0.06)	-0.05 (0.29)	-0.08 (0.04)	-0.02 (0.67)	-0.03 (0.51)	0.03 (0.35)	-0.07 (0.09)	-0.001 (0.98)	-0.01 (0.75)
>90th%ile WAZ β (p)	0.004 (0.95)	-0.10 (0.19)	0.09 (0.36)	-0.20 (0.01)	0.004 (0.95)	-0.03 (0.78)	-0.07 (0.43)	-0.01 (0.93)	0.02 (0.81)	0.11 (0.11)	-0.04 (0.68)	0.02 (0.67)	0.01 (0.81)
Sumsf β (p)	0.01 (0.22)	-0.002 (0.71)	0.01 (0.30)	<0.001 (0.99)	-0.01 (.001)	-0.01 (0.15)	-0.01 (0.12)	-0.003 (0.58)	-0.01 (0.40)	0.001 (0.73)	-0.01 (0.17)	-0.002 (0.55)	-0.003 (0.45)
>90th%ile Sumsf β (p)	0.03 (0.74)	-0.1 (0.27)	0.12 (0.28)	-0.04 (0.66)	-0.25 (<.001)	-0.17 (0.10)	-0.14 (0.12)	0.16 (0.12)	-0.09 (0.35)	0.08 (0.27)	-0.01 (0.89)	0.08 (0.24)	0.02 (0.81)

[a]Models control for infant sex, age and birthweight

[b]Feeding styles are abbreviated: LF=laissez-faire, PR=pressuring, RS=restrictive, RP=responsive and IN=indulgent.

[c]Size variables are abbreviated WAZ: CDC/NCHS weight-for-age Z-score, >90th%ile WAZ: above the 90th percentile for the CDC/NCHS weight-for-age Z-score, Sumsf: sum of skinfolds, >90th%ile Sumsf: above the 90th percentile for age- and sex-adjusted sample sum of skinfold measure.