Maternal Feeding Practices Become More Controlling After and Not Before Excessive Rates of Weight Gain

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It is unclear whether controlling maternal feeding practices (CMFPs) lead to or are a response to increases in a child's BMI. Our goal was to determine the direction of this relationship. Data were obtained from National Institute of Child Health and Human Development's Study of Early Child Care and Youth Development. Child BMI *z*-score (zBMI) was calculated from measured weight and height. CMFP was defined by, "Do you let your child eat what he/she feels like eating?". Change in child zBMI was calculated between 4–7 years and 7–9 years, and dichotomized into "increasing" vs. "no change or decreasing". Change in CMFP was calculated over the same time periods, and dichotomized into "more controlling" vs. "no change or less controlling." Multiple logistic regression, stratified by gender and controlling for race, maternal education, maternal weight status, and baseline child weight status, was used for analysis. A total of 789 children were included. From 4 to 9 years, mean zBMI increased ($P = 0.02$) and mothers became more controlling ($P < 0.001$). Increasing CMFP between 4 and 7 years was associated with decreased odds of increasing zBMI between 7 and 9 years in boys (odds ratio = 0.52, 95% confidence interval = 0.27–1.00). There was no relationship in girls. Increasing zBMI between 4 and 7 years was associated with increasing CMFPs between 7 and 9 years in girls (odds ratio = 1.72, 95% confidence interval = 1.08–2.74), but not boys. Early increases in CMFP were not associated with later increases in zBMI for boys or girls. However, early increases in zBMI among girls were associated with later increases in CMFP. Clarifying the relationship between maternal feeding practices and child weight will inform future recommendations.

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INTRODUCTION

There is great interest in the role of maternal feeding practices in the etiology of childhood obesity. Controlling feeding practices have been associated with increased caloric intake among young children in unrestricted settings (1–3). These practices are thought to contribute to the development of poor child self-regulatory abilities regarding caloric intake and subsequent excessive weight gain and obesity. Recent Expert Committee Recommendations state that parents should "avoid overly restrictive feeding behaviors" when helping children control their weight (4). However, research on the relationship between controlling feeding practices and child weight has been inconsistent, with various studies showing a positive relationship (5,6), a negative relationship (7–9), or no relationship at all (10–13).

Because many studies have been cross-sectional, it is difficult to determine whether controlling feeding practices lead to poor child eating behaviors and subsequent weight gain, or whether these feeding practices arise from concerns over existing child weight. Some researchers have suggested that restrictive and controlling maternal feeding practices (CMFPs) are a response to concerns over the child's perceived risk of obesity rather than a cause (11,14,15). It has also been suggested that the relationship between controlling feeding practices and future child eating behavior or weight status is moderated by baseline child or maternal weight. Birch *et al.* found in a cohort of 140 white girls that high levels of maternal restrictive feeding practices at age 5 were associated with the child exhibiting greater eating in the absence of hunger at age 7 and 9, but particularly for girls who were already overweight at age 5 (ref. 3). Faith *et al.* also found in a cohort of 57 children that restrictive feeding practices at age 5 predicted elevated child BMI *z*-score (zBMI) at age 7, but only for high-risk families (i.e., families in which mothers had an elevated pre-pregnancy weight) (16). So

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even though controlling feeding practices may be used in overweight and nonoverweight children, the relationship between these practices and greater eating in the absence of hunger or weight status may only exist among those who are already at risk for obesity, and not the population at large.

There is also a lack of longitudinal studies examining how these feeding practices change over time, possibly in response to changes in child characteristics. Two studies with relatively homogenous samples noted that parental feeding practices between the age of 5 and 7 years did not change significantly over time (16,17). Another study in younger children (age 6–24 months) also found relative stability in maternal feeding practices, but that higher infant weight at age 1 predicted the use of more restriction at age 2 (ref. 18). Similar studies evaluating older children as their weights change have not been done.

The goal of this study was therefore to examine the temporal relationship between CMFPs and child weight status over a longer time frame in a larger cohort than previous reports. We were specifically interested in examining whether changes in CMFP preceded or followed changes in child zBMI. We sought to test two hypotheses: (i) increases in CMFP between the ages of 4 and 7 years predict later increases in child zBMI between the ages of 7 and 9 years; (ii) increases in child zBMI between the ages of 4 and 7 years predict later increases in CMFP between the ages of 7 and 9 years. We stratified these analyses by gender because evidence exists to suggest that children respond to the same maternal feeding practices differently depending on gender (1,2) and that some maternal feeding practices vary based on gender (19). Furthermore, only girls have been the participants in many prior studies (3,15,17,20,21).

METHODS

Participants

In 1991, 1,364 families were recruited to participate in the National Institute of Child Health and Human Development Study of Early Child Care and Youth Development, which sought to examine child behavior and development over time in relation to childcare experiences. It was conducted at 10 sites across the United States and used a conditional random sampling plan designed to prevent selection bias (22). Information about the original cohort is presented elsewhere (23). The study was approved by the Institutional Review Boards of all relevant institutions.

Measures

Child heights and weights were measured during laboratory visits scheduled at age 4, 7, and 9 years (mean ages ± s.d. 4.6 ± 0.1 years, 7.0 ± 0.3 years, and 9.0 ± 0.3 years). The protocol for anthropometric measures was standardized across sites and is detailed elsewhere (24). BMI was calculated and zBMI derived based on norms from the National Center for Health Statistics growth curves (25). Because the normal distribution of BMI differs by age and gender, using zBMI was necessary in order to standardize the degree to which child BMI deviates from the mean across age and gender. Changes in zBMI were measured between 4 and 7 years (4–7y zBMI Δ) and between 7 and 9 years (7–9y zBMI Δ).

CMFP was measured at ages 4, 7, and 9 years using the question, "Do you let your child eat what he/she feels like eating?" from the Raising Children Questionnaire (26), a simplified revision of Greenberger's Raising Children Checklist (27), which is a standardized measure of parenting strategies. This question was scored using a four-point scale: 1—definitely no, 2—mostly no, 3—mostly yes, 4—definitely yes. Higher CMFP scores therefore indicated less use of maternal control.

To better understand how this item related to observed feeding behaviors, we examined the relationship between CMFP scores and the number of maternal prompts given to a child to eat, coded to reliability using a standardized scheme (28) from a 10-min videotaped snack session with this cohort of mother–child dyads ($n = 773$) when children were 36 months old. Analysis of variance demonstrated significant differences in the number of maternal prompts given to the child to eat across the four-response categories ($P = 0.02$). *Post hoc* analyses indicated that mothers who replied "definitely no" to the question "Do you let your child eat what he/she feels like eating?" prompted the child to eat more often.

Changes in scores were measured between 4 and 7 years (4–7y CMFP Δ) and between 7 and 9 years (7–9y CMFP Δ). If a mother indicated that she "mostly" allowed her child to eat what he/she felt like eating (score = 3) at age 4 years, but became more controlling over time and answered "mostly no" (score = 2) when the child was 7 years old, the change score would have been 3 − 2 = 1. Thus, those with increasing control had a positive CMFP Δ score while those with less control over time had a negative CMFP Δ score.

The National Institute of Child Health and Human Development Study of Early Child Care and Youth Development data set does not include a baseline or self-reported maternal weight or height. To include maternal weight status as a covariate, the nine-point Stunkard Figure Rating Scale (FRS) (29) was applied to the mother's videotaped image when the child was 15, 24, and 36 months old. Each tape was coded by two raters with high inter-rater reliability (intraclass correlation coefficient 0.90, 0.83, and 0.80 at 15, 24, and 36 months, respectively). FRS codes correlate with measured BMI in prior studies ($r = 0.87$) (ref. 30) and with mother's self-reported BMI when the child was 15 years old in this cohort ($r = 0.74$). Scores range from 1 to 9. Higher scores represent a higher BMI.

Children with missing data for CMFP or child height and weight at the 7- or 9-year visit were excluded from the analysis, resulting in a final sample size of 789 participants (58% of the original cohort). The sample with complete data ($n = 789$) differed from the sample without complete data ($n = 575$) in that the retained sample was more likely to be white (84 vs. 76%, $P < 0.001$), female (52 vs. 43%, $P < 0.001$), and had higher mean maternal education (14.6 vs. 13.7 years, $P < 0.001$).

Statistical analysis

χ^2-Statistics, *t*-tests, and ANOVA were used to describe the sample by our two primary outcome measures. Multiple logistic regression models were stratified by gender. Two-category race (white, not white), maternal education in years (continuous), and maternal FRS score were included in the models *a priori*. We also controlled for child weight status at the age of 4 years (categorized as "obese" (BMI ≥ 95th percentile) vs. "not obese") (4,31,32) because CMFPs could have varied based on whether or not the child was perceived as "obese" at the beginning of the study period. Controlling for child weight status also allowed for focused examination of the effect of zBMI changes between ages 4 and 9 years, independent of the child's baseline weight status. In the model examining the effect of change in CMFP on change in zBMI, baseline CMFP at 4 years was used as a control. SAS v9.1 (SAS Institute, Cary, NC) was used to perform the analysis.

Main effect of increasing CMFP between 4 and 7 years predicting an increase in zBMI between 7 and 9 years. The outcome, 7–9y zBMI Δ, was dichotomized into "increase" (top quartile of change scores (+0.33 to +2.08)) vs. "no change or decrease" scores (bottom three quartiles (−2.27 to +0.33)). A child with an increase in 7–9y zBMI Δ became relatively heavier between the ages of 7 and 9 while a child with no change or decrease in 7–9y zBMI Δ became relatively thinner or maintained a relatively stable weight percentile during that period. The predictor, 4–7y CMFP Δ, was trichotomized into positive, negative, and zero change scores, reflecting increasing, decreasing, and no change in controlling feeding practices during this time frame. Zero change scores served as the reference group.

Given that maternal weight status and baseline child weight status may moderate the effect of controlling feeding practices on future child zBMI (3,16), the interactions of maternal FRS score and baseline child weight status with increasing CMFP were tested. The interaction between baseline CMFP and increasing CMFP was also tested.

Main effect of increasing zBMI between 4 and 7 years predicting an increase in CMFP between 7 and 9 years. The outcome, 7–9y CMFP Δ, was dichotomized into those who had a positive change score and became more controlling vs. those who had a negative or zero change score and became less controlling or did not change. The predictor, 4–7y zBMI Δ, was also dichotomized into those who were in the highest quartile of change (+0.42 to +2.59) vs. those in the bottom three quartiles (+0.41 to −4.93) to represent those with the greatest increase in child zBMI and those with minimal change or a decrease in zBMI, respectively. The interactions of maternal FRS score and baseline child weight status with increasing zBMI were also tested.

RESULTS

The sample included 789 children, 52.3% of whom were female. The majority of the sample was white (83.8%), with mean maternal education of 14.6 ± s.d. 2.4 years (Table 1). Both child weight and the degree to which mothers exhibited controlling feeding practices increased over time. Mean zBMI for the three age points were: 0.36 ± 1.0 (age 4), 0.44 ± 1.0 (age 7), and 0.51 ± 1.0 (age 9) ($P = 0.02$). Mean CMFP scores at the same age points were 2.60 ± 0.62, 2.48 ± 0.64, and 2.10 ± 0.72, respectively ($P < 0.001$).

Table 1 Characteristics of the sample by each outcome

		7–9y zBMI Δ (*N* = 728)			7–9y CMFP Δ (*N* = 789)		
	Total (*N* = 789)	Increase (0.33 to 2.08) (*N* = 182)	No change or decrease (−2.27 to 0.33) (*N* = 546)	*P* value	Increase (*N* = 321)	No change or decrease (*N* = 468)	*P* value
Gender (*n* (%))							
Male	376 (47.7)	91 (50.0)	250 (45.8)	0.32	145 (44.6)	236 (50.0)	0.17
Female	413 (52.3)	91 (50.0)	296 (54.2)		180 (55.4)	240 (50.4)	
Race (*n* (%))							
White	661 (83.8)	152 (83.5)	458 (83.9)	0.91	247 (84.0)	397 (83.4)	0.82
Other	128 (16.2)	30 (16.5)	88 (16.1)		52 (16.0)	79 (16.6)	
Maternal education, years (mean, (s.d.))	14.61 (2.39)	14.54 (2.46)	14.64 (2.33)	0.62	14.72 (2.51)	14.53 (2.31)	0.26
Maternal FRS score (mean, (s.d.))	4.58 (1.43)	4.70 (1.45)	4.46 (1.38)	0.04	4.55 (1.48)	4.60 (1.41)	0.61
CMFP at 4 years (mean, (s.d.))	2.62 (0.62)	2.62 (0.62)	2.59 (0.62)	0.51	—	—	—
CMFP at 7 years (mean, (s.d.))	2.48 (0.64)	2.49 (0.65)	2.47 (0.63)	0.71	—	—	—
CMFP at 9 years (mean, (s.d.))	2.10 (0.72)	2.14 (0.74)	2.08 (0.72)	0.33	—	—	—
4–7y CMFP Δ (*n* (%))							
Increase	208 (26.4)	43 (23.6)	147 (26.9)	0.31	—	—	—
Decrease	128 (16.2)	25 (13.7)	92 (16.9)				
No change	453 (57.4)	114 (62.6)	307 (56.2)				
zBMI at 4 years (mean, (s.d.))	0.34 (1.03)	—	—	—	0.29 (1.03)	0.40 (1.02)	0.13
zBMI at 7 years (mean, (s.d.))	0.44 (0.97)	—	—	—	0.40 (0.99)	0.46 (0.95)	0.41
zBMI at 9 years (mean, (s.d.))	0.51 (1.04)	—	—	—	0.45 (1.06)	0.54 (1.02)	0.25
4–7y zBMI Δ (*n* (%))							
Top 25% (0.42 to 2.59)	198 (25.1)	—	—	—	90 (28.0)	108 (23.1)	0.28
Middle 50% (−0.29 to 0.41)	394 (49.9)				155 (48.3)	239 (51.1)	
Bottom 25% (−4.94 to −0.30)	197 (25.0)				76 (23.7)	121 (25.9)	

CMFP, controlling maternal feeding practice; FRS, Figure Rating Scale; zBMI, BMI *z*-score.

Table 1 also shows demographic characteristics of the sample by each of our primary outcomes (7–9y zBMI Δ and 7–9y CMFP Δ). Those who experienced an increase in zBMI between 7 and 9 years did not differ by gender, race, or maternal education, but their mothers had a significantly higher FRS score, as compared to children who did not have an increase in zBMI. Absolute CMFP scores did not differ significantly at any time point between children who increased their zBMI between 7 and 9 years and those who did not. Nearly half (41.2%) of mothers increased their controlling feeding practices between 7 and 9 years. Children whose mothers increased their CMFP score between 7 and 9 years did not differ by gender, race, maternal education, or maternal FRS scores compared to those who did not. Child zBMI also did not differ significantly at any time point between children whose mothers increased their controlling feeding practices from 7 to 9 years and those who did not.

Table 2 shows the main effect of increasing CMFP between 4 and 7 years on increases in zBMI between 7 and 9 years in the adjusted model, stratified by gender. For girls, neither an increase nor decrease in maternal control over feeding between 4 and 7 years was associated with later increases in zBMI. However, boys had decreased odds of increasing zBMI if mothers increased their CMFP between 4 and 7 years (odds ratio = 0.52, 95% confidence interval = 0.27–1.00). There was no significant interaction between baseline CMFP, maternal FRS score, or baseline child weight status and change in CMFP between 4 and 7 years in either gender.

Table 2 Relationship between change in zBMI and change in CMFP

	Odds of an increase in zBMI between 7 and 9 years (OR (95% CI))	
	Girls (*N* = 387)	Boys (*N* = 341)
Change in CMFP between 4 and 7 years		
More controlling	1.00 (0.54–1.83)	0.52* (0.27–1.00)
Less controlling	1.06 (0.52–2.17)	0.47 (0.20–1.08)
No change	1.00	1.00
Race (other vs. white)	1.63 (0.86–3.09)	0.60 (0.28–1.27)
Maternal education	0.96 (0.86–1.07)	1.01 (0.91–1.12)
Maternal FRS score	1.10 (0.92–1.31)	1.20* (1.01–1.43)
Child BMI ≥ 95th percentile at 4 years	0.15** (0.04–0.67)	0.48 (0.19–1.22)
CMFP at 4 years	1.05 (0.67–1.66)	1.16 (0.72–1.88)
	Odds of an increase in CMFP between 7 and 9 years (OR (95% CI))	
	Girls (*N* = 413)	**Boys (*N* = 376)**
Change in zBMI between 4 and 7 years		
Highest 25th% vs. lowest 75th%	1.72* (1.08–2.74)	1.07 (0.66–1.74)
Race (other vs. white)	1.10 (0.63–1.92)	0.79 (0.43–1.44)
Maternal education	1.01 (0.92–1.10)	1.05 (0.96–1.15)
Maternal FRS score	0.96 (0.83–1.11)	0.99 (0.85–1.15)
Child BMI ≥ 95th percentile at 4 years	0.96 (0.47–1.96)	1.07 (0.52–2.21)

CI, confidence interval; CMFP, controlling maternal feeding practice; FRS, Figure Rating Scale; OR, odds ratio; zBMI, BMI *z*-score.
*$P \leq 0.05$; **$P \leq 0.01$.

We next examined the association between increasing zBMI between 4 and 7 years and an increase in CMFP between 7 and 9 years using an adjusted model stratified by gender (Table 2). Among girls, those who had the greatest increase in zBMI between 4 and 7 years were most likely to have mothers who increased control over what their children ate between 7 and 9 years (odds ratio = 1.72, 95% confidence interval = 1.08–2.74). Among boys, there was no association between changing zBMI and change in later CMFP scores. Again, there was no interaction between either baseline child weight status or maternal FRS score and change in zBMI between 4 and 7 years in either gender.

DISCUSSION

In this study, we examined the longitudinal relationship between changes in CMFPs and child BMI. Previously, there has been evidence to suggest that controlling feeding practices are associated with excessive weight gain in children (1,5,6). However, this longitudinal study of a large national cohort demonstrated that early increases in CMFPs were not associated with later increases in zBMI in girls or boys. In boys, the odds of increasing one's zBMI were actually decreased. On the other hand, increases in child zBMI between 4 and 7 years were significantly associated with later increases in CMFP among girls, but not boys.

Our study adds further evidence that controlling feeding practices may not be associated with future excessive weight gain in children. Although restrictive feeding practices have been shown to be associated with increased caloric intake in a controlled laboratory environment (1,5), restrictive behaviors outside the laboratory, influenced over time by other environmental and parenting factors, may not show the same associations. Therefore, we propose that it may be premature to recommend for all children that parents avoid restrictive or controlling feeding practices to prevent excessive weight gain.

We also did not find a moderating effect of maternal weight status or baseline child weight status on this feeding practice and its association with future excessive child weight gain. However, boys were found to have decreased odds of increasing their zBMI if mothers displayed increasing control between ages 4 and 7 years. This finding supports previous work that boys and girls may respond differently to maternal feeding practices (1,2). However, in contrast to their null association for boys, we found that boys had a significant response to controlling feeding practices such that their risk for excessive weight gain was reduced. This again may reflect differences between studying behaviors in a laboratory setting vs. a naturalistic setting. This result may also be secondary to different forms of controlling practices being used for boys compared to girls. Future discrimination between these forms of controlling practices, used for each gender, may help to clarify our findings.

In actuality, there may be some children for whom these or similar types of feeding practices are necessary to help

regulate a child's intake and limit excessive weight gain. Recently Ogden *et al*. tried to expand the concept of controlling feeding practices by distinguishing between overt (i.e., being firm about what, when, where, and how much a child eats) and covert (i.e., not going to restaurants or bringing sweets and snacks into the house) practices (33). Several studies have suggested that these different forms of controlling behavior may be associated with healthier eating behaviors and less snack food intake (33,34). Aspects of covert control are currently used in many family-based weight control programs (35). In addition, controlling feeding practices may be like many other efforts at providing discipline. Depending on how it is delivered, it may not have a negative impact on child eating behaviors or weight. Rather, the more harmful effects may only occur with more extreme versions of the parenting practice. Again, future discrimination between different forms of controlling practices and how they are delivered may help to clarify our findings.

We also found that significant increases in CMFPs occurred after significant increases in girls' zBMI, but not boys'. These findings suggest that mothers are more concerned with a female child's rapid weight gain than a male child's, and will become more controlling as a result. Our results complement the results of other cross-sectional studies noting that mothers do not exert different types of controlling feeding practices in relation to boys' weight status (36), and parents are much less likely to recognize or be concerned about the overweight status of sons compared to daughters (37–39). These behaviors may represent a sensitivity to societal values that girls should be slim while boys may have a physical and social advantage by being larger. The stronger response to rapid weight gain in girls could also stem from personal factors like dietary restraint or history of eating disorders that are often projected onto the same sex child (40,41) and are highly correlated to monitoring or restriction of daughters' eating (42,43).

An important limitation of this study is that maternal controlling feeding practices were assessed with a single question. Psychometrics of this question and how it relates to other commonly measured feeding practices, like restriction, pressure and monitoring, as measured by the Child Feeding Questionnaire (44) are unknown. However, our study is not the first to use a single question to capture the concept of maternal feeding practices (7,45) and using a construct with more than one item does not necessarily protect against misinterpretation of these items (46). Of note, in this data set, increased CMFP correlated with increased pressure to eat in the videotaped snack sessions. Specific restrictive behaviors were not observed. However, this does not mean that mothers are not restrictive in other situations and settings. Rather, it was not captured on this videotaped procedure. Second, interpretation of this question between subjects could have been quite variable. However, as it was asked repeatedly over time, the within subject interpretation of the question likely remained stable. As controlling feeding practices are thought to affect child weight gain through its impact on child eating behaviors, the availability of these data would have also been helpful. Finally, there were significant differences between those included and excluded in the sample and generalizability may be limited.

In conclusion, our study provides further evidence that CMFPs may not be associated with later increases in child zBMI, and may instead be a response to increasing child weight. Recommendations to avoid controlling feeding practices may need to be clarified, particularly if certain forms of controlling practices help to promote healthier eating habits (33,34,47,48). Applying other methodologies that examine dyadic interactions between parent and child may allow for a richer understanding of how specific feeding practices play a role in the development or prevention of obesity. Further definition and exploration of these types of feeding practices and their relationship with child weight gain is needed to better inform recommendations for obesity treatment and prevention.

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DISCLOSURE

The authors declared no conflict of interest.

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