LONGITUDINAL INFLUENCE OF MOTHER'S CHILD-FEEDING PRACTICES ON ADIPOSITY IN CHILDREN

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Objective **Parental child-feeding practices are potentially significant determinants of body weight in youth. To date, research has focused on white middle class mother-child dyads. This study examines the longitudinal influences of child-feeding practices with time on total fat mass in white and African American boys and girls.**

Study design **Seventy-four white children (49 girls, 25 boys) and 47 African American children (25 girls, 22 boys; mean age at baseline, 11.0 years) and their mothers participated in this study. Child-feeding practices were measured with the Child Feeding Questionnaire. Total fat mass was measured by means of Dual energy X-ray absorptiometry on a yearly basis. The average follow-up period was 2.7 years.**

Results **Pressure to eat and concern for the child's weight in white participants and restriction and concern for the child's weight in African American participants were significantly related to total fat mass at baseline. Concern for the child's weight was negatively related to the change of total fat mass with time in white participants. No longitudinal effects of child feeding practices on the change of total fat mass were found in African American participants.**

Conclusion **Parental concern for weight is a predictor of change in total fat mass with time in white children, but not African American children.** ***(J Pediatr 2006;148:314-20)***

The identification of modifiable determinants of adolescent adiposity has become a central concern in public health.[1] Parental child-feeding practices, including monitoring of their children's food intake, feelings of responsibility for what their children eat, restriction of palatable foods, pressure to eat, and concern for weight,[2] have been identified as potentially significant determinants of body weight in children and adolescents.[3]

Several studies have suggested that mothers' monitoring of their children's food intake, restriction of palatable foods and concern for their children's weight may be counterproductive, endangering self-regulation mechanisms and ultimately leading to higher energy intake when restricted foods become available. Although a handful of studies have included or focused on minority children,[4-6] much of the research on child feeding practices has been conducted in white middle-class mother-daughter dyads, and findings across ethnicity, socioeconomic class, and sex are inconsistent.

Initial longitudinal studies on child-feeding practices in samples of white mother-daughter dyads found that high maternal restriction of palatable foods at age 5 was related to girls' likelihood to eat in the absence of hunger at age 7 years.[7] This effect was strongest for girls with a body mass index (BMI) >75th percentile.[8]

This study is unique because it examines the influences of child-feeding practices with time on total fat mass as measured by using Dual energy X-ray absorptiometry (DEXA), which has been shown to be a more accurate indicator of adiposity in children and adolescents than the more commonly used measure of BMI.[9,10] Most studies on child feeding practices have focused on Caucasian girl-mother pairs.[11] However, we have shown that although the sex of the child has modest influence on child-feeding practices, ethnicity has a strong influence. African American mothers report more restriction, concern, responsibility, pressure to eat, and concern for child's weight than white mothers.[1] This study therefore examines the influence of the 5 most frequently studied domains of child-feeding practices (pressure to eat, responsibility, restriction, monitoring, and

CFQ	Child Feed Questionnaire	TFM	Total fat mass
DEXA	Dual energy X-ray absorptiometry	TLM	Total lean mass
GCRC	General Clinical Research Center		

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Table 1. Sample characteristics by ethnicity at baseline

	Total sample (n = 121)	White (n = 74)	African American (n = 47)	Significant effects of ethnicity or sex*
Sex	38.8% boys	33.8% boys	46.8% boys	NS
Age in years (mean, SD)	10.9 (± 1.7)	11.0 (± 1.7)	10.8 (± 1.7)	NS
Socioeconomic status (SES) (mean, SD)	44.9 (± 14.0)	52.1 (± 8.3)	34.0 (± 14.2)	Ethnicity F = 76.4 ($P < .0001$)
Total lean mass (kg, mean, SD)	30.6 (± 7.2)	29.6 (± 7.0)	32.3 (± 7.3)	Ethnicity F = 4.19 ($P = .04$)
Total fat mass (kg, mean, SD)	14.5 (± 10.2)	13.5 (± 9.0)	16.0 (± 11.7)	NS

*A chi-square test was used to examine the differences in the proportion of boys, whereas a *t* test was used to examine the differences in the means of SES, total lean mass, and total fat mass between white and African American children. Higher values on SES indicate higher SES.

concern for child's weight) on child adiposity in African Americans and Caucasians and includes boys as well as girls in the child-mother dyads.

METHODS

The data presented are derived from an ongoing, longitudinal study of childhood obesity.[12] The children make annual overnight visits to the General Clinical Research Center (GCRC) at the University of Alabama at Birmingham. At one of these visits (most frequently the fourth visit), psychosocial data, including data on child feeding practices, are collected. Psychosocial data are collected 1 time only. Two weeks after the initial GCRC visit, the children complete further testing at the Department of Nutrition Science at the University of Alabama at Birmingham clinic, including assessment of body composition by using DEXA (with the children arriving in the fasted state). Anthropomorphic/DEXA measures are repeated at each annual visit.

The study was approved by the Institutional Review Board of the University of Alabama at Birmingham. Informed consent was obtained from all subjects before testing, and all subjects received compensation for their participation.

Only subjects with completed child-feeding questionnaires and subsequent anthropomorphic/DEXA data for at least 2 annual visits to the GCRC were included in these analyses. According to these criteria, data were available for 74 white children (49 girls, 25 boys) and 47 African American children (25 girls, 22 boys; Table I). The mean number of annual visits completed was 2.7 (range, 2-5). Mean age at baseline was 11.0 years (± 1.7 years). The subjects were recruited by newspaper advertisements, distribution of flyers, and word of mouth. Absence of major illness since birth was the sole inclusion criterion for participation in the study. Our sample included children who were obese and children of normal weight.

Mother's feeding practices were measured by using 5 subscales from the Child Feeding Questionnaire (CFQ). The CFQ is a self-report questionnaire that measures perceptions of child's overweight and mothers' child-feeding attitudes and practices with five subscales: 1) Pressure to eat (4 items), assessing parents' tendency to try to get child to eat more food, especially during meals; 2) Responsibility for feeding (3 items), assessing how frequently parents feel responsible for what, when, and how much their children eat; 3) Restriction (8 items), assessing the degree to which mother restricts access to sweets and high-fat foods or uses favorite foods as rewards; 4) Monitoring (3 items), assessing the degree to which mothers keep track of the amount of sweets and high fat junk food that their children eat; and 5) Concerns for child's weight (3 items), assessing parental concerns about the child's risk of being overweight.[2] Items are scored on a 5-point Likert-type scale from 1 (low) to 5 (high). Internal consistency of the subscales in this sample ranged from 0.72 to 0.78 and has been given previously.[1] Scores on these subscales have been related to energy-intake regulation, child weight status,[13] and parent's and children's energy intake.[14]

Ethnic differences in health indicators are often confounded by socioeconomic differences.[15,16] Therefore, socioeconomic status was measured with the Hollingshead 4-factor index of social class. This scale combines the educational attainment and occupational prestige for the number of working parents in the child's family.[17] This index ranges from 8 to 66. Higher values indicate higher social class background. Socioeconomic status has been associated with BMI,[18-20] physical activity levels,[21-23] and diet.[24,25]

Body composition, including total lean tissues mass and total fat mass, was assessed with DEXA using a Lunar DPX-L densitometer and pediatric software.[26] The subjects were scanned while lying on their backs in light clothing, with the pediatric medium or large mode, depending on the weight of the child.[27] DEXA scans were completed on a yearly basis for an average follow-up period of 2.7 years after the administration of the CFQ. DEXA has been shown to be a reliable and valid measure for body composition in children.

Total fat mass (TFM) and total lean mass (TLM) were log-transformed to approximate a normal distribution before analysis. Chi-square tests were used to examine the differences in the proportion of boys between white subjects and African American subjects. *t* tests were used to examine the differences in means of continuous variables between white subjects and African American subjects. The differences in mean scores of child-feeding subscales (pressure, responsibil-

Table II. Comparison of CFQ subscales by sex and ethnicity, means (SD)

	Pressure	Responsibility	Restriction	Monitor	Concern
Total sample (n = 121)	2.1 (1.1)	3.8 (0.8)	3.0 (1.0)	3.7 (0.8)	3.2 (1.4)
Sex					
Male (n = 47)	2.3 (1.2)	3.9 (0.7)	3.0 (1.0)	4.0 (0.7)	3.3 (1.5)
Female (n = 74)	1.9 (1.1)	3.7 (0.9)	3.0 (1.0)	3.5 (0.8)	3.2 (1.4)
Ethnicity					
White (n = 74)	1.6 (0.8)	3.6 (0.8)	2.8 (1.0)	3.6 (0.9)	2.9 (1.5)
African American (n = 47)	2.8 (1.2)	4.2 (0.7)	3.3 (1.0)	3.9 (0.7)	3.5 (1.2)
Significant effects*					
	Sex F: 3.83 (*P* = .053)			**Sex** F: 11.06 (*P* = .0012)	
	Ethnicity F: 39.66 (*P* < .0001)	**Ethnicity** F: 17.44 (*P* < .0001)	**Ethnicity** F: 9.72 (*P* = .0023)	**Ethnicity** F: 4.72 (*P* = .032)	**Ethnicity** F: 5.57 (*P* = .0199)

*F-test was used to examine the differences in means in the one-way analysis of variance models, with a degree of freedom (*df*) of 1 and 119 for all significant effect.

ity, restriction, monitor, and concern) between sex and ethnicity at baseline were tested using F-tests in one-way analysis of variance models.

To examine the rate of change in TFM from baseline to follow-up years, we performed a linear mixed-effects analysis.[28,29] Conceptually, the analyses were performed in 2 steps. First, the repeated measures of TFM were modeled as a function of time (mean, 2.7 measures) for each individual to examine the rate of change in TFM with time (the slope). Second, the rate of change in TFM with time was regressed on the child-feeding subscales (pressure, responsibility, restriction, monitor, and concern) to examine the effects of child feeding subscales on the changing rate of TFM with time. In the mixed-effects analysis, these 2 steps were combined to obtain the estimates for the effects of co-variates on the average levels at baseline and the average rate of change for TFM. The regression weight for each predictor represented the effect of each predictor on the level of TFM at baseline, whereas the regression weight for the interaction terms between the time variable and each predictor represented the effect of the particular predictor on the rate of change for TFM with time. *t* tests were used to determine the *P* values for the regression weights in the linear mixed-effects models. In keeping with earlier approaches to understanding the effects of child-feeding practices, 2 models were developed: one examining effects of parental attitudes (concern for child's weight and responsibility) on child adiposity, and another examining the effects of parental behaviors (monitoring, pressure, and restriction) on child adiposity.[30] These 2 models were developed for the total sample and subsequently for African American and white participants separately.

We controlled for TLM at baseline as a potential confounder.[31,32] We included sex, ethnicity (in the model for the total sample), and socioeconomic status in the model to adjust for their potential confounding effects on the association between the child-feeding subscales and the changing rate of TFM. All descriptive analyses were performed on SPSS software for Windows, version 9.0, and the mixed-effects analyses were conducted by using the PROC MIXED procedure in SAS software, version 8.2.[33,34] A *P* value <.05 was considered to be an indication of statistical significance for all 2-tailed tests.

RESULTS

As shown in Table I, there were no significant differences in sex distribution between ethnic groups, and no ethnic or sex differences in age. All mothers reported being the same ethnicity as their children (data not shown). African American subjects scored significantly lower on the Hollingshead index of socioeconomic status. African American children had significantly more TLM than white children. There were no significant ethnic or sex differences in TFM.

Descriptive statistics and results of 2 time 2 (ethnicity x sex) analyses of variance for each of the CFQ subscales completed by the mothers are shown in Table II. Mothers tended to pressure boys to eat more at mealtime and to clean their plates more often than they did girls. Mothers also tended to monitor boys' sweets, fat, and junk food intake more than that of girls. African American mothers scored higher on all 5 CFQ subscales, reporting more pressure to eat, feelings of responsibility, restrictive practices, monitoring, and concern for child's weight. There were no significant interaction effects of sex and ethnicity on any of the CFQ subscales.

Table III shows the zero-order correlations between CFQ subscales and TFM by race. We include fat mass at baseline, end point, and changes between baseline and end point.

To ensure that possible multicollinearity was not responsible for obscuring effects of separate subscales, 2 models exploring effects of 1) parental attitudes and 2) parental feeding behavior subscales were developed. Results from these mixed models, which examined the effects of CFQ measured at baseline on the changes in TFM during an average follow-up period of 2.7 years after the administration of the CFQ, are presented in Table IV. TLM at baseline was

Table III. Correlation coefficients between CFQ subscales and total fat mass by race

Total fat mass (kg, log)	White (n = 74)					African American (n = 47)				
	Pressure	Responsibility	Restriction	Monitor	Concern	Pressure	Responsibility	Restriction	Monitor	Concern
At baseline	−0.16	−0.07	0.46	0.01	0.62	−0.14	0.23	−0.05	−0.05	0.38
At end point	−0.15	−0.10	0.43	−0.02	0.51	−0.12	0.27	0.02	−0.03	0.36
Changes between baseline and end point	0.13	0.00	−0.13	−0.04	−0.34	0.06	0.06	0.14	0.03	−0.05

included as a co-variate in the model, with a significant effect on TFM.

There were no significant effects of ethnicity, sex, or socioeconomic status. There was a significant main effect of time on the change of TFM for the total sample and white subjects only.

Responsibility was related to lower fat mass at baseline in white subjects only. In white subjects, the children of mothers who reported feeling more responsible for what their children ate were less adipose at baseline. Concern for child's weight was positively related to TFM at baseline in the full sample, white subjects, and African American subjects, indicating that the higher the child's initial TFM, the more concern their mothers reported about their children's weight. Pressure to eat was related to lower TFM at baseline for the full sample and white subjects only. In white subjects, the lower the TFM, the higher the pressure to eat. Restriction was related to higher TFM at baseline for the full sample and white subjects only. White children whose mothers reported higher restriction of palatable foods tended to be more adipose at baseline.

Only 1 subscale showed a significant relationship with the change in TFM with time. This was mother's concern for child's weight, which was significantly and negatively related with the rate of change in TFM with time. However, this effect was only found in the full sample and in white subjects. All mothers who showed higher concern for their child's weight at baseline did indeed have children with higher TFM at baseline. However, only in white children was this concern related to less increase in TFM with time. We found no longitudinal effects of CFQ variables on TFM in African American children.

DISCUSSION

The findings from this study provide longitudinal evidence that a mother's concern for her child's weight may protect against an increase in adiposity during an average follow-up period of 2.7 years in white mother-child dyads. White mothers who were concerned about their children's weight at baseline had heavier children, and this concern was related to a slower increase in body fat with time. Although a mother's concern for her child's weight represents an affective state and does not directly correspond to action or behavior, this concern might be linked to as-yet-undefined behaviors that can help children to regulate weight gain.

A major finding of this study is that models of the effects of maternal child-feeding practices on child's TFM did not generalize across ethnicities. In separate models of attitudinal and behavioral child-feeding practices, responsibility was related to adiposity in white subjects only, whereas pressure was related to lower TFM and restriction was related to higher TFM at baseline in white subjects. These relationships did not persist with time. Consistent with our previous work, there is no evidence that restriction is effective in reducing adiposity with time.[7,35,36]

In African American and white subjects, concern for a child's weight was related TFM at baseline. The effect of concern with time was significant for white subjects only—white children whose mothers were concerned about their weight were heavier at baseline, but accrued less body fat with time. African American mothers who were concerned about their children's weight at baseline had heavier children, but concern for child's weight had no effect on the accrual of TFM with time in this group. None of the child-feeding practices studied here showed any effect on the adiposity of African American children with time. Despite African American subjects having higher levels on all CFQ subscales than white subjects, behaviors that may be used by parents to address their concern were linked to weight status in white subjects but not in African American subjects. This suggests that although white parents may use feeding behaviors, for instance restriction, to address their concerns about the child's weight, this is not the case in African American families. The feeding behaviors measured by the CFQ are unrelated to fat mass in African American subjects across the board. Comparisons of the overall model with the models developed separately for each ethnicity suggests that: 1) when ethnicities are combined in 1 model, important differences may be obscured, and 2) the same model cannot be assumed across ethnicities.

There was a significant difference in socioeconomic status between African American subjects and white subjects in our sample (Table I). Socioeconomic status was also significantly related to TFM (r = 0.11, $P < .02$) and to all child feeding practices except monitoring of child's food intake (correlations significant at $P < .001$). Although removal of socioeconomic status from the models yielded the same significant relationships between the child feeding practices and TFM (data not shown), the significant correlations among socioeconomic status, predictors, and criterion suggest that

Table IV. Mixed-effects model for demographic variables, child feeding practices, and total fat mass with time, separate models for attitude and behavior sub-domains

	Total			White			African American		
	Parameter estimates	SE	*P* value	Parameter estimate	SE	*P* value	Parameter estimate	SE	*P* value
Attitude subdomain									
Main effects									
Time	0.18	0.08	.03	0.21	0.10	.04	0.12	0.15	.39
Responsibility	−0.07	0.06	.16	−0.14	0.07	.05	0.07	0.13	.59
Concern	0.23	0.03	<.0001	0.23	0.04	<.0001	0.21	0.08	.01
Interaction terms									
Time*Responsibility	0.02	0.02	.45	0.01	0.03	.74	0.02	0.04	.54
Time*Concern	−0.03	0.01	.02	−0.03	0.01	.02	−0.02	0.02	.35
Behavior subdomain									
Main effects									
Time	0.10	0.07	.20	0.08	0.08	.33	−0.08	0.17	.61
Pressure	−0.08	0.06	.15	−0.20	0.07	.01	0.02	0.09	.82
Restriction	0.15	0.06	.01	0.26	0.06	<.0001	−0.02	0.10	.85
Monitoring	−0.01	0.07	.94	−0.08	0.06	.23	0.19	0.14	.20
Interaction terms									
Time*Pressure	0.01	0.01	.42	0.05	0.03	.05	0.01	0.02	.68
Time*Restriction	−0.01	0.02	.57	−0.00	0.02	.81	0.00	0.03	.90
Timey*Monitoring	0.02	0.02	.40	0.003	0.02	.88	0.05	0.04	.21

The effects were adjusted for sex, race, socioeconomic status, and initial total lean mass by using SAS PROC Mixed procedure software.

socioeconomic status and ethnicity may nonetheless be confounded. Socioeconomic status has profound effects on health and health-related behaviors and may influence child-feeding practices independently or in interaction with ethnicity. High socioeconomic status is related to drive for thinness, higher levels of physical activity,[23] healthier food purchasing behavior,[37] healthy diet,[38] lower BMI,[20] and negative attitudes toward overweight.[39] Conversely, low socioeconomic status is related to lack of resources, education, social support, poor diet, and lack of access to low-fat and low-calorie palatable foods.[37] Mothers with a low socioeconomic status tend to think that heavier infants are healthier, to consider a heavy child to be a sign of good mothering,[40,41] and to be less concerned about their child's weight.[41] Mothers with a low income may find it emotionally very difficult to deny their children food, even when the child has just eaten a full meal, and tend to provide sweets or high-fat snacks to children on demand.[41] One possible interpretation for our finding that concern for child's weight at baseline had no protective effect on TFM in African American children is that differences in food environments between middle-class white Americans and low-income African Americans may interact with feeding practices. There is evidence that there are more fast food restaurants and convenience stores but fewer supermarkets where fruit and vegetables are available in low-income neighborhoods.[42] Therefore, parental concern for child's weight may be more difficult to translate into effective feeding practices for low-income African American parents. These conditions would contribute to a very different feedback cycle in the bi-directional pathways of influence in parent-child interactions in white dyads than in African American dyads.[43]

Our findings support recent literature suggesting that ethnicity and socioeconomic status need to be taken into account in the study of parental approaches to child-feeding practices.[8,44-46]

The literature on parenting practices and child outcomes reveals that interactions between parents and children do not represent a simple, unidirectional system. Our findings and findings of others suggest that parental feeding attitudes and behaviors may be a response to child adiposity. In African American and white parents, concern about child weight is related to TFM. For white families, the child's TFM is also related to restriction, suggesting that concern is translated into parental action, depending on child adiposity. Restriction is positively linked to adiposity for white families. However, there is no selective use of restriction by African American parents, although they do report high levels of restriction. Although African American parents report high levels on all CFQ subscales, only concern is related to weight status; no feeding behaviors are. However, although African American parents report using relatively high levels of pressure and restriction, they apparently are not applying it as a response to child adiposity.

The CFQ was developed to assess feeding practices in parents of preschool-aged children. This study followed children from periadolescence into adolescence. Parenting practices change as children develop.[47] Parents of preschool-aged children may have a different level and nature of involvement in their children's eating than parents of children nearing adolescence. Interviews with adolescents (12-17 years of age) suggest that parents relinquish involvement and influence on eating habits as children progress through adolescence.[47] As children mature, they are increasingly exposed to opportunities to purchase energy-dense foods away from home and without parental supervision.[42] It is possible that new dimensions of child-feeding practices emerge as children develop and that child-feeding practices have diminished influence on child adiposity as children move through adolescence.

Our earlier research found that child-feeding practices are key behavioral variables that explained more of the variance in body fat than did dietary fat intake.[1] However, we assume that the link between child-feeding practices and weight status must be mediated or moderated by energy intake, energy expenditure, or both. Future research should include longitudinal measures of dietary intake and physical activity to better understand the pathways by which child-feeding practices influence child adiposity. More formative research is needed to uncover dimensions of child-feeding practices relevant in ethnically and socioeconomically diverse populations.

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50 Years Ago in *The Journal of Pediatrics*

THE MEASUREMENT OF INTELLIGENCE IN CHILDREN WITH CEREBRAL PALSY: THE COLUMBIA MENTAL MATURITY SCALE

Berko, MJ. J Pediatr 1955;47:253-60

The Columbia Mental Maturity Scale (CMMS) was published in 1954. Because it required no verbal response, minimal motor response, and little verbal communication, it was considered to be a promising instrument to measure intelligence in children with multiple handicaps such as cerebral palsy. Berko administered the CMMS to 30 children with cerebral palsy and compared these results with a recent Stanford-Binet IQ score.

Surprisingly, the mean CMMS IQ was 52.9 while the mean Binet IQ for the same group of children was 67.9. This 17-point discrepancy was contrasted to a one-point discrepancy between the CMMS and the Stanford-Binet IQ that was reported in a group of 30 children without cerebral palsy. Thus the CMMS's theoretical advantages failed to translate into an improved instrument to assess cognition in these children. Berko explained the failure by a closer inspection of the pattern of cognitive impairment that occurs in brain-injured children. The CMMS's dependence on visual perception, categorization, and abstraction was considered to interfere with children with cerebral palsy performing optimally on the test; their tendency to perseverate only made things worse.

Berko's review of the clinical picture of brain-damaged children remains relevant; he described "an emotionally toned reaction pattern" similar to what is seen in "childhood aphasia" with propositional defects, catastrophic reactions, hyperirritable attention, emotional lability, and initiatory confusion and delay. The "propositional defect" refers to the child's different performance (pass/fail) on the same test item in different situations. This would typically relate to the presence (or perception) of greater stress in one situation. A "catastrophic reaction," on the other hand, is in response to perceived danger; the child either withdraws and "blanks out" or simply "does anything" (impulsively offers wildly wrong answers) just to escape the demands of the test situation.

Measures of intelligence appropriate to children with multisystem impairments such as cerebral palsy remain difficult to use without qualifying the results.

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