Parental Feeding Attitudes and Styles and Child Body Mass Index: Prospective Analysis of a Gene-Environment Interaction

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ABSTRACT. *Background.* **Parental feeding styles were linked to child weight in cross-sectional studies, which were unable to test the direction of effect. Prospective studies can best establish causal relationships among such variables.**

Objective. **We tested the 2-year stability of parental feeding attitudes and styles and investigated whether these variables predict child body mass index (BMI) *z* scores 2 years later. We evaluated whether these associations were dependent on children's predisposition to obesity.**

Methods. **Participants were 57 families enrolled in an Infant Growth Study of children born at high risk or low risk for obesity, on the basis of maternal prepregnancy overweight or leanness. Children were evaluated for weight and height at 3, 5, and 7 years of age. Measures of parental feeding attitudes and styles were ascertained with the Child Feeding Questionnaire at 5 and 7 years of age. Correlation and multiple regression analyses tested whether parental feeding styles at age 5 predicted increased child BMI *z* scores 2 years later.**

Results. **Parental feeding attitudes and styles were stable for child ages of 5 to 7 years. With respect to feeding attitudes, perceived responsibility at age 5 predicted reduced child BMI *z* scores at age 7 among low-risk families, whereas child weight concern and perceived child weight predicted increased child BMI *z* scores among high-risk families. With respect to feeding styles, monitoring predicted reduced child BMI *z* scores at age 7 among low-risk children. In contrast, restriction predicted higher BMI *z* scores and pressure to eat predicted reduced BMI *z* scores among high-risk children. These associations remained significant after controlling for child weight status at age 3.**

Conclusions. **The relationship between parental feeding styles and child BMI *z* scores depends on child obesity predisposition, suggesting a gene-environment interaction. Among children predisposed to obesity, elevated child weight appears to elicit restrictive feeding practices, which in turn may produce additional weight gain. Parenting guidelines for overweight prevention may benefit from consideration of child characteristics such as vulnerability to obesity and current weight status.** ***Pediatrics*** **2004;114:e429–e436. URL: www.pediatrics.org/cgi/doi/10.1542/peds.2003-1075-L;** ***childhood overweight, obesity, feeding styles, restriction, gene-environment interaction.***

ABBREVIATIONS. BMI, body mass index; CFQ, Child Feeding Questionnaire.

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Childhood overweight is an increasingly prevalent disorder that is associated with multiple health complications in childhood and later adulthood.[1] The rapid increase in obesity in America provides strong evidence that, whatever the genetic liability, environmental influences play a key role in its development. There is active interest in identifying specific environmental influences on childhood obesity.[2] If these environmental factors are driving the current epidemic, then modifying these factors might reduce the epidemic.

A prominent environmental influence on children's eating may be parental control of child eating.[3] Johnson and Birch[4] reported that parental control of child eating was associated with poorer eating regulation in a child development laboratory setting, which, in turn, was associated with increased child body weight. Other reports suggested that parental restriction of child eating was associated with increased food intake by children,[5–7] including findings from experimental laboratory studies.[5] However, child eating and weight status may elicit parental control and restriction of child eating,[8–10] and cross-sectional studies cannot determine the direction of associations. Furthermore, at least 3 cross-sectional studies have failed to detect an association between parental feeding styles and child body mass index (BMI) or obesity status.[11–13]

One factor that has not been explicitly studied is children's genetic predisposition to obesity, in conjunction with parental feeding attitudes and styles. Some children are at greater risk for overweight than others, and this factor might influence the relationship between parental control of child eating and child weight.[10] Children born at high risk for overweight experience more rapid weight gain by 6 years of age than do children at low risk for obesity,[14,15] a situation that could elicit increased parental restriction of child eating.[8,9] Studying children who differ in predisposition to obesity may contribute to an understanding of inconsistent findings in the literature, particularly on the part of mothers who are overweight themselves.

This report describes a prospective analysis designed to clarify the direction of causation between parental control over child eating and the child BMI *z* score, both assessed at child ages 5 and 7 years. This age span encompasses a potential critical period for the development of overweight among children.[16] Subjects were enrolled in the Infant Growth Study,[17] which measured the growth and development of children born at high or low risk of obesity, on the basis of maternal overweight or leanness before the birth of the child.

The present analysis addressed the following 3 questions: (1) Are parental feeding attitudes and styles stable for 2 years? (2) Are parental feeding attitudes and styles associated with child BMI *z* scores cross-sectionally and then prospectively, and do these associations depend on child obesity risk status? (3) Do parental feeding attitudes and styles predict subsequent child BMI *z* scores, when controlling for the child's prior BMI *z* score?[18] We hypothesized the following. First, we predicted that parental feeding attitudes and styles would be stable for 2 years. Second, on the basis of prior studies,[19] we predicted that increased parental restriction of child eating, reduced parental pressure to eat, and increased concerns about child weight would be associated cross-sectionally and prospectively with increased child weight status. We expected that these associations would be more pronounced among high-risk families. Finally, we predicted that any prospective influence of parental feeding attitudes or styles on child BMI *z* scores would be attenuated when controlling for the child's prior BMI *z* score. This would suggest that the effects of parental feeding attitudes and styles on child weight are elicited by the child's prior body weight, at least in part.[18]

METHODS

Participants

Participants were 57 white families enrolled in the longitudinal Infant Growth Study,[17] which was designed to test the growth and development of children born to either overweight or lean mothers. Families were recruited through the Growth and Nutrition Laboratory of the Children's Hospital of Philadelphia. Families were invited to participate in a prospective study of growth and development, with most enrolling parents being recruited from Pennsylvania and Lankaneau Hospitals during birth admissions. Infants were enrolled at birth, and the cohort has been continuously monitored to the present. For the current study, the parent bringing his or her child to the annual evaluation was responsible for completing the pertinent questionnaires; in the majority of cases, this individual was the mother. The procedures described herein were performed when the children were 5 and 7 years of age.

Measures

Child Demographic Features

Age and gender were noted for all children.

Obesity Risk Status

Children were classified as high risk for obesity at study enrollment if their mothers had a prepregnancy weight of >66th percentile or as low risk if their mothers' weight was <33rd percentile.[17] The BMI of high-risk mothers was 30.3 ± 4.2, whereas that of the low-risk mothers was 19.5 ± 1.1. Among the 12 fathers included in the present analyses, the mean BMIs were 27.6 ± 5.9 and 27.9 ± 2.9 for fathers of high-risk ($n = 5$) and low-risk ($n = 7$) children, respectively.

Child BMI

Child weight was measured with a digital scale (model 4800; Scaletronix, Carol Stream, IL), and height was measured with a wall-mounted stadiometer (Holtain, Crymych, United Kingdom). Child BMIs were computed and converted to *z* scores for analyses.[20] BMI measurements were recorded at the year 3, year 5, and year 7 visits.

Parental Feeding Attitudes and Styles

Parental feeding attitudes and styles were measured with the Child Feeding Questionnaire (CFQ).[19] The following 3 feeding attitudes were evaluated: perceived child weight, ie, parents' perceptions of their child's weight status (this 3-item subscale has an internal consistency of Cronbach's $\alpha = .83$); child weight concern, ie parents' concerns about their child's weight (this 3-item subscale has an internal consistency of Cronbach's $\alpha = .75$); perceived responsibility, ie, parents' beliefs about parental responsibility for feeding their child (this 3-item subscale has an internal consistency of Cronbach's $\alpha = .88$). The following 3 feeding styles were evaluated: restriction, ie, the extent to which parents attempt to restrict their child's eating during meals (this 8-item subscale has an internal consistency of Cronbach's $\alpha = .73$); pressure to eat, ie, parents' inclination to pressure their child to consume more food (this 4-item subscale has an internal consistency of Cronbach's $\alpha = .70$); monitoring, ie, the degree to which parents monitor their child's fat intake (this 3-item subscale has an internal consistency of Cronbach's $\alpha = .92$). Additional information on the development, validation, and specific items of the CFQ was provided by Birch et al.[19]

Data Analysis

Descriptive statistics are presented as means ± SD, according to obesity risk group. Differences in parental feeding attitudes and styles for high-risk and low-risk children at years 5 and 7 were compared with *t* tests. Pearson's correlation coefficients evaluated the 2-year stability of CFQ subscale scores. The association between parental feeding attitudes and styles and child BMI *z* scores was tested with correlation analyses and multiple-regression models. We first tested the cross-sectional correlations between individual CFQ subscale scores and child BMI *z* scores at both the 5-year and 7-year visits. We then tested the cross-lag correlations with time; the CFQ subscale scores at year 5 were correlated with the BMI *z* scores at year 7, and the BMI *z* scores at year 5 were correlated with the CFQ subscale scores at year 7.

Hierarchical, multiple-regression models tested whether feeding attitudes and styles at year 5 predicted elevated child BMI *z* scores at year 7. Separate analyses were conducted for feeding attitudes (ie, child weight concern, perceived child weight, and perceived responsibility) and feeding styles (ie, restriction, monitoring, and pressure to eat). In each analysis, we entered the appropriate CFQ subscale scores (step 1), followed by child BMI *z* scores at age 3 (step 2), to control for the influence of each child's prior weight status.[18] If the effect of year 5 CFQ subscale scores becomes nonsignificant when year 3 BMI *z* scores are controlled, then this suggests that the effect of feeding styles on future child weight status is elicited by initial child weight status.[18,21] If the prospective effect of year 5 CFQ scores on child weight status remains significant after controlling for prior BMI *z* scores, then this suggests a residual influence of feeding style beyond initial child weight. All analyses were stratified according to risk group. We adjusted the α level by using the Bonferroni correction (ie, $\alpha = .05/n$, where n equals the number of comparisons in a given analysis). We also note the associations that were significant at $\alpha = .05$, because the Bonferroni correction can be overly stringent.[22]

In preliminary analyses (not presented), we pooled the sample to test formally the interaction between risk group and CFQ subscale scores. We did this for the CFQ feeding attitude and feeding style subscales. We tested the following 2-step hierarchical regression analysis. In step 1, we jointly entered the respective CFQ subscale scores. In step 2, we jointly entered the appropriate interaction term variables. Child BMI *z* score at age 7 was the outcome. Results indicated that the block of CFQ score-risk status interaction terms (ie, step 2) was significant in both analyses ($P = .05$). This confirmed that the relationship between CFQ subscale scores and child BMI *z* scores differed according to risk group.

RESULTS

Descriptive Data

The sample included 57 families, ie, 24 high-risk families and 33 low-risk families. Forty-four percent of the girls were high risk and 56% were low risk. The CFQ subscales were completed by 50 mothers and 7 fathers at year 5 and by 47 mothers and 10 fathers at year 7. The mean ± SD child BMIs at years 5 and 7 were 16.2 ± 2.4 and 16.7 ± 3.6, respectively, whereas the child BMI *z* scores at years 5 and 7 were 0.30 ± 1.2 and 0.21 ± 1.2.

Table 1 presents means and SDs for each CFQ subscale at ages 5 and 7, according to obesity risk status. The only significant obesity risk status group difference was for child weight concern, with greater parental concern for high-risk versus low-risk children at both year 5 and year 7 ($P < .05$). When controlling for child BMI *z* scores at years 5 and 7, these differences in parental concern about child weight were no longer significant ($P > .05$). None of the other null findings changed when controlling for child BMI *z* scores.

Stability of Parental Feeding Styles

All 3 parental feeding attitudes (child weight concern, perceived child weight, and perceived responsibility) were stable for 2 years among both low-risk children ($r = 0.59–0.72$, $P < .004$) and high-risk children ($r = 0.44–0.60$, $P < .05$). Two of 3 feeding styles were stable for low- and high-risk children, ie, restriction ($r = 0.52–0.46$, $P < .05$) and pressure to eat ($r = 0.83$ and 0.64, respectively; $P < .004$). The 2-year stability of the monitoring feeding style was not significant for either low-risk children ($r = 0.23$, $P > .05$) or high-risk children ($r = 0.30$, $P > .05$).

The same findings were observed when the stability of the CFQ subscale scores was tested with regression models. Specifically, we regressed each year 7 CFQ subscale score onto the following predictors: year 5 CFQ subscale score, risk status, and 2-year change in BMI *z* scores. These analyses tested whether CFQ subscales were stable with time when controlling for concurrent changes in BMI *z* scores from ages 5 to 7 years and child risk status. With the exception of the monitoring subscale, all year 5 CFQ subscale scores predicted the respective year 7 CFQ subscale scores ($P < .001$). Increased monitoring scores at year 5 were associated with increased monitoring scores at year 7, although the effect was not significant ($P = .10$).

Correlations Among CFQ Subscale Scores and Child BMI *z* Scores

Cross-Sectional Correlations

Table 2 shows that child weight concern was positively associated with child BMI *z* scores among high-risk families at year 5 ($r = 0.77$, $P < .001$) and year 7 ($r = 0.68$, $P < .001$). Perceived child weight was positively associated with child BMI *z* scores at year 5 among high-risk families ($r = 0.62$, $P = .002$) and at year 7 among high-risk families ($r = 0.77$, $P < .001$) and low-risk families ($r = 0.51$, $P = .003$). Among low-risk families, monitoring of child eating ($r = -0.40$, $P = .02$) and perceived responsibility ($r = -0.39$, $P = .03$) were negatively associated with child BMI *z* scores at year 5.

Cross-Lag Correlations

Table 3 shows that, among high-risk families, child weight concern at year 5 predicted increased child BMI *z* scores at year 7 ($r = 0.79$, $P < .001$); conversely, child BMI *z* scores at year 5 predicted increased child weight concern at year 7 ($r = 0.61$, $P = .002$). Perceived child weight at year 5 predicted increased child BMI *z* scores at year 7 ($r = 0.61$, $P = .002$) among high-risk families. Child BMI *z* scores at year 5 predicted increased perceived child weight at year 7 among both high-risk families ($r = 0.75$, $P < .001$) and low-risk families ($r = 0.39$, $P = .03$). Finally, parental monitoring of child fat intake at year 5 predicted reduced child BMI *z* scores at year 7 ($r = -0.48$, $P = .006$) among low-risk families.

Regression Models Predicting Child BMI *z* Scores at Year 7

Feeding Attitudes

Among low-risk families, parental feeding attitudes accounted for 26% of the variance in year 7 child BMI *z* scores ($P = .04$) when entered in step 1

TABLE 1. CFQ Attitude and Style Scores (Mean ± SD) at Child Ages of 5 and 7 Years

CFQ Subscale	Subgroup	*N*	Style Score	
			Age 5 y	Age 7 y
Attitudes				
Child weight concern	High risk	24	2.22 ± 1.3*	2.46 ± 1.4*
	Low risk	32	1.40 ± 0.6	1.52 ± 0.8
Perceived child weight	High risk	24	2.93 ± 0.3	2.95 ± 0.6
	Low risk	33	2.90 ± 0.4	2.81 ± 0.4
Perceived responsibility	High risk	24	4.10 ± 0.6	4.14 ± 0.7
	Low risk	33	4.08 ± 0.6	4.12 ± 0.8
Styles				
Restriction	High risk	24	3.26 ± 0.7	3.18 ± 0.7
	Low risk	33	2.98 ± 0.8	2.88 ± 0.9
Monitoring	High risk	24	4.07 ± 0.8	3.86 ± 0.6
	Low risk	33	4.02 ± 0.8	3.92 ± 0.8
Pressure to eat	High risk	24	1.78 ± 1.0	1.82 ± 1.0
	Low risk	33	2.15 ± 1.1	2.31 ± 1.1

* High-risk group versus low-risk group: $P < .05$.

TABLE 2. Cross-Sectional Correlations Between CFQ Attitude and Style Scores and Child BMI *z* Scores at the Year 5 and 7 Assessments

	CFQ and Child BMI *z* Score at Age 5 y, *r*		CFQ and Child BMI *z* Score at Age 7 y, *r*	
	High Risk	Low Risk	High Risk	Low Risk
Child weight concern	0.77*	0.14	0.68*	0.19
Perceived weight	0.62*	0.26	0.77*	0.51†
Responsibility	0.17	−0.39†	0.03	−0.02
Restriction	0.28	−0.002	0.12	−0.03
Monitoring	0.22	−0.40†	0.05	−0.23
Pressure to eat	−0.29	−0.18	−0.38	−0.13

* $P < .002$ (Bonferroni correction, $\alpha = .05/24$).
† $P < .05$.

TABLE 3. Cross-Lag Correlations Between CFQ Attitudes and Style Scores and Child BMI *z* Scores at the Year 5 and 7 Assessments

	CFQ at Year 5 and BMI *z* Score at Year 7, *r*		BMI *z* Score at Year 5 and CFQ at Year 7, *r*	
	High Risk	Low Risk	High Risk	Low Risk
Child weight concern	0.79*	0.28	0.61†	−0.04
Perceived weight	0.61†	0.33	0.75*	0.39†
Responsibility	0.11	−0.29	0.06	−0.10
Restriction	0.25	−0.10	0.31	−0.13
Monitoring	0.22	−0.48†	0.14	−0.23
Pressure to eat	−0.35	−0.28	−0.09	−0.16

* $P < .002$ (Bonferroni correction, $\alpha = .05/24$).
† $P < .05$.

TABLE 4. Hierarchical Regression Model: Effects of Year 5 Parental Feeding Attitudes on Year 7 Child BMI *z* Score

Variable Entry	β	
	Model 1	Model 2
Low-risk families		
Step 1		
Year 5, child weight concern	.24	.12
Year 5, perceived child weight	.29	.10
Year 5, perceived responsibility	−.36*	−.30*
Step 2		
Year 3, child BMI *z* score		.55†
High-risk families		
Step 1		
Year 5, child weight concern	.65†	.45†
Year 5, perceived child weight	.34*	.12
Year 5, perceived responsibility	.05	.09
Step 2		
Year 3, child BMI *z* score		.55†

β is the standardized β (regression) coefficient.
* $P \leq .05$.
† $P < .006$ (Bonferroni correction, $\alpha = .05/8$).

(Table 4). Reduced perceived parental responsibility predicted increased child BMI *z* scores 2 years later ($P = .05$). Entering year 3 child BMI *z* scores in step 2 accounted for an additional 30% of the variance in year 7 BMI *z* scores ($P < .001$). Year 3 BMI *z* scores were significantly predictive of year 7 BMI *z* scores. In their presence, the effect of perceived parental responsibility was attenuated but remained significant ($P = .04$) (Fig 1, top).

Among high-risk families, parental feeding attitudes accounted for 70% of the variance in year 7 child BMI *z* scores ($P < .001$) when entered in step 1 (Table 4). Increased child weight concern ($P < .001$) and perceived child weight ($P = .02$) predicted increased child BMI *z* scores 2 years later. Entering year 3 child BMI *z* scores in step 2 accounted for an additional 18% of the variance in year 7 BMI *z* scores ($P < .001$). In their presence, only the effect of child weight concern remained significant but was attenuated ($P < .001$) (Fig 1, bottom).

Feeding Styles

Among low-risk families, parental feeding styles accounted for 29% of the variance in year 7 child BMI *z* scores ($P = .03$) when entered in step 1 (Table 5). Reduced monitoring of child fat intake predicted increased child BMI *z* scores 2 years later ($P = .009$). Entering year 3 child BMI *z* scores in step 2 accounted for an additional 28% of the variance in year 7 BMI *z* scores ($P < .001$). In their presence, the effect of monitoring was attenuated but remained significant ($P < .001$) (Fig 2, top).

Among high-risk families, the 3 CFQ feeding styles accounted for 31% of the variance in year 7 child BMI *z* scores ($P = .08$) when entered in step 1 (Table 5). Increased restriction of child eating ($P = .05$) and reduced pressure to eat ($P = .02$) predicted increased child BMI *z* scores 2 years later. Entering year 3 child BMI *z* scores in step 2 accounted for an additional 50% of the variance in child outcomes ($P < .001$). In their presence, the effects of restriction ($P = .01$) and pressure to eat ($P = .02$) were attenuated but remained significant (Fig 2, bottom).

For both feeding attitudes and styles, we conducted additional regression analyses that included maternal BMI and child gender as predictors within each risk group. Neither variable significantly predicted year 7 child BMI *z* scores. Similarly, when the interactions between gender and the 3 CFQ subscale scores were tested, none of the interactions was statistically significant, individually or jointly.

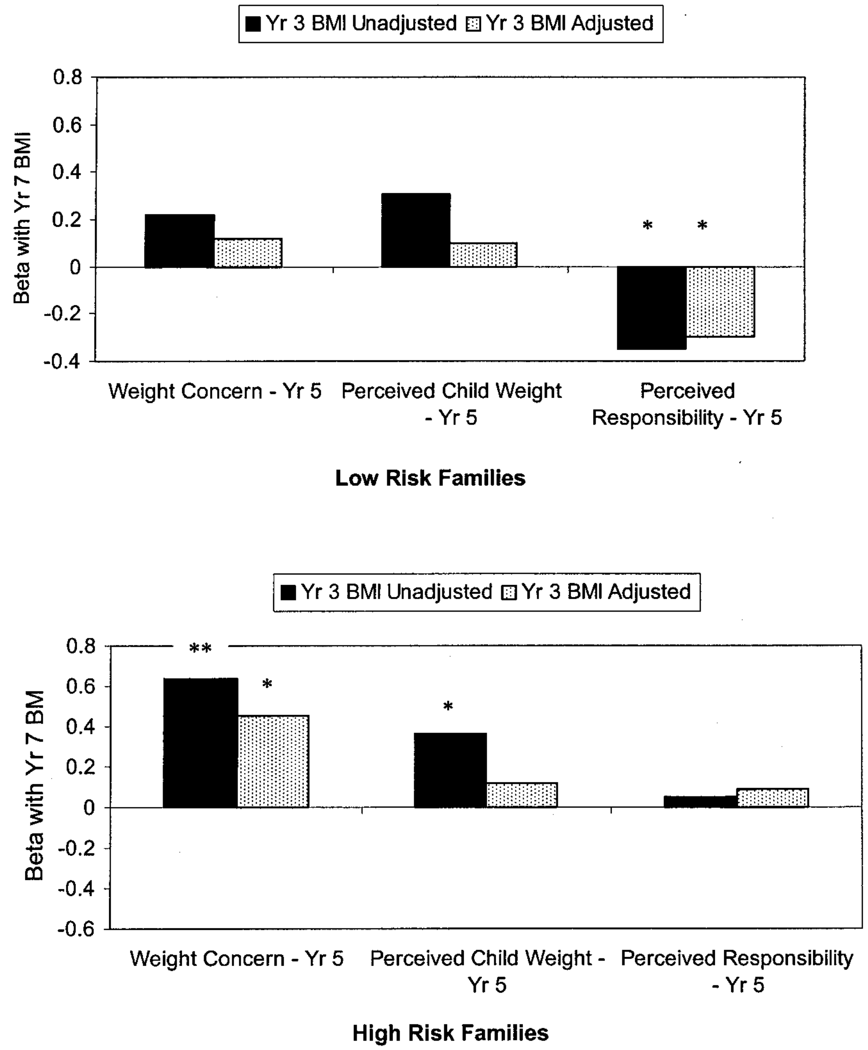

Fig 1. β weights representing associations of year 5 child weight concern, perceived child weight, and perceived responsibility with year 7 child BMI z scores. Associations were unadjusted (solid bars, ■) and then adjusted (dotted bars, ⊡) for year 3 child BMI z scores. The comparison of standardized β weights across risk groups is discouraged. Rather, the figures draw attention to differences in β weights within risk groups depending on whether or not child BMI z scores at age 3 were controlled. *, $P < .05$; **, $P < .006$.

TABLE 5. Hierarchical Regression Model: Effects of Year 5 Parental Feeding Styles on Year 7 Child BMI z Score

Variable Entry	β	
	Model 1	Model 2
Low-risk families		
Step 1		
Year 5, restriction	.20	.07
Year 5, monitoring	−.49*	−.33†
Year 5, pressure to eat	−.32	−.11
Step 2		
Year 3, child BMI z score		.57*
High-risk families		
Step 1		
Year 5, restriction	.55†	.39†
Year 5, monitoring	.12	.10
Year 5, pressure to eat	−.57†	−.35†
Step 2		
Year 3, Child BMI z score		.89*

β is the standardized β (regression) coefficient.
* $P < .006$ (Bonferroni correction, $\alpha = 0.05/8$).
† $P \leq .05$.

DISCUSSION

Research into the role of parental attitudes about child feeding and child feeding control has achieved notable attention, because the theory pinpoints a potentially modifiable risk factor for the development of overweight among children. One main finding from this study was that most parental feeding attitudes and styles were highly stable for child ages 5 to 7 years. This is the first report to document such stability and suggests that, within this developmental period, parental feeding styles are not ephemeral traits. Instead, they appear to withstand the passage of time and child growth and development. The finding that parental feeding attitudes and styles and child BMI z scores were stable for 2 years lends plausibility to the concept that feeding styles might influence child weight, child weight might influence feeding styles, or both. These results support the validity of the CFQ in recording this type of information.[19]

A second key finding was that the relationship between CFQ subscale scores and child BMI z scores differed for high- and low-risk families, suggesting a gene-environment interaction. With respect to parental feeding attitudes, concern with child weight was associated cross-sectionally and prospectively among high-risk children only. These associations were strong (r = ~0.60–0.80) and in line with previous studies.[12,19] The present findings indicate that predisposition to obesity moderates this relationship, because parents whose children are at higher risk for

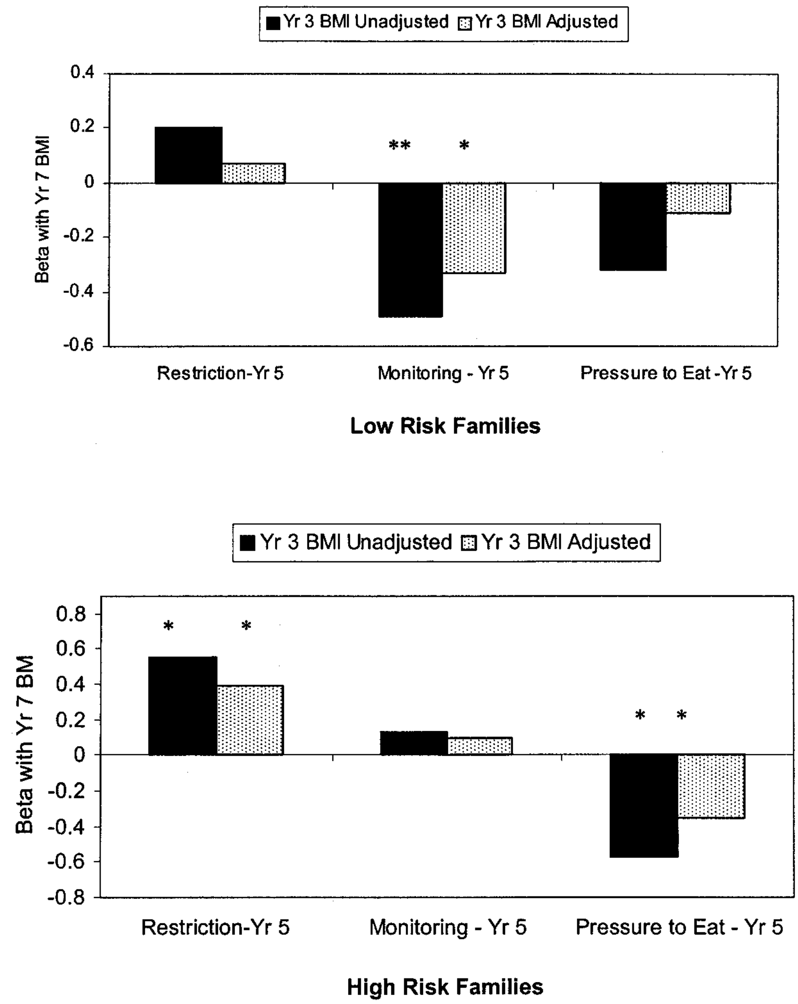

Fig 2. β weights representing associations of year 5 restriction, monitoring, and pressure to eat with year 7 child BMI z scores. Associations were unadjusted (solid bars, ■) and then adjusted (dotted bars, ⊡) for year 3 child BMI z scores. The comparison of standardized β weights across risk groups is discouraged. Rather, the figures draw attention to differences in β weights within risk groups depending on whether or not child BMI z scores at age 3 were controlled. *, $P < .05$; **, $P < .006$.

obesity may be more concerned about their children's weight status. These findings were supported by the regression analyses. It is conceivable that the heavier parents of high-risk children are more sensitized to the health complications of obesity because of their personal weight and medical histories. Whether such concerns may motivate parents to instill more healthful eating and activity habits in their children for obesity prevention awaits investigation.

With respect to parental feeding styles, different associations were also found for low-risk and high-risk families. Among low-risk children, parental monitoring of child fat intake predicted reduced child BMI z scores at year 7, suggesting that these parenting strategies may protect against excess weight gain in these families. Similarly, in a 10-year prospective study of 552 Danish children, Lissau et al[23] found that individuals whose mothers had previously reported a lack of knowledge concerning their sweet-eating habits at 9 to 10 years of age were 4.5 times more likely to be overweight as young adults. In another study, Lissau et al[24] found that children who had been neglected when they were 9 to 10 years of age were ~10 times more likely to be overweight at 10-year follow-up assessments. Our finding of a protective effect of monitoring complements these findings, although we did not observe this finding among high-risk families.

The prospective effect of monitoring was attenuated with adjustment for the child's BMI z score at age 3, suggesting that parental monitoring of child fat intake is also responsive to child weight status. Indeed, among families predisposed to thinness, parents may be more inclined to monitor the eating of thinner rather than heavier children, because of fear of inadequate food intake and growth. These are common concerns of parents[25] and might have been especially true of parents of our low-risk children, many of whom were notably underweight. These parents might have been more inclined to monitor the food intake of a "scrawny" child, compared with a "well-nourished" or overweight child. These findings are consistent with a bidirectional relationship between parental monitoring of fat intake and child weight status among families predisposed to thinness.

Among high-risk families, the most notable finding was that parental restriction of child food intake predicted increased BMI z scores 2 years later. This finding was attenuated but remained significant when controlling for child weight status at age 3. This pattern of results, which was observed only among high-risk families, is consistent with a bidirectional model in which parents and children influence each other.[9] That is, increased child body weight likely elicits parental restriction of child eating, which may exacerbate child weight control problems. Mechanisms through which restrictive feeding practices may affect child weight were not evaluated in this study, although recent prospective studies implicated the behavioral trait of "eating in the absence of hunger."[7,26] Birch et al[26] found that restrictive parental feeding practices toward 5-year-old girls promoted an increased tendency to eat in the absence of hunger over 2 years, although this effect was limited to those who were already overweight at age 5. Therefore, among children predisposed to be overweight, excessively restrictive feeding practices may exacerbate weight control problems by disrupting the children's eating patterns. This would be an interesting issue to explore in future studies using genetic markers for obesity.

An implication of our findings is that childhood overweight prevention programs may benefit from being tailored to family characteristics, such as a child's risk for overweight or current weight status, rather than using 1 set of guidelines for all families. Expert panel guidelines for overweight prevention caution against restrictive feeding practices for children.[27] However, the present findings, in conjunction with results of recent studies,[7,26] suggest that concerns about excessive restriction may be especially relevant for young children predisposed to overweight. An alternative clinical strategy would be to target and reinforce more actively the intake of healthier foods to displace the intake of less-healthy foods. Indeed, an overweight prevention program targeting increased intake of fruits and vegetables was as effective as an overweight prevention program targeting reduced intake of energy-dense foods among children at risk for adulthood obesity.[28] This study suggests the potential value of educating parents about alternative attitudes toward feeding their children and feeding patterns that focus on increased fruit and vegetable intake.

Previous research indicated that maternal BMI is a predictor of child BMI.[29] Within our total sample of low- and high-risk families, maternal BMI also predicted child BMI z scores at year 7 ($r = 0.44$, $P = .001$). It is noteworthy that, among the entire sample, maternal BMI was associated only with child weight concern ($r = 0.42$, $P < .001$), and none of the other parental feeding attitudes or styles showed this association.

Our results should be considered in light of the study limitations. First, this cohort was white, and findings cannot be generalized to other ethnic or racial groups. Second, our sample size was underpowered to detect weak associations ($r = 0.1–0.2$). Third, the present analysis did not examine dietary or food intake measures. Any potential effects of parental feeding practices on child weight status are likely "downstream" from those on child eating behavior and thus may be obscured without inclusion of dietary measures. Future studies are encouraged to include such measures. Fourth, because this study examined a 2-year time period between 5 and 7 years of age, it cannot address the earlier onset of these feeding dynamics. However, these ages correspond to an important period of child growth and development, including a potentially critical period for obesity onset.[16] Moreover, the longitudinal design, range of parental BMIs, and diversity of family backgrounds represent unique strengths of this cohort that build on the existing literature.

CONCLUSIONS

Parental attitudes toward and styles of feeding children were stable from 5 to 7 years of age, as was child weight status. The prospective relationship between feeding styles and subsequent child weight depends on child obesity predisposition. Increased restriction and reduced pressure to eat predicted increased BMI z scores among high-risk children. These effects were attenuated but remained significant with control for prior child weight status, suggesting bidirectional influences between child and parent, as documented elsewhere in the child development literature.[30] Parental styles of child feeding are not random; they are elicited in part by child characteristics, including overweight and current weight status. Against this backdrop, some concern about excessively restrictive feeding practices among young children may be warranted. Prevention strategies that target the promotion of healthier foods that substitute for energy-dense foods may warrant additional attention.

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