Relation between mothers’ child-feeding practices and children’s adiposity

Donna Spruijt-Metz, Christine H Lindquist, Leann L Birch, Jennifer O Fisher, and Michael I Goran

ABSTRACT

Background: The prevalence of obesity in American children is currently estimated to be 25%. Poor nutritional habits during childhood have been directly related to pediatric obesity.

Objective: Our objective was to evaluate the relation between mothers’ child-feeding practices and children’s adiposity in a sample of boys and girls from 2 ethnic groups.

Design: A total of 74 white (25 boys and 49 girls) and 46 African American (22 boys and 24 girls) children (x ± SD age: 11 ± 1.7 y) and their mothers participated in this study. The children’s body composition was assessed by dual-energy X-ray absorptiometry. The mothers’ child-feeding practices were assessed with the Child Feeding Questionnaire. Dietary intake data were based on three 24-h dietary recalls conducted by use of the multiple-pass technique.

Results: Two subscales of the Child Feeding Questionnaire, pressure to eat and concern for child’s weight, explained 15% of the variance in total fat mass in both African American and white boys and girls (P < 0.001) after correction for total lean mass and energy intake (which explained 5% of the variance in total fat mass). Ethnicity, sex, and socioeconomic status did not contribute significantly to variance in total fat mass.

Conclusions: Child-feeding practices are key behavioral variables that explain more of the variance in total fat mass than does energy intake in a biethnic population of boys and girls. These findings have important implications for the prevention of obesity in children because they suggest that prevention programs need to focus on the feeding behaviors of parents in addition to the macronutrient and energy intakes of children. Am J Clin Nutr 2002;75:581–6.

INTRODUCTION

The prevention of pediatric obesity has become a vital and strategic public health priority (1). To be effective, interventions to prevent and correct pediatric obesity must target modifiable determinants of childhood obesity such as dietary practices. Food preferences and especially intake patterns develop early and track throughout life (2–4). Promising research into child-feeding practices, as well as possible influences of the child’s sex on the prevention of pediatric obesity, they present potentially important avenues for interventions to prevent pediatric obesity.

Several studies found a relation between various indexes of children’s body mass and parents’ child-feeding practices (6, 7). Birch and Fisher (6) found that greater maternal restriction of palatable foods and monitoring of daughters’ eating habits were related to higher energy intake and body mass in the daughters. Lee et al (7) found that daughters’ body masses were negatively correlated with maternal pressure to eat and positively correlated with maternal restriction of palatable foods. Two recent studies failed to find a relation between maternal control over child feeding and body mass index (BMI) (8, 9). To our knowledge, no studies have examined the relation between child-feeding practices and total fat mass. This relation is important because indexes of body mass have been shown to be imperfect proxy measures for obesity, particularly in children and adolescents. An exploration of the possible relation between child-feeding practices and a more reliable measure of adiposity is necessary to determine the extent of the effect that these modifiable behaviors might have on pediatric obesity. Dual-energy X-ray absorptiometry (DXA) has been shown to be a reliable and accurate means of measuring adiposity (total fat mass) in pediatric populations (10).

The present study is unique because it reports the relations between child-feeding practices and total fat mass as measured by DXA. This study is also unique in exploring the relation between child-feeding practices and total fat mass in both African American and white children in a sample that includes both boys and girls. Furthermore, this study explores ethnic differences in child-feeding practices, as well as possible influences of the child’s sex on the prevention of childhood obesity, they present potentially important avenues for interventions to prevent pediatric obesity.

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mother’s child-feeding practices, and takes the possible influence of socioeconomic status into account. This is one of the few studies to address the relation between mothers’ child-feeding practices and adiposity in boys, and the only one to examine this relation with the use of reliable and accurate measures of body fat. A final unique feature of this study is that we were able to compare the relative influences of the mothers’ child-feeding practices and the children’s energy intake on the children’s total fat mass.

SUBJECTS AND METHODS

Subjects

The data presented here are derived from an ongoing, longitudinal study of childhood obesity (11–13). The subjects were 74 white (25 boys and 49 girls) and 46 African American (22 boys and 24 girls) children recruited in Birmingham, Alabama. The subjects’ ages ranged from 7 to 14 y (x ± SD: 11 ± 1.7 y). The subjects were recruited through newspaper advertisements, distribution of flyers, and word of mouth. Absence of major illness since birth was the sole inclusion criteria for participation in the study. The sample contained both obese and normal-weight children.

Procedure

Dietary data were collected from the pediatric subjects during an overnight visit to the General Clinical Research Center (GCRC) at the University of Alabama at Birmingham (11–13). While at the GCRC for testing, the mothers participated in a brief, in-person interview asking about their feeding practices. Two weeks after the GCRC visit, the children completed further testing at the Department of Nutrition Science at the University of Alabama at Birmingham clinic, including assessment of body composition by DXA (with the children arriving in the fasted state). The present sample includes children for whom complete data on feeding practices were obtained. 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.

Measures

Independent variable: child-feeding practices

The Child Feeding Questionnaire is a self-report questionnaire that measures the mother’s child-feeding attitudes and practices and her perceptions of child’s overweight (6, 14, 15). The mother’s feeding practices were measured by using 5 subscales from the Child Feeding Questionnaire. Scores on these subscales have been related to energy intake regulation and child weight status (6) and to parents’ and children’s energy intake (5).

Mother’s monitoring of food intake. This measure is a 3-item subscale that examines the degree to which a mother keeps track of her child’s consumption of sweets, snack foods, and high-fat foods. The scale has response ratings of 1 (never) to 5 (always). For all subscales of the Child Feeding Questionnaire, scores for the subscale items were averaged to obtain a total score. The reliability (Cronbach’s α) in the present sample for this scale was 0.78.

Responsibility for feeding. This is a 3-item subscale measuring how responsible the mother feels for feeding her child, determining portion sizes, and providing a healthy diet. Scores range from 1 (low feelings of responsibility) to 5 (high feelings of responsibility). The reliability (Cronbach’s α) in the present sample for this scale was 0.73.

Food restriction. This is an 8-item scale that measures the mother’s attempts to control her child’s eating by restricting access to palatable foods. It concerns the restriction of both the type and amount of food. Restriction of food by mothers was previously shown to be related to both daughters’ daily energy intake and short-term ability to control energy intake (6). The scale is scored from 1 (low restriction) to 5 (high restriction). The reliability (Cronbach’s α) in the present sample for this scale was 0.76.

Pressure to eat. This is a 4-item scale that measures the degree to which the mother encourages the child to eat by behaviors such as insisting that the child eat everything on his or her plate. The scores range from low (1) to high (5) levels of pressure. The reliability (Cronbach’s α) in the present sample for this scale was 0.72.

Concerns for child’s weight. This is a 3-item subscale that reflects the degree to which the mother is concerned that her child is or will become overweight and be forced to diet. Scores range from 1 (unconcerned) to 5 (highly concerned). The reliability (Cronbach’s α) in the present sample for this scale was 0.77.

Control variables

Socioeconomic status. Socioeconomic status was measured with the use of the Hollingshead 4-factor index of social class (16). This scale combines the educational attainment and occupational prestige for the number of working parents in the child’s family; the index ranges from 8 to 66. Higher values are indicative of higher social class background. This measure was included because socioeconomic status has been repeatedly associated with measures of body mass (17–19) and factors that influence BMI such as physical activity (12, 20) and diet (21, 22). Furthermore, ethnic differences are often confounded by socioeconomic differences (23–25).

Energy intake. Dietary data were gathered by trained interviewers using the 24-h dietary recall technique. Three dietary recalls were collected for each subject, 2 during the children’s visits to the GCRC and 1 by telephone. This multiple-pass method was previously validated against doubly labeled water in children as young as 4 y of age (26). Data from all 3 passes were used to obtain a representative average of energy and macronutrient intakes as previously described (27). In keeping with the present controversy over the influence of energy intake from fat compared with that of total energy intake on obesity (28), we assessed the effect of energy intake from fat on total fat mass and the effect of energy intake from sources other than fat on total fat mass separately.

Body composition

Body composition, including total lean tissue mass and total fat mass, was assessed by DXA with a Lunar DPX-L densitometer and pediatric software (version 1.5e; Lunar Corp, Madison, WI) (29). The subjects were scanned while lying on their backs in light clothing. The pediatric medium or large mode was used depending on the weight of the child. A detailed description of this procedure is given elsewhere (30). DXA has been shown to be a reliable and valid measure of body composition in children (30).
TABLE 1
Descriptive characteristics of the study population

<table>
<thead>
<tr>
<th></th>
<th>Total sample (n = 120)</th>
<th>White (n = 74)</th>
<th>African American (n = 46)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex (% boys)</td>
<td>39</td>
<td>34</td>
<td>48</td>
</tr>
<tr>
<td>Age (y)</td>
<td>10.95 ± 1.72</td>
<td>11.04 ± 1.7</td>
<td>10.80 ± 1.7</td>
</tr>
<tr>
<td>Socioeconomic status</td>
<td>44.81 ± 14.06</td>
<td>52.07 ± 8.33</td>
<td>33.46 ± 13.73</td>
</tr>
<tr>
<td>Total daily energy intake from fat (MJ)</td>
<td>2.57 ± 0.79</td>
<td>2.49 ± 0.65</td>
<td>2.68 ± 0.96</td>
</tr>
<tr>
<td>Total daily energy intake not from fat (MJ)</td>
<td>4.90 ± 1.36</td>
<td>4.97 ± 1.27</td>
<td>4.79 ± 1.51</td>
</tr>
<tr>
<td>Total lean mass (kg)</td>
<td>30.68 ± 7.18</td>
<td>29.55 ± 6.99</td>
<td>32.51 ± 7.192</td>
</tr>
<tr>
<td>Total fat mass (kg)</td>
<td>14.52 ± 10.16</td>
<td>13.47 ± 8.99</td>
<td>16.20 ± 11.70</td>
</tr>
</tbody>
</table>

1 There were no significant two-way interactions between ethnicity and sex and no significant main effects of sex.

2 ± SD.

3 Main effect of ethnicity: *P* < 0.001, †P < 0.04.

Statistical analyses

All analyses were performed with SPSS for WINDOWS (version 9.0; SPSS Inc, Chicago). Chi-square tests were used to explore any relation between sex and ethnicity in the sample. Sex (31) and ethnic (32) differences in total fat mass have been found in some samples, and ethnic differences in socioeconomic status are common (12). Therefore, influences of sex and ethnicity on the control variables and on total fat mass were explored with the use of 2 × 2 univariate factorial analyses of variance (ANOVAs). Correlations between the child-feeding questionnaire subscales and total fat mass were examined. Subsequently, 2 × 2 univariate factorial ANOVAs were used to determine whether the mothers’ child-feeding practices differed according to the children’s sex, ethnicity, or both.

Multiple regression analysis was used to determine how much of the variance in total fat mass could be explained by child-feeding practices after adjustment for total lean mass, sex, ethnicity, socioeconomic status, energy intake from fat, and energy intake from sources other than fat. Variables were entered in a series of 4 blocks. First, we adjusted for total lean mass. Justification for this type of correction as opposed to use of the fat-to-lean ratio was given earlier (33, 34). Then, socioeconomic status, sex, and ethnicity were entered. Next, energy intake was included, and finally child-feeding practices were entered. Preliminary analyses showed that interactions between ethnicity and child-feeding practices and between sex and child-feeding practices did not explain any additional variance in total fat mass. These interaction terms were thus excluded from the final model.

TABLE 2
Correlations between the 5 Child Feeding Questionnaire subscales and total fat mass (TFM)

<table>
<thead>
<tr>
<th></th>
<th>Monitoring</th>
<th>Responsibility</th>
<th>Restriction</th>
<th>Pressure</th>
<th>Concern</th>
<th>TFM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitoring</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Responsibility</td>
<td>0.40 †</td>
<td>—</td>
<td>0.34†</td>
<td>0.28†</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Restriction</td>
<td>0.22 ± 0.52</td>
<td>0.34†</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Pressure</td>
<td>0.08</td>
<td>0.39†</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Concern</td>
<td>0.10</td>
<td>0.29†</td>
<td>0.60†</td>
<td>0.21†</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>TFM</td>
<td>0.01</td>
<td>0.12</td>
<td>—0.07</td>
<td>0.26†</td>
<td>0.53†</td>
<td>—</td>
</tr>
</tbody>
</table>

†P < 0.001.

Sex and ethnic differences in child-feeding practice subscales

Descriptive information and the 2 × 2 ANOVAs carried out for the 5 Child Feeding Questionnaire subscales completed by the mothers are shown in Table 3. Mothers differed significantly on the monitoring subscale according to the sex of their child, scoring higher for monitoring boys’ junk food, sweets, and fat intake than girls’. This was the only significant difference found in child-feeding practices according to the sex of the child. The African American mothers scored significantly higher on all 5 of the Child Feeding Questionnaire subscales, reporting more monitoring, feelings of responsibility, restrictive practices, pressure to eat, and concern for child’s weight. There were no significant interaction effects of sex and ethnicity.

Multivariate predictors of total fat mass

As shown in Table 4, multiple regression analysis showed that 2 subscales from the Child Feeding Questionnaire, concern for child’s weight and pressure to eat, explained 15% of the variance in total fat mass after adjustment for total lean mass, sex, ethnicity,
socioeconomic status, and energy intake. Because of significant ethnic differences in child-feeding practices and socioeconomic status, ethnicity and socioeconomic status were entered into the equation in block 2. However, both failed to account for any variance in total fat mass. Sex also failed to account for any variance in total fat mass. Energy intake from sources other than fat predicted 5% of the variance in total fat mass. Dietary fat intake did not contribute significantly to the equation.

**DISCUSSION**

Previous research identified significant relations between various indexes of body mass, which serve as proxies for total fat mass, and mothers’ child-feeding practices. This is the first study to show that a mother’s concern about her child’s weight and her pressure in child feeding are directly related to the child’s total fat mass. Our results show that a mother’s concern for her child’s weight is related to higher total fat mass in the child and that a mother’s pressure to eat is related to lower total fat mass in the child in both white and African American boys and girls. Previous studies found relations between BMI and restrictive practices (6, 7, 35) and monitoring (6), as well as between BMI, weight concern (6), and pressure to eat (5, 7, 35). Our new findings suggest that only concern for child’s weight and pressure to eat are directly related to total fat mass. This finding has important implications for obesity prevention efforts because these data show a relation between specific, modifiable parental behaviors and children’s total fat mass. One of the implications for public health is that more family-directed dietary interventions with concentrated parent-education components are needed to combat the current epidemic of childhood obesity.

Earlier research often focused on the influences of mothers’ child-feeding practices on their daughters (6, 35). When both boys and girls were included, stronger effects of child-feeding practices on BMI were frequently found in girls than in boys (15, 36). Our data suggest that specific child-feeding practices are equally related to total fat mass in both girls and boys.

Despite the fact that African American mothers reported higher levels of monitoring, feelings of responsibility, restrictive practices, pressure to eat, and concern for child’s weight than did white mothers, ethnicity was not a significant predictor of total fat mass in this sample. This finding is important because it suggests that similar mechanisms could be at work across these 2 ethnicities. Although ethnic and cultural differences in food preference, socioeconomic status, personal style, family status, and other elements that influence child-feeding practices will need to be taken into account, our findings suggest that the same theoretical framework could be used to develop interventions in both African American and white populations. This would facilitate the comparison of the efficacy and effectiveness of interventions across cultures.

In our study, concern for child’s weight was positively related to total fat mass whereas pressure to eat was negatively related to total fat mass. Similar relations were reported when BMI was used as the outcome variable (7). One possible interpretation of this finding is that mothers prepare their thinner children to eat, whereas they are concerned about their heavier children. In this study, restrictive practices were highly correlated with concern for child’s weight and significantly correlated with total fat mass. The fact that restrictive practices did not remain in the final model with concern for child’s weight might indicate that restrictive practices and concern for child’s weight explain a similar part of the variance in total fat mass. Alternatively, restrictive practices may be indirectly related to total fat mass as a behavioral product of concern for child’s weight.

The cross-sectional nature of this study does not allow for conclusions concerning cause and effect. Parents’ child-feeding

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### TABLE 3

Results and $2 \times 2$ ANOVAs for the 5 Child Feeding Questionnaire subscales

<table>
<thead>
<tr>
<th></th>
<th>Monitoring</th>
<th>Responsibility</th>
<th>Restriction</th>
<th>Pressure</th>
<th>Concern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total sample ($n = 120$)</td>
<td>3.68 ± 0.84</td>
<td>3.82 ± 0.81</td>
<td>2.97 ± 1.01</td>
<td>2.03 ± 1.01</td>
<td>3.17 ± 1.40</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male ($n = 47$)</td>
<td>3.99 ± 0.67</td>
<td>3.96 ± 0.71</td>
<td>3.00 ± 1.01</td>
<td>2.30 ± 1.18</td>
<td>2.92 ± 1.50</td>
</tr>
<tr>
<td>Female ($n = 73$)</td>
<td>3.47 ± 0.87</td>
<td>3.73 ± 0.87</td>
<td>2.96 ± 1.02</td>
<td>1.86 ± 1.02</td>
<td>3.57 ± 1.17</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>White ($n = 74$)</td>
<td>3.56 ± 0.90</td>
<td>3.60 ± 0.79</td>
<td>2.75 ± 0.99</td>
<td>1.60 ± 0.77</td>
<td>2.92 ± 1.49</td>
</tr>
<tr>
<td>African American ($n = 46$)</td>
<td>3.87 ± 0.69</td>
<td>4.18 ± 0.73</td>
<td>3.33 ± 0.96</td>
<td>2.71 ± 1.21</td>
<td>3.57 ± 1.17</td>
</tr>
</tbody>
</table>

**Significant effects**

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>$P &lt; 0.002$</td>
<td>NS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethnicity</td>
<td>$P &lt; 0.039$</td>
<td>$P &lt; 0.001$</td>
<td>NS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$^1 \bar{x} \pm SD$. There were no significant interaction effects.

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### TABLE 4

Variance in total fat mass explained by child-feeding practices

<table>
<thead>
<tr>
<th>Block and variable</th>
<th>Standard $\beta$ coefficient</th>
<th>$P$</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total lean mass</td>
<td>0.52</td>
<td>0.001</td>
<td>0.39</td>
</tr>
<tr>
<td>$R^2$ block 1 (lean mass)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Block 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>–0.02</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Ethnicity</td>
<td>–0.04</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Socioeconomic status</td>
<td>0.00</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>$R^2$ block 2 (with demographics)</td>
<td></td>
<td></td>
<td>NS</td>
</tr>
<tr>
<td>Block 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy intake from fat</td>
<td>0.19</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Energy intake not from fat</td>
<td>–0.24</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>$R^2$ block 3 (with energy intake)</td>
<td></td>
<td></td>
<td>0.45</td>
</tr>
<tr>
<td>Block 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitoring</td>
<td>–0.01</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Responsibility</td>
<td>0.04</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Restriction</td>
<td>–0.03</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Pressure</td>
<td>–0.18</td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td>Concern</td>
<td>0.42</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>$R^2$ block 4 (with child-feeding practices)</td>
<td></td>
<td></td>
<td>0.60</td>
</tr>
</tbody>
</table>
practices may be a reaction to children’s total fat mass rather than a precursor or cause of it. Additional longitudinal research is needed to tease out cause and effect. In another sample, we ascertained that parents’ pressure to eat and restrictive practices at child’s age 5 are related to BMI at age 7 (7). More research into the behavioral aspects of concern for child’s weight needs to be undertaken. Although there is a significant relation between restrictive practices and concern for child’s weight, it is possible that other behavioral correlates of concern for child’s weight have yet to be uncovered. Finally, socioeconomic status has been shown to influence diet and physical activity (12, 37, 38). African American participants in the present study scored significantly lower than did white participants on socioeconomic status. However, socioeconomic status failed to contribute significantly to the regression equation for total fat mass when child-feeding practices were included. The influence of socioeconomic status and ethnicity were entirely subsumed by child-feeding practices. These interrelations are not yet well understood. Given the existing disparities in levels of obesity between different cultural and socioeconomic groups, the possible influences of culture and socioeconomic status on child-feeding practices warrant further study.

A unique finding of the present study is that child-feeding practices are key behavioral variables that explained more of the variance in body fat than did dietary fat intake. In one previous study of dietary fat and body fat in African American and white children, no significant correlations between dietary fat intake and body fat indexes were found (39). In another study of the role of dietary fat in adiposity in Mohawk children, dietary fat explained some of the variance in body fat in boys ($R^2 = 0.2$), but not in girls (31). In the present study, dietary fat intake did not explain any of the variance in total fat mass. Energy intake from sources other than fat explained 5%, whereas child-feeding practices explained 15% of the variance in total fat mass above and beyond energy intake. Although we assume that the link between child-feeding practices and weight status must be mediated or moderated by energy intake or energy expenditure at some level, we found no significant moderator effects of energy intake in this study. Because energy expenditure is related to family variables (12, 40) as well as to adiposity (11) in children, inclusion of physical activity and fitness measures in future research might help to explain the nature of these relations.

In interpreting our findings, possible inaccuracies in the dietary intake data must be considered because underreporting of dietary intake is linked to higher weight status in children (41) and in adults (42, 43). However, research shows minimal influence of dietary fat on adiposity in rats (44) and in adults (45). Taken together, our results show that the addition of information about the social context of feeding to the estimates of energy intake obtained from the 24-h dietary recall significantly improved our ability to predict total fat mass after taking the more conventional predictors of total fat mass (lean body mass and demographic factors) into account. These findings are important for prevention efforts because they suggest that these efforts need to focus on the feeding behaviors of the parents rather than on the macronutrient or energy intake of the children.

In conclusion, the results of our study support earlier work showing that highly controlling feeding strategies may be related to problems of energy balance by interfering with children’s ability to self-regulate their energy intake (5, 46). The relation between certain aspects of mothers’ behaviors and total fat mass indicates that preventive interventions for childhood obesity need to include strategies that target mothers’ behaviors.

REFERENCES


