Modifications in Parent Feeding Practices and Child Diet During Family-Based Behavioral Treatment Improve Child zBMI

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Objective: To examine associations between modifications in parent feeding practices, child diet, and child weight status after treatment and to evaluate dietary mediators.

Methods: Children classified as overweight or obese and 7-11 years old (N = 170) completed a 16-session family-based behavioral weight loss treatment (FBT) program. Anthropometrics (standardized body mass index (zBMI)), Child Feeding Questionnaire, and 24-hr dietary recalls were collected at baseline and post-FBT. Linear regression predicted child zBMI change. Single and multiple mediation tested child dietary modifications as mediators between change in parent feeding practices and child zBMI.

Results: Restrictive parent feeding practices significantly decreased during FBT. Reductions in parent restriction, child weight concern, child’s total energy intake, and percent energy from fat, and increases in parent perceived responsibility, and child percent energy from protein, predicted reductions in child zBMI. Change in child total energy intake mediated the relation between parent restriction and child zBMI change after accounting for covariates and additional dietary mediators.

Conclusions: FBT is associated with a decrease in parental restriction, which is associated with reductions in child relative weight, which was mediated by a decrease in child energy intake. Teaching parents to reduce children’s energy intake without being overly restrictive may improve child weight.

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Introduction

Pediatric obesity represents a major health crisis, due to the associations with numerous physiological and psychological consequences (1-4). Guidelines for pediatric obesity treatment recommend comprehensive multidisciplinary interventions that emphasize diet, activity, and behavior change (5). Family-based behavioral weight loss treatment (FBT) is an evidence-based intervention, which simultaneously treats both parent and child with obesity, using a comprehensive approach aimed to reduce energy intake, increase physical activity, improve family behaviors, and modify the home environment. While there are extensive efficacy data on FBT, data are limited regarding the best parent feeding styles, an important factor that may impact child weight change during treatment.
Restrictive parent feeding practices have shown to negatively impact child dietary intake in favor of excess calories and added sugars, which could lead to increased body weight (15,16). Accordingly, it is plausible that decreases in restrictive feeding practices while enhancing the diet quality of the home food environment may facilitate positive changes in child food intake and improve treatment response. Evidence to support the association between parental restriction and child diet comes primarily from laboratory feeding studies and may not generalize to eating in a natural environment (6,9,15,16). Consequently, examination of the influence of parent feeding practices on usual intakes within FBT is warranted.

Therefore, the aims of this study were to: (1) identify modifications in parent feeding practices and child dietary intake that predict improvements in child standardized body mass index (zBMI) following FBT; and (2) identify child dietary modifications that mediate the relation between change in parent feeding practices and child zBMI. We hypothesized that modifications in parent feeding practices and child diet would result in decreases in child zBMI and that the relation between parent feeding practices and child zBMI would be partially mediated by dietary changes.

Methods

Study design

This study evaluated data from the weight loss phase of a larger multisite randomized controlled trial. All participants received identical treatment. The participating parent and child were assessed at baseline and post-FBT and completed anthropometrics, questionnaires, and 24-hr recalls. Families were recruited and attended treatment sessions at two clinical sites located in the United States. Families attended 16 weekly sessions conducted by trained interventionists. All participants provided informed consent, and the Institutional Review Boards at each site approved the study protocol.

Family-based behavioral treatment

FBT is an evidence-based, multicomponent intervention that targets diet, activity, behavioral techniques, and parenting skills. The Traffic Light Eating Plan, which classifies foods and activities into RED, YELLOW, and GREEN categories, was used (17). FBT modifies the shared family environment by encouraging parents to remove RED (energy-dense) foods from the home, while making GREEN (nutrient-dense) foods readily available to create an environment that promotes healthy choices and eliminates the need to be overly restrictive so the child does not feel deprived. Additionally, parents are taught to model healthy behaviors and implement household changes to create a supportive environment rather than targeting the child in isolation. Positive reinforcers for healthy behavior change, such as rewards for achieving behavioral goals were also used (i.e., increasing GREEN fruits and vegetables to ≥5 servings per day and decreasing RED foods to ≤15 servings per week).

Participants

Families were recruited via advertisements through fliers, newspapers, television, radio, referrals from schools and community providers, and word of mouth. Families were excluded if either child or parent were participating in another weight control program, had major psychiatric problems or eating disorder diagnosis, food allergies limiting diet participation, and/or physical activity limitations that impeded moderate to vigorous physical activity. Participants were 170 children with BMI ≥85th percentile for age and sex, 7–11 years old, and at least one parent with BMI ≥25 kg/m².

Measures

Parent attitude/feeding practices. Parent feeding practices were measured using the Child Feeding Questionnaire (CFQ) (8). The CFQ is a validated questionnaire that assesses the following domains: perceived responsibility (parent feeling of responsibility for the quantity and quality of the child’s diet); perceived child overweight (parent perception of child weight status); child weight concern (degree of parent concern for child weight gain); monitoring (degree of parent monitoring of energy-dense, high-fat food consumption); restriction (degree of parent control over access to palatable foods); and pressure to eat (degree of parent encouragement to eat more food).

Demographics. Demographics were collected via the Barratt (Hollingshead Modified) Demographics Questionnaire to assess child and parent race, ethnicity, age, sex, and household income (18).

Anthropometrics. Child height and weight were measured in light clothing without shoes using a stadiometer and calibrated digital scale, to the nearest 0.1 cm and 0.1 kg, respectively. The average of three measurements was calculated to determine the final value. Body mass index was calculated by dividing weight (kg) by height (m²). Child zBMI was computed based on Centers for Disease Control and Prevention normative data and the lambda-mu-sigma (LMS) method (19).

Dietary intake. Child dietary intake was assessed via three telephone-administered 24-hr recalls using the Nutrition Data System for Research (NDSR version 2009, Nutrition Coordinating Center, University of Minnesota). This assessment is considered to be the most accurate method for children aged 4–11 years (20). Parents reported on child intake and were assisted by the child if present. Recalls were conducted on nonconsecutive days, using at least one weekday and one weekend day. Mean intakes for each nutrient/food group were averaged across the 3 days for each time point.

Dietary recall reporting status was determined using the method developed by Huang et al. (21). Predicted energy requirement (pER) was calculated using sex-specific equations for overweight boys and girls ages 3–18 years of age (22). To account for low fitness and physical activity levels (PAL) of children with obesity, (23,24) the...
TABLE 1 Baseline characteristics of the study sample and differences by reporting status

| Characteristic                     | All children (n = 170) | Plausible (n = 128) | Implausible (n = 42) | P valuea |
|------------------------------------|------------------------|---------------------|----------------------|----------|
| zBMI[c]                            | 2.16 ± 0.39            | 2.10 ± 0.41         | 2.36 ± 0.25          | <0.001   |
| Age (years)b                       | 9.4 ± 1.2              | 9.3 ± 1.2           | 9.7 ± 1.2            | 0.114    |
| Sex [n (%)]                        |                        |                     |                      |          |
| Male                               | 66 (38.8)              | 40 (31.3)           | 26 (61.9)            | <0.001   |
| Female                             | 104 (61.2)             | 88 (68.8)           | 16 (38.1)            |          |
| Race [n (%)]                       |                        |                     |                      |          |
| African American                   | 29 (17.1)              | 16 (12.5)           | 13 (31.0)            | 0.022    |
| White                              | 119 (70.0)             | 95 (74.2)           | 24 (57.1)            |          |
| Other                              | 22 (12.9)              | 17 (13.3)           | 5 (11.9)             |          |
| Ethnicity [n (%)]                  |                        |                     |                      |          |
| Hispanic                           | 17 (10.0)              | 15 (11.7)           | 2 (4.8)              | 0.192    |
| Non-Hispanic                       | 153 (90.0)             | 113 (88.3)          | 40 (95.2)            |          |
| Annual household income [n (%)]    |                        |                     |                      |          |
| <$50,000                           | 42 (24.7)              | 27 (21.1)           | 15 (35.7)            | 0.057    |
| ≥$50,000                           | 128 (75.3)             | 101 (78.9)          | 27 (64.3)            |          |

zBMI = Standardized body mass index.

a Indicates significant differences between plausible and implausible reporters.
b Mean ± SD.

sedentary PAL category was used as the majority (90.2%) of our sample was classified as obese. The ±2 SD cutoff was chosen to identify plausible reporters, given the incidence of underreporting is higher in children with obesity (25). This cutoff may provide better representation of variation in daily intakes (26) and has been used previously in both children (27) and adults (28). Thus, plausible reporters were defined as those within ±2 SD of their pER (reported energy intake ≥ 135% and ≤ 65% of pER). Misreporting was also estimated using the Goldberg method, (26) but as results were similar, only data using the Huang method are presented.

Statistical methods

Differences between plausible and implausible reporters were determined using t-tests and χ² analyses. Differences between baseline and post-FBT variables were determined using paired samples t-tests or nonparametric Related-Samples Wilcoxon signed-rank test. Change variables were calculated by subtracting baseline from post-FBT. Linear regression examined associations between parent feeding practices, child diet, and zBMI. All models included child age, sex, race/ethnicity, baseline weight status, household income, baseline parent feeding practice (for parent attitude/feeding practice change variables) or baseline diet variable (for diet change variables), and change in energy intake (for all remaining diet change variables) as covariates. Residual diagnostics were evaluated for each model using histograms, normal P-P plots, and plots of standardized residuals against predicted values.

Single and multiple mediation assessed mediating effects of change in child diet on the relation between change in parent feeding practices and change in child zBMI (29). Models for each parent feeding practice that significantly predicted change in child zBMI were tested in both all children and plausible reporters. Parent feeding practice variables were entered as independent variables and dietary variables associated with weight loss were included as mediators. The magnitude of the indirect effect was assessed using a nonparametric, bootstrapping procedure. Confidence intervals of the indirect effect were constructed using 20,000 bootstrap resamples from the SPSS macro INDIRECT (29). The indirect effect was considered significant if the 95% confidence interval did not contain zero. The proportion mediated was calculated by dividing indirect effect by total effect (Path a * Path b/Path c). Alpha was set at P < 0.05. Results are presented for plausible reporters and also for the full sample as the classification of misreporting is merely an assumption and stratification may be more informative than elimination of a large portion of the sample (30). All analyses were conducted using SPSS version 19.

Results

Sample characteristics

Sample characteristics are described in Table 1. Mean (±SD) child baseline zBMI and age in the full sample were 2.16 ± 0.39 and 9.4 ± 1.2 years, respectively. After accounting for reporting bias, 75.3% of the sample was classified as plausible reporters. The mean age of plausible and implausible reporters was similar; however, plausible reporters had a significantly lower baseline zBMI and were more likely to be female and White as compared to implausible reporters. Plausible reporters also reported higher income than implausible reporters, which trended toward significance (P = 0.061).

Post-FBT changes in parent feeding practices and child dietary intake

Changes in parent feeding practices and child dietary intake were evident from baseline to end of treatment (Table 2). In plausible
reporters, scores for parent perceived child overweight and monitoring significantly increased, and parent weight concern and restriction significantly decreased (P < 0.001). Following FBT, children had significantly reduced total energy, percent energy from fat, sugar-sweetened beverages, added sugars, and added fats, while increasing percent energy from protein, percent energy from carbohydrate, fiber, and total fruits and vegetables (P < 0.001). Results in all children were similar.

**Associations with child zBMI change**

Associations with change in child zBMI are shown in Table 3. In plausible reporters, increased parent perceived responsibility and child percent energy from protein and decreased parent restriction, parent weight concern, child total energy intake, and child percent energy from fat were associated with decreased children zBMI (P < 0.05). When data from all children were analyzed, decreased child consumption of added sugars and increased total fruits and vegetables also predicted decreased child zBMI (P < 0.05).

**Mediating effects of dietary modifications**

Mediation models to test the mediating effects of dietary modifications on the association between parent perceived responsibility and parent concern about child weight and change in child zBMI were not significant and, thus, only the results for parent restriction are presented. In plausible reporters, change in child total energy intake and child percent energy from protein significantly mediated the association between change in parent restriction and change in child zBMI when tested in single mediation models, proportion mediation 18.7 and 21.5%, respectively; indirect effects and confidence intervals for the energy model and the percent energy from protein model were 0.0181 (0.0026, 0.0447, P < 0.05) and 0.0186 (0.0028, 0.0512, P < 0.05), respectively. Change in percent energy from fat was not a significant mediator (data not shown) in the model using plausible reporters. These results indicate that as parents became less restrictive, children consumed less total energy, and more energy from protein as percent of total energy, which resulted in reductions in child zBMI. When single mediation models were conducted in all children, change in child total energy, child percent energy from protein, and child added sugars acted as significant mediators of the association between change in parent restriction and change in child zBMI (P < 0.05), proportion mediated 17.6, 20.4, and 13.0%, respectively. The indirect effects and bias corrected bootstrapping confidence intervals for the energy model, percent energy from protein model, and added sugars model were 0.0144 (0.0021, 0.0346, P < 0.05), 0.0167 (0.0042, 0.0390, P < 0.05), and 0.0009 (0.0009, 0.0219, P < 0.05), respectively. Models testing change in percent energy from fat and fruits and vegetables were not significant (data not shown).

Multiple mediation models using all significant dietary predictors of change in child zBMI were also conducted. In plausible reporters (Figure 1), Paths a and b were significant for total energy (P < 0.05). The bootstrapped confidence intervals indicated the indirect effect of change in parent restriction on change in zBMI through change in child total energy intake was significant (P < 0.05). Portion mediated by child total energy intake was 18.7%. The full model explained 47.2% of the variance in change in zBMI. In all children (Figure 2), Path a was significant for child total energy, percent energy from protein, and added sugars (P < 0.05). Path b was significant for child total energy and percent

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**TABLE 2** Baseline, post-FBT, and change in child dietary intake and parent attitude/feeding practices by reporting status

|                         | All Children (N = 170) |                               | Plausible reporters (n = 128) |                               |
|-------------------------|------------------------|--------------------------------|------------------------------|--------------------------------|
|                         | Baseline | Post-FBT | Change | Baseline | Post-FBT | Change |
| zBMI                    | 2.16 ± 0.39 | 1.87 ± 0.56 | -0.29 ± 0.24 | 2.10 ± 0.41 | 1.78 ± 0.58 | -0.32 ± 0.26 |
| Parent attitude/feeding practices |          |                |        |          |                |        |
| Perceived responsibility | 2.9 ± 0.7 | 3.0 ± 0.7 | 0.1 ± 0.6 | 2.9 ± 0.7 | 2.9 ± 0.7 | 0.0 ± 0.6 |
| Perceived child overweight | 2.5 ± 0.4 | 3.5 ± 0.6 | 1.0 ± 0.6 | 2.4 ± 0.4 | 3.5 ± 0.6 | 1.1 ± 0.6 |
| Child weight concern     | 3.1 ± 0.8 | 2.7 ± 1.0 | -0.4 ± 1.0 | 3.1 ± 0.8 | 2.6 ± 1.0 | -0.5 ± 1.0 |
| Monitoring               | 2.5 ± 0.8 | 3.4 ± 0.7 | 0.9 ± 1.0 | 2.6 ± 0.8 | 3.4 ± 0.6 | 0.9 ± 1.0 |
| Restriction              | 2.9 ± 0.6 | 2.5 ± 0.7 | -0.4 ± 0.7 | 2.9 ± 0.5 | 2.5 ± 0.7 | -0.4 ± 0.7 |
| Pressure to eat          | 0.7 ± 0.7 | 0.7 ± 0.7 | 0.0 ± 0.7 | 0.6 ± 0.7 | 0.6 ± 0.7 | -0.0 ± 0.7 |
| Child dietary intake     |          |                |        |          |                |        |
| Energy (kcal)            | 1708.4 ± 440.8 | 1351.5 ± 296.1 | -357.0 ± 444.8 | 1785.5 ± 395.5 | 1370.7 ± 296.9 | -414.9 ± 394.3 |
| Percent energy from protein (%) | 16.4 ± 3.0 | 18.7 ± 3.6 | 2.3 ± 3.7 | 16.1 ± 2.8 | 18.5 ± 3.6 | 2.5 ± 3.7 |
| Percent energy from fat (%) | 31.5 ± 4.9 | 24.6 ± 6.2 | -6.9 ± 7.0 | 31.7 ± 4.6 | 24.4 ± 6.1 | -7.3 ± 6.9 |
| Percent energy from carbohydrate (%) | 52.1 ± 5.6 | 56.7 ± 6.4 | 4.6 ± 7.2 | 52.2 ± 5.3 | 57.1 ± 6.4 | 4.9 ± 7.1 |
| Fiber (g)                | 13.7 ± 4.5 | 16.0 ± 5.6 | 2.3 ± 6.1 | 14.1 ± 4.5 | 16.2 ± 5.6 | 2.1 ± 6.0 |
| Total Fruit and Vegetables (svg/d) | 2.4 ± 1.4 | 3.8 ± 2.1 | 1.4 ± 2.1 | 2.4 ± 1.5 | 3.9 ± 2.1 | 1.5 ± 2.1 |
| Sugar-sweetened beverages (svg/d) | 0.6 ± 0.6 | 0.2 ± 0.4 | -0.4 ± 0.7 | 0.7 ± 0.7 | 0.2 ± 0.3 | -0.7 ± 0.7 |
| Added Sugars (g)         | 68.3 ± 36.1 | 35.9 ± 21.7 | -32.4 ± 38.8 | 74.0 ± 38.4 | 36.9 ± 22.2 | -37.2 ± 41.3 |
| Added Fats (svg/d)       | 1.8 ± 1.4 | 1.0 ± 0.8 | -0.7 ± 1.6 | 1.9 ± 1.4 | 1.0 ± 0.8 | -0.8 ± 1.6 |

All values represent mean ± SD.

*a* Significantly different between baseline and post-FBT at P < 0.001.
### TABLE 3 Association between post-FBT changes in parent feeding practices and child dietary intake with child zBMI change

| Independent variable | All Children (N = 170) | Plausible reporters (n = 128) |
|----------------------|------------------------|------------------------------|
| Change in parent attitude/feeding practices | | |
| Perceived responsibility | $-0.153$ | $0.031$ | $-0.160$ | $0.059$ |
| Perceived child overweight | $-0.083$ | $0.344$ | $-0.063$ | $0.525$ |
| Child weight concern | $0.229$ | $0.001$ | $0.242$ | $0.003$ |
| Monitoring | $-0.177$ | $0.057$ | $-0.183$ | $0.130$ |
| Restriction | $0.250$ | $0.001$ | $0.261$ | $0.002$ |
| Pressure to eat | $-0.097$ | $0.187$ | $-0.076$ | $0.397$ |
| Change in child dietary intake | | |
| Energy (kcals) | $0.378$ | $<0.001$ | $0.382$ | $<0.000$ |
| Percent energy from protein (%) | $-0.212$ | $0.003$ | $-0.230$ | $0.006$ |
| Percent energy from fat (%) | $0.166$ | $0.026$ | $0.184$ | $0.032$ |
| Percent energy from carbohydrate (%) | $-0.036$ | $0.629$ | $-0.044$ | $0.600$ |
| Fiber (g) | $-0.120$ | $0.097$ | $-0.110$ | $0.185$ |
| Total fruit and vegetables (svg/d) | $-0.144$ | $0.031$ | $-0.127$ | $0.105$ |
| Sugar-sweetened beverages (svg/d) | $0.223$ | $0.060$ | $0.156$ | $0.343$ |
| Added sugars (g) | $0.307$ | $0.008$ | $0.213$ | $0.145$ |
| Added fats (svg/d) | $0.208$ | $0.088$ | $0.235$ | $0.106$ |

Data are standardized regression coefficients from linear regression models adjusted for child age, child sex, child race/ethnicity, household income, child baseline weight status, baseline parent feeding practice (for parent attitude/feeding practices) or eating behavior (for change in child dietary intake variables), and change in energy intake (among the remaining child dietary intake variables).

![Multiple mediation model for plausible reporters only (n = 128), which tests the mediating effects of changes in dietary intake on the relationship between change in parent restriction and change in child zBMI, adjusting for child age, child gender, child race/ethnicity, household income, child baseline weight status, baseline restriction score, and baseline eating behavior. Unstandardized regression coefficients for each path are presented. The indirect effects and the bias corrected bootstrapping confidence intervals of change in energy are 0.012 (0.0002, 0.0356). Model $R^2$ was 0.472. *$P < 0.05$; †$P = 0.060$.

![Multiple mediation model for plausible reporters only (n = 128), which tests the mediating effects of changes in dietary intake on the relationship between change in parent restriction and change in child zBMI, adjusting for child age, child gender, child race/ethnicity, household income, child baseline weight status, baseline restriction score, and baseline eating behavior. Unstandardized regression coefficients for each path are presented. The indirect effects and the bias corrected bootstrapping confidence intervals of change in energy are 0.012 (0.0002, 0.0356). Model $R^2$ was 0.472. *$P < 0.05$; †$P = 0.060$.](image-url)
energy from protein ($P < 0.05$). A mediation effect for child total energy and percent energy from protein was evident ($P < 0.05$). Proportion mediated by change in child total energy was 22.1% and that by change in percent energy from protein was 15.1%.

Because the mediation models testing change in parent restrictive feeding practices were significant, individual questions of the restriction subscale were examined to identify the specific aspects of parental restriction that were modified after treatment. Scores for all but one question decreased after treatment, indicating parents reduced their restrictive feeding practices during the intervention. The question “I intentionally keep some foods out of my child’s reach” increased, but this change was nonsignificant in plausible reporters.

Discussion

Reductions in restrictive parent feeding practices during treatment promoted improvements in child zBMI, and this association was mediated by reductions in child energy intake. The present study builds upon these findings to show that modifications in parental restriction within the context of treatment may reverse these negative associations, resulting in reduced child energy intake and improvements in child relative weight.

All aspects of parental restriction decreased after treatment except intentionally keeping foods out of a child’s reach. There are two aspects of the Traffic Light Eating Plan component of FBT that may have elicited these findings: (1) encouraging moderate consumption (i.e., 2 servings per day) of RED foods within energy needs, rather than elimination; and (2) eliminating RED foods in the home to limit temptation. A central tenet of contemporary FBT is the role of choice and the importance of providing a choice among many healthy foods, which can improve food selection (31). In support of this tenet, a study by Epstein et al. (14) examined the effects of two FBT approaches targeting either increasing healthy eating or reducing high energy-dense foods on child weight loss. At 24-month follow-up weight loss was significantly greater in the increase healthy eating condition than the reducing high energy-dense foods condition. The authors speculate that by focusing on increasing healthy foods, families may have altered their food purchasing habits and changed the home environment, which increased access to healthier dietary choices. These results provide support for the concept of “covert” control, a feeding style defined as controlling a child’s food intake in a way that cannot be detected by the child, (32) which has been associated with positive dietary behaviors (33).
Therefore, the primary goal for parents is to reduce intake without creating feelings of deprivation in the child. This goal may be difficult to achieve in situations in which, prior to treatment, a family had unlimited access to unhealthy foods (e.g., potato chips or sugar-sweetened beverages). Total, rapid elimination of these foods may result in greater feelings of deprivation and restriction in a child from this environment than a child who never had access to these foods at home. Similarly, effects of restriction of a particular food may differ based on the alternatives that are available. It may be easier to resist a specific food if there is a choice of palatable alternatives available than if no choice is available (31). Thus, strategies to reduce restrictive feeding practices and improve child weight include: (1) eliminating high-fat snacks from the home and replacing with readily available healthy alternatives (e.g., fruits, vegetables, and low-fat dairy products); (2) stimulus control to reduce eating prompts such as changing the daily routine to include nonsedentary after school activities in place of television, (3) making household changes so that all family members adopt the new eating habits and no one is singled out, (4) parent modeling of healthy eating and activity behaviors, and (5) moderating rather than restricting consumption of RED foods to fit within energy needs.

Increased perceived responsibility and decreased child weight concern also predicted reductions in child zBMI and complement the parent restriction findings to establish a solid parenting approach to improve child weight. The association between increased parent responsibility and improved child weight may have resulted from greater parental attention to the establishment of a healthy home environment and routines, which is a major component of FBT. Our results for parent concern about child weight are similar to those reported by Epstein et al., (2008), and may reflect a change in attitude as parent and child become actively engaged in treatment. FBT empowers children with knowledge and skills to adopt healthy behaviors independently, which may shift some responsibility for in the moment decisions from parent to child. Once parents have established a home environment that supports healthy behaviors, children are encouraged to make choices from a variety of healthy options. As the child becomes more autonomous in eating-related decisions, the parent may feel less concerned about the child’s weight and be less likely to engage in controlling feeding practices (34). We did not elucidate a mechanism to explain these associations with child zBMI change. These constructs reflect parent attitudes, which are not directly related to child dietary behaviors and thus, may act through another energy balance behavior (e.g., physical activity).

To our knowledge, this is the first study to directly link improvements in child zBMI with specific dietary modifications. Child intakes for energy, fruit and vegetables, and sugar-sweetened beverages are similar to those reported by the limited number of studies that include nutrition outcomes in children (35-38). Child modifications in total energy, percent energy from protein, and percent energy from fat were associated with zBMI change and these associations remained after accounting for reporting bias. Because successful weight loss can only be achieved during a state of negative energy balance, a reduction in caloric intake is the cornerstone of obesity treatment (39). Thus, it is not surprising that reductions in child total energy intake were associated with zBMI change. Our results regarding percent energy from protein contrast with Kirk and colleagues (40) who reported no difference in weight loss between children assigned to diets that varied in macronutrient content after a 3-month intervention. In our study, increased percent energy from protein was accompanied by decreased percent energy from fat, which could have been accomplished by replacing high-fat sources of protein with low-fat sources (e.g., lean meats, low-fat dairy, and legumes). These dietary changes are encouraged in the Traffic Light Eating Plan and recommended by national nutrition guidelines, and they could potentially explain the effects on improved weight outcomes.

The strengths of this study include the large multisite sample of treatment-seeking children with overweight/obesity and that most results remained significant after stratification by child dietary reporting status. Limitations include self-reported measures for dietary intake and parent feeding practices. Additionally, change in restriction and change in diet were measured only at baseline and post-FBT, thus, the temporal order of the association to zBMI change cannot be confirmed. It is possible that parent feeding practices changed only after observing improvements in child weight.

In conclusion, these results underscore the importance of including parental feeding practices as treatment targets for pediatric weight loss, specifically, reducing restrictive parent feeding practices. For example, children should be allowed to select foods from a variety of healthy options, and parents should focus on what children can eat instead of what they cannot. Additionally, an allowance of moderate consumption of less healthful foods within energy needs may produce calorie reduction without causing children to feel overly deprived. Our results also support prescribing a diet lower in calories, fat, and added sugars, and higher in low-fat sources of protein and fruits and vegetables for pediatric obesity treatment. These results are important to consider within the framework of FBT approaches and highlight the critical role of parents in addressing pediatric obesity.

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