Increasing Fruit and Vegetable Intake and Decreasing Fat and Sugar Intake in Families at Risk for Childhood Obesity

Leonard H. Epstein, Constance C. Gordy, Hollie A. Raynor, Marlene Beddome, Colleen K. Kilanowski, and Rocco Paluch

Abstract

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Objective: The goal of this study was to evaluate the effect of a parent-focused behavioral intervention on parent and child eating changes and on percentage of overweight changes in families that contain at least one obese parent and a non-obese child.

Research Methods and Procedures: Families with obese parents and non-obese children were randomized to groups in which parents were provided a comprehensive behavioral weight-control program and were encouraged to increase fruit and vegetable intake or decrease intake of high-fat/high-sugar foods. Child materials targeted the same dietary changes as their parents without caloric restriction.

Results: Changes over 1 year showed that treatment influenced targeted parent and child fruit and vegetable intake and high-fat/high-sugar intake, with the Increase Fruit and Vegetable group also decreasing their consumption of high-fat/high-sugar foods. Parents in the increased fruit and vegetable group showed significantly greater decreases in percentage of overweight than parents in the decreased high-fat/high-sugar group.

Discussion: These results suggest that focusing on increasing intake of healthy foods may be a useful approach for nutritional change in obese parents and their children.

Key words: fruits, vegetables, pediatric, prevention

Introduction

The prevalence of obesity in children (1) is increasing. Although pediatric treatment has been relatively successful, many treated children also regain weight during follow-up (2). Given difficulties in changing established eating and exercise behaviors, research is needed to prevent obesity during development. Primary prevention may involve modifying intake and/or increasing expenditure, but the biggest effect on energy balance will come from modifying intake, because research suggests that obese and non-obese children have similar activity levels (3,4).

Most dietary approaches for obesity treatment or prevention attempt to limit intake of high-fat, low-nutrient dense foods. This may be perceived as a dietary restriction by people who find these foods reinforcing. The perceived restriction can lead to increases in preference for these foods (5), thereby increasing the probability of relapsing to previous eating habits when structured interventions are removed. An alternative approach would be to teach children to increase intake of healthy high-nutrient dense foods, such as fruits and vegetables, which has been the target of large public health interventions (6).

Components of programs to prevent obesity in at-risk children can include modifying environmental cues leading to positive energy balance, changing parental eating habits, thereby providing healthy models for children to observe, and teaching new parenting skills that reduce using food as a reward (7). Because parental obesity represents one of the major risk factors for pediatric obesity (8,9), many at-risk children will live in families with obese parents. The inclusion of parental behavior change as a target for obesity prevention programs may have benefits beyond prevention

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Department of Pediatrics, School of Medicine and Biomedical Sciences, State University of New York, Buffalo, New York.
Address correspondence to Dr. Leonard H. Epstein, Division of Behavioral Medicine, Department of Pediatrics, State University of New York, Farber Hall, Room G56, 3435 Main Street, Building No. 26, Buffalo, NY 14214-3000. E-mail: lhenet@acsu.buffalo.edu

of pediatric obesity, because a change in the eating habits related to parental obesity may result in a reduction in parental obesity. If obese parents of at-risk children reduce access to low-nutrient dense foods available in the shared family environment, model healthier eating and activity habits, and share positive food-related family experiences that reinforce eating high-nutrient dense foods, the parents may reduce the risk of their child becoming obese as well as modify their own body weight. Golan et al. (10,11) have documented the effectiveness of programs that intervene only with parents in the treatment of childhood obesity. In addition, focusing on the parent has the potential to change the familial environment of a normal-weight child who is at risk for obesity, without identifying the normal-weight child as a patient.

This study was designed to test a new parent-focused approach for modifying eating behavior in at-risk children and their parents. Parents were instructed to modify their behavior and the familial environment to reduce their obesity and were taught parenting skills for promoting and reinforcing behavior change in the at-risk children. The dietary changes suggested for the parents would also result in a secondary goal of reducing weight in parents of at-risk children. Families with at least one obese parent and a normal-weight child were randomized to groups that targeted either a decrease in consumption of high-fat, high-sugar foods or an increase in consumption of fruits and vegetables and were followed for 1 year. The targeted behavior was a change in the eating habits for parents and children, leading to a decrease in weight for parents and to stabilization of relative weight for children.

Research Methods and Procedures

Participants

Families with at least one obese parent and a 6- to 11-year-old non-obese child were recruited through physician referrals, posters, newspapers, and television advertisements for the Childhood Weight Control and Prevention Programs at the University of New York at Buffalo. A total of 30 families were accepted into the program. All of these families met the criteria: a child with a body mass index (BMI) that was less than the 85th BMI percentile, at least one parent with a BMI that was more than the 85th BMI percentile (12,13), one parent willing to attend treatment meetings, no family member on an alternative weight-control program, no parent or child with current psychiatric problems, and no dietary or activity restrictions on the participating parent or child. In 28 of the 30 families, the participating parent was the obese parent. A total of 15 families began in each of the two groups. Complete 1-year data were available for 27 of the 30 families (90%).

Procedure

Families who met entrance criteria were randomly assigned to one of two groups for which the targeted behaviors varied: increase fruit and vegetable intake (Increase Fruit and Vegetable) or decrease high-fat/high-sugar food intake (Decrease Fat and Sugar).

Treatment

Common Components of Treatment. Weight-control treatment was provided to the parents for eight weekly meetings, followed by four biweekly and two monthly meetings during the 6-month intensive treatment. Participating parents and children attended the first meeting, at which they received the first modules in their parent and child workbooks. The workbook included five main sections: introduction to weight control and prevention, the Traffic-Light Diet (14), developing a healthy eating and activity environment for children, behavior change techniques, and maintenance of behavior change. Child materials were sent home with the parents each week and included new workbook modules and program-related activities for the children to do with their parents. At treatment meetings, participating parents were weighed and their weight was graphed. The participating parents also met with an individual therapist for 30 minutes and attended a 30-minute group meeting. During the individual meeting, therapists reviewed the program-related child/parent activity, the weight change of the parent, and the targeted dietary goal and parent-activity goal of at least 30 minutes of moderately intense physical activity $\geq$6 days per week (15). Participating parents and children were seen at for follow-up at 6 and 12 months.

The Traffic Light Diet (14) was used to promote a balanced diet and to decrease energy intake in overweight parents. Traffic Light Diet foods are categorized into the colors of the stoplight: red, yellow, or green based on their calorie and nutrient content. Green foods are very high in nutrients and low in calories. Yellow foods are higher in calories and include the dietary staples needed for a balanced diet. Red foods are higher in calories with low nutrient density. While they were attempting to lose weight, overweight parents were instructed to consume between 1200 and 1500 calories (kcal) per day and to maintain nutrient balance by eating the recommended servings based on the Food Guide Pyramid. When participants got below the obesity criterion ($<$85th BMI percentile) they were instructed on how to develop a maintenance calorie level, which involved gradually increasing caloric intake in 100-kcal/d increments until weight gain occurred. Non-overweight parents had no caloric restriction but were asked to meet their targeted dietary goal. Families were provided additional nutritional information regarding reading food labels and shopping.

Parents were taught positive reinforcement techniques that included praise for targeted behaviors. Children were reinforced for completing their program-related activities at home by having a sticker placed on a tracking sheet. At the 6-month follow-up, children were given gift certificates

based on the number of activities completed during the program. Parents were taught stimulus control to reduce access to high-fat/high-sugar foods and to increase access to fruits and vegetables, and to increase access to physical activity and to reduce access to sedentary behaviors. Preplanning and problem solving were taught to facilitate decision-making and handling of difficult eating and activity situations such as parties, holiday gatherings, school functions, and work functions.

Targeted Dietary Goals. The between-group differences focused on which dietary behaviors were targeted for change. Both groups received the same basic information, but the groups differed in the behaviors targeted for change. In the Increase Fruit and Vegetable group, the goal was to incrementally increase intake of fruits and vegetables to reach at least two servings of fruits and three servings of vegetables per day. Participants in the Decrease Fat and Sugar group were provided incremental goals to reach a goal of no more than 10 servings of high-fat/high-sugar foods per week.

Measurement

All dependent measures were collected at baseline and 12 months.

Anthropometric Measures. Height was measured in 0.125-inch (0.32 cm) intervals using a stadiometer (Seca, Columbia, MD), and weight was measured in 0.25-lb (0.55 kg) intervals using a balance beam scale (Healthometer, Bridgeview, IL); equipment was calibrated daily. BMI (kg/m^2) was calculated and compared with population standards based on gender and age (12,13). All children were under the 85th BMI percentile and were considered non-obese. Parents who were greater than the 85th BMI percentile were considered obese. BMI changes reliably with the age of the child, with a decrease from ages 2 to 5 years and gradual increases through development. Thus, the BMI value cannot be used to establish obesity or assess change, because an older child with a higher BMI value than a younger child may be less obese. Percentage of overweight was established by comparing the BMI of the subject with the 50th BMI percentile based on the gender and age of the subject. This provides a continuous value that determines the extent to which the subject is overweight in comparison with the population average.

Family History of Obesity and Related Diseases. Parents were asked how many of the child's parents or grandparents were obese and had diagnosed hypertension, hyperlipidemia, diabetes, or stroke. They were also asked what their perception was of the probability of the enrolled child becoming obese (from 0 [no risk] to 100 [will become obese]). Parents' confidence in changing their weight and their eating and exercise habits and in helping their children change their eating and exercise habits was assessed using a 1 to 5 scale (from 5 [very confident] to 1 [not confident at all]).

Food Intake. Changes in eating habits over the past month were assessed using the Food Habits Questionnaire (16), which assesses changes in patterns of behavior associated with avoiding meat, avoiding fat as a seasoning, replacing high-fat foods with low-fat alternatives, substituting foods with manufactured substitutes, and using fruits and vegetables. Participants rated how often they engaged in specific patterns of eating habits on a four-point scale, ranging from rarely or never to usually or always.

Daily intake of fruits and vegetables and high-fat/high-sugar foods was assessed using the Food Intake Questionnaire,[1] a laboratory-constructed, self-administered food frequency questionnaire. This questionnaire lists 15 fruits, 18 vegetables, and 33 high-fat/high-sugar foods along with the serving size for each food. Serving sizes for fruits and vegetables were similar to the serving sizes defined by Domel et al. (6) and met the fruit and vegetable definitions of the Food Guide Pyramid (17); serving sizes for high-fat/high-sugar foods were defined using standard serving sizes (18). Participants circled "Yes" if they ate the food that day and circled "Less" if they ate less than the serving listed, "Equal" if the amount listed was the exact amount that they consumed, or "More" if the amount eaten was greater than the serving listed. The questionnaires were handed out to parents and children at the first treatment meeting and returned by the parents at the second treatment meeting. Parents completed the food questionnaire for themselves and assisted their child by prompting the child's recall. Parents were instructed on how to prompt recall without introducing demand bias of healthy eating. The questionnaire was completed for 3 days: 2 weekdays and 1 weekend day. All families were given a one-half cup measuring cup to help with portion size estimation.

The Food Intake Questionnaire was validated for fruits and vegetables and high-fat/high-sugar foods for 48 adult subjects and 32 child subjects against 24-hour dietary recalls administered by trained research personnel (a registered dietitian and a master's level nutritionist). The percentage of agreement between the questionnaire and the dietary recall for parents was 91.4% ($\kappa = 0.66$) for fruits and vegetables and 89.4% ($\kappa = 0.60$) for high-fat/high-sugar foods. The percentage of agreement between the questionnaire and the dietary recall for children was 94.8% ($\kappa = 0.69$) for fruits and vegetables and 88.8% ($\kappa = 0.64$) for high-fat/high-sugar foods. The mean number of servings for parents estimated by the 24-hour recalls and the questionnaire was 1.75 vs. 1.83 for fruits, 3.30 vs. 3.17 for vegetables, and 10.52 vs. 10.10 for high-

[1] This questionnaire is available from the authors.

fat/high-sugar foods. Measured and estimated servings for children were 1.73 vs. 1.82 for fruits, 1.29 vs. 1.27 for vegetables, and 12.07 vs. 11.16 for high-fat/high-sugar foods. The high levels of agreement and similar outcomes of total number of servings between the recall and questionnaire indicate an acceptable level of agreement between the methods.

Psychological Measures. Parental control over child eating was assessed with the older, short version of the Child Feeding Questionnaire, a well-validated instrument (19) that measures concern about child overweight, parental control over food, and perception of parent overweight (20). The range of scores for the concern about child overweight scale is 3 to 21, and the range of scores for parental control is 7 to 49. Scores for perception of parent overweight are based partly on parent weight, so there is a very broad range of scores for this scale.

Socioeconomic Status. Socioeconomic status was assessed using Hollingshead's Four-Factor Index of Social Status (21).

Statistical Analysis

Between-group differences at baseline were assessed using *t* tests. Changes in dependent variables were established separately for parents and children using mixed ANOVAs with the between-subject factors of group (Increase Fruit and Vegetable/Decrease Fat and Sugar) and a repeated measures within-subjects (0, 12) factor. Residuals were plotted, and outliers were examined for their contribution to the model; outliers were removed if they exerted an undue influence on the probability levels. One obese parent was an outlier for weight loss and intake and was removed from all analyses. Predictors of change in child and parent intake and percentage of overweight were established using Pearson product-moment correlation coefficients.

Results

Characteristics of Participants

Baseline values for subjects are shown in Table 1. No differences between groups for any of the baseline values were observed, except for more hypertension in families in the Decrease Fat and Sugar group ($p < 0.01$). The average participating parent was 65.7% overweight, with a clustering of obesity-related risk factors in the family. Every family had at least one parent or grandparent with an obesity-related risk factor. The parents were quite confident that they could lose weight (4.1 $\pm$ 0.9, mean $\pm$ SD) but less confident that they could make eating (2.1 $\pm$ 1.0) or activity (2.1 $\pm$ 1.1) changes. The parents were less confident that they could help their children change their eating (1.8 $\pm$ 0.9) or their activity (1.7 $\pm$ 1.3) habits.

Evaluation of Treatment Effects

There were no differences in the number of sessions attended by each group. Families in the Increase Fruit and Vegetable group attended 11.5 of 14 (82%) sessions, whereas those in the Decrease Fat and Sugar group attended 12.2 of 14 (87%) sessions. Table 2 shows parent and child changes in servings of fruits and vegetables and high-fat/high-sugar foods and percentage of overweight change. Significance levels are presented for main effects of time and for between-group differences in change over time. As shown in Table 2, parents showed significant differences in fruit and vegetable intake over time by group ($F_{(1,23)} = 6.56$; $p < 0.025$). High-fat/high-sugar intake showed a significant decrease across groups over time ($F_{(1,23)} = 45.70$; $p < 0.001$). Children also showed significant between-group differences in fruit and vegetable intake over time ($F_{(1,24)} = 7.20$; $p = 0.025$) and significant changes in high-fat/high-sugar food intake for both groups over time ($F_{(1,24)} = 18.14$; $p < 0.001$).

Significant decreases over time were observed for the Food Habits Questionnaire, with an average decrease of -0.6 for use of fat as a seasoning ($F_{(1,23)} = 14.84$; $p < 0.001$) and an average decrease of -0.31 for substituting low-fat versions of high-fat foods ($F_{(1,23)} = 7.09$; $p < 0.025$), while use of fruits increased by $+0.47$ ($F_{(1,23)} = 4.45$; $p < 0.05$). A significant interaction of group by time was observed for parent perception of being overweight on the Child Feeding Questionnaire ($F_{(1,23)} = 6.52$; $p < 0.25$), with parents in the Increase Fruit and Vegetable group showing greater decreases (-15.9) than parents in the Decrease Fat and Sugar group (-2.4). Nonsignificant decreases in parent control over child eating (-1.6) were observed.

Parents showed significant differences in percentage of overweight change by group ($F_{(1,23)} = 5.64$; $p < 0.05$), while children showed a stable percentage of overweight over time.

Correlational Analyses

Baseline parent high-fat/high-sugar intake was related to high-fat/high-sugar changes ($r = -0.82$; $p < 0.001$), and baseline parent fruit and vegetable intake was related to fruit and vegetable changes ($r = -0.45$; $p < 0.025$). Baseline child high-fat/high-sugar intake was related to high-fat/high-sugar changes ($r = -0.82$; $p < 0.001$). Baseline parent and child fruit and vegetable intake was related ($r = 0.38$; $p < 0.05$). Parent changes in fruit and vegetable intake over the year were related to changes in habits of eating fruit ($r = 0.50$; $p < 0.001$). Age and gender were not related to child changes.

Table 1. Baseline values for parent and child (mean ± SD)

	Groups	
	Increase Fruit and Vegetable	**Decrease Fat and Sugar**
	Parent	
Gender (males/females)	1/12	1/11
Age	39.1 ± 4.1	42.2 ± 4.8
Height (cm)	166.5 ± 6.5	167.8 ± 5.0
Weight (kg)	101.4 ± 19.7	102.1 ± 25.8
Percentage of overweight	68.4 ± 23.4	67.3 ± 42.8
Family history (number of immediate family members with)		
Obesity	3.2 ± 1.7	3.1 ± 1.4
Hypertension	0.9 ± 1.0	1.8 ± 0.8
Hypercholesterolemia	1.4 ± 1.3	1.0 ± 1.2
Stroke	0.6 ± 0.9	0.5 ± 0.7
Diabetes	0.5 ± 0.7	0.4 ± 0.7
Risk of child obesity	44.6 ± 20.3	45.0 ± 22.0
Servings per day of fruits and vegetables and high-fat/high-sugar intake		
Fruits and vegetables	3.8 ± 1.8	4.2 ± 2.6
High-fat/high-sugar	12.8 ± 6.7	12.6 ± 7.6
Food habits		
Meat	2.1 ± 0.8	1.9 ± 0.8
Fat as a seasoning	2.7 ± 0.9	2.5 ± 0.8
Replace high-fat foods	3.2 ± 0.6	3.1 ± 0.5
Substitute for high-fat foods	2.5 ± 0.7	2.3 ± 0.7
Eat fruits and vegetables	1.9 ± 1.2	1.2 ± 1.0
Child feeding questionnaire		
Perception of child obesity risk	11.1 ± 2.3	11.3 ± 1.6
Perception of parent control	26.9 ± 6.7	22.6 ± 5.3
Perception of parent obesity	251.7 ± 44.6	250.7 ± 60.7
Confidence in making choices		
Losing weight	4.3 ± 0.5	3.8 ± 1.1
Parent eating changes	2.1 ± 1.0	2.4 ± 1.0
Parent activity changes	1.8 ± 0.9	2.5 ± 1.3
Child eating changes	1.9 ± 0.6	1.8 ± 1.1
Child activity changes	1.7 ± 1.1	1.8 ± 1.5
	Child	
Gender (males/females)	6/7	3/10
Age	8.8 ± 1.8	8.6 ± 1.9
Height	132.4 ± 9.8	131.3 ± 11.6
Weight	31.2 ± 5.4	30.8 ± 8.2
Percentage of overweight	7.2 ± 6.0	6.5 ± 8.0
Servings per day of fruits and vegetables and high-fat/high-sugar intake		
Fruits and vegetables	2.8 ± 1.5	3.2 ± 1.6
High-fat/high-sugar	12.9 ± 8.3	14.1 ± 7.6

Discussion

The goal of this study was to evaluate the effects of targeting increased fruit and vegetable intake versus decreased high-fat/high-sugar intake in parents on eating and percentage of overweight, as well as the associated effects of parent-initiated changes on fruit and vegetable intake and

Table 2. Changes in servings per day of fruits and vegetables and high-fat/high-sugar foods, and changes in percentage of overweight over 12 months for parents and children in the increase fruit and vegetable or decrease fat and sugar groups (mean ± SD)

	Groups		Significance levels	
	Increase Fruit and Vegetable	**Decrease Fat and Sugar**	**Time**	**Group X Time**
Parent				
Fruits and vegetables	3.41 ± 3.47	−0.23 ± 3.66	0.035	0.017
High-fat/high-sugar	−6.47 ± 4.63	−8.22 ± 6.19	<0.001	NS
Percentage of overweight	−12.01 ± 11.05	−3.94 ± 4.17	<0.001	0.026
Child				
Fruits and vegetables	0.72 ± 1.11	−0.55 ± 1.31	NS	0.12
High-fat/high-sugar	−4.50 ± 7.97	−8.50 ± 7.58	<0.001	NS
Percentage of overweight	−1.10 ± 5.29	−2.40 ± 5.39	NS	NS

NS, not significant.

high-fat/high-sugar intake and percentage of overweight in non-obese offspring. Results showed that fruit and vegetable intake was greater for parents in the Increase Fruit and Vegetable group, and the reduction in high-fat/high-sugar foods was greater for parents in the Reduce Fat and Sugar group. The Increase Fruit and Vegetable intervention also reduced high-fat/high-sugar intake, whereas the intervention to Decrease Fat and Sugar was associated with no changes in fruit and vegetable intake. The Food Habits Questionnaire, which deals with patterns of food use rather than the more specific measures of daily intake, showed significant improvement over time for both groups in reducing use of fat as a seasoning and substituting for high-fat foods, while at the same time increasing use of fruit.

Children showed trends toward greater increases in fruit and vegetable intake for the Increase Fruit and Vegetable group through the 1 year of observation. High-fat/high-sugar food intake significantly decreased across all children, independent of group. These data are consistent with parent results, suggesting that targeting fruit and vegetable intake in children increases intake of nutritionally dense healthy foods while simultaneously decreasing intake of low nutrient dense foods. Targeting fruit and vegetable intake in an environment in which parents were working on weight control was associated with a reduction in the consumption of high-fat/high-sugar foods, whereas targeting a reduction in dietary fat and sugar did not improve fruit and vegetable intake.

There are a number of ways in which targeting an increase in fruit and vegetable intake may modify eating behavior. Interventions targeting intake of healthier alternatives for low-nutrient dense foods may increase preference for healthier foods (22). Increasing carbohydrate and fiber intake by eating more fruits and vegetables may enhance satiation, reducing caloric and fat intake (23,24). Families who are working on increasing fruit and vegetable intake in the context of parental weight control may shift their buying habits of food, and in the attempt to maintain total food cost, reduce storage of lower nutrient dense foods as healthier foods are bought and consumed. Reducing access to high-fat/high-sugar foods did not have the side effect of increasing intake of fruits and vegetables in parents or children. This may be because there are many substitute foods that are available that may not improve fruit and vegetable intake as high-fat/high-sugar foods are reduced. Reducing access to specific high-fat and/or high-sugar foods may simply result in a substitute of other highly palatable, but less calorically dense foods (25).

Changes in fruit and vegetable intake were greatest for those parents with the lowest initial levels, and reductions in high-fat/high-sugar intake were greatest for those parents and children with the highest initial levels. Thus, the interventions generally benefited those with poorer baseline eating habits.

Percentage of overweight change was greater for parents who targeted increases in fruit and vegetable intake than reductions in high-fat/high-sugar intake. The main contribution to weight control is a reduction in caloric intake, and dietary restriction is needed to lose weight. These results suggest that a differential focus on what can be eaten versus what cannot be eaten may make it easier to adhere to the caloric reductions needed for weight control. The interventions were designed to improve child eating habits and to prevent increases in the percentage of overweight in these high-risk children. The interventions were successful in meeting this goal, and if continued over time, the interventions might be useful in preventing the development of obesity.

The present study suggests that reductions in high-fat/high-sugar intake in children can be achieved by focusing on parent change and providing materials for parent–child use at home. This approach is particularly well-suited for obesity prevention when the child is normal weight and does not require caloric restriction. In addition, this intervention is cost-effective because it can influence multiple family members by treating only one parent. The use of parent-only intervention has been tested in the treatment of childhood obesity, with initial results suggesting that better results are observed when parents rather than children are treated (10,11).

This study is limited by the small sample size for a treatment study. Subjects were recruited over a 2-year period with newspaper advertisements, letters to pediatricians, community lectures, and direct mailings to families in a large managed-care organization. It was challenging to recruit an adequate number of families with obese parents and normal-weight children who were interested in preventing obesity. The majority of successful prevention trials have been implemented in schools (26,27), not in clinical settings. Clinical settings may be better suited to family-based interventions that directly involve the parents in prevention, but parents must become better informed about the importance of prevention and not wait until an at-risk child becomes obese before deciding that changes in family health habits are needed.

There are several issues to consider when evaluating the clinical utility of this intervention. First, the sample included families with obesity and related cardiovascular risk factors in parents and grandparents, and parents who were concerned enough about preventing obesity in their offspring to enter a behavioral-change program. Parents who are obese but have not yet experienced obesity-related disease in family members may be less motivated to participate in an obesity prevention program. Second, the percentage of overweight change for parents was significant over time, but less than we have observed in previous studies in which both parents and children are provided treatment (28,29). Motivation for behavior change may be very different in families in which the targeted child is obese and needs to lose weight compared with families in which the targeted child is non-obese, where the goal would be to prevent the probable but not definite outcome of obesity. Finally, the intervention targets only one family member and thus may not benefit from interactions between family members that support behavior change or changes in the shared family environment that may enhance the treatment effects of the parent.

This study has implications for the prevention of obesity in non-obese children and perhaps for family-based intervention for obese adults. Further tests of programs to enhance healthy eating rather than decrease unhealthy eating are warranted. Because obesity often runs in families (8,30), cost-effectiveness may be enhanced when multiple family members benefit. The family-based model has demonstrated positive treatment effects in untreated siblings over a 5-year interval (31), but further research is needed to evaluate family-based interventions that target and provide treatment for multiple family members that are at-risk or prone to obesity. Prevention of obesity in the child using the same program that also treated obesity in an obese parent would represent a powerful and cost-benefit intervention.

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