Improving Healthy Eating in Families With a Toddler at Risk for Overweight: A Cluster Randomized Controlled Trial

William S. Agras, MD,* Lawrence D. Hammer, MD,† Lynne C. Huffman, MD,† Anthony Mascola, MD,* Susan W. Bryson, MS,* Carol Danaher, PhD‡

ABSTRACT: Objective: To ascertain whether a parent education program based on Satter’s division of responsibility in feeding children (DOR) is effective in enhancing parent/child feeding interactions for children with an overweight/obese parent. The primary hypothesis was that the intervention would decrease parental pressure to eat. Methods: Sixty-two families with a child between 2 and 4 years with at least 1 overweight/obese parent were randomly allocated using a cluster design to either the DOR intervention or a control group. The control group focused on increasing family consumption of healthy foods and activity levels and enhancing child sleep duration. The primary outcome was parent pressure on their child to eat. Results: The DOR intervention was superior to the control group in reducing the pressure to eat. Two moderators of pressure to eat were found: disinhibition of eating and hunger. The parents in the DOR group, irrespective of disinhibition levels, lowered the pressure to eat, whereas those in the control group with low disinhibition increased the pressure to eat. There were similar findings for hunger. Gender moderated restrictive feeding with DOR parents lowering restriction more than parents of the control group in girls only. Conclusion: The DOR intervention was more effective in reducing the parent pressure to eat and food restriction (in girls only) than the control group.


The increase in US childhood overweight/obesity over the past 20-years across all income and ethnic groups in the United States1,2 underlines the need for early prevention programs to reduce the increasingly prevalent and costly medical comorbidities associated with overweight.3 To date, however, prevention programs that are often implemented in school settings have met with only moderate success,4 perhaps because the family environment continues to reinforce maladaptive behaviors. At the family level, parent feeding practices, such as taking excessive control over their child’s eating, appear to contribute to childhood overweight.5,6 It is hypothesized that these parental behaviors interfere with the child’s perception of hunger and satiety, leading to loss of control over eating and eventually to overweight.

Family studies suggest that restrictive feeding by the parent is related to childhood overweight, although the majority of these are cross-sectional studies.6,7 Laboratory studies also suggest that restrictive feeding is associated with childhood overweight. For example, when children have restricted access to a specific food, they tend to eat more of that food in a later test, although this finding was for girls but not boys.8 On the other hand, if children are pressured to eat a healthy food, in this case by making play contingent on consuming a particular food, their preference for that food will diminish in subsequent tests.9 Observational studies also demonstrate the importance of parental behavior on children’s feeding. For example, higher rates of parent food offers, presentations, and prompts (all measures of pressure to eat) were associated with higher caloric intake in young children in a laboratory setting.10 Another study found that higher rates of parental prompts to eat and food offers were associated with higher child relative weights.11 It can be argued that parental control over their child’s eating is simply a reaction to their child’s feeding problems. However, a prospective study from birth to 7 years of age found that parental attributes at infancy predicted overcontrol at 7 years.12 Such attributes included the following: parental body dissatisfaction, parental eating disorders, minority status, and parents being born outside the United States. This study indicates that parental overcontrol of their child’s eating is not simply a reaction to an existing feeding problem.

Thus, parent behaviors, particularly restricting food choices, are risk factors for overweight. However, to determine whether changing these behaviors affect...
weight gain in young children, which are causal risk factors, an evidence-based intervention to reduce parental overcontrol during mealtimes is first needed. A child development-based feeding relationship model, division of responsibility (DOR), formalized by Satter\textsuperscript{13,14} has been used to foster optimal feeding practices. The American Academy of Pediatrics recommends the model during child health supervision visits.\textsuperscript{15} However, this model has not been tested in a controlled trial; hence, it is unclear whether it actually reduces parent attempts to control their child’s eating. The aim of this study was to compare, in a randomized trial, an intervention based on the Satter’s model, which is aimed at reducing parental interference during feeding, with a control group adapted from the “We Can” program developed by the National Institutes of Health, which is aimed at enhancing family nutrition and activity levels.\textsuperscript{16} The children involved in the study were at the risk for overweight or obesity because at least 1 parent was overweight or obese.

**METHODS**

**Design**

A cluster design was used in which participants were allocated in the order in which they were entered to the study to a small group. The group was then randomized to 1 of the 2 interventions (see Figure 1). Each group met weekly for 5 sessions, with each session lasting approximately 1 hour. Both parents were invited to the groups, but usually only 1 parent attended. Children were not involved directly in the study because the study was aimed at changing parent behaviors.

**Participants**

The participants were 62 families with a child between 2 and 4 years. At least 1 parent was overweight/obese.
with a body mass index (BMI) greater than 28 kg/m². Participants were recruited from several sources including preschools, mother’s clubs, Santa Clara County Supplemental Nutrition Program for Women and Children (WIC) clinics, and Internet sources such as Craigslist and the study Web site. All parents had to speak and understand English to complete the assessments and take part in the interventions. Parent exclusions were ongoing serious illness, such as cancer, or serious psychiatric illness, such as schizophrenia, uncontrolled bipolar disorder, mental retardation, that would prevent participation in the assessments or interventions. Children’s exclusions included serious physical illness or related treatments that would affect feeding or weight (including a history of feeding aversion, failure to thrive, prematurity below 37 weeks associated with prolonged hospitalization, ongoing need for nutritional supplementation) and serious current developmental problems including any that might interfere with self-feeding or require additional parental feeding support (e.g., developmental delay, autism).

Parents were told that we were studying the comparative effectiveness of 2 different methods that may help to prevent childhood overweight. The study was approved by the Institutional Review Board of the Stanford University. All potential participants signed a consent form.

**Interventions**

Three therapists treated groups in both conditions to reduce therapist bias. The therapists were clinical psychology graduate students with experience as therapists. They read the treatment manuals, which were then discussed with them in several preliminary sessions ensuring mastery of the content and procedures. Each therapist then role-played situations likely to arise in both interventions. When they reached a satisfactory level of expertise, they began leading the groups. Each group session was audited (by W.S.A.), and the therapists were supervised in weekly sessions by an expert (C.D.) in the division of responsibility (DOR) intervention. Feedback to the therapists was provided from the previous sessions’ recordings.

**Division of Responsibility Intervention**

The DOR program was based on the Satter’s model in which parents take responsibility for providing and serving food, maintaining a regular schedule of meals and snacks, and deciding where food is to be served including family meals, during which the child serves him or herself depending on age and skills. The child’s responsibilities are to decide whether to eat and how much to eat. The primary principle is that crossing parent or child boundaries leads to feeding problems. The intervention incorporates behavior change principles such as self-monitoring of behavior and progress and making changes in small steps.

**Control Group**

The “We Can” program, which has been tested in a number of community settings, focuses on changing parental behaviors to increase the consumption of healthy foods by increasing intake of vegetables, decreasing fats and sweetened beverages, and increasing family exercise and decreasing TV and computer time. Results from 9 sites suggest that the program is effective in changing attitudes and behaviors, and no safety concerns were noted. In the light of recent findings concerning the relation between short sleep time and overweight, attention was also paid to regular and sufficient sleep. This is an addition to the original program. As the original program targeted older children and their families, the content, particularly activity levels and types and introduction of healthy foods, was adapted for the age group involved in this study. Behavior change procedures were also incorporated in this intervention. Hence, this group controls for the therapy mode, parental involvement and information, and practice with behavior change procedures focused on the family and toddler involved in the study, similar to the DOR intervention, but does not target specific feeding behaviors such as pressure to eat and food restriction.

**Outcome Measures**

The primary outcome measure was pressure to eat. Secondary outcome measures were food restriction and satisfaction with treatment. Both pressure to eat and food restriction were assessed using the Child Feeding Questionnaire (CFQ). The CFQ was developed to assess 2 broad categories of factors: (1) parent perceptions and concerns about their child’s risk of obesity and (2) parent use of child feeding practices, particularly pressure to eat and food restriction. Responses range from unconcerned to extremely concerned on a 5-point Likert scale. Satisfaction with treatment was assessed using the Client Satisfaction Questionnaire (CSQ). The CSQ consists of 8 items each rated on a 4-point scale forming a global score. The internal consistency and reliability of the questionnaire is high as is its validity.

Descriptive variables were collected at baseline. In this study, the children’s age was verified from their birth certificates. Parent birthplace, age, ethnicity, and race were collected, and parent BMI was measured using a balance beam scale that was calibrated daily. Other baseline data collected for descriptive purposes and to investigate possible moderators of outcome included the Three Factor Eating Questionnaire (TFEQ) used to assess parent dietary restraint, hunger, and disinhibition of eating because these variables have been associated with children’s eating behaviors. Disinhibition represents responses to food cues, with high disinhibition often associated with binge eating. Hunger refers to the parent’s habitual level of hunger, with high levels of hunger associated with lessened ability to control eating. The TFEQ consists of 36 items of Yes/No format. It has good internal consistency, and the test-retest reliability over a 1-month period is 0.90. A revised version of the Stanford Child Feeding Questionnaire was used to assess parent/child feeding behaviors. This questionnaire was revised for this study from a previous version by removing items not applicable to the present study. It consists of

---

*Vol. 33, No. 7, September 2012*
Table 1. Baseline Characteristics of the Sample by Intervention (N = 61)

<table>
<thead>
<tr>
<th></th>
<th>DOR Program</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paternal BMI, mean (SD)</td>
<td>29.2 (6.4)</td>
<td>30.5 (6.0)</td>
</tr>
<tr>
<td>Paternal age, mean (SD) (yr)</td>
<td>38.2 (8.5)</td>
<td>37.0 (7.6)</td>
</tr>
<tr>
<td>Maternal BMI, mean (SD)</td>
<td>32.8 (7.2)</td>
<td>32.1 (8.1)</td>
</tr>
<tr>
<td>Maternal age (yr), mean (SD)</td>
<td>35.6 (6.1)</td>
<td>38.4 (6.6)</td>
</tr>
<tr>
<td>Child age, mean (SD) (mo)</td>
<td>40.5 (11.8)</td>
<td>39.47 (10.0)</td>
</tr>
<tr>
<td>Child gender, n (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>21 (64)</td>
<td>14 (48)</td>
</tr>
<tr>
<td>Female</td>
<td>12 (36)</td>
<td>11 (42)</td>
</tr>
<tr>
<td>Paternal ethnicity, n (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not Hispanic</td>
<td>26 (84)</td>
<td>16 (67)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>5 (16)</td>
<td>7 (33)</td>
</tr>
<tr>
<td>Paternal race, n (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Native American</td>
<td>0 (0)</td>
<td>1 (4)</td>
</tr>
<tr>
<td>Asian</td>
<td>3 (9)</td>
<td>3 (12)</td>
</tr>
<tr>
<td>Black</td>
<td>3 (9)</td>
<td>1 (4)</td>
</tr>
<tr>
<td>Pacific Islander</td>
<td>0 (0)</td>
<td>1 (4)</td>
</tr>
<tr>
<td>White</td>
<td>21 (58)</td>
<td>15 (42)</td>
</tr>
<tr>
<td>More than 1 race</td>
<td>5 (15)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Did not answer</td>
<td>1 (3)</td>
<td>4 (16)</td>
</tr>
<tr>
<td>Paternal disinhibition, mean (SD)</td>
<td>10.2 (3.1)</td>
<td>8.9 (3.9)</td>
</tr>
<tr>
<td>Parental hunger, mean (SD)</td>
<td>7.8 (2.7)</td>
<td>7.6 (3.7)</td>
</tr>
<tr>
<td>Parental restraint, mean (SD)</td>
<td>7.5 (4.3)</td>
<td>7.1 (3.7)</td>
</tr>
<tr>
<td>Child temperament, mean (SD)</td>
<td>59.2 (8.0)</td>
<td>60.0 (8.8)</td>
</tr>
<tr>
<td>Child picky eating, mean (SD)</td>
<td>2.5 (1.3)</td>
<td>2.5 (1.4)</td>
</tr>
<tr>
<td>Child mealtime tantrums, mean (SD)</td>
<td>3.5 (1.6)</td>
<td>2.9 (1.7)</td>
</tr>
<tr>
<td>Parental pressure to eat, mean (SD)</td>
<td>2.2 (1.0)</td>
<td>2.6 (0.8)</td>
</tr>
<tr>
<td>Parental food restriction, mean (SD)</td>
<td>2.9 (0.8)</td>
<td>2.8 (0.8)</td>
</tr>
</tbody>
</table>

DOR, Satter’s division of responsibility; BMI, body mass index. aThree Factor Eating Questionnaire (possible range for disinhibition, 0–16; hunger, 0–14; restraint, 0–21). bChild Behavior Questionnaire (possible range, 0–91). cStanford Child Feeding Questionnaire-R (possible range, 0–7). dChild Feeding Questionnaire (possible range, 0–5).

Behavior Questionnaire developed by Rothbart et al to evaluate temperament in preschool and early school-age children. For this study, temperament as perceived by the parent was assessed as the mean of 4 dimensions that have been related to childhood overweight (anger/frustration, activity, approach, anticipation, impulsivity) using a 7-point range from “extremely untrue of your child” to “extremely true of your child.” The scales have good internal consistency with coefficient alphas ranging from 0.63 to 0.92, with a mean of 0.74. The scales are also relatively stable across periods as long as 2 years and have moderate to high levels of parental agreement. Temperament was assessed because it has been associated with child overweight in a few previous studies. Therapist fidelity to the 2 treatment conditions was assessed by one of the investigators (W.S.A.) auditing all audiotapes of the group sessions. A global score was used based on a 0-5 Likert scale from low to high fidelity.

Data Analysis

A baseline comparison of treatment groups was used to determine the success of randomization; we utilized t tests (for continuous variables) and x² tests (for categorical variables). Spearman correlations were used to examine relationships between baseline behaviors and outcome measures. Because randomization occurred at the group level, analysis techniques were selected to appropriately model the data. Thus, linear mixed modeling was used where the group was the second-level model, with the parent as the first-level model. Baseline values were controlled for using the baseline measure as a covariate. Effect sizes were calculated using Cohen’s d, correcting for cluster intraclass correlations. Analysis was based on the intent to treat. In addition, a moderator analysis was performed. A moderator is a baseline variable that interacts with an outcome variable where the moderator divides the treatment group into 2 subgroups with different outcomes (i.e., greater or lesser responsiveness to treatment). Exploratory moderator analysis using the methodology of Kraemer et al suggests that all baseline (prerandomization) measures (see Table 1) be considered as potential moderators. Moderators were determined for both outcome measures: parental pressure to eat and food restriction controlling for the baseline measure and using treatment, moderator, and interaction as the independent measures.

RESULTS

Demographics and Baseline Findings

Figure 1 shows the flow of participants into the study. Sixty-two families were entered, 35 to the division of responsibility (DOR) intervention and 27 to the control group. One family (3.7%) dropped out of the control intervention and 3 (8.5%) from the DOR intervention, leaving 59 families who were assessed at the end of the treatment. On average, fathers were aged (±SD) 37.6 ± 8.0 years and mothers were 36.8 ± 6.4 years, with
a body mass index of 29.8 ± 6.2 and 35.3 ± 7.6 respectively. Baseline characteristics by group are presented in Table 1. There were no statistically significant differences between treatment groups on any parent or child baseline variable. Hence, randomization appeared successful. Pressure to eat at baseline correlated with the child’s temperament (r = 0.29; p < .05) and with picky eating (r = 0.54; p < .001). Food restriction at baseline correlated with mealtime tantrums (r = 0.34; p < .01).

Pressure to Eat

The primary outcome, parent pressure on their child to eat, decreased significantly more in the DOR intervention than in the control group at the end of the treatment (F[1,10] = 26.0; p < .001) with a number needed to treat (NNT) = 2 (i.e., the number of families needed to treat to prevent one additional bad outcome). (Table 2) Two parent variables from the Three Factor Eating Questionnaire moderated pressure to eat, namely, disinhibition of eating and hunger. Parents in the DOR intervention decreased the pressure to eat irrespective of disinhibition scores (low disinhibition parents decreased by 67% and high disinhibition parents by 59%), whereas parents with low disinhibition scores in the control group increased the pressure to eat (low disinhibition parents increased by 33% and high disinhibition parents decreased by 33%) (F(1,55) = 7.5; p = .008). There was a similar pattern for hunger. Parents in the DOR intervention lowered the pressure to eat irrespective of hunger levels (low hunger parents decreased by 57% and high hunger parents by 63%), whereas parents with low hunger in the control group increased the pressure to eat (low hunger parents increased by 31% and high hunger parents decreased by 36%) (F(1,53) = 4.1; p = .047) (Table 2).

Food Restriction

Change in the level of food restriction was not significantly different between the 2 groups. However, child gender moderated food restriction with parents of male children hardly decreasing food restriction (DOR males decreased by 20%, control males no change), whereas parents of female children decreased food restriction in the DOR intervention by 117% compared to the control group, which decreased by 19% (F(1,50) = 5.1; p = .029).

Table 2. Estimated Means (Standard Errors) for the Outcome Variables by Treatment Group

<table>
<thead>
<tr>
<th>Outcome Variable</th>
<th>DOR Intervention</th>
<th>Healthy Living Intervention</th>
<th>Baseline Adjusted Mean Difference DOR-Healthy Living (95% Confidence Interval)</th>
<th>t value</th>
<th>p</th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure to eat</td>
<td>1.6 (0.10)</td>
<td>2.4 (0.12)</td>
<td>−0.771 (−1.11 to −0.435)</td>
<td>−5.10</td>
<td>&lt;.001</td>
<td>0.88</td>
</tr>
<tr>
<td>Food restriction</td>
<td>2.4 (0.12)</td>
<td>2.8 (0.15)</td>
<td>−0.338 (−0.74 to 0.07)</td>
<td>−1.82</td>
<td>NS</td>
<td>0.44</td>
</tr>
<tr>
<td>Client satisfaction questionnaire&lt;sup&gt;a&lt;/sup&gt;</td>
<td>27.1 (0.7)</td>
<td>25.6 (0.9)</td>
<td>1.55 (−0.74 to 3.85)</td>
<td>1.36</td>
<td>NS</td>
<td>0.34</td>
</tr>
</tbody>
</table>

<sup>a</sup> Scores range from 0 to 32.

Therapist Fidelity and Client Satisfaction

Mean therapist fidelity scores derived from auditing session tapes were 4.1 ± 1.2 for the DOR group and 4.3 ± 1.3 for the control group on a 0-5 Likert scale. Client satisfaction was not significantly different between the 2 groups at the end of the treatment.

DISCUSSION

In this randomized study of children with an overweight/obese parent, an intervention aimed at improving child feeding practices was compared to a group focused on increasing physical activity and consumption of healthy foods. The first intervention was based on Satter’s model, the division of responsibilities (DORs) between parents and children relating to feeding, whereas the control group was adapted from the “We Can” program of the National Institutes of Health. The DOR intervention was superior to the control group in reducing parent pressure on their child to eat. A moderator analysis revealed that parents with low disinhibition and hunger somewhat increased the pressure on their child to eat in the control group. Hence, there is evidence that promoting consumption of healthy foods led to decrements in positive feeding practices. This may arise from parents pressuring their children to eat healthy foods. The 2 treatments appeared equally acceptable to the participating parents.

Gender also moderated outcome with parents of girls reducing food restriction more in the DOR group than in the control group. Parents of boys were not affected. It may be that parents are more focused on their female children’s eating patterns in line with the greater concern about female weight and shape.26,27

The main limitation of this study is the relatively small sample size, which may have minimized differences between the 2 treatments. A second limitation is the reliance on parent reporting of behavior change. For example, pressure to eat assessed by parent report is associated with reductions in intake,28 whereas direct observations suggest that prompts to eat (an indication of parent pressure) are associated with increased caloric intake.10 Future research could strengthen these findings by incorporating direct observation of parent-child interactions during mealtime. A final limitation is that data on income and socioeconomic status were not collected for this study.
A recent Institute of Medicine policy statement suggested that health and education professionals providing guidance to parents of young children and those working with young children should be trained and educated and have the right tools to increase children’s healthy eating and counsel parents about their children’s diet. Similarly, an expert panel selected from 15 organizations proposed 4 stages of obesity care; the first brief counseling delivered in a health care office with subsequent stages requiring more time and resources. This study suggests that the DOR program based on the Satter’s model may be an effective intervention, if brief physician counseling does not result in appropriate changes, to enable parents to enhance their management of child feeding in children at the risk for overweight or obesity. Physician counseling could be based on the principles underlying the DOR intervention.

CONCLUSION

The division of responsibility (DOR) intervention based on the Satter’s developmental model of feeding was more effective in reducing parent pressure on their child to eat and restrictive feeding in girls than the control group. However, a larger longer-term study will be needed to establish whether modifying restrictive feeding and pressure to eat reduces the risk of overweight. The study also provides a note of caution that efforts to increase consumption of healthy foods in toddlers should include counseling to parents to model eating such foods and not to pressure children to eat them.

REFERENCES