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# Parent Predictors of Child Weight Change in Family Based Behavioral Obesity Treatment

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## Abstract

Family based behavioral treatment for overweight and obese children includes parenting skills targeting the modification of child eating and activity change. The purpose of this study was to examine parenting skills and parent weight change as predictors of child weight change in a sample of 80 parent/child dyads who were enrolled in a family based behavioral weight loss program for childhood obesity. Eighty overweight and obese children and their parents who enrolled in treatment in two sites were included in the study. Variables included those related to parent modeling (parent BMI), home food environment, parenting (parent and child report), and demographics. Results suggested that parent BMI change was a significant predictor of child weight, in that a reduction of 1 BMI unit in the parent was associated with a 0.255 reduction in child BMI. None of the other variables were significant in the final model. This study is consistent with other research showing that parent weight change is a key contributor to child weight change in behavioral treatment for childhood obesity. Researchers and clinicians should focus on encouraging parents to lose weight to assist their overweight and obese child in weight management.

Family based behavioral treatment programs are considered the most effective intervention strategies for childhood obesity. These programs typically include a parent-training component that incorporates stimulus control, an authoritative parenting style, modeling of healthy behaviors, and behavioral reinforcement techniques designed to increase the chances that the child will adopt and maintain behaviors to facilitate weight loss (1,2). As part of the program, parents make similar eating and physical activity changes as the child, and overweight and obese parents are expected to lose weight.

A developing body of research delineates the importance of parenting in family based behavioral treatment for childhood obesity. Research shows that treatments targeting both parent and child are more effective than child-only or no target in treatment (3). Recently,



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parent-only (PO) treatments have been shown to perform similarly to parent and child treatments (4–6). Notably, the results of a recent meta-analysis indicate that the degree of parental involvement in the treatment arm is significantly associated with treatment efficacy (7). Specifically, the magnitude of the effect favoring treatment relative control was larger in studies in which treatment consisted of: greater overall parent involvement (as rated by the researchers), teaching parents about nutrition, and general behavior modification principles (7). However, very little is known about how changes in specific parenting behaviors during treatment influence the child's weight in family based obesity treatment. Three studies to date have demonstrated that parent weight loss is a predictor of child weight loss in family based obesity treatment (8–10). One study showed that changes in parenting style over 1 year, specifically a child's perception of their father's acceptance vs. rejection, was related to weight changes over the same time period (11). In another study, adherence to praising the child and modeling healthy eating habits were significant predictors of child weight change (12). Although interesting, these studies were limited in that they only included one or a few variables (e.g., only one domain of parenting style), increasing the chances that the estimates are biased due to the presence of confounded effects.

The present study seeks to add to the above literature by evaluating the impact of three bodies of skills taught in family based behavioral treatment for childhood obesity on child body weight; modeling, changes in home food environment, and parenting style and techniques.

## Methods

### Participants

Eighty overweight or obese children (age 10.5 years; 60% female, BMI = 29.37) and their parent (age 42.8 years; 89% female, BMI = 32.0) were recruited in Minneapolis and San Diego for a treatment study comparing a PO and parent + child (PC) treatment for childhood obesity (5). Parents were included in the study irrespective of their weight status. Participants provided written informed consent (participating parent) and assent (child). The institutional review boards of both universities approved the study.

### Intervention description

The intervention provided was a 5-month family based behavioral weight loss program (2), as part of a study evaluating a PO treatment for childhood obesity. Families were randomized to PO or parent + child. Parent + child treatment was delivered in 60-min separate child and parent groups, while PO treatment was delivered in 60-min parent groups. Group size ranged from 6 to 10 participants (5). Standardized manuals were used to teach the same skills to the parents in both arms of the study. The treatment program includes dietary modification (13), increases in physical activity, behavioral change skills and parenting skills. Behavioral change and parenting skills included self-monitoring of targeted behaviors, positive reinforcement, stimulus control, preplanning, and modeling. Parenting, in particular positive reinforcement, modeling, motivation system, was specifically targeted in each group meeting. Parents were targeted for weight loss if overweight and asked to maintain their weight if normal weight.

## Measurements

All measurements were completed at baseline, post-treatment (month 5), and at follow-up (month 11). All items in scales reported below were summed and divided by the total number items on the scale.

## Parent modeling

**Parent anthropometry—**Standardized protocols were used to evaluate weight and height of parents at each assessment point, which were converted to BMI (BMI = ($kg/m^2$)).

## Home food environment

Parents responded to the following question "How often are the following AVAILABLE at home?" Parents responded never, sometimes, often, always or don't know on the following items; (i) fruits, (ii) vegetables, (iii) regular soda, (iv) potato chips or other salty snack foods, (v) chocolate or other candy, (vi) sugar-sweetened drinks (e.g., Gatorade, Fruitopia, Kool-aid), (vii) cookies or cake, (viii) skim or 1% milk, (ix) 2% milk, (x) whole milk, and (xi) special diet foods. Foods promoted by the program (i–v) were scored positively, and foods targeted for reduction in the program (vi–xi) were reverse scored. Higher scores suggest a healthier food environment.

## Parent report of parenting skills

**Parenting style—**Parenting style was measured using the Parenting Styles and Dimensions Questionnaire (14,15) that was designed to tap into theoretically meaningful parenting dimensions that are associated with child behavioral outcomes (16). The PSDQ is a 62-item measure of self- and spouse-reported parenting practices for parents of preadolescent children. Items use a 5-point Likert scale ranging from never (1) to always (5). The PSDQ evaluates tap three dimensions of parenting; authoritativeness, authoritarianism, and permissiveness (authoritative, Cronbach's $\alpha = 0.91$; authoritarian, $\alpha = 0.86$; and permissive, $\alpha = 0.75$) (14,15).

**Limiting the child's behavior—**Parental limits on food and sedentary activity were assessed with the following questions. "I usually put limits on the amount of food my child eats at home," "I usually let my child decide how much to watch TV," "I usually let my child decide how much to play video games or be on the computer." Parents rated their agreement as strongly agree, somewhat agree, somewhat disagree or strongly disagree. The first item was reverse scored. Items were summed and divided by the total number items on the scale (range = 0–3). Higher scores indicate higher levels of permissiveness.

**Encouraging the child—**Parent encouragement of the child around food and physical activity were assessed with the following questions. "I encourage my child not to eat while watching TV," "I encourage my child to not eat junk food," "I encourage my child to eat less fast food," "I encourage my child to spend less time on the computer (not including for school work)," "I encourage my child to watch less TV," "I encourage my child to be physically active." Parents rated their agreement as strongly agree, somewhat agree, somewhat disagree or strongly disagree. Items were summed and divided by the total

number items on the scale (range = 0–4). Higher scores indicate higher levels of encouragement for these activities.

**Participating in program activities with the child—**Parental participation in activities recommended in child weight loss was assessed with three questions. The first two questions "In the past week, how many times did you cook dinner at home for your family?" and "In the past week, how many times did you eat dinner with your child (who is here with you today)?" had seven response items that ranged from 0 times/week to 7 times/week. The third question, "How often do you engage in physical activities/exercise with your child who is here with you today (e.g., walking, riding bikes, going to the gym)? had eight responses options, which included Never, <1 time/month, 1 time/month, 2–3 times/month, 1 time/week, 2–3 times/week, 4–5 times/week, 6–7 times/week, more than 7 times/week. Items were summed and divided by the total number items on the scale (range = 0–7 or 0–8). Higher scores indicate a greater agreement with participating in these activities.

**Child report of parenting—**Child's report of parenting was measured by the Child's Report of Parental Behavior Inventory (CRPBI) (17–19) which provides scores on both parents on three parenting dimensions: acceptance vs. rejection, psychological control vs. autonomy, and firm vs. lax control. Reliabilities in the range of 0.65 to 0.80 have been reported in previous studies for child reports of parents on these scales (20,21).

## Child anthropometry

Child height and weight were converted to BMI (BMI = ($kg/m^2$)) and child BMI was standardized for age and gender (BMI-Z) using the US Centers for Disease Control and Prevention growth curves (22).

## Demographics

Demographics of the parent and child (child gender, child race, child age, parent gender, parent age, family income, and parent education) were reported on the parent questionnaire. Demographic information for this sample can be found in a previous publication (5).

## Analyses

The analyses are based on linear mixed models implemented in SAS version 9.2 using the MIXED procedure. Missing data were handled through multiple imputation using the MI procedure (23–25) and results were aggregated using MIANALYZE. The imputation model consisted of all variables at each time point. This inclusive strategy to imputing values decreases the chances of obtaining biased estimates of the slope parameters (26,27). The primary analysis models consisted of either child BMI or BMI-Z as the outcome and the predictors time, condition (PO vs. PC), time by condition interaction, parent modeling variables (parent BMI), home food environment, variables related to parent report and child report of parenting, and demographics. In these models the response is a vector of child weights (i.e., BMI or BMI-Z, depending on the model) with three different measurements per person, corresponding to baseline, post-treatment and follow-up. Predictors are either fixed (e.g., child gender) or time-varying (e.g., parent BMI), with three distinct measurements per person for time-varying covariates, corresponding to baseline, post-

treatment, and follow-up. These models incorporate information from all three time points in determining the relationship among the predictors and the response. As a sensitivity analysis we considered two additional types of models. First, we reduced the primary model so that we only used baseline and post-treatment data, given the possibility that parent influences may be more pronounced during treatment than at follow-up. In the second model, we used as the response, post-treatment and follow-up scores for the response expressed as a change from baseline, with time-varying covariate values from baseline and post-treatment predicting each of these, respectively. Similar types of models have been considered in other contexts (28). Repeated measures were modeled with an unstructured covariance matrix, and an additional random effect error term was included to account for the possible additional variation resulting from parents/children being treated in treatment groups. In order to maintain the family wise error rate at 0.05, we used Hochberg's adjustment procedure (29), which is not as conservative as adjustments that assume independence (e.g., Bonferroni). The adjustment was applied to significance tests of predictors from each regression model separately.

## Results

We have reported the results comparing the two intervention arms in a previous publication (5). Across the two arms we observed BMI changes of 0.96 from baseline to post-treatment and 0.17 from baseline to follow-up. Across the two arms we observed BMI-Z changes of 0.16 from baseline to post-treatment and 0.18 from baseline to follow-up. While these represent modest changes in weight, it should be realized that both children and parents were significantly overweight at treatment follow-up (mean child BMI = 29.20; mean child BMI-Z = 2.09; mean parent BMI = 32.13)

### Parenting predictors of child weight change

In the model-treating child BMI as the outcome, the only significant predictor was parent BMI, b = 0.272 (see Table 1). Given that parent BMI is specified as a time-varying covariate in these models, coefficients can have between- and within-subjects interpretations (28). The between subjects interpretation suggests that average parent BMI is positively associated with average child BMI. A within-subjects interpretation suggests that changes in parent BMI is associated with a change in child's BMI. Specifically, a 1 unit decrease in parent BMI is associated with a 0.272 reduction in child BMI, controlling for all other variables in the model. When BMI-Z was the outcome the only significant predictor was parent BMI, b = 0.017 (see Table 1), with a within-subjects interpretation suggesting that a 1 unit decrease in parent BMI is associated with a 0.017 reduction in child BMI-Z, controlling for all other variables in the model. As a sensitivity analysis we considered additional models that only utilized baseline and post-treatment data. Results of these models did not differ from the original in terms of predictors identified as statistically significant or in the magnitude of the parent BMI effect (results not shown). As another sensitivity analysis we treated post-treatment and follow-up scores expressed as a change from baseline as the response, with time-varying covariate values from baseline and post-treatment predicting each of these, respectively. In these models no statistically significant predictors were identified (results not shown).

## Discussion

This article evaluates a variety of parental factors that may influence child weight during a family based behavioral treatment for childhood obesity. Consistent with other published research (8) parent BMI change was the only significant predictor of child weight loss. Given that each one unit decrease in parent BMI resulted in approximately one quarter BMI reductions in children, the magnitude of this observed relationship appears to be clinically relevant. It is interesting that none of the other parenting skills measured in this study were significant contributors of child weight loss, although they are targeted in the family based behavioral weight control program. These results suggest that special emphasis should be placed on parent weight loss as a target in family based behavioral weight control programs.

It is surprising that the other parenting skills taught in behavioral weight loss programs were not significant predictors of child BMI change in this study. The absence of significant findings does not imply the absence of an effect and does not negate the potential impact of parenting skills on child weight loss. It is possible that as a package, these parenting skills do influence the child's weight loss and further research is needed to dismantle the components of this treatment. Additionally, it is possible that unmeasured parenting changes contributed to child weight loss, such as changes in the mood and discussions around eating and physical activity in the home, or parent self-efficacy for weight loss. Variables such as these deserve further research in future studies.

There are strengths and weaknesses that should be noted. This study includes repeated measures of a moderate sized cohort of parent/child dyads who participated in the family based behavioral weight loss program. Additionally, the number of parenting variables included in this study are larger than other studies and all the parenting variables are included in one model, limiting concerns about the presence of confounders. These data are from a randomized controlled trial, so the study sample is limited to families who chose to join an obesity treatment research program. Of note, some of the parenting measures included in this study has not been subject to extensive psychometric evaluation. Finally, unmeasured variables may act as confounders that bias the observed effects. However, the inclusion of a large number of variables in our models somewhat attenuate this concern.

Despite these limitations, this study adds to a small body of literature that supports changes in parent BMI as an important predictor of changes in child BMI in family based behavioral treatment for childhood obesity. In family based treatment of childhood obesity, it is possible that a focus on parent BMI change could enhance child weight change. It is also possible that PO treatments that focus on parent BMI change may be sufficient to assist the children and other members of the family to lose weight.

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**Table 1**

Mixed models predicting child BMI and child BMI-Z scores using baseline, post-treatment, and follow-up data

| | BMI-Z | | BMI | |
|---|---|---|---|---|
| | **b (95% CI)** | ***P*** | **b (95% CI)** | ***P*** |
| *Parent modeling* | | | | |
| Parent BMI | 0.017 (0.007, 0.027) | 0.0010[a] | 0.255 (0.103, 0.406) | 0.0018[a] |
| Home food environment score | −0.041 (−0.184, 0.101) | 0.555 | −0.587 (−2.041, 0.868) | 0.410 |
| *Parent report of parenting* | | | | |
| Authoritative parenting | −0.025 (−0.139, 0.089) | 0.653 | −0.189 (−1.163, 0.785) | 0.688 |
| Authoritarian parenting | 0.137 (0.013, 0.261) | 0.032 | 1.230 (0.068, 2.392) | 0.039 |
| Permissive parenting | 0.024 (−0.118, 0.167) | 0.724 | 0.406 (−0.925, 1.738) | 0.528 |
| Limiting child | −0.006 (−0.057, 0.045 | 0.803 | 0.083 (−0.401, 0.567) | 0.723 |
| Encouraging child | 0.032 (−0.065, 0.128) | 0.508 | −0.140 (−1.134, 0.854) | 0.772 |
| Participating in program activities with the child | 0.030 (0.001, 0.060) | 0.047 | 0.272 (−0.014, 0.558) | 0.061 |
| *Child report of parenting* | | | | |
| Acceptance-mother | −0.0017 (−0.0091, 0.0056) | 0.626 | −0.037 (−0.103, 0.029) | 0.256 |
| Psychological control-mother | 0.0010 (−0.0074, 0.0094) | 0.806 | −0.046 (−0.123, 0.030) | 0.221 |
| Lax control-mother | −0.0001 (−0.0078, 0.0076) | 0.974 | 0.004 (−0.064, 0.072) | 0.903 |
| Acceptance-father | −0.0009 (−0.0055, 0.0036) | 0.670 | 0.002 (−0.048, 0.052) | 0.923 |
| Psychological control-father | 0.0052 (−0.0052, 0.0156) | 0.305 | 0.066 (−0.036, 0.168) | 0.193 |
| Lax control-father | −0.0060 (−0.0152, 0.0032) | 0.190 | −0.010 (−0.096, 0.076) | 0.812 |
| *Demographics* | | | | |
| Child gender | −0.020 (−0.182, 0.141) | 0.800 | 1.347 (−1.092, 0.558) | 0.273 |
| Income | −0.028 (−0.128, 0.072) | 0.575 | −0.228 (−1.776, 1.319) | 0.767 |

All models include time, condition, time by condition interaction as covariates.

[a]Statistically significant using Hocheberg's adjustment procedure.