The Association Between Weight Loss in Caregivers and Adolescents in a Treatment Trial of Adolescents With Obesity

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Objective The relationship between weight change in caregivers and their adolescents was evaluated following a randomized trial of lifestyle modification for adolescents, which included either a conventional diet or meal replacements. Methods Adolescents (N = 113) had an M ± SD age of 15.0 ± 1.3 years (62% African American; 26% Caucasian, 12% other; 81% female) and body mass index of 37.1 ± 5.1 kg/m². Results Mixed effects models yielded a significant association between percentage change in body mass index of caregivers and adolescents from baseline to months 4 and 12 (p = .01). When caregivers lost above the median (−1.67%) at month 4, their adolescents achieved a significantly greater loss at month 12 (−9.1 ± 1.3%) compared with adolescents whose caregivers lost less than the median (−4.3 ± 1.3%) (p = .003). Conclusion Engaging caregivers in their own weight loss efforts during adolescent weight loss treatment may improve adolescent weight loss.

Key words adolescent; behavioral intervention; caregiver; weight loss.

Introduction

The inclusion of parents in the treatment of their offspring who are obese improves weight loss in children, as compared with treatment of the child alone (Brownell, Kelman, & Stunkard, 1983; Golan & Crow, 2004; Golan, Weizman, Apter, & Fainaru, 1998; Jelalian et al., 2008; Oude Luttikhuis et al., 2009; Willfley et al., 2007; Young, Northern, Lister, Drummond, & O’Brien, 2007). Parents in these programs are taught to model appropriate eating and activity habits and to reinforce their children’s adherence to key behaviors that include caloric restriction, increased physical activity, stimulus control, and self-monitoring (Barlow, 2007; Israel, Silverman, & Solotar, 1988; Saelens & McGrath, 2003). Social learning theory is the basis of this model of treatment, which supports the idea that learning occurs based on observational experiences, goal setting, and reinforcement of behavior change (Bandura, 1977). A family system potentially provides an ideal environment in which acquiring and maintaining health behaviors, such as choosing healthy foods and being more physically active, can be reciprocally reinforced among family members (Bandura, 1978).

An efficient and effective approach to treat adolescents uses a group format while including parents in a separate concurrent group (Brownell et al., 1983; Wadden et al., 1990). The frequency of parental involvement is also important as demonstrated by Wadden and colleagues, who found that the more treatment sessions mothers attended, the more weight their daughters lost (Wadden et al., 1990). Furthermore, it has been shown that greater parental self-monitoring of (parent) food intake and adherence to healthy eating are associated with greater weight loss in...
Most parents who participate in their children’s treatment are overweight or obese themselves. This is not surprising, given the contribution of genetics and shared environment to the development of obesity (Borecki, Bonney, Rice, Bouchard, & Rao, 1993; Burke, Beilin, & Dunbar, 2001; Faith, Johnson, & Allison, 1997; Garn, Sullivan, & Hawthorne, 1989; Maes, Neale, & Eaves, 1997). Parents who participate in their children’s weight loss efforts often lose weight themselves. Multiple studies have reported a positive relationship between the parent’s weight loss and the child’s reduction in body mass index (BMI) (Boutelle, Cafri, & Crow, 2012; Epstein, Wing, Steranchak, Dickson, & Michelson, 1980; Hunter, Steele, & Steele, 2008; Kalarchian et al., 2009; Kirschenbaum, Harris, & Tomarken, 1984; Sato et al., 2011). Epstein and colleagues reported associations between parent and child weight loss (\( \rho = .75 \)) in 6–12-year-old children with obesity who attended separate but concurrent groups with their parent (Epstein et al., 1980). Parents in this treatment condition lost an average of 3.5 kg during 7 weeks of treatment and an additional 1 kg at a 3 month follow-up visit. Kirschenbaum and colleagues assigned parent–child dyads who were overweight to one of two treatment groups: parent-plus-child in session or child-only (Kirschenbaum et al., 1984). At 1-year follow-up, parents’ and children’s weight losses were positively correlated (\( r = .57 \)) for those in the parent-plus-child group. Further, parents’ percentage overweight decreased from 43.5 to 32% overweight at 1 year. In a family-based study of children with severe obesity, Kalarchian and colleagues observed that greater decreases in adult BMI were associated with larger decreases in children’s percent overweight [\( \beta = 1.68, \text{standard error (SE)} = 0.57, p = .004 \)]. Parents whose children were in the intervention group lost an average of 1.2 kg/m\(^2\) at month 6 and 0.7 kg/m\(^2\) at month 12 (Kalarchian et al., 2009). In a recent study of a family-based behavioral treatment for children who were overweight or obese, the only significant predictor of child weight change was parental weight change such that a reduction of 1 BMI unit in a parent was associated with a 0.255 reduction in child BMI (Boutelle et al., 2012). Further, Hunter and colleagues found that the single greatest predictor of change in children’s BMI was parent weight loss (Hunter et al., 2008).

Compared with studies of children, there are fewer data reported regarding the association between adolescent weight loss and their caregivers’ weight loss. Sato and colleagues found a relationship between weight change in parents and adolescents (\( r = .40 \)) after 16 weeks of treatment in which adolescents were the targets of treatment, and parents were not necessarily encouraged to lose weight (Sato et al., 2011). Mean adolescent BMI fell by 1.6 kg/m\(^2\), and mean parental BMI decreased by 0.6 kg/m\(^2\) at the end of treatment.

Parent–child interactions typically change during adolescence. Major developmental changes that often occur during adolescence are the development of oneself as an individual and an increased drive for autonomy, as well as a shift of increased focus on peers (Eccles, 1999). Adolescents often have more opportunity to experience independence outside of the home and spend more time socializing with peers (e.g., in person, through activities and through use of technology such as texting and social networking) (Brown, 2004; Fuligni & Stevenson, 1995). Further, peers tend to have as much influence on adolescent behaviors as parents (Eccles et al., 1993). Therefore, it is not clear whether the effect of caregiver weight change on child weight change is similar for adolescents. The present study examined the relationship between weight change in caregivers and their adolescent in a lifestyle modification program (LMP) targeted to promote weight loss for adolescents (but not for their caregivers, who were receiving a program to support their adolescents’ efforts and did not promote or directly address caregiver weight loss). We hypothesized that greater reductions in caregivers’ BMI would be associated with greater decreases in adolescents’ BMI both during the induction (i.e., month 4) and maintenance (month 12) of weight loss. Further, we hypothesized that change in caregivers’ BMI from baseline to month 4 would predict change in adolescents’ BMI from baseline to month 12.

**Methods**

**Participants**

As described previously (Berkowitz et al., 2011), participants recruited were 13–17-year-old males and postmenarchal females who had a BMI of 28–50 kg/m\(^2\) without contraindications such as cardiovascular disease (including arrhythmias), types 1 or 2 diabetes mellitus, major psychiatric disorders, pregnancy, use of a weight-loss medication or a weight loss of \( \geq 5 \) kg in the prior 6 months, use of medications promoting weight gain (e.g., oral steroids), or cigarette smoking. Participants were recruited from local newspapers, radio advertisements, and pediatrician and specialty care offices associated with the institution conducting the research. Before randomization, adolescents and a parent or guardian completed a behavioral assessment conducted by a staff...
psychologist or psychiatrist and provided written informed consent (participating parent) and assent (adolescent) before completing any study-related activities. One hundred ninety-six adolescents attended the behavioral health assessment, and 76 were excluded (e.g., low academic achievement, not being interested, adolescent psychopathology, adolescent medical contraindications, caregiver psychopathology, not liking the taste of SlimFast, scheduling conflicts). Seven participants were randomized but never started treatment and were lost to follow-up. Participants who began treatment were 113 adolescents (81% female; 62% African American) with a mean (M ± SD) age of 15.0 ± 1.3 years, all of whom had caregivers who agreed to attend treatment (Table I). This study was approved by the institutional review boards of the Children’s Hospital of Philadelphia and of the University of Pennsylvania (ClinicalTrials.Gov Identifier: NCT00212177).

Intervention

In our trial of lifestyle modification for weight loss, all adolescents received the same comprehensive family-based manualized LMP (Wadden & Berkowitz, 2001a, 2001b) plus either a calorically restricted conventional diet (CD, 1,300–1,500 kcal/day) or a plan using meal replacements (MRs) to achieve the same caloric goals. For those randomized to MR, the daily MR plan consisted of three SlimFast shakes that were provided free of charge (Unilever, Englewood, NJ), combined with one prepackaged meal of the adolescents’ choice, two servings of fruit and three servings of vegetables (all of which were purchased by families). Prepackaged meals were selected from a list of lower calorie frozen food entrees (225–300 calories per serving). Participants who consumed the CD were instructed to consume a diet consistent with recommendations of the US Dietary guidelines (Dietary Guidelines for Americans, 2005). Participants were encouraged to consume a variety of foods that were nutritionally dense and low in fat and calories with a macronutrient content consistent with ≤30% of kcal/day from fat, ~15% from protein, and the remainder from carbohydrates. After month 4, participants who originally received MR for 4 months either continued use of MR for weight maintenance (i.e., MR/MR, which included the use of two liquid MR/day and one prepackaged meal/day, a breakfast of conventional foods, and five servings/day of fruits and vegetables) or transitioned to a CD for weight maintenance (i.e., MR/CD). Participants treated with CD during months 1–4, continued with CD. From months 5–12, it was recommended that all participants consume 1,300–1,500 kcal/day. It was recommended to all adolescent participants that they be active for at least ≥30 min daily from months 2–12.

Adolescents and their caregivers attended a total of 30 separate but concurrent group LMP sessions. For the first 4 months, families attended weekly group sessions. After month 4, all participants received twice monthly group LMP meetings from months 5 to 7 and monthly group meetings from months 8 to 12. Sessions focused on self-monitoring of eating habits and physical activity, goal setting, stress management, stimulus control, problem solving, contingency management, cognitive restructuring, and social support. Counseling at each visit promoted increased physical activity (with a goal of ≥30 min a day) and reduced sedentary behavior. Groups were led by dietitians, master’s level therapists, psychologists, or psychiatrists. Caregivers were not instructed to lose weight, and there was no program provided to them to lose weight; however, they were taught how to best support their adolescents’ weight loss, including role modeling, using positive reinforcement, and managing the home environment (by purchasing healthy foods and encouraging adolescents to be physically active). The caregivers’ program for both the MR and CD conditions covered the same topics, at the same

Table I. Baseline Characteristics for Participants and Their Caregiver

<table>
<thead>
<tr>
<th>Demographic Characteristics</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristics of adolescents</td>
<td></td>
</tr>
<tr>
<td>Age, year</td>
<td>15.0 (1.3)</td>
</tr>
<tr>
<td>Weight, kg</td>
<td>101.1 (17.7)</td>
</tr>
<tr>
<td>Height, cm</td>
<td>164.8 (7.1)</td>
</tr>
<tr>
<td>BMI kg/m²</td>
<td>37.1 (5.0)</td>
</tr>
<tr>
<td>BMI z-score</td>
<td>2.3 (3.1)</td>
</tr>
<tr>
<td>Sex, female, N (%)</td>
<td>91 (81)</td>
</tr>
<tr>
<td>Race, N (%)</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>28 (26)</td>
</tr>
<tr>
<td>African American</td>
<td>69 (62)</td>
</tr>
<tr>
<td>Other</td>
<td>13 (12)</td>
</tr>
<tr>
<td>Characteristics of caregivers</td>
<td></td>
</tr>
<tr>
<td>Age, year (N = 108)</td>
<td>43.0 (7.7)</td>
</tr>
<tr>
<td>Weight, kg</td>
<td>92.0 (23.3)</td>
</tr>
<tr>
<td>Height, cm</td>
<td>164.9 (7.2)</td>
</tr>
<tr>
<td>BMI kg/m²</td>
<td>33.7 (8.0)</td>
</tr>
<tr>
<td>Relation to adolescent, N (%)</td>
<td></td>
</tr>
<tr>
<td>Mother</td>
<td>95 (84.1)</td>
</tr>
<tr>
<td>Father</td>
<td>10 (8.9)</td>
</tr>
<tr>
<td>Other relative (grandmother, other)</td>
<td>8 (7.1)</td>
</tr>
<tr>
<td>Caregiver level of education, N (%)</td>
<td></td>
</tr>
<tr>
<td>High school or less</td>
<td>27 (23.9)</td>
</tr>
<tr>
<td>Some college</td>
<td>47 (41.6)</td>
</tr>
<tr>
<td>College or more</td>
<td>36 (1.9)</td>
</tr>
</tbody>
</table>

Note. BMI = body mass index calculated as weight in kilograms divided by the square of height in meters.
weeks, as those discussed in the adolescents’ sessions. Caregivers in both conditions were asked to assist their adolescents by encouraging them to limit the number of high-fat high sugar foods that they purchased and brought into the home. Caregivers were instructed to model the healthy eating and activity habits that the adolescents were to adopt (i.e., eating slowly, storing foods out of sight, increasing physical activity, and reducing consumption of high-fat/high-sweet foods). Caregivers were asked to positively reinforce adolescents for making appropriate lifestyle changes. Caregivers were also instructed in positive communication skills to use with their adolescents (i.e., using praise, avoiding criticism). Lastly, caregivers were encouraged to discuss any concerns about their adolescents’ eating and exercise habits during group meetings. All caregivers were instructed to encourage their adolescents to eat at regular meal times and aim for 1,300–1,500 calories each day (30% of calories from fat, ∼15% from protein, and the remainder from carbohydrates).

Caregiver sessions for the CD group focused on reducing the fat content of the diet to 30% of calories per day and consuming ∼15% of calories from protein and the remainder of calories from carbohydrates. Caregivers in this group were instructed to substitute low- and very-low-fat alternatives and practiced developing menu plans of conventional foods (i.e., including packing low-fat healthy lunches and snacks for school). Caregivers in the MR group were further encouraged to assist their adolescent in developing an “eating schedule” that identified when and where the adolescents would consume MRs, the frozen-food entrée, and the servings of fruits and vegetables. They were also instructed in how to purchase frozen entrees or provide ingredients for the “prepackaged” home-made meals. Caregivers were taught how to assist their adolescent with adhering to the MR by experimenting with different MR recipes (e.g., smoothies) and in special situations (e.g., at school or on vacation). At no time was caregiver weight loss recommended as part of the protocol. If caregivers expressed interest in losing weight themselves, it was recommended that they could follow a similar CD program with consultation with their primary care doctor.

**Measures**

Adolescent and caregiver weight were measured by trained staff in triplicate using a digital scale that was calibrated to within 0.1 kg. Adolescent and caregiver height was measured with a stadiometer (Holtain Inc., Crymch, UK) in triplicate according to standardized techniques (World Health Organization, 1989; Williamson et al., 2008). The average of each of the three measures was used in analyses. Adolescent height and weight and caregiver weight were obtained at baseline, 4 and 12 months. Caregiver height was taken only at baseline, as adult height is not expected to change during the course of 12 months. Baseline BMIs of adolescents and caregivers were 37.1 ± 5.1 kg/m² and 33.7 ± 8.0 kg/m², respectively.

**Procedure**

The primary findings of the primary study have been published previously (Berkowitz et al., 2011) and showed a mean (±SE) difference in percentage change in initial BMI between MR and CD groups at month 4 (−6.3 ± 0.6% vs. −3.8 ± 0.9%; p = .01), but not at month 12 (“time × group” p = .40). Collapsed across treatment groups, mean reduction in BMI at month 12, as measured from baseline, was −3.4 ± 0.7%. The present study is a secondary analysis examining the effects of caregivers’ weight loss on adolescents’ weight loss at months 4 and 12. For all analyses, the significance level (α) was equal to 0.05. All analyses were conducted using the statistical software package SAS, version 9.2.

**Results**

**Overview of Analyses**

For all analyses, we adjusted for group and race a priori because they were significantly related to change in adolescent BMI in the primary analyses (Berkowitz et al., 2011). The main analyses for the present study were mixed effects models, which were fit to evaluate percentage change in initial BMI in caregivers and adolescents at months 4 and 12. The primary analyses are the mixed effects model analyses, which allow inclusion of all data available, regardless of whether the adolescent or caregiver attended all study visits. In the mixed effects model analyses, all 113 adolescents who began treatment were included. For the mixed models with caregiver as the outcome, height, and weight data were available on 102 caregivers.

Ordinary least squares regression models were then fit to further evaluate the association between percentage change in caregivers’ BMI with percentage change in adolescents’ BMI at months 4 and 12. For clinical utility, logistic or linear regression models were fit for median split analyses, categorizing parental weight loss as percentage change of parental initial BMI, to further evaluate the association between percentage change in adolescents’ BMI at months 4 and 12. To replicate and extend findings by Sato and colleagues (Sato et al., 2011), logistic regressions were performed to predict “minimally successful” weight loss at months 4 and 12 using a 3.6 kg cut-off (0.5 lbs/week for 16 weeks) for adolescents. Caregivers’
Weight loss was categorized according to whether the caregiver lost ≥1.0 kg after 4 months of the adolescents’ receiving intervention (Sato et al., 2011).

**Primary Results**

At month 4, caregivers lost (mean ± SD) −2.0 ± 3.9% of initial BMI and maintained a loss of −1.3 ± 4.1% at month 12. Mixed effects models yielded a significant association between the percentage change in the BMI of caregivers and adolescents from baseline to months 4 and 12 (p = .01). The ordinary least square regression also revealed significant associations between percentage change in caregivers’ and adolescents’ BMI at month 4 (p = .03), accounting for 15.8% of the variance in adolescents’ BMI change, as well as at month 12 (p = .001), accounting for 24% of the variance in the change in BMI in adolescents.

**The 4-Month Results and Early Changes as a Predictor of Long-Term Changes**

Using linear regression models, a median split analysis of percentage change in caregiver BMI revealed that when caregivers lost above the median (−1.67%) at month 4, adolescents lost (mean ± SE) −7.9 ± 0.77% of initial BMI at month 4, compared with −4.7 ± 0.70% when caregivers lost less than the median (p = .001) (Figure 1). In addition, adolescents whose caregivers lost more than the median at month 4 achieved a significantly greater loss at month 12 (−9.1 ± 1.3%), compared with adolescents whose caregivers lost less than the median at month 4 (−4.3 ± 1.3%) (p = .003) (Figure 2). Logistic regressions revealed that adolescents whose caregivers lost more than the median at month 4 had significantly greater odds of achieving a 5% [odds ratio (OR) 5.29; 95% confidence interval (CI) 1.78–15.78; p = .003] and 10% (OR 6.62; 95% CI 1.37–32.11; p = 0.019) reduction in initial BMI at month 4. Further, compared with adolescents whose caregivers lost less than the median at month 4, adolescents whose caregivers lost more than the median also had significantly greater odds of achieving a 5% (OR 5.50; 95% CI 1.87–16.14; p = .002) and 10% (OR 9.12; 95% CI 1.94–42.84; p = .005) reduction in initial BMI at month 12.

Logistic regressions revealed that adolescents whose caregivers lost at least 1 kg were more likely than adolescents whose caregivers lost <1 kg (or gained weight) to achieve a 3.6 kg weight loss at month 4 (OR 3.6; 95% CI 1.4–9.4; p = .01), thereby replicating previous findings by Sato and colleagues (Sato et al., 2011). However, caregiver weight loss of at least 1 kg did not predict a 3.6 kg weight loss at month 12 in the present study (OR 1.4; 95% CI 0.5–4.2; p = .51)

**The 12-Month Results**

At month 12, when caregivers lost above the median (−0.78%), adolescents lost 7.0 ± 1.5% of initial BMI compared with 2.8 ± 1.7% for adolescents whose caregivers lost less than the median (p = .052) (Figure 1). Adolescents whose caregivers lost more than the median at month 12 did not have significantly greater odds of achieving a 5% reduction in initial BMI at month 12 (OR 1.64; 95% CI 0.50–5.37; p = .417). There was a trend for them to have a significantly greater odds of achieving a 10% reduction in initial BMI at month 12 (OR 5.81; 95% CI 0.90–37.57; p = .065).

**Discussion**

The principal finding of this study is a significant association between the weight losses of caregivers and adolescents with obesity, even when caregivers were not targeted for weight reduction. We found a strong association between caregivers’ and adolescents’ weight loss at month 4, which persisted at month 12. To date, this
study represents the longest-term data examining the relationship between caregiver and adolescent weight loss. Median split analyses at months 4 and 12 clearly indicate the benefits of caregivers’ weight loss on adolescents’ weight loss and weight loss maintenance, whether looking at absolute percentage change in adolescents’ BMI or the odds of achieving 5% or 10% changes in initial BMI. One of the more striking findings that broaden the scope of the current body of literature is the effect of change in caregivers’ weight early on in the intervention on adolescents’ weight loss at month 12. Adolescents whose caregivers lost more than the median at month 4 lost —9% of initial BMI compared with only —4% of initial BMI at month 12 for those whose caregivers lost less than the median at month 4. These results indicate that engagement of parents in their own weight loss efforts from the start of their adolescents’ treatment may contribute to their adolescents’ long-term success. These results (9% reduction of BMI at month 12) are more than double that of the mean change usually obtained for adolescents in lifestyle treatment and similar to that achieved by lifestyle modification with the addition of weight loss medication in two previous trials (Berkowitz et al., 2006; Berkowitz, Wadden, Tershakovec, & Cronquist, 2003).

A family approach, addressing the entire family’s weight and health behaviors, may facilitate greater short-term weight loss and long-term success. Further, given the significant percentage reduction in BMI at month 12 for adolescents whose caregivers lost more weight at month 4, engaging caregivers in their own weight loss efforts may serve as a relapse prevention approach for weight regain for adolescents. Long-term weight losses have been shown in adults (Wadden et al., 2011) but have not been demonstrated in adolescents who tend to regain their weight loss (Berkowitz et al., 2006). Caregivers who are successful at weight loss serve as positive role models for their adolescents. Further, caregivers are the individuals in the home who usually purchase groceries, prepare meals, and have the greatest ability to change the shared environment in the home. Caregivers (and their behaviors) potentially serve as agents of change for weight loss in adolescents with obesity. Future studies should examine process data, including role modeling, eating, and physical activity behaviors in multiple family members and in the adolescent participant interested in weight loss to better evaluate these variables and the relation with weight loss and weight loss maintenance in adolescents.

Additionally, we found that adolescents whose caregiver lost at least 1 kg from baseline to month 4 (i.e., “purposeful weight loss”) were more likely to achieve at least a 3.6 kg weight loss (i.e., “successful weight loss”) at month 4. These results are similar to those found by Sato and colleagues following 16 weeks of active treatment (Sato et al., 2011). At month 4, they found that change in parental weight was the only significant predictor of change in BMI in adolescents. Kirschenbaum and colleagues found that changes within parent–child dyads were not strongly related during active treatment but were more strongly related at 3-month and 1-year follow-up assessments (Kirschenbaum et al., 1984). Conversely, Epstein and colleagues found that the correlation between parent and child weight change faded during follow-up (Epstein, Wing, Koeske, Andrasik, & Ossip, 1981; Epstein, Wing, Koeske, & Valoski, 1984; Epstein et al., 1980). Thus, the present study adds to the existing literature on the association between weight loss in caregivers and their children and adolescents; there are some differences between studies as to the duration of the effects.

The relationship between weight losses of caregivers and adolescents may be explained by social learning theory. Caregivers who actively engage in weight loss with their adolescent may more effectively model appropriate eating and activity habits for their offspring, as well as make changes in the home environment that affect the family as opposed to one individual. Parental modeling could increase weight loss in their adolescent. Alternatively, it is also possible that adolescents who were successful in changing their eating and activity habits served as role models for their caregivers, thereby motivating them to lose weight. Further, families develop recurring and enduring patterns established by daily interactions between family members, such as physical activity or eating routines. These interactions, which become fixed over time and with repetition, could set the foundation for maintaining future interactions and ways of accomplishing tasks (Jones & Lindblad-Goldberg, 2002).

The family system may promote these interactions. Eating and physical activity habits are likely set into motion based on interactional patterns and a set of “norms” for the family is developed. An adolescent engaging in weight loss efforts without other members of the family engaging in them as well, thereby going against the family norm, is less likely to be successful at weight loss compared with a adolescent whose caregivers want to change the “norm” of the family interactions around these habits. The results of the present study suggests that developing an intervention that focuses on the family structure and interactions, such as engaging caregivers in their own weight loss efforts while an adolescent is attempting to change eating and activity habits may be a more successful and efficient method of treatment than focusing only on the adolescent’s weight loss. There do not appear to be any
randomized trials of adolescents that have experimentally manipulated caregivers’ weight loss by providing caregivers a behavioral weight loss program that parallels that of their adolescents. This approach would have the benefit of strengthening the caregiver’s role as a model for appropriate eating and activity behaviors because the caregiver would be asked to engage in similar weight reducing behaviors as the adolescent.

There are limitations to the current study. This study is a secondary analysis. The original study was a randomized controlled trial examining the use of MRs and lifestyle modification for weight loss in adolescents (Berkowitz et al., 2011); therefore, the current study was not specifically designed to answer the aim of the current analyses. Owing to the design of the original study, there was limited information on caregiver characteristics. As a result, there was little emphasis on collecting complete information on caregiver characteristics. Moreover, to reduce burden of caregivers, neither the data about caregiver characteristics nor were process data about caregivers collected.

The present sample was a predominantly urban, African American female population with the majority of caregivers also being female (particularly mothers) and African American. This likely limits the generalizability of the study but focused on a population that is high risk for obesity and often experiences health care inequities. These findings are not generalizable to other adolescent–caregiver relationships, nor can we make conclusions about potential effects of multiple family members being involved in weight loss treatment on adolescent weight loss. However, results of this study are consistent with those of Sato and colleagues (2011), whose sample was predominately Caucasian (76%); therefore, the relationship appears robust across races. Also, given the proposed theoretical model of social cognitive theory, we speculate that the more people who are involved in the adolescent’s life and in weight loss treatment, the more likely adolescents will be successful at weight loss and maintenance.

Another limitation was that caregivers were not prescribed the same meal or weight loss plan as their adolescent. Strategies that caregivers may have adopted to lose weight were not assessed. To evaluate whether purposeful caregiver weight loss improves adolescent weight loss, a randomized controlled trial of a combined caregiver and adolescent LMP compared with an adolescent alone program would be required and would be a future research goal, given the results of this current study.

In summary, the present study found that changes in caregivers’ weight are significantly associated with changes in adolescents’ weight, both during the induction of weight loss at month 4 of treatment and in the maintenance of lost weight at month 12. Further studies explaining the mechanisms underlying this association, as well as randomized controlled investigations aimed at inducing simultaneous weight loss in caregivers and adolescents are needed to expand our understanding of how to optimize weight loss in adolescents with obesity. If confirmed, treating both caregivers and adolescents with obesity in separate but concurrent groups would present a new model of weight management for families. Thus, having a combined LMP that emphasizes caregiver and adolescent health behavior change potentially offers a highly efficient model for treating weight and health complications in adolescents and caregivers simultaneously. If effective, the proposed intervention could lead to a truly family-based weight loss intervention in which multiple overweight or obese members of a family were treated simultaneously. Moreover, we believe this treatment modality will increase weight losses as well as weight loss maintenance in the adolescents, a highly desired outcome, given the lack of effective treatments for markedly obese adolescents. Adolescents with extreme obesity desperately need safer and more affordable treatment options than are provided by bariatric surgery.

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Conflicts of interest: None declared.
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