Original Research

Outcomes of a Family Based Pediatric Obesity Program - Preliminary Results

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ABSTRACT

Int J Exerc Sci 4(4) : 217-228, 2011. Children that are classified as obese (body mass index (BMI) > 95th percentile for age and sex, Centers for Disease Control and Prevention) have an increased risk for metabolic and cardiovascular complications. Family based programs that focus on physical activity (PA) and healthy eating are recommended for treatment of pediatric obesity. The purpose of the current study is to determine the outcomes of Building Healthy Families (BHF), a family-based pediatric weight loss treatment program composed of nutrition, physical activity and behavioral modification strategies. In addition, mediating variables that are associated with weight loss in children, in order to enhance the retention and success of this program will be identified. Twenty-two obese (>95th percentile BMI) children (age: 9.94 ± 1.58 yrs) volunteered to participate. Children and their parents (20 moms, 20 dads, 68% obese; BMI > 30 kg•m ²) participated in weekly nutrition education, family lifestyle PA, and one-on-one meetings with a behavioral psychologist. Overall, child participants lost an average of 2.3 ± 2.0 kg of body mass in 12 weeks while parents lost 6.4 ± 4.3 kg of their body mass. There was a significant inverse association between percentage of program goals met and weight loss (r = -0.67, p < 0.05). Decreases in the child participants intake of high fat, high calorie foods significantly predicted weight change (R²=0.98, p<0.05). In conclusion, family based pediatric obesity programs may offer significant benefits and lead to healthier lifestyles for obese children and their parents.

KEY WORDS: Childhood, combined modality therapy, health behavior

INTRODUCTION

The prevalence of childhood obesity in the United States has continued to increase in recent decades and has become one of the leading public health concerns (33). Today, 16.3% of children and adolescents are considered obese based on a Body Mass Index (BMI) greater than or equal to the 95th percentile for age and gender (31, 32). The International Obesity Task Force 2000 (2, 28), and Centers for Disease Control and Prevention (CDC) stated the following percentile classifications for children and

adolescents (ages 6-19 years old): underweight as BMI < 5th percentile for age and gender, healthy weight as BMI between 5th-84.9th percentile, overweight as BMI between 85th-94.9th percentile, and BMI > 95th percentile as obese (2, 6).

Environmental factors such as a decrease in physical activity, increase in television watching and video games, and increase in energy intake have led to more sedentary and overweight children (35). The increase in body mass is associated with hypertension, metabolic syndrome, coronary heart disease, type 2 diabetes, and other chronic diseases (34), which were once only common in adults, but are now also prevalent in children (5, 25, 37, 39). Poor nutrition habits and physical inactivity of children have shown to persist into adulthood (21). Therefore, a need for strategies to prevent and treat childhood obesity is imperative.

An expert committee of child and adolescent obesity researchers was created in 1998 to make recommendations on prevention, assessment, and treatment of obesity based on clinical and scientific research (2). It was suggested that obesity treatment should focus on healthy eating and increasing physical activity of the child and family. This committee created guidelines to follow for successful treatment. These recommendations included starting treatment with children as young as three and involving the family in all aspects of treatment, educating on medical complications of obesity, instituting healthy lifestyle habits, teaching families how to monitor eating and activity, and administering treatment in a stepwise method for changes (2, 3).

Family based behavioral treatment programs for childhood obesity have been shown to have a degree of efficacy as they have been replicated since the late 1970s (14). Epstein (11) has demonstrated that when children and parents are targeted for behavioral changes together, outcomes of weight loss are generally improved. Furthermore, family-based treatments effectively improve nutrition and exercise habits of the entire family and have been shown to facilitate successful child weight loss (19). However, it is still unclear which aspects contribute to the child's weight loss success.

Parents are typically targeted due to the fact that they are the most influential to their child's dietary habits and levels of physical activity (2, 8, 22, 26, 45). A decrease in parental body mass has been shown to influence the weight loss success of their children. Wrotniak et al. (44) demonstrated a decrease in parental weight was predictive of change in child's BMI z-score in a weight management program that targeted modification of parent and child's activity and eating patterns. These strategies have demonstrated the importance of parental involvement and child weight loss.

However, reviews of treatment studies conducted on children in weight management programs have indicated success rates ranging from 43 to 73% (29, 38). These results suggested that there is variability in weight loss of children in weight management programs. Therefore, there is a need to understand or identify mediating variables that are associated with weight loss in children in order to enhance the retention and success of pediatric weight control programs.

The purpose of the current study was to determine the outcomes of Building Healthy Families (BHF), a family-based pediatric weight loss treatment program composed of nutrition, physical activity and behavioral modification strategies. Specifically we will determine which variables, if any, mediate changes in physical activity or energy intake behaviors and in turn impact the weight loss of the child.

METHODS

Participants
The current study used data from two cohorts of families who participated in Building Healthy Families (BHF) between April 2009 and January 2010 (n=20 families). Twenty-two obese children (10 girls, 12 boys) ages 7-12 years old and their families volunteered to participate in BHF, a pediatric weight loss program, through area physician referrals, media advertisements and school nurses. In addition, 20 mothers and 20 fathers participated with their child/children during this program. Children with a BMI percentile greater or equal to the 95th percentile for age and gender were eligible to participate in BHF. Recruitment of participants occurred in a rural Nebraska community of 30,000 people. Approval from University of Nebraska-Kearney Institutional Review Board was obtained prior to participant recruitment. All participants signed an assent form and parents signed an informed consent that explained assessments and procedures of the BHF program.
 Not all participants and parents completed all of the same assessments; therefore, variation in sample size is shown for some variables as additional assessments were

completed with Cohort 2. The importance of parents as role models in child's weight loss was eluded in Cohort 1 and therefore additional physiological variables, such as body composition, and dietary intake, were measured in Cohort 2 parents.

Protocol
BHF included a 12-week intensive intervention that consisted of weekly sessions of behavior modification, nutrition education and family lifestyle physical activities that lasted approximately 1.5-2 hours each week. The intervention was a family based behavioral program based on a similar program created by Epstein et al. (11, 14-16, 19). Weekly attendance was expected to all sessions and entire family participation was encouraged. Participants were dismissed from the study if they missed more than two sessions.

The weekly nutrition education sessions were 30 minutes in duration and conducted by a registered dietician. The Stoplight Diet curriculum created by Epstein et al. (14, 19) was modified for the nutrition component of the program. Eliminating specific foods has been shown to be an easier strategy for child success than trying to count and reduce calories as a whole (13,15). Therefore, the Stoplight Diet was used for its easy understanding of colors which are correlated with foods that are low- (green), medium- (yellow), and high-calorie/fat (red) foods. Furthermore, the emphasis of the Stoplight diet was to reduce the amount of red foods consumed on average each week. Red foods were defined as foods with greater than 200 kcal/serving or with greater than 5 grams of fat per serving. Each participant was provided a self-monitoring habit book to keep daily records of energy intake and minutes of physical

activity per week. Nutrition education sessions provided information on nutrition related topics such as MyPyramid.gov, label reading, portion size, modifying recipes, etc.; in order to increase participant's knowledge of nutrition and healthy lifestyle habits.

The lifestyle physical activities were conducted by a physical educator and were 30 minutes in duration. Activities were based on lifestyle-based curriculum that included the whole family. This component of the BHF was aimed at increasing physical activity in a fun, non-threatening environment. Families received information about ways to reduce sedentary activities and increase physical activity to meet the current recommendation of 60 minutes of physical activity a day suggested by the Department of Health and Human Services (33).

The behavioral counseling was conducted by licensed psychologists specializing in behavior therapy. Each family met one-on-one with a behavioral psychologist each session to determine barriers to healthy living and design strategies to meet weekly goals. Goals were developed based on effective weight reduction techniques that have been well established (13, 16, 19).

Assessments
Physical activity was measured for seven consecutive days during baseline and week 12 using an accelerometer (MTI Actigraph GT1) for child participants and measured daily by Omron™ pedometers for both participants and parents. Body composition, energy intake, cardiorespiratory fitness, behavioral assessments and nutrition knowledge were

assessed at baseline and at 12 weeks for both child and parent participants.

Accelerometry. Accelerometers are the most widely used measurement of physical activity and are considered a reliable assessment of movement in children and adolescents (40). The Actigraph activity monitor (Manufacturing Technology Incorporated; Pensacola, Florida) has been a valid indicator of determining physical activity and movement in youth (9). Participants were asked to wear the monitor over their right hip and it was attached via an elastic band. Compliance of accelerometers was evaluated for each day that the research participants wore the monitor using previously established procedures by Welk et al. (43). Participants with more than 3 non-compliant days were removed from overall analyses. Criteria developed by Trost (41) were used to determine metabolic equivalent (MET) levels of activity and minutes greater than 4 METs were considered above moderate activity (40).

Pedometers. Omron™ pedometers were worn by children and parents to assess number of steps per day accumulated. The Omron™ pedometers have been shown to be valid and reliable measures of walking and lifestyle activities in adults (23, 24). Pedometers were downloaded each week by staff members to determine the average number of steps per day that were accumulated from the previous weeks to set goals for the following week.

Anthropometry. Body mass and stature were measured and used to calculate body mass index using the formula $BMI = kg \cdot (m^2)^{-1}$. BMI percentiles were calculated using growth charts from CDC website (6, 28). Body mass was measured

using a Seca platform scale (Model 707, Seca Corp., Columbia, MD) to the nearest 0.1kg. Stature was measured using a standard wall mounted stadiometer to the nearest 0.25 cm. BMI z-scores are considered a better tool for assessment of adiposity changes within a group and therefore were calculated using a reference program that was obtained from the CDC website (28, 30).

Body Composition. Dual energy x-ray absorptiometry (DXA) was used to determine percent body fat, fat-free mass, and fat mass. DXAs are able to detect changes in body composition by 1.6-3.8% (42). Therefore, a whole body scan was performed using General Electric Lunar Prodigy Advance Plus with a pediatric medium scan mode (Lunar Radiation Corp., Madison, WI; software version Encore 2007).

Cardiorespiratory fitness. The Progressive Aerobic Cardiovascular Endurance Run (PACER) is a valid and reliable method for all ages and measured an individual's aerobic capacity (7).This test was administered according to the instructions outlined on the FITNESSGRAM CD (Cooper Institute for Aerobic Research, 2000). The PACER test was a multistage fitness test set to music, with each stage getting progressively faster. Participants were instructed to run across the gym before the beep sounded on the audio CD. The test was terminated either due to exhaustion or because the participant was unable to reach the distance before the beep for two laps. The number of laps completed by each participant was recorded by staff for data analysis.

Energy Intake Analysis. Participants were required to complete a three-day food log at baseline and at the end of the 12 week program. Child participants completed food logs with the assistance of their parents. The food log was kept for three consecutive days, one weekend day and two weekdays. Participants were required to record the method of preparation, location, and quantity of foods and liquids that were consumed through each day. At the collection of food logs, the investigator reviewed the food logs with the participant for clarity and accuracy.

All food logs were entered and analyzed using the Food Processor Plus, Version 8.0 Program (ESHA Research, Salem, OR). The Food Processor Plus Program has been shown to be a valid and reliable program for analysis of energy intake (4). Energy intake was analyzed for total energy intake, grams of fat, and calories from fat for each participant.

Behavioral Assessment. Behavioral counselors met weekly with families to assess self-monitoring and goal obtainment. Habit books, a self-monitoring tool, were collected weekly and analyzed for completion and compliance. A five point scale with set criteria was used to determine percent completion of the habit books for each week of the intervention. The criteria for the scoring included self-reported recording of information from participants on weekly totals, food intake, amount of food consumed, identification of "red foods", physical activity, and daily goals. The five point scale ranged from 1 (No completion/ not turned in) to 5 (met each criteria).

In addition, weekly program goals were created for each family. These goals included a body weight loss goal of 1-2 pounds for adults and 0.5-1.0 pounds for children, an energy intake goal of reducing red foods consumed from previous week by 1 until participants reached 2 red foods a day and a physical activity goal of increasing steps by 1000 steps per day from the previous week.

In addition to program goals, individual family strategy goals were developed each week. These goals were created with behavioral counselors and focused on specific strategies necessary to meet the program goals and behaviors. For example, strategy goals included menu planning, determining by whom and where meals would be prepared, transportation of children to activities, limiting television, limiting fast food, increasing family meal time, etc. Each week behavioral counselors recorded the weekly goal attainment for strategy goals and participants were scored for both program goals and strategy goals with a 1(met goal) or 0 (didn't meet goal) for each week.

Nutrition Knowledge. A 10-item questionnaire was created by the BHF research team to assess participant's knowledge of nutrition before and after the intervention. This was a multiple choice questionnaire that asked information related to basic nutrition. Questions were generated from nutrition education materials that were taught during nutrition sessions of this intervention and written at the second grade reading level.

Statistical Analysis
All data analysis was completed using SAS version 10.0 (Cary, NC). Standard descriptive statistics were calculated within each testing period for each independent measurement using means and standard deviations. Paired t-tests were used to analyze differences between baseline and 12 weeks. A Pearson correlations matrix was developed to determine the mediating variables that were associated with the child's change in physical activity and energy intake behaviors over the 12 week intervention. Potential mediating variables included nutrition knowledge scores, weekly goal attainment, habit book scores, attendance, total energy intake, red food intake, fat gram intake, fat calorie intake, minutes of MVPA (child only), steps per day, aerobic minutes, BMI, BMI z-scores (child only) and PACER laps for both child and parent. Associations between weight change and mediating changes of child's physical activity and energy intake were also analyzed.

Mediating variables that correlated with the dependent variables at $p < 0.10$ were entered into a separate stepwise regression analysis. Three different sets of regressions were performed: 1) correlated mediating variables of both children and parent with child's energy intake, 2) correlated mediating variables of both child and parent with child's physical activity, and 3) energy Intake and physical activity variables of the child with child's body mass loss. Figure 1 is a diagram of regression models 1-3 (listed above) depicting children's body mass loss mediated through variables of the child and parents. Regressions were then used to determine which independent variables predict child weight loss by examining the effect of child's change in physical activity and energy intake behaviors. Effects of mediation through child and parent on

child' energy intake and physical activity behaviors were also investigated.
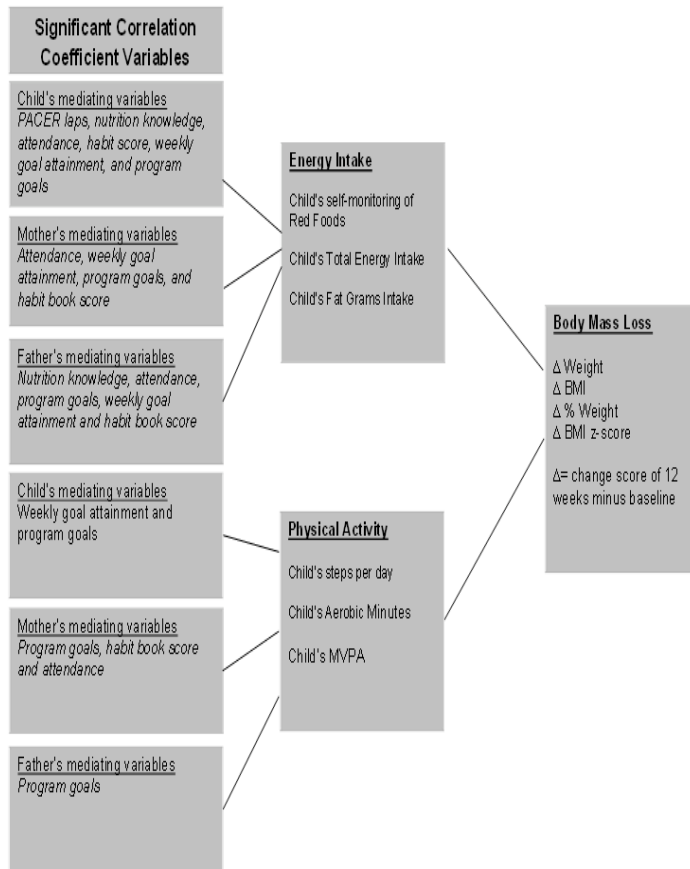

Figure 1. Variables loaded into Regression Analysis.

RESULTS

Baseline descriptive characteristics and change scores from baseline to 12 weeks, for participant and parents, are presented in Tables 1 and 2. Child participants ranged from 7 to 12 of age (average: 9.94± 1.58 years) and 58% of the child participants had a BMI greater than the 97th percentile. Participating parents (n=40) averaged 41.66 ± 4.79 years old with 68% classified as obese with a BMI of 31.94 ± 7.10 kg·m-2. Mean attendance for the program was 80.57 ± 18.52% for child participants and 74.45 ± 25.56% for parents. Family ethnicity was 90% Caucasian (n=17) and 10% Hispanic

(n=2). After 12 weeks, 72% of child participants and 96% of parents decreased body mass. The average percent weight change was 4.52 ± 3.82% for child participants and 7.39 ± 2.27% for parents. In addition, child participants decreased total body fat percentage by 3.16 ± 2.95%, while fat free mass increased by 0.81 ± 1.39 kg ($p<0.05$). Significant differences were also found in body mass, BMI, BMI z-score, body fat, cardiorespiratory fitness (PACER) and energy intake from baseline to the 12 weeks for participants (Table 1). Parents significantly decreased energy intake, BMI and body fat percentage and increased cardiorespiratory fitness after the 12 weeks intervention ($p<0.05$) (Table 2).

Table 1. Descriptive Characteristics of Children at Baseline, week 12 and Change Scores (mean ± SD)

	N	Baseline	Week 12	score
Body mass (kg)	22	53.6 ± 13.5	51.3 ± 13.4	-2.3 ± 2.0*
Height (cm)	22	143.7 ± 10.7	145.4 ± 11.3	1.7 ± 1.3*
BMI (kg·m²)	22	25.5 ± 3.9	23.8 ± 3.81	-1.7 ± 0.9*
BMI Z-score	22	1.9 ± 0.4	1.7 ± 0.47	-0.3 ± 0.2*
BMI Percentile	22	96.9 ± 2.5	93.8 ± 5.83	-3.1 ± 3.7*
Body Fat (%)	22	39.4 ± 8.1	36.2 ± 9.66	-3.2 ± 2.9*
Fat Mass (kg)	22	21.0 ± 35.9	18.8 ± 8.93	-2.2 ± 2.0*
Fat-Free Mass (kg)	22	31.3 ± 5.9	32.1 ± 6.15	0.8 ± 1.4*
PACER (laps)	22	28.7 ± 19.1	43.1 ± 30.26	14.4 ± 15.3*
Energy Intake (kcals/day)	16	1816.4 ± 326.5	1400.8 ± 149.0	-430.5 ± 348.6*
MVPA (min)	18	76.4 ± 36.5	63.2 ± 36.66	-13.2 ± 27.9

* Significant difference between Baseline and 12 week ($p < 0.05$)

Pearson correlation coefficients were computed for mediators of energy intake and physical activity. Decreases in the child participants total energy intake were significantly associated with increases in child's nutrition knowledge (r = -0.53, $p<0.05$) and child's habit score (a self-monitoring tool) (r= -0.50, $p<0.05$). The decrease in number of red foods (energy > 200 kcal/serving or fat/serving > 5 grams per of fat) was associated with decreases in

body mass($r = 0.49$, $p<0.05$) Baseline moderate-vigorous physical activity (MVPA) was significantly inversely associated with child change in BMI z-scores ($r = -0.53$, $p< 0.05$).

Table 2. Descriptive Characteristics of Parents at Baseline, week 12 and Change Scores (mean ± SD)

	N	Baseline	Week 12	score
Body mass (kg)	40	95.1 ± 24.4	88.5 ± 22.4	-6.4 ± 4.3*
Height (cm)	40	170.6 ± 7.0	170.8 ± 6.9	0.2 ± 0.5*
BMI (kg·m²)	40	31.9 ± 7.1	30.2 ± 7.0	-2.2 ± 1.4*
Body Fat (%)	11	38.1 ± 8.7	35.9 ± 9.6	-2.8 ± 2.7*
Fat Mass (kg)	11	33.4 ± 14.1	29.5 ± 14.5	-4.1 ± 3.7*
Fat-Free Mass (kg)	11	55.1 ± 15.6	53.8 ± 15.8	-0.4 ± 2.4
PACER (laps)	19	25.4 ± 17.1	39.1 ± 23.9	16.2 ± 16.9*
Energy Intake (kcals/day)	10	1885.9 ± 422.3	1465.2 ± 249.7	-442.8 ± 296.9*
Steps per Day (steps)	16	8892.4 ± 2317.8	8829.4 ± 3174.2	-64.5 ± 4095.5

*Significant difference between Baseline and Week 12 ($p<0.05$)

Parental variables that were significantly associated with change in child's behaviors included father's change in nutrition knowledge which was associated with child's decrease in fat gram intake ($r = -0.92$, $p<0.05$) and decrease in total energy intake ($r = -0.85$, $p<0.05$) at 12 weeks. Both child and parent's percent goal attainment of program goals was significantly associated with their weight loss ($r = -0.67$, $p<0.05$).
After Pearson correlations coefficients were calculated, a conservative approach was chosen and all variables at a significance level at or below $p<0.10$ were entered into stepwise regression equations. Stepwise regression analysis indicated changes in child's red food intake accounted for 80% of the variance in changes in body mass ($R^2=0.80$, $p=.10$), 20% of the variance in changes in BMI ($R^2=0.20$, $p<0.05$), 92% of the variance in changes in BMI z-score ($R^2=0.92$, $p<0.05$) and 98% of the variance associated with percent weight change ($R^2=0.98$, $p<0.05$) of the child.

DISCUSSION

There is convincing evidence that family-based behavioral treatment programs have shown some success in child weight loss (11, 14, 19). Results from the Building Healthy Families (BHF) program were consistent with previous studies (11, 14, 19) for child weight loss in a family based treatment program. Completion of the BHF intervention showed significant improvements in body mass, BMI z-score, BMI percentile, body fat percentage, fat free mass, and energy intake of the children (Table 1). The current study emphasized that the strongest predictor of child weight loss was a reduction in red food intake, suggesting that nutrition may be the primary component of the BHF intervention.

Child participants decreased their consumption of red foods from 5 (ranging from 3 to 8) per day to 2 (ranging from 1 to 5.5) per day and decreased total energy intake by 430.48 ± 348.68 kcal/day at the end of 12 weeks. Reductions in red foods have been shown to have significant associations with weight loss (10, 17), which was replicated in the current study. Stepwise regression analysis indicated that child's change in red foods accounted for 98% variance in their body mass change. These findings indicated simple dietary modifications can increase weight loss and help reduce childhood obesity. However, due to season influences, we actually saw a decrease in MVPA suggesting that physical activity has the potential to play a mediating role, but we were unable to

increase MVPA. It is also possible, that our participants were moderately active to begin with and thus the primary behavior that was changed was energy intake.

Changes in body weight have been found to be better evaluated and explained by alterations in body composition (36). The children in the current study decreased their body fat by 3.16 ± 2.94% in 12 weeks and increased in fat free mass by 0.81 ± 1.39 kg (p<0.05). This indicates that the child participants were able to maintain and increase muscle during weight loss. Studies have shown an average decrease of 2-2.5% in body fat, a decrease of 1.81 kg of fat mass and increase of 0.68 kg of fat-free mass in a 24 week intervention (12, 27). Our results indicated a significant decrease in BMI of 1.7±0.89 kg•m-^{2} compared to previous research that has indicated decrease between 0.3-1.5 kg•m-^{2} (1, 20). This suggests that our child participants revealed significant changes in body composition in 12 weeks compared to other research; although our percent weight change was slightly lower than average. This may imply that a component of the physical activities from this intervention could have positively impacted the changes in body composition as the intervention progressed.

Epstein et al. (18) has indicated that patterns of improved fitness levels, physical activity, and energy intake may show a relationship to weight loss success. In the current study, both the parents and the children significantly increased cardiorespiratory fitness levels at 12 weeks, however, daily physical activity displayed little to no change. After further investigation, 46% of the child participants at baseline already met the 60 minutes per

day guideline for physical activity according to the 2008 Physical Activity Guidelines(33). This implies that our child participants began the intervention with recommended levels of daily physical activity and therefore focused more on the energy intake alterations. Associations between baseline steps per day and baseline minutes of MVPA with child's change in BMI z-score were illustrated (r = -0.58, p<0.05; r = -0.53, p<0.05, respectively). These results suggest that participants with higher baseline activity levels had a greater change in BMI Z-scores at the end of the 12 weeks (p<0.05). This may imply that children who are already active may see better weight loss as only one behavior is modified versus children who need to modify two behaviors at once.

Furthermore, our data indicated that attainment of program goals by both the child and the parent showed significant correlation with weight loss (r = -0.67, p<0.05). Program goals were set each week for every family member; weight loss (1-2 lbs for adults and 0.5-1 lbs for child), energy intake (decrease amount of red foods from previous week by 1 until 2 per day could be maintained) and physical activity (increase steps per day by 1000 steps from last week's data until a ceiling was met). With further analysis of this association, a threshold of at least 50% of goals met by both child and parent at the end of 12 weeks led to the success of meeting their weight loss goal of 5%. These findings signify the importance of creating programs that have weekly goals for their participants. In addition, goals should be more specific than just weight loss, but include quantifiable changes in dietary and physical activity behaviors. Both child and parents who adhered to program goals

were successful in decreasing red foods and decreasing body mass at the completion of the 12 week BHF intervention.

Limitations of this study included a convenience sample study design that was limited to participants who chose to join Building Healthy Families. Second, sample size of the current study was relatively small, with only 22 child participants, 20 mothers, and 20 fathers. Furthermore, future studies with a larger sample size and complete data for all participants would make this study stronger and possibly indicate other influences to child weight loss success. However, 72% of child participants and 96% of parents lost weight during this program. Hence, this type of family based pediatric obesity program offered significant benefits and led to healthier lifestyles for obese children and their parents. The long-term weight loss outcomes as these children reach adolescence and move into young adulthood is still unknown.

In conclusion, this study revealed the importance of goal setting and behavior change, especially the reduction of high calorie, high fat foods as the main components of success in a pediatric weight loss program. Although, children were the identified participants, the parents lost weight due to engaging in the same healthy behaviors as their children. This demonstrates that it is essential for the entire family to be involved in order to create an environment to support the children's healthy behaviors.

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