Published in final edited form as:

J Nutr Educ Behav. 2019 June ; 51(6): 740–748. doi:10.1016/j.jneb.2019.04.002.

Efficacy of a home-based parent training-focused weight management intervention for preschool children: The DRIVE randomized controlled pilot trial

KR Hawkins¹, JW Apolzan¹, AE Staiano¹, JR Shanley², CK Martin¹

¹Pennington Biomedical Research Center, Louisiana State University System, 6400 Perkins Road, Baton Rouge, LA, 70808

²Georgia State University, School of Public Health, 14 Marietta St., Atlanta, GA 30303

Abstract

Objectives: To pilot test a home-based parent training intervention aimed at maintaining body weight among children at risk for obesity (>75th BMI percentile).

Methods: Sixteen parent/child dyads were randomized to a Health Education or DRIVE intervention arms. DRIVE is a structured parenting program to promote healthy weight in children by relying on behavioral principles to promote skill acquisition in the family's natural setting. Body weight and waist circumference were measured at baseline, week 9, and week 19.

Results: BMIz, body weight, and % body weight increased in children in the Health Education arm vs. DRIVE at weeks 9 and 19. Body weight, % body weight, and waist circumference decreased in parents in DRIVE vs. the Health Education arm at week 19, while no differences were shown at week 9.

Conclusions and Implications: DRIVE mitigated weight gain in a small sample of at-risk children and shows promising results to reduce weight in parents. Home-based interventions emphasizing parent-child interactions are indicated as a practical model to deliver weight management in children.

Keywords

home-based intervention; childhood obesity; parent-child interactions (PCIs); weight maintenance; toddlers

Corresponding Author: Corby K. Martin, PhD, 6400 Perkins Rd, Baton Rouge, La 70808, Corby.martin@pbrc.edu.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

NCT registry: [ClinicalTrials.gov](https://clinicaltrials.gov) Identifier: [NCT02160847](https://clinicaltrials.gov/ct2/show/study/NCT02160847)

Conflicts of Interest Statement: The authors have no potential conflicts of interest.

Introduction:

Childhood obesity is a major threat to the health of children, with recent rapid increases in obesity prevalence in both developed and developing nations¹. Among children aged 2 to 5 years in the U.S., 9.4% are classified as obese² and these children are four times more likely to become obese adults compared to normal weight peers³. Obesity places children at higher risk for early onset of cardiovascular disease, hypertension, and type 2 diabetes, conditions once thought to be nearly exclusive to adulthood⁴.

There is no gold standard for the prevention of obesity among preschool-aged children at this time; however, the World Health Organization emphasizes the importance of providing multi-component family-based lifestyle weight management services for children with obesity⁵. A committee of experts from the field of pediatric obesity⁶ highlighted many parenting skills that promote children's healthy lifestyles, including: 1) praising children's behaviors, 2) not utilizing food as rewards, 3) establishing routine snack and meal times as a family, 4) parents deciding what foods to offer and children deciding if and how much to eat, 5) offering healthy choices for children and having healthy foods in the home, 6) parents modeling desired health behaviors, and 7) parents' consistency in their interaction with their children⁶. Many of these parenting skills are the hallmark of behavioral parent training programs targeting child behavior and the fundamental component is targeting parent-child interaction (PCI) while also utilizing the home environment as key to optimize generalization of skills^{7,8}.

While prior interventions have targeted parents of preschoolers in a childcare center⁹ or clinical setting¹⁰, intervening directly on parenting practices in the home environment is a promising strategy to promote healthy weight among young children^{7,8}. Common recommendations during face-to-face interviews with parents who had a child enrolled in multidisciplinary pediatric weight management clinics were to provide comprehensive weight management support tailored to individual family needs and circumstances and for them to take place closer to home¹¹. Bringing multi-disciplinary weight management interventions into the family's home aligns with these recommendations helps to increase retention and adherence in the study. However, the strength of evidence to support home-based child obesity prevention programs is low and largely focused on middle childhood¹², with less known about home visits for parents of preschoolers.

Parents are typically the most important and influential people in a child's environment, and existing evidence-based parent training interventions currently used by state and federal programs, such as programs to teach safety like Safecare (an evidence-based parent training program delivered in the homes of children 0–5 years of age addressing risk factors for child abuse and neglect by focusing on parent-child relationship, home safety, and child health), provide an optimal vehicle to implement family-based weight loss treatment programs⁸. These programs are founded on PCI principles, and in the context of weight management, parents help their children lose or maintain weight by verbally teaching children the weight control material taught through sessions delivered in the homes and by modelling and reinforcing healthy behaviors¹³. Emerging evidence indicates that parent-only interventions can significantly reduce weight among children with obesity^{14,15}, while others observed that

including both parents and children increased success in behavioral weight loss interventions¹⁶.

This study is the first to pilot test the DRIVE (Developing Relationships that Include Values of Eating and Exercise) program, a structured parenting program delivered in the home environment and aims to promote healthy weight in children by relying on behavioral principles (e.g., didactic, modeling, practice, feedback) to promote skill acquisition in the family's natural setting. The primary focus was to utilize the home environment to optimize generalization of skills targeting parent-child interactions, as recommended by the WHO, to decrease body weight trajectory in at-risk children before they become obese. The objective of this pilot project was to test the feasibility of the DRIVE curriculum by examining the impact on reducing body mass index-for-age z-score (BMIz) among children at risk for obesity (>75th BMI percentile) and on parents' health behavior, knowledge, attitudes, and home environment compared a health education arm. Exploratory measures included change in body weight in children and one parent (percent of initial body weight and kg) and body mass (BMI/waist circumference) in the parent. It was hypothesized that children in the DRIVE intervention would reduce BMIz and parent's body weight, body mass, and health behavior, knowledge, attitudes, and home environment would improve when compared to the health education arm.

Methods:

Participants

Sixteen parent/child dyads (16 children and 16 parents) enrolled in this randomized controlled pilot study. Participants were recruited through community organizations based upon their child's obesity risk and were randomly assigned to the health education arm (health information only) or the DRIVE intervention arm. To participate in this study, the child had to be between 2 and 6 years of age with BMI 75th percentile based on the CDC Growth Charts at screening. Exclusion criteria included if the child had HIV/AIDS or any chronic diseases or used medication that affected body weight, appetite, or metabolism. Exclusion criteria for the participating parent consisted of a BMI 45 or being pregnant or planning to become pregnant while enrolled in the intervention. All procedures were approved by the institutional review board (2014-026-PBRC). Written consent was obtained from each parent for themselves and their child.

Measures and Procedures

Participants in the DRIVE arm received the DRIVE intervention (15 sessions) conducted in their home by a Pennington Biomedical Research Center interventionist with a master's degree in psychology or a registered dietician nutritionist (RDN) trained in behavioral change strategies for nutrition and physical activity (PA). Parents in the DRIVE arm with a BMI 25 were also given information about adult nutrition and PA targeting weight loss in the mail, while parents with a BMI <25 were not given this information.

Development of the DRIVE Intervention: The DRIVE intervention was developed by a multi-disciplinary panel of specialists in pediatric obesity, including clinical and behavioral

psychologists, doctoral-level experts in nutrition, a Registered Dietitian (RD), and an Exercise Physiologist. Educational and behavior change material was developed following guidelines from professional organizations who have established criteria to help address the childhood obesity epidemic^{17–19}. The primary focus of DRIVE is the promotion of health and a healthier body mass among young children by working with parents to help instill healthy habits early in life. This approach incorporates principles of social learning theory²⁰ and covers three specific topics: healthy nutrition (2010 USDA Dietary Guidelines for Children)²¹, increased physical activity (>60 minutes per day)²², and parent-child interactions (PCIs)²³.

DRIVE was delivered in 15-in person sessions in the family's home focusing on Parent-Child Interaction (PCI), health, nutrition, and PA (see supplemental material Table 1). Each session was ~30 minutes and the parent was given a handout that was customized by the interventionist based on the family's needs when it was delivered. The first 12 sessions occurred during weekly meetings in the home and the final 3 sessions were bi-weekly based on the family's availability. Sessions were held in the morning or evening depending on family's preference. Each session utilized PCI strategies to engage parents and children in practicing healthy daily routines through child Planned Activities Training (cPAT), which is an activity-based strategy that provides parents with opportunities to practice the PCI skills with their child²⁴. These activities focused on establishing regular snack and meal times, reducing screen-time, and incorporating more opportunities for physically active play. Each session discussed a specific health topic with the parent (e.g., proper nutrition and portion size based on child's age, healthy food preparation, physical activities for the family and child, discussing weight and growth concerns with their pediatrician, effective parenting strategies around meals, etc.) and involved a related activity to promote parent's use of the knowledge.

Health Education Control: The control arm was mailed information on nutrition, PA, and PCIs at the beginning of the 19-week intervention. Nutrition information provided was based on the "MyPlate" website (<http://www.choosemyplate.gov/preschoolers.html>) in addition to information on proper nutrition and suggested levels of PA for preschoolers. Lastly, families were provided with the free publication "Adventures in Parenting: How Responding, Preventing, Monitoring, Mentoring, and Modeling Can Help You Be A Successful Parent," authored by National Institutes of Health, Eunice Kennedy Shriver National Institute of Child Health and Human Development. Information covered in this document includes effective parenting strategies for children at specific ages.

Adiposity Measures: Both parent (12 hrs) and child (6 hrs) were instructed to fast prior to all measures which were collected in the homes of the participants at baseline, 9 weeks (mid-point), and 19 weeks (end of intervention) by the assessment team who was blind to randomization. Parent and child height (cm) and weight (kg) were measured using a stadiometer (Seca 213 Portable Stadiometer). Waist circumference (cm) was measured in duplicate with a non-stretch tape measure as the midpoint between the iliac crest and lowest rib. BMIz, which measures relative weight adjusted for child age and sex²⁵, was calculated for each child, and BMI (kg/m²) was calculated for adults.

Parents' Health Behavior, Knowledge, Attitudes, and Home Environment: Five questionnaires were given to the parents at baseline and 19 weeks follow-up and took approximately 30 minutes to complete. Specifically, feeding strategies used by parents were assessed via the Caregiver Feeding Styles Questionnaire (CFSQ). This 38-item measure has been used frequently with low-income families and African-American and Hispanic families with toddlers²⁶. Second, 5 Likert scale questions from the Behavior and Attitudes Questionnaire for Healthy Habits (BAQ-HH) were used to assess parents' knowledge, awareness, attitudes, concerns, and behaviors around healthy foods and physical activity habits. This instrument has previously been used with parents of pre-school age children²⁷. Third, the Healthy Home Survey was used to assess the health environment of the home, including food available in the home, the physical space in and outside of the home, and electronics available in the home²⁸. Fourth, the 6-item Food Security Questionnaire was used to gather information about parents' ability to easily and readily access enough food for their family. This scale is a well-validated measure of food security developed by researchers at the National Center for Health Statistics. Two or more affirmative answers (2) indicated food insecurity²⁹. Fifth, a screen time questionnaire was used to assess children's time spent using screens for watching television or playing games.

Statistical Analysis

Continuous baseline measures for were calculated as mean (SD) and compared using two sample t-tests and categorical baseline measures were calculated as n (%) and compared using a chi-square test of independence. Change in primary and secondary outcome measures were calculated as mean (SE). A multivariate analysis of covariance (MANCOVA) for repeated measures was performed to investigate treatment effects on changes from baseline (at week 9 and at week 19) in child's BMIz (primary outcome), child and parent weight (kg and %), waist circumference, parent BMI, and parents' health behavior, knowledge, attitudes, and home environment. The model fixed effects were treatment arm, time, and treatment arm by time interaction, and the random effects were subjects within time with the baseline measure of the dependent variable included as a covariate. All statistical analysis were planned a priori and conducted using SPSS version 23 (IBM Corp. Armonk, NY) with significance set at $\alpha = 0.05$. No adjustments for the statistical significance of multiple comparisons were made because this was an exploratory, pilot trial. Data were checked for normality and a Mann Whitney U test was used to confirm significance when data were not normally distributed. All primary outcomes measures were normally distributed. Significance was verified for all secondary measures that were not normally distributed using a Mann-Whitney U test and include change in child BW at week 9 ($p=0.02$) and 19 ($p=0.002$), change in child %BW at week 19 ($p=0.02$), change in parent weight ($p=0.03$), change in parent BMI at week 19 ($p=0.04$), change in parent waist circumference at week 19 ($p=0.006$), change in parent health behavior knowledge ($p=0.02$), and change in healthy foods in the home ($p=0.04$). Only parametric tests of significance are reported below. An outlier in the Health Education arm resulted in post-hoc changes to the statistics resulting in one parent being dropped from the analysis, all intervention group participants were included in the analysis.

Results:

Characteristics of the Sample:

Sixteen (n=16) parent-child dyads were randomized to the DRIVE intervention or the Health Education control arm. Eight parent-child dyads participated in each arm, 1) DRIVE and 2) Health Education. All families completed all sessions and make-up sessions were scheduled as necessary. One parent (n=1) was dropped from analysis in the Health Education arm due to intentional excessive weight loss (>10% body weight) not associated with the study that was greater than 3 standard deviations from the mean. Baseline characteristics for children and their parents were calculated as mean±SD (standard deviation) for the DRIVE intervention and the Health Education arm and compared using two sample t-tests for continuous measures and chi-squared test for independence for categorical measures and are reported in Table 1 and Table 2. Study arms were not significantly different on any demographic or primary and secondary outcome variables at baseline. Children in this study were approximately 4.1±1.7yrs of age, 23.2±8.6 kg, and had a waist circumference of 56.5±9.6 cm and a BMI percentile of 86.5±13.0. Half (50%; n=8, Health Education: n=5, DRIVE: n=3) of the children were female and 50% (n=8; Health Education: n=5 African American, DRIVE: n=2 African American and n=1 other) were not Caucasian. Parents were approximately 35.1±5.3 years of age, 89.2±23.3 kg, and had a waist circumference of 95.6±16.2 cm and a BMI of 33.5±6.6 (kg/m²). Most (93.3%; n=14, Health Education: n=6, DRIVE: n=8) of the parents were female and half (n=8; Health Education: n=5, Drive: n=2) were African-American. Baseline measures were included as a covariate for outcome measures.

Primary and Secondary Outcomes:

Figure 1 represents change in child BMIz, body weight (kg), % body weight from baseline to 9 weeks and baseline to 19 weeks follow-up using MANCOVA of Change. Change in BMIz differed significantly between the children in the Health Education vs. the intervention arm at week 9 (0.4±0.1 vs. -0.3±0.1, $p=0.007$; respectively) and 19 (0.5±0.1 vs. -0.1±0.1, $p=0.004$; respectively) (Figure 1A). This effect was due to significant increases in children's BMIz in the Health Education arm at week 9 ($p<0.05$) and week 19 ($p<0.05$). Change in BW (kg) and percent BW (%BW) was greater in children in the Health Education arm vs. intervention at 9 weeks (BW: 1.5±0.3 vs. 0.3±0.3 kg, $p=0.03$, and BW%: 6.4±1.5% vs. 1.3±1.5%, $p=0.03$; respectively) and 19 weeks (BW: 2.3±0.4 vs. 0.6±0.4 kg, $p=0.006$ and BW%: 10.3±1.5% vs. 2.7±1.5%, $p=0.004$; respectively) (see Figure 1B and 1C).

Figure 2 represents change in parent weight (kg), % body weight, BMI, and waist circumference (cm) from baseline to 9 weeks and baseline to 19 weeks follow-up using MANCOVA of Change (outlier removed). Change in parents' body weight (kg and %) differed significantly in the intervention vs. Health Education arm at week 19 (BW: -3.4±1.4 vs. 2.2±1.5 kg, $p=0.02$, and BW%: -3.5±1.5 vs. 2.0±1.6%, $p=0.03$; respectively), but no differences were observed at the mid-point/week 9 (BW: -1.3±1.2 vs. 0.3±1.3 kg, $p=0.5$, and BW%: -1.6±1.3 vs. -0.1±1.4%, $p=0.5$; respectively) (Figure 2A and 2B). This effect was due to significant decreases in parent's body weight at week 19 in the DRIVE group ($p<0.05$). Parental BMI decreased significantly in the DRIVE group vs. the Health Education

arm at week 19 (-1.2 ± 0.5 vs. 0.7 ± 0.5 , respectively; $p=0.02$), though this effect was not significant at week 9 (-0.6 ± 0.4 vs. -0.4 ± 0.5 , respectively; $p=0.4$) (Figure 2C). Waist circumference increased in the parents in the Health Education vs. the DRIVE intervention arm at week 19 (5.1 ± 2.4 vs. -2.0 ± 1.3 cm, $p=0.02$; respectively), while no difference was observed between arms at week 9 (1.7 ± 2.4 vs. -1.4 ± 1.9 cm, $p=0.4$; respectively). It should be noted that when the outlier parent in the Health Education arm was included in the analysis, differences were attenuated to non-significance in all parent primary outcomes measures (see supplemental material Figure 1).

Parents' Health Behavior, Knowledge, Attitudes, and Home Environment:

Change in questionnaire scores in parents from baseline to week 19 are reported in Table 3. Parent-reported BAQ-HH was improved in the DRIVE intervention compared to the Health Education arm (9.2 ± 4.1 vs. -3.0 ± 3.8 , $p=0.05$; respectively). Specifically, parents' health behavior knowledge improved significantly in the intervention compared to the Health Education arm (1.8 ± 3.1 vs. -3.4 ± 5.7 , $p=0.01$; respectively). Parent-reported child screen-time increased more in the Health Education arm compared to the intervention (4.1 ± 1.4 vs. 0.0 ± 1.3 hrs/week, $p=0.05$; respectively). Healthy foods in the home decreased in the Health Education arm and it increased in the intervention (-2.6 ± 1.6 vs. 3.1 ± 1.5 , $p=0.03$; respectively), while no difference was observed for changes in unhealthy foods in the home (-0.6 ± 1.4 vs. -1.9 ± 1.4 , $p=0.50$; respectively). A majority of the sample was food secure and this did not change over the course of the 19 week intervention. No differences were observed for the change in caregiver feeding scores.

Discussion:

The DRIVE intervention was developed to improve parent-child interactions through the delivery of health sessions to improve the child's nutrition and physical activity in their home environment. Based on results from this pilot project with a small sample of at-risk children, DRIVE appears to mitigate child weight gain. Children in the DRIVE intervention arm generally maintained body weight (kg and %BW), resulting in a modest reduction in BMIz over the course of 19 weeks, while the Health Education arm significantly increased body weight and BMIz. The intervention also appeared to help parents decrease their body mass, though this conclusion is qualified by the presence of an outlier and, when this outlier was included in the analyses, the results for the parents are not significant. Among parents, the DRIVE intervention appeared to improve measures of self-reported health behaviors and attitudes, children's screen-time exposure, and changes to the home environment.

Obesity in childhood is associated with obesity later in life³ and growing evidence suggests that once obesity is established it is very difficult to reverse and that obesity treatment becomes further complicated the longer an individual has obesity³⁰. DRIVE recruited at-risk children between 2–6 years of age with a BMI equal to or above the 75% percentile. Children in the Health Education arm gained 3.3 lbs (1.5 kg) or 6.4 % of their body weight by 9 weeks and 5 lbs (2.3 kg) or 10.3% of their body weight at 19 weeks, while children in the intervention maintained weight at both 9 and 19 weeks. This resulted in a slight (non-significant) reduction in BMIz in the intervention group and a significant increase in the

Health Education arm, similar to the LAUNCH home-based behavioral intervention for preschool children where children receiving the control (pediatric counseling) gained weight over 6 months while the intervention arm decreased BMI z-scores and BMI percentile³¹. In contrast to Stark et al^{31,32}, the DRIVE intervention arm and Health Education arm were delivered entirely in the home-based setting increasing the individual intensity of the DRIVE intervention model and makes the effects the intervention compared to the Health Education control completely independent of the setting. Promoting weight maintenance in growing children reduces BMIz as children gain stature over time³³, though in this short-term study the treatment effect was largely due to increased BMIz in the Health Education arm and the long-term effects of the DRIVE intervention are not known.

The most effective weight management interventions have been family-centered and multidisciplinary, focusing on positive lifestyle changes by the incorporation of behavioral strategies and frequent contact with the interventionist³⁴. Social ecological models indicate the importance of the social environment in addition to individual factors in influencing health behaviors³⁵. Similar to the LAUNCH intervention³¹, parents' weight loss in the DRIVE intervention, about 7.5 lb (3.4 kg) or 3.5% of their body weight over 19 weeks, and parents' improvements in healthy behaviors and attitudes may benefit children both by modeling healthy behaviors and creating a healthy household. The current study reveals that while the intervention was successful at promoting weight maintenance in children and decreasing adiposity measures in parents at the 19 week mark, improvements at the 9 week mark were only shown for children and not parents. This implies parents are applying techniques learned in the intervention to their children before incorporating these healthy behaviors in their own lives suggesting the need for long-term family-based interventions.

Past obesity prevention interventions in clinical settings have produced positive, although small, changes in body weight measures in children but very limited success has been shown in underserved, low-income children^{36,37}. One potential reason for the lack of effectiveness may be the low intensity and duration of weight management counseling. For example, in a recent 2-year primary care-based intervention to treat and manage obesity in children 2–6 years of age with BMI 85th percentile, there was no difference in the children who participated in the intervention (four in-person visits with two phone calls) as compared to the usual care participants (two in-person visits)³⁸. By contrast, home-based programs have been highly successful in delivering more intensive behavioral counseling for various health services, such as promoting children's health and safety and reducing risks associated with poor academic and psychosocial outcomes⁸, and the present study contributes to the nascent field of using home-based parent training programs to effectively reduce childhood obesity. In contrast to traditional clinic or community programs that typically have high attrition rates, with ~75% of families discontinuing treatment before completion,³⁹ home-based programs help to eliminate common barriers of access to these interventions such as childcare and transportation, as evidenced by 100% attendance in the DRIVE home-based intervention.

The DRIVE intervention was designed primarily to: 1) assess the feasibility of recruiting children and their parents for a home-based weight management intervention, 2) test the intervention materials and measurement techniques, and 3) obtain preliminary evidence on

the efficacy of a brief home-based weight gain prevention program for children. Therefore, the sample size for the current study was limited and the duration was short. Additionally, a number of measures relied on self-report by the parents of the child and therefore imperative mediating variables may have been disregarded. This study had a high number of African American children and parents, which is representative of the population in Louisiana but the intervention was not tailored for this demographic specifically. Further, despite randomization, the sample size was small and so the two intervention arms varied by demographics; for instance, the DRIVE intervention arm included more white children and the Health Education arm included more African American children. While this pilot study did demonstrate significant differences between groups, larger sample sizes are required for sufficient power and to ensure well-balanced arms. Additionally, this study did not include measures of acceptability and satisfaction and future studies should include this.

Implications for Research and Practice:

To the Authors knowledge, this pilot was the first to demonstrate that DRIVE, a parent training weight management intervention delivered entirely in the homes of preschoolers, attenuated weight gain and shows promising results to reduce weight in their parents. This study suggests that designing and assessing home-based weight management programs for families which can be integrated into the existing infrastructure of family homes, improves the likelihood to disseminate on a larger scale. As of 40 years ago, established home visitation programs were focused on decreasing the incidence of low birth weight, but including weight management techniques in these programs better reflects the current childhood obesity crisis⁴⁰. Future research should explore the feasibility of integrating weight management to attenuate excessive weight gain for families into federal and state services that already provide family-based home visitation programs.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements:

We would like to thank all members of the ingestive behavior laboratory for their hard work on this project, specifically the project management and statistical support provided for this project from Lindsay Hall, MA and Allison Davis, MS.

Funding Source:

The DRIVE project was supported by the Board of Regents of the University System of Georgia. This work was also partially supported by the NORC center grant #1P30 DK072476 entitled "Nutritional Programming: Environmental and Molecular Interactions" sponsored by the NIDDK. K. Hawkins is supported by NIH grant T32 DK064584. J. Apolzan and A. Staiano were **supported in part by 1 U54 GM104940 xfrom the National Institute of General Medical Sciences of the National Institutes of Health, which funds the Louisiana Clinical and Translational Science Center.**

References

1. Quattrin T, Roemmich JN, Paluch R, Yu J, Epstein LH, Ecker MA. Treatment outcomes of overweight children and parents in the medical home. *Pediatrics*. 2014;134(2):290–297. [PubMed: 25049340]

2. Ogden CL, Carroll MD, Lawman HG, et al. Trends in obesity prevalence among children and adolescents in the United States, 1988–1994 through 2013–2014. *Jama*. 2016;315(21):2292–2299. [PubMed: 27272581]
3. Freedman DS, Khan LK, Serdula MK, Dietz WH, Srinivasan SR, Berenson GS. The relation of childhood BMI to adult adiposity: the Bogalusa Heart Study. *Pediatrics*. 2005;115(1):22–27. [PubMed: 15629977]
4. Raj M Obesity and cardiovascular risk in children and adolescents. *Indian journal of endocrinology and metabolism*. 2012;16(1):13. [PubMed: 22276248]
5. Organization WH. Report of the Commission on ending childhood obesity. Geneva, Switzerland: Available;2016.
6. Spear BA, Barlow SE, Ervin C, et al. Recommendations for treatment of child and adolescent overweight and obesity. *Pediatrics*. 2007;120(Supplement 4):S254–S288. [PubMed: 18055654]
7. Kitzmann KM, Beech BM. Family-based interventions for pediatric obesity: methodological and conceptual challenges from family psychology. *Journal of family psychology : JFP : journal of the Division of Family Psychology of the American Psychological Association (Division 43)*. 2006;20(2):175–189.
8. Salvy SJ, Haye K, Galama T, Goran MI. Home visitation programs: an untapped opportunity for the delivery of early childhood obesity prevention. *Obesity Reviews*. 2017;18(2):149–163. [PubMed: 27911984]
9. Bélanger M, Humbert L, Vatanparast H, et al. A multilevel intervention to increase physical activity and improve healthy eating and physical literacy among young children (ages 3–5) attending early childcare centres: the Healthy Start-Départ Santé cluster randomised controlled trial study protocol. *BMC public health*. 2016;16(1):313. [PubMed: 27068684]
10. Quattrin T, Roemmich J, Paluch R. Comparison of parent and child versus child-only weight management interventions in the patient-centered medical home. *JCOM*. 2015;22(2).
11. Tremblay M, Perez AJ, Rasquinha AM, et al. Recommendations From Parents to Improve Health Services for Managing Pediatric Obesity in Canada. *Acad Pediatr*. 2016;16(6):587–593. [PubMed: 27236018]
12. Showell NN, Fawole O, Segal J, et al. A systematic review of home-based childhood obesity prevention studies. *Pediatrics*. 2013;132(1):e193–e200. [PubMed: 23753095]
13. Boutelle KN, Rhee KE, Liang J, et al. Effect of Attendance of the Child on Body Weight, Energy Intake, and Physical Activity in Childhood Obesity Treatment: A Randomized Clinical Trial. *JAMA pediatrics*. 2017.
14. Golan M, Kaufman V, Shahar DR. Childhood obesity treatment: targeting parents exclusively v. parents and children. *British Journal of Nutrition*. 2006;95(5):1008–1015. [PubMed: 16611394]
15. Loveman E, Al- Khudairy L, Johnson RE, et al. Parent- only interventions for childhood overweight or obesity in children aged 5 to 11 years. *The Cochrane Library*. 2015.
16. Hughes SO, Power TG, Fisher JO, Mueller S, Nicklas TA. Revisiting a neglected construct: parenting styles in a child-feeding context. *Appetite*. 2005;44(1):83–92. [PubMed: 15604035]
17. Krebs NF, Jacobson MS, American Academy of Pediatrics Committee on N. Prevention of pediatric overweight and obesity. *Pediatrics*. 2003;112(2):424–430. [PubMed: 12897303]
18. Koplan JP, Liverman CT, Kraak VI, Committee on Prevention of Obesity in C, Youth. Preventing childhood obesity: health in the balance: executive summary. *J Am Diet Assoc*. 2005;105(1):131–138. [PubMed: 15635359]
19. Daniels SR, Jacobson MS, McCrindle BW, Eckel RH, Sanner BM. American Heart Association Childhood Obesity Research Summit Report. *Circulation*. 2009;119(15):e489–517. [PubMed: 19332458]
20. Bandura A Social Learning Theory. Oxford, England:: Prentice-Hall 1977.
21. McGuire SUS Department of Agriculture and U.S. Department of Health and Human Services, Dietary Guidelines for Americans, 2010. 7th Edition, Washington, DC: U.S. Government Printing Office, January 2011. *Advances in nutrition*. 2011;2(3):293–294. [PubMed: 22332062]
22. Services USDoHaH. Physical Activity Guidelines for Americans In: Services DoHaH, ed. 2nd edition ed. Washington, DC: U.S2018.

23. Mercy JA, Saul J. Creating a healthier future through early interventions for children. *JAMA*. 2009;301(21):2262–2264. [PubMed: 19491188]
24. Bigelow KM, Lutzker JR. Using video to teach planned activities to parents reported for child abuse. *Child & Family Behavior Therapy*. 1998;20(4):1–14.
25. Kuczmarski RJ, Ogden CL, Grummer-Strawn LM, et al. CDC growth charts: United States. Advance data. 2000(314):1–27.
26. Hughes SO, Cross MB, Hennessy E, Tovar A, Economos CD, Power TG. Caregiver's feeding styles questionnaire. Establishing cutoff points. *Appetite*. 2012;58(1):393–395. [PubMed: 22119478]
27. Henry BW, Smith TJ, Ahmad S. Psychometric assessment of the Behavior and Attitudes Questionnaire for Healthy Habits: measuring parents' views on food and physical activity. *Public health nutrition*. 2014;17(5):1004–1012. [PubMed: 23332083]
28. Bryant MJ, Ward DS, Hales D, Vaughn A, Tabak RG, Stevens J. Reliability and validity of the Healthy Home Survey: a tool to measure factors within homes hypothesized to relate to overweight in children. *International Journal of Behavioral Nutrition and Physical Activity*. 2008;5(1):23. [PubMed: 18442392]
29. Blumberg SJ, Bialostosky K, Hamilton WL, Briefel RR. The effectiveness of a short form of the Household Food Security Scale. *American journal of public health*. 1999;89(8):1231–1234. [PubMed: 10432912]
30. Kelly AS, Barlow SE, Rao G, et al. Severe obesity in children and adolescents: identification, associated health risks, and treatment approaches. *Circulation*. 2013;128(15):1689–1712. [PubMed: 24016455]
31. Stark LJ, Spear S, Boles R, et al. A pilot randomized controlled trial of a clinic and home-based behavioral intervention to decrease obesity in preschoolers. *Obesity*. 2011;19(1):134–141. [PubMed: 20395948]
32. Stark LJ, Clifford LM, Towner EK, et al. A pilot randomized controlled trial of a behavioral family-based intervention with and without home visits to decrease obesity in preschoolers. *J Pediatr Psychol*. 2014;39(9):1001–1012. [PubMed: 25080605]
33. Grossman DC, Bibbins-Domingo K, Curry SJ, et al. Screening for obesity in children and adolescents: US Preventive Services Task Force recommendation statement. *Jama*. 2017;317(23):2417–2426. [PubMed: 28632874]
34. Whitlock EP, O'Connor EA, Williams SB, Beil TL, Lutz KW. Effectiveness of weight management interventions in children: a targeted systematic review for the USPSTF. *Pediatrics*. 2010;125(5):e126–e135. 2009–1955.
35. Stokols D, Lejano R, Hipp J. Enhancing the resilience of human–environment systems: A social ecological perspective. *Ecology and Society*. 2013;18(1).
36. Reinehr T. Lifestyle intervention in childhood obesity: changes and challenges. *Nature Reviews Endocrinology*. 2013;9(10):607–614.
37. Flynn M, McNeil D, Maloff B, et al. Reducing obesity and related chronic disease risk in children and youth: a synthesis of evidence with 'best practice' recommendations. *Obesity reviews*. 2006;7(s1):7–66. [PubMed: 16371076]
38. Rifas-Shiman SL, Taveras EM, Gortmaker SL, et al. Two-year follow-up of a primary care-based intervention to prevent and manage childhood obesity: the High Five for Kids study. *Pediatric obesity*. 2017;12(3).
39. Dhaliwal J, Nosworthy NM, Holt NL, et al. Attrition and the management of pediatric obesity: an integrative review. *Childhood Obesity*. 2014;10(6):461–473. [PubMed: 25496035]
40. Sackoff J, Schwarz AG, Senter L. Reducing low birth weight through home visitation. *American journal of preventive medicine*. 2009;37(5):472. [PubMed: 19840705]

Figure 1. Change in child BMIz, body weight (kg), % body weight from baseline to 9 weeks and baseline to 19 weeks follow-up using MANCOVA of Change.

Change in A) BMIz, B) Body Weight, and C) % Body Weight increased in the Health Education group at week 9 and week 19 and the difference in the change in BMIz, Body Weight, and % Body Weight increased in children in the Health Education arm compared to the children in the intervention at week 9 and at week 19.

* Denotes significant within group change from baseline $p > 0.05$, error bar indicates standard error

Figure 2. Change in parent weight (kg), % body weight, BMI, and waist circumference (cm) from baseline to 9 weeks and baseline to 19 weeks follow-up using MANCOVA of Change (outlier removed).

Change in **A)** body weight, **B)** % body weight, **C)** BMI, and **D)** waist circumference decreased in the intervention and increased in the Health Education arm at week 9 and week 19 and the difference in change in body weight, % body weight, BMI, and waist circumference decreased more in parents in the intervention compared to Health Education arm at week 19, but no differences were shown at week 9.

* Denotes significant within group change from baseline $p > 0.05$, error bar indicates standard error

Table 1.

Baseline Anthropometric, Gender, and Race for Children Enrolled in Drive and the Health Education Control (n=16).

Child	Total Sample (n=16)	Health Education (n=8)	DRIVE (n=8)	P value
Age, y	4.1 (1.7)	4.3 (1.7)	3.9 (1.8)	0.67
Height, cm	108.1 (15.0)	111.5(15.2)	104.6 (15.1)	0.38
Body weight, kg	23.2 (8.6)	26.2 (9.8)	20.3 (6.5)	0.18
BMI percentile	86.5 (13.0)	88.8(13.8)	84.2 (12.7)	0.50
BMI -for-age z-score	1.5 (1.0)	1.8 (1.1)	1.3 (0.8)	0.27
Waist circumference, cm	56.5 (9.6)	60.0 (9.1)	53.1 (9.4)	0.16
	n (%)	n (%)	n (%)	P (X ²)
Sex				
Female	8 (50.0)	5(62.5)	3 (37.5)	0.62
Male	8 (50.0)	3 (37.5)	5 (62.5)	
Race				
African-American	7 (43.8)	5 (62.5)	2 (25.0)	0.25
Other/Mixed	1.(63)	0 (0.0)	1 (12.5)	
Caucasian	8 (50.0)	3 (37.5)	5 (62.5)	

BMI (Body Mass Index), y (years), cm (centimeters), kg (kilograms)

Continuous measures reported as mean (SD), significant at p 0.05, compared using two sample t-tests

Categorical measures reported as n (%) and compared using a chi-square test of independence

Table 2.

Baseline Anthropometric, Gender, and Race for Parents Enrolled in Drive and the Health Education Control (n=15).

Parent	Total Sample (n=15)	Health Education (n=7)	DRIVE (n=8)	<i>P</i> value
Age, y	35.1 (5.3)	34.5 (5.9)	35.8 (5.0)	0.65
Height, cm	162.5 (8.9)	165.3 (10.0)	159.7 (7.2)	0.22
Body weight, kg	89.2 (23.3)	96.3 (23.4)	82.1 (22.3)	0.24
BMI, kg/m ²	33.5 (6.6)	34.9 (6.3)	32.0 (6.9)	0.39
Waist Circumference, cm	95.6 (16.2)	99.6 (17.1)	92.1 (15.7)	0.39
	n (%)	n (%)	n (%)	<i>P</i> (X²)
Sex				
Female	14 (93.8)	6 (85.7)	8 (100.0)	0.62
Male	1 (6.3)	1 (12.5)	0 (0.0)	
Race				
African-American	7 (46.6)	5 (71.4)	2 (25.0)	0.25
Caucasian	8 (53.3)	2 (28.6)	6 (75.0)	

BMI (Body Mass Index), y (years), cm (centimeters), kg (kilograms)

Continuous measures reported as mean (SD), significant at p 0.05, compared using two sample t-tests

Categorical measures reported as n (%) and compared using a chi-square test of independence

Table. 3

Change in Scores of Questionnaires given to Parents from Baseline to 19 weeks.

	Control (n=7)	Intervention (n=8)	*P<.05
BAQ-HH	-3.0 (3.8)	9.2 (4.1) ^a	0.05
Attitude	-2.2 (1.4)	-2.2 (1.5) ^b	0.99
Communication	0.5 (1.2) ^b	1.4 (1.2) ^a	0.64
Environment	-0.5 (0.7) ^b	0.6 (0.8) ^a	0.33
Knowledge	-3.4 (5.7)	1.8 (3.1)	0.01
Parent Role	-1.7 (1.1) ^b	-0.5 (1.1) ^b	0.84
Caregiver Feeding Styles			
Demand	-0.2 (0.4)	-0.09 (0.6)	0.18
Respond	-0.03 (0.1)	0.07 (0.2)	0.95
Parent-Centered/High-Controlled	-0.2 (0.3)	-0.25 (0.9)	0.76
Parent-Centered/Contingency Management	-0.1 (0.5)	-0.11(1.0)	0.24
Child Centered	-0.3 (0.4)	0.0 (0.5)	0.24
Screen-time (hrs/day)	4.1 (1.4)	0.0 (1.3)	0.05
Healthy Foods in the Home	-2.6 (1.6) ^b	3.1 (1.5) ^a	0.03
Unhealthy Foods in the Home	-0.6 (1.4)	-1.9 (1.4) ^a	0.50

MANCOVA of Change results expressed as mean (SE);

^a:
n=7,^b:
n=6*
between group differences at 19 weeks