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Secondary Impact of a Behavioral Intervention on Dietary Quality in Preschoolers with Obesity

Elizabeth K. Towner¹, Shannon M. Robson², and Lori J. Stark³

¹Department of Family Medicine and Public Health Sciences, Wayne State University School of Medicine, 6135 Woodward Avenue H206, Detroit, MI 48202. (ekuhl@med.wayne.edu). Phone: (313) 577-1080. Fax: (313) 972-8024.

²Department of Behavioral Health & Nutrition, College of Health Sciences, University of Delaware, 308 McDowell Hall, Newark, DE 19716. robson@udel.edu.

³Department of Pediatrics, Division of Behavioral Medicine & Clinical Psychology, Cincinnati Children's Hospital Medical Center and University of Cincinnati College of Medicine, Cincinnati, OH 45229. Lori.Stark@cchmc.org. Phone: (513) 636-4336. Fax: (513) 636-3677.

INTRODUCTION

Dietary quality remains poor for preschoolers in America (Ford, Poti, Ng, & Popkin, 2017). More specifically, preschoolers are consuming an average of 1,537 calories per day (Slining, Mathias, & Popkin, 2013), which is consistent with recommendations for 9–12 year olds (Gidding et al., 2005). Sugar-sweetened beverages, pizza, full-fat milk, grain-based desserts, breads, pasta, dishes, and savory snacks are among the most commonly consumed foods for all children in the United States, irrespective of age, over the past 20 years (Slining et al., 2013). Snacking frequency has also increased significantly over the past 40 years for children between the ages of 2 and 5 years old, with the most recent data suggesting preschoolers eat an average of 2.75 snacks per day. The foods preschoolers eat for snacks are also generally nutrient-poor and energy-dense, so it is not surprising that nearly 1/3 of preschooler daily caloric intake is derived from snacks (Piernas & Popkin, 2010).

Caregivers have more control over foods and beverages purchased and served during the preschool years than perhaps any other stage of childhood. They also shape preschooler dietary habits by their own eating behavior (modeling), expectations set specific to eating, and how they respond to food requests and child eating behavior (Birch & Fisher, 1998). However, several unique barriers to the preschool years challenge caregivers in their efforts to ensure preschoolers consume a high-quality diet including innate preferences for foods with sweet and salty tastes, fear of new and unfamiliar foods (food neophobia), food refusal, and food-related tantrums (Birch & Fisher, 1998). Interventions to assist caregivers in addressing these barriers are imperative because dietary habits are established during this stage of development and track to adulthood, when they are associated with chronic health

conditions like cardiovascular disease and cancer (Heidemann et al., 2008; Kaikkonen et al., 2013; Magnussen et al., 2011; van Dam, Li, Spiegelman, Franco, & Hu, 2008).

Poor diet is also a risk factor for obesity (Barlow, 2007). Previously, we conducted a series of iterative pilot randomized controlled trials to develop a 6-month, family-based, behavioral weight control intervention for preschoolers with obesity (Learning About and Understanding Child nutrition and Health; LAUNCH; Stark et al., 2014; Stark et al., 2011). LAUNCH was specifically designed to address the aforementioned barriers to preschooler dietary modification and included dietary recommendations similar to those outlined in the Dietary Guidelines for Americans (see Table 1)(U.S. Department of Health and Human Services U.S. Department of Agriculture, 2010). In both pilot studies, LAUNCH showed a significant decrease in BMI z-score (e.g., -0.49 ± 0.36 and -0.37 ± 0.41) at 6 and 12 months respectively compared to an enhanced standard of care session with a pediatrician (ESC; 0.10 ± 0.32 and 0.40 ± 0.49). LAUNCH also showed a decrease in calories (e.g., -218 ± 354 and -214 ± 327) at 6 and 12 months respectively compared to ESC (e.g., 322 ± 280 and 311 ± 172 ; Stark et al., 2011). While weight control was the primary target of LAUNCH, improving preschooler dietary quality is a potential secondary health benefit given the dietary recommendations provided to participating families.

The purpose of this secondary data analysis is thus to examine whether improvements in dietary quality were observed concurrent with reductions in obesity status and caloric intake for preschoolers who received LAUNCH. Dietary quality was evaluated using the Health Eating Index-2010 (Guenther et al., 2013; Guenther et al., 2014), a measure of diet quality that assesses adherence of the diet to the Dietary Guidelines for Americans (U.S. Department of Health and Human Services U.S. Department of Agriculture, 2010). Based on the LAUNCH dietary recommendations, we hypothesized preschoolers would experience significant improvements in HEI-2010 total score (overall dietary quality) and on the following HEI-2010 subscales from baseline to post-treatment (6 months) and baseline to 6 months post-treatment (12 months): total fruit, whole fruit, total vegetables, whole grains, refined grains, and empty calories. The HEI-2010 also includes subscales measuring fatty acids (ratio of monosaturated + polysaturated or “good” fats to saturated or “bad” fats), beans and greens, and sodium intake. While these food groups and macronutrients were not specifically targeted by LAUNCH dietary recommendations, they are important to overall child health and development (U.S. Department of Health and Human Services U.S. Department of Agriculture, 2010), and should improve if overall dietary quality improves. As such, an exploratory aim was to examine changes in the fatty acid, beans and greens, and sodium subscale scores of the HEI-2010 from baseline to 6 and baseline to 12 months. Finally, because LAUNCH encouraged increases in nutrient-dense foods and decreases in energy-dense foods as one mechanism for weight control, we hypothesized changes in overall dietary quality as measured by the HEI total score would be significantly and inversely associated with changes in preschooler BMI z-score at 6 and 12 months.

METHODS

Study Design

Assessments were conducted at baseline, 6 months, and 12 months. Written parent consent for participation was obtained for all families. The institutional review board at XXX approved the trial protocol.

Participants

Families were recruited from Midwestern pediatric practices. Inclusion criteria were: a) child between the ages of 2 years and 5 years, 11 months with BMI 95th percentile but <100% over ideal body weight, b) at least one caregiver with BMI 25, c) English-speaking family living within 50 miles of the medical center where the study was conducted, and d) caregiver who was willing to participate and met criteria for overweight or obesity (BMI 25). Exclusion criteria were child a) taking medications (e.g., stimulants, steroids) or diagnosed with a health condition known to impact weight and b) diagnosed with a developmental disability (e.g., autism), or c) condition that would limit or preclude engagement in moderate physical activity (e.g., broken bone). Medical records of children between the ages of 2 and 5 years old were reviewed and screened based upon all eligibility criteria except caregiver weight status. Families of children who were preliminarily eligible were sent a letter signed by the pediatrician who saw the family at their last well-child visit. Enclosed in the letter were postcards families could mail to the pediatric office if they did not want to be contacted about the study. Families who did not return the postcard were contacted by the research team ten days after the mailing. The purpose of this call was to provide more details about the study and invite the family to participate. For families interested in participation, a phone screening was conducted on inclusion/exclusion criteria including a preliminary screen for caregiver weight status. Interested and preliminarily eligible families were scheduled for a home and clinic-based research visit, which included taking height and weight measures for preschoolers and caregivers to confirm eligibility, and the informed consent procedure. Caregivers provided written consent for their and their child's participation in the study. Full details of the recruitment flow are described in the publications detailing the main trial outcomes (Stark et al., 2014; Stark et al., 2011). Across iterations, 23 families were randomized to receive the LAUNCH program. Five families withdrew after randomization and four dropped out during treatment. Thirteen families had complete dietary recall data at the 6 and 12 month assessments and were included for analysis.

Intervention

Due to the focus of this secondary analysis, only treatment components specific to dietary changes are described below. Readers are referred to primary outcome papers for the preliminary (Boles et al., 2010) and first and second iteration pilot studies (Stark et al., 2014; Stark et al., 2011) for details on components of the program related to weight loss, physical activity, and sedentary activity.

LAUNCH is a 6-month, 18-session family-based behavioral obesity intervention developed based upon social cognitive theory (Bandura, 1991) and extant, empirically supported

weight control interventions for school-aged children (Epstein, Paluch, Roemmich, & Beecher, 2007). Families were seen weekly for the first 3 months and bi-weekly for the second 3 months, with sessions alternating between group visits conducted at an academic medical center and individual sessions conducted at the family's homes. During group visits, parents and children were seen separately but simultaneously. Dinner was provided during each group session. Parent groups were led by a licensed clinical psychologist or a pediatric psychology post-doctoral fellow. Child groups were conducted by pediatric psychology postdoctoral fellows and a research coordinator. Home-based sessions were led by pediatric psychology post-doctoral fellows.

Families were provided with dietary recommendations as outlined in Table 1, which were based upon the Expert Committee Prevention Plus Guidelines (Barlow, 2007), age- and sex-based daily calorie goals (Gidding et al., 2005), and a modified version of the Traffic Light Diet (Epstein & Squires, 1988) that focused on reducing intake of energy-dense foods (high in calories, fat, and sugar) and increasing intake of nutrient-dense foods (e.g., fruits, vegetables, etc.). Caregivers completed a daily diary of preschooler diet during each week of the intervention program and were provided with individualized feedback and recommendations based upon monitoring efforts. Child behavior management techniques (e.g., praise, ignoring, giving effective commands) were taught to aide parents in minimizing unique barriers to dietary modification for preschoolers like food neophobia (fear of trying new foods) and food-related tantrums (Birch & Fisher, 1998). Caregivers were also asked to implement vegetable taste-tests throughout the intervention, which included providing a structured opportunity each day for 14 days for the family to taste the same vegetable (Wardle, Cooke, et al., 2003). The intention of the vegetable taste tests was to maximize the likelihood that preschoolers received the minimum number of taste exposures necessary to develop a new taste preference (5–15 trials) for vegetables included in the taste tests (Caton et al., 2013; Sullivan & Birch, 1990; Wardle, Herrera, Cooke, & Gibson, 2003). Home-based sessions provided the opportunity to model and coach caregivers in use of behavior modification techniques and to actively engage families in use of stimulus control by rearranging the home food environment to support healthier dietary choices (e.g., “cabinet clean-outs” to remove high-calorie, high-fat foods and increase availability and visibility of lower energy dense, nutrient dense foods such as fruits and vegetables).

Measures

All measures were completed at each assessment except for the demographics questionnaire about preschooler and family sociodemographic characteristics (e.g., age and annual income), which parents completed at the baseline assessment only.

Anthropometrics.—Trained personnel blinded to participant treatment group obtained height and weight measurements for all preschoolers and caregivers using standard procedures (Cameron, 1986). Child BMI value (kg/m^2) was standardized in relation to the population mean and standard deviation for the child's age and gender was used to determine BMI z-score (Kuczmarski et al., 2000). Caregiver BMI was calculated as kg/m^2 .

24-Hour Dietary Recalls.—Trained dietitians blinded to participant treatment group allocation obtained three, 24-hour dietary recalls (two weekdays, one weekend day) from parents regarding preschooler dietary intake over a two-week time period using the multiple pass method. Multiple 24-hour dietary recalls are considered to be a valid and reliable measure of diet in preschoolers (Baranowski, Sprague, Baranowski, & Harrison, 1991; Guenther, DeMaio, Ingwersen, & Berline, 1995; Klesges, Klesges, Brown, & Frank, 1987). Dietary data were analyzed using the Nutrition Data Systems for Research (NDS-R) software (Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN, version 5.0). The HEI-2010 SAS macro available from the National Cancer Institutes (<https://epi.grants.cancer.gov/hei/sas-code.html>) was then applied to analyze NDS-R output files. The HEI-2010 score is derived from 12 components, including 9 adequacy components (total fruit, whole fruit, total vegetables, greens and beans, whole grains, dairy, total protein foods, seafood and plant proteins, and fatty acids) and 3 moderation components (refined grains, sodium, and empty calories) (Guenther et al., 2013; Guenther et al., 2014). Higher scores for each component represent better diet quality, with moderation components being reverse scored (e.g., higher score on empty calories reflects lower intake of empty calories). Each component score is summed to obtain the HEI total score which ranges from 0–100. According to Snetselaar (2015) scores 50 reflect a “poor” diet, scores 51–79 reflect a diet that “needs improvement,” and scores 80 reflect a “good” diet (Snetselaar, 2015). The HEI-2010 is appropriate for use with individuals who are at least two years of age. As noted previously, HEI-2010 analyses for this secondary analysis include six adequacy subscales (total fruit, whole fruit, total vegetables, beans and greens, whole grains, and fatty acids) and all moderation subscales.

Data Analysis

Separate one-way repeated measures analyses of variance (RM-ANOVA) were conducted to explore changes in the total HEI-2010 score and each HEI-2010 subscale score from baseline to 6 months and baseline to 12 months. Holm’s sequential approach was applied to correct for multiple comparisons within analyses of the HEI subscales consistent with LAUNCH dietary recommendations (non-exploratory analyses) only. Post-hoc comparisons were run for RM-ANOVA tests that reached statistical significance ($p < .05$). Estimates of effect sizes are reported as partial eta squared (η^2). Bivariate correlation analyses were conducted to examine the association of changes in preschooler BMI z-score (BMIz) and overall dietary quality at 6 and 12 months. All analyses were completed using SPSS Statistics version 24 (Armonk, NY: IBM Corp.).

RESULTS

Baseline sociodemographic characteristics for the sample are described in Table 2. Descriptive data for the HEI-2010 total and each subscale score and summary statistics for RM-ANOVAs using these scales are presented by time point in Table 3. Neither the HEI total nor any of the subscale scores differed by preschooler sex or minority status and were not associated with preschooler BMIz or age at baseline.

Overall Dietary Quality.

RM-ANOVA revealed a significant time effect for the HEI-2010 total score ($F_{2,24}=5.42$, $p=.01$, $\eta^2=0.31$), with post-hoc comparisons indicating a significant improvement in overall dietary quality from baseline to 12 months ($p<.01$, CI: -17.84 – -4.81). Despite this improvement, HEI total score for the majority of preschoolers (77%, see Table 3) remained in the “Needs Improvement” range (between 51–79) at 12 months. Change in the HEI total score was not associated with change in BMIz from baseline to 6 months ($r=0.34$, $p=0.26$) or baseline to 12 months ($r=0.17$, $p=0.58$).

HEI-2010 Subscales Consistent with LAUNCH recommendations.

A significant time effect was observed for empty calories ($F_{2,24}=11.27$, $p<.001$, $\eta^2=0.48$). Similar to the HEI total score, post-hoc comparisons indicated a significant improvement in this subscale score from baseline to 12 months only ($p<.001$, CI: -6.02 – -2.46), suggesting preschoolers consumed significantly fewer empty calories per day at 12 months compared to baseline. Time effects were not observed for changes in total fruit, whole fruit, total vegetables, refined grains, or whole grains.

Exploratory HEI-2010 Subscales.

RM-ANOVA revealed a significant time effect for the fatty acids ($F_{2,24}=3.80$, $p<.05$, $\eta^2=0.24$) subscale. Post-hoc comparisons indicated a significant improvement from baseline to 12 months ($p<.05$, CI: -4.27 to -0.51), suggesting preschoolers consumed significantly more fatty acids per day at 12 months compared to baseline. A significant time effect was also observed for the sodium subscale ($F_{2,24}=4.89$, $p<.05$, $\eta^2=0.29$). Post-hoc comparisons revealed a significant worsening in this score from baseline to 12 months ($p=.01$, CI: 0.89 – 5.52), suggesting preschoolers consumed significantly more sodium per day at 12 months compared to baseline. Time effects were not observed for changes in beans and greens subscale.

DISCUSSION

The preschool years are an ideal and critical time to establish healthy dietary habits given their persistence into adulthood. The Dietary Guidelines for Americans are a translation of current scientific evidence to food-based guidance to help Americans choose a nutritionally adequate diet (U.S. Department of Health and Human Services U.S. Department of Agriculture, 2015). Epidemiological data indicate preschooler adherence to the Dietary Guidelines for Americans is $<50\%$ (Ford et al., 2017), suggesting a far from optimal diet in terms of the nutrient quality necessary to support healthy growth and development. Outcomes of the current study expand this literature by providing some of the first data on adherence to the Dietary Guidelines for Americans for preschoolers with obesity and the impact of a preschool obesity intervention on improving dietary quality. Preschoolers who received the LAUNCH program experienced a significant, 10-point improvement in HEI total score from baseline to month 12, which suggests an overall improvement in dietary quality and adherence to the Dietary Guidelines for Americans. Improvements in overall dietary quality were primarily driven by improvements on the empty calorie and fatty acid subscales, and thus by preschoolers decreasing their intake of empty calories and added fats

and consuming more “good” than “bad” fats. However, despite these positive changes, dietary quality for the majority of preschoolers remained in the “needs improvement” range at 6 and 12 months (Snetselaar, 2015). Improvements in dietary quality were also not associated with reductions in weight status, indicating children may have reduced consumption overall facilitating weight loss, but nutrient-dense foods were not necessarily replacing energy-dense foods.

LAUNCH is a 6-month, family-based intervention that targets obesity reduction in preschoolers. A key component of LAUNCH is teaching caregivers behavior change (e.g., goal setting and monitoring) and child management strategies (e.g., positive praise, ignoring, and giving effective commands) to address challenging behaviors like food refusal and food-related tantrums that often serve as barriers to dietary modification, and consumption of healthful foods in particular, for this age-group. Our hypotheses that this treatment package would yield significant improvements in overall dietary quality for preschoolers participating in LAUNCH were partially supported. While we hypothesized that the HEI-2010 total score would improve from baseline to post-treatment (6 months), our data indicate this change was more gradual, with the improvement not reaching statistical significance until 6 months post-treatment. The finding that the HEI-2010 total score significantly improved 6 months following treatment is encouraging as it suggests families continued efforts to improve preschooler dietary quality in the absence of active intervention.

Our hypotheses about improvements to the HEI-2010 subscales that are consistent with LAUNCH dietary recommendations were partially supported. Specifically, scores on the whole fruit, total vegetable, and whole grain subscales improved from baseline to 6 month and baseline to 12 months, suggesting better adherence to the Dietary Guidelines for Americans for these food groups; however, changes did not reach statistical significance. Improvements were also observed for the empty calories subscale from baseline to both time points, suggesting preschoolers decreased their empty calorie consumption and thus increased adherence to DGA for this macronutrient. However, improvements only achieved statistical significance from baseline to 12 months. Our finding that preschoolers consumed a smaller portion of their daily calories from added sugars and fats following LAUNCH participation is positive given energy-dense foods and beverages are a major source of calories in the diets of American children (Slining et al., 2013). This change also suggests the combination of tailored feedback on diet monitoring, strategies to specifically target decreasing availability of energy-dense foods (e.g., removal from the home food environment or rearranging so less visible to preschoolers), and skills for managing negative behaviors that may appear when families implemented these changes (e.g., ignoring) included in the LAUNCH program may have been helpful to families achieve this dietary modification. While inclusion of the vegetable taste tests (Wardle, Cooke, et al., 2003) may have facilitated the 1.5-point increase observed from baseline to 12 months for the total vegetable subscale, further improvement on this scale requires diversity in the types of vegetables preschoolers consume. Providing caregivers with strategies for increasing preschooler intake of a larger variety of vegetables may be necessary to achieve further improvements on the total vegetable subscale score.

In contrast to our hypotheses, little change was observed for the total fruit and refined grain subscale scores. One hundred percent fruit juice is the primary food differentiating the total fruit and whole fruit subscale scores. LAUNCH families were provided with the recommendation to serve no more than 6 fluid ounces of fruit juice daily, and educated that whole fruit was a better choice due to more nutrients and fewer calories (Nutrition, 2001). Given the 1-point increase observed for the whole fruit subscale at 12 months, the slight reduction in the total fruit subscale suggests additional strategies may be necessary to help LAUNCH families reduce preschooler fruit juice intake and increase overall whole fruit intake. The lack of change on the refined grains scale score was surprising given this food group was heavily targeted for reduction in tailored feedback on dietary monitoring efforts and in-home stimulus control exercises (e.g., cabinet clean-outs). Improvements in whole grain intake were also minimal given the score for this subscale at 12 months was less than half of the total points possible. Grains are a component of many of the top foods and snacks consumed by preschoolers (e.g., pizza, grain-based desserts, pasta) and whole grain choices for these preferred foods are available. In order to best help families with substituting nutrient-dense for energy-dense grains, more research is needed to determine whether preschoolers refused whole grain foods or whether whole grains were not offered, or both.

Within the exploratory HEI-2010 subscales, the observation that the sodium subscale decreased significantly from baseline to 12 months (suggesting a significant increase in preschooler sodium intake) was surprising and an unintended, negative change. Excess sodium intake is problematic due to its association with cardiovascular (CVD) diseases. While CVD is typically not diagnosed until adulthood, dietary patterns associated with CVD risk are established during the preschool years, and current estimates suggest 93–94% of preschoolers in the United States exceed daily recommendations for sodium intake (Jackson, King, Zhao, & Cogswell, 2016). Sodium intake was not specifically targeted in LAUNCH, but several dietary recommendations encouraged decreases in foods that often are high in sodium. For example, families were encouraged to eat out no more than once per week, reduce high calorie snacks that are often high in salt (e.g., chips), and to cook using fresh or frozen instead of canned vegetables.

This secondary data analysis provides some of the first data on the impact of pediatric behavioral weight control interventions on dietary quality for preschoolers. Despite several positive findings, this study is not without limitations. Data analyzed were collected across two pilot studies. The small size of our sample increases the possibility of Type II error. As such, replication with a larger sample is thus necessary to make stronger conclusions about the statistical significance of dietary changes preschoolers achieve through LAUNCH participation. Replication with a larger sample is thus necessary to make stronger conclusions about dietary changes preschoolers achieve through LAUNCH participation. Further, extending the follow-up period is important to more fully understand the stability of dietary changes. Due to a small, homogenous sample, generalizability of findings is an additional limitation. LAUNCH is an intensive intervention, and thus there may be challenges to its implementation in real-world treatment settings. Given the superiority of intensive, multi-component obesity interventions in yielding significant and sustained improvements to preschoolers (Colquitt et al., 2016) and school-aged children (Mead et al., 2017), efforts are underway to examine strategies for improving access to this type of

evidence-based care (Wilfley et al., 2017). Finally, our attrition rate of 39%, while similar to other family-based behavioral interventions (e.g., <46%; Sung-Chan, Sung, Zhao, & Brownson, 2013) and hospital-based treatment programs (27–50%; Skelton, Irby, & Geiger, 2014), is also a limitation to the generalization of the study.

IMPLICATIONS FOR RESEARCH AND PRACTICE

Modification of the types of foods preschoolers consume to improve dietary quality is challenging but necessary for promoting optimal growth, development, and minimizing long-term risk for chronic health conditions like cardiovascular disease and cancer (Expert Panel on Integrated Guidelines for Cardiovascular, Risk Reduction in, Adolescents, National Heart, & Blood, 2011; Kushi et al., 2012). Findings from this secondary analysis, while preliminary, suggest that the combination of nutrition education, parenting, and child management strategies within a weight management program improves weight outcomes and yields some positive changes in overall dietary quality. However, the lack of significant improvements in adherence to dietary guidelines for key foods groups including fruits, vegetables, and whole grains indicates the need for more specific strategies to enact changes in these dietary categories. Future research is needed to identify strategies that yield obesity reduction by achieving a healthier diet for preschoolers.

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Table 1

Comparison of LAUNCH dietary recommendations to Dietary Guidelines for Americans^a and the Healthy Eating Index-2010^b

	LAUNCH Dietary Recommendation	Dietary Guidelines for Americans for 1,000–1,400 calorie diet ^a	Healthy Eating Index-2010 Categories
Fruit	Fresh, frozen, and canned (if <6 grams sugar per serving); 100% fruit juice Goal: 2 servings ^c and 4–6oz 100% fruit juice daily	Fresh, frozen, canned, dried fruit; fruit juice Goal: 1 cup daily	Total Fruit ^d Whole Fruit ^e
Vegetables	Fresh, frozen, and canned; limit starchy vegetable (e.g., peas Goal: 3 servings ^a)	All cooked or raw fresh, frozen, and canned vegetables; cooked beans and peas Goal: 1–1.5 cups daily	Total vegetables
Grains	Serve whole grain products; 6 gramssugar per serving	All whole-grain products and whole grains used as ingredients (e.g., rice) Goal: 1.5–2.5 ounces daily	Whole grains
Empty Calories	Moderation: sweet/salty snacks, desserts Limit sugar-sweetened beverage intake	Calories from solid fats and sugars	Empty Calories

^aU.S. Department of Agriculture (2010);

^bGuenther et al., 2013, 2014

^c1 serving=1/2 cup;

^dincludes 100% fruit juice

^eexcludes 100% fruit juice

Table 2

Baseline Sociodemographic Characteristics of Participants [Mean±SD (range) or n(%)]

Preschooler	
Age (years)	4.90±1.12 (2.33–5.99)
Female	7 (54%)
White/Caucasian	11 (85%)
BMI percentile	98.39±1.23 (95.69–99.83)
BMI z-score	2.26±0.37 (1.72–2.94)
Caregiver	
Age (years)	35.77±4.97 (27–44)
Female	11 (85%)
Married	12 (92%)
>High School Education	11 (85%)
BMI	32.30±3.49 (25.33–39.53)
Family	
Annual Income >\$50,000	12 (100%)*

* Data on annual income was provided for 12 of 13 families included in the analyses

Table 3
Healthy Eating Index-2010^a Total and Subscale Scores Across Time Mean (SD)

	HEI-2010					
	Score Range	Baseline	6-Months	12-Months		
HEI Total	0–100	54.06(13.39)	58.67(10.23)	64.21(11.44) ^{**}		
Good	80	-	-	7.7%(1)		
Needs Improvement	51–79	61.5%(8)	69.2%(9)	76.9%(10)		
Poor	50	38.5%(5)	30.8%(4)	15.4%(2)		
<i>Adequacy subscales^c</i>						
Total Fruit	0–5	3.35(1.93)	3.28(1.72)	3.28(1.72)		
Whole Fruit	0–5	3.10(1.97)	3.88(1.68)	4.04(1.41)		
Total Vegetable	0–5	2.44(1.69)	3.19(1.94)	3.76(1.76)		
Beans/Greens	0–5	1.03(1.80)	1.32(1.86)	0.56(1.18)		
Whole Grain	0–10	3.81(4.02)	4.05(2.95)	4.78(3.64)		
Fatty Acids	0–10	2.98(2.15)	3.57(2.69)	5.50(1.98) [*]		
<i>Moderation subscales^d</i>						
Sodium	0–10	5.59(3.05)	3.99(3.49)	2.27(2.20) [*]		
Refined Grains	0–10	6.00(2.76)	5.32(3.50)	5.80(3.29)		
Empty Calories ^a	0–20	12.52(4.26)	15.15(3.57)	16.92(2.59) ^{***}		

^aGuenther et al., 2013, 2014;

^bEmpty Calories=calories from added fats, alcohol, and added sugars;

^cHigher scores reflect increased consumption of food groups/nutrients and higher adherence to DGA;

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Higher scores reflect decreased consumption of food groups/nutrients and higher adherence to DGA

Change from baseline to 12-months significant at

$p < .05$
*
 $p < .01$
**
 $p < .001$