

Promoting Healthy Weight Among Children With Developmental Delays

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Abstract

An extensive body of research demonstrates a higher prevalence of obesity among children with developmental delays (DD) versus children without delays. This analysis examined the effectiveness of a randomized controlled trial to promote healthy weight in a subsample of preschool-age children with DD ($n = 71$) on the adoption of quality nutrition and increased physical activity habits versus controls. Child care centers ($N = 28$) randomized to the intervention group received a multilevel (parent, teacher, child) role modeling program and curriculum on obesity prevention. Results showed that children in the intervention group slightly decreased their junk food consumption while the control group increased their junk food consumption. In addition, among preschool-age children with DD, change in parent fruit and vegetable consumption significantly influenced change in their child's consumption. Conversely, the greater the consumption of junk food by parents, the greater consumption by their children. Results imply that preschool-age children with DD may benefit from child care center-based healthy weight programs.

Keywords

obesity prevention, young children, disabilities, preschoolers, special needs

Introduction

Youth with developmental delays (DD) and disabilities comprise 13% of school-age children in the United States (U.S. Department of Education, National Center for Education Statistics, 2013). Research consistently shows that children with special health care needs and psychiatric disorders, particularly autism spectrum disorder (ASD), attention deficit hyperactivity disorder (ADHD), and learning disabilities (Chen, Kim, Houtrow, & Newacheck, 2010; De, Small, & Baur, 2008), have higher rates of obesity versus children without disabilities. For example, among youth aged 12 to 18 years old, the prevalence of overweight and obesity was 42.5% among those with ASD, and 55% among those with Down syndrome, compared with 28.8% among youth without delays (Rimmer, Yamaki, Lowry, Wang, & Vogel, 2010).

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Current studies report that children with DD may have a higher propensity to become obese or overweight due to particular food preferences and restricted diets (Curtin, Anderson, Must, & Bandini, 2010). For example, children with ASD have been found to eat fewer vegetables, salads, and fresh fruits (Edmond, Emmett, Steer, & Golding, 2010). In addition, in a Canadian sample of children diagnosed with autism, a higher consumption of carbohydrate based foods and lower consumption of fat were found among these children when compared with children without autism (Ho, Eaves, & Peabody, 1997). Patterns of physical activity were also reported related to obesity and weight in youth with disabilities as a result of physical and sensory limitations, as well as cognitive impairments (Rimmer & Marques, 2012). Yet, limited research exists on the prevention and treatment of overweight and obesity among children with delays/disabilities and other special health care needs, especially very young children.

Review of the Literature

Obesity is not something children “grow out of.” In fact, preschool-age children who are overweight are 4 times as likely to be obese adults when compared with their normal weight counterparts (Ong et al., 2009; U.S. Center for Disease Control, National Center for Chronic Disease Prevention and Health Promotion, Division of Nutrition, Physical Activity, and Obesity, 2006). Research also shows that children who have excessive weight gain in the first years of life can alter developing neural, metabolic, and behavioral systems in ways that increase the risk of obesity and chronic disease later in life (Birch & Anzman, 2010; Gluckman, Hanson, Cooper, & Thornburg, 2008). Childhood obesity is a precursor to type 2 diabetes, cardiovascular disease, hypertension, stroke, osteoarthritis, asthma, and certain cancers (Birch & Anzman, 2010; Gluckman et al., 2008). In addition, Rimmer et al. (2010) found that chronic and secondary conditions associated with obesity in youths with intellectual disability have the potential to undermine physical independence and community participation.

Child care centers present an ideal setting for an obesity prevention intervention because they provide an opportunity to modify most risk factors for childhood-onset obesity including increased physical activity, provision of healthy nutrition, healthy lifestyle education, and decreased screen time. Hip-Hop to Health Jr., a 14-week intervention that incorporated a physical activity and healthy eating curriculum for preschool children and a parent component consisting of weekly newsletters and homework assignments (Fitzgibbon, Stolley, Dyer, VanHorn, & KauferChristoffel, 2002), was found to have positive intervention results in children’s weight. While most published models of preschool child obesity prevention have developed behavior modification curricula targeting parents alone (Harvey-Berino & Rourke, 2003; McGarvey et al., 2004) or children alone (Dennison, Russo, Burdick, & Jenkins, 2004; Mo-suwan, Pongprapai, Junjana, & Puetpaiboon, 1998), some have included both a parent component and a child curriculum (Fitzgibbon et al., 2002; Stolley et al., 2003).

The family and home environment are also important in shaping the dietary patterns of children with and without DD. If home practices are unhealthy, it can put young children at risk of obesity because they depend on adults for their nutritional needs (Lindsay, Sussner, Kim, & Gortmaker, 2006). Young children learn by observing the behavior of the important adults in their lives, and if their caregiver enjoys a particular food, a young child is likely to view that food as a safe and nutritious choice to try for themselves. Caregivers have an effect on the nutritional habits of the children under their care not only by making choices regarding the types of foods that are available but also by influencing children’s attitudes and beliefs about that food. The U.S. Department of Agriculture’s (USDA) concept of the “nutritional gatekeeper” suggests that the person buying and serving the food has a powerful effect on the child’s outcomes (USDA: Center for Nutrition Policy and Promotion [CNPP], 2008). The Project M.O.M campaign further suggests that empowering the nutritional gatekeepers in both the home and the child care center will

potentiate a lasting and effective impact on the health and nutrition of future adults (young children in child care centers; USDA: CNPP, 2008). Even at a young age, children are able to benefit from information regarding healthy lifestyle choices and often repeat this information to their caregivers, thereby reinforcing behavioral change in both children and adults (Natale, Lopez-Mitnik, Uhlhorn, Asfour, & Messiah, 2014; Natale, Messiah, et al., 2014). Thus, utilizing the nutritional gatekeeper within a child care setting can have powerful effects on obesity prevention.

The Healthy Caregivers–Healthy Children (HC2) is an obesity prevention program for preschool children that highlights the importance of the nutritional gatekeeper and parents as role models. HC2 was a randomized controlled intervention trial of an obesity prevention program (Clinical Trial No. NCT01722032) to examine the effect of the intervention program on healthy weight maintenance of children 2 to 5 years old, enrolled in 28 subsidized child care centers in Miami-Dade County, Florida, from 2010 to 2013. The purpose of the study was to assess the effectiveness of a child care center–based parent and teacher healthy lifestyle role modeling program on child nutrition and physical activity outcomes. The development of HC2 was guided by social cognitive theory (SCT; Bandura, 1986), which states that children learn new behaviors by observing and imitating models such as parents, teachers, and peers. Specifically, the theoretical underpinnings selected from SCT include expectancies (the values and benefits placed on a particular outcome), self-control and performance (decisions made to achieve self-control), behavior capability/knowledge/skills acquisition to perform that behavior, environment and situation (actual and perceived), observational learning, and self-efficacy for specific behaviors.

In the original HC2 study, it was found that intervention parents' baseline ($\beta = .52, p < .0001$) and school year consumption ($\beta = .47, p < .0001$) of fruits/vegetables significantly increased their children's consumption of fruits/vegetables from T1 to T2. Intervention parents significantly influenced a decrease in children's junk food (JF) consumption ($\beta = -.04, p = .04$), while control parents significantly influenced an increase in their children's JF consumption ($\beta = .60, p < .001$) from T1 to T2. Control children showed a significant increase in JF consumption ($\beta = .11, p = .01$) and sedentary behavior ($\beta = .09, p = .003$) from T1 to T2, thus concluding that parent nutrition and physical activity patterns significantly influence their preschool-age children's consumption of fruits/vegetables, JF, and level of sedentary behavior (Natale, Messiah, et al., 2014).

The purpose of this article is to report the effectiveness of the HC2 program on preschool children with or at risk of a DD as a subanalysis of the full HC2 data set. In particular, we examined the impact of the intervention on the adoption of quality nutrition and screen time habits for children with DD over 1 school year. In addition, we were interested in the role of parents' behaviors and their influence on outcomes for children with DD related to increasing fruit and vegetable (FV) intake, decreasing JF, and limiting screen time.

Method

Study Design

The HC2 program was developed as a randomized controlled trial examining healthy weight maintenance of children 2 to 5 years old, enrolled in 28 subsidized child care centers. Twelve centers randomized to the intervention group received onsite training and technical assistance related to a nutrition-based curriculum and 16 centers were randomized to a control group, which received similar levels of training and technical assistance with a safety curriculum. This study protocol was reviewed and approved by the University of Miami Institutional Review Board. Each child's parent or legal guardian provided informed consent. Results reported here are from the beginning to the end of the 2010–2011 school year. Details of the protocol can be found elsewhere (Natale, Messiah, et al., 2014; Natale et al., 2013).

Participants

Selection criteria used to determine child care center eligibility were based on the following: (a) more than thirty 2- to 5-year-olds attending the center, (b) ethnicity reflective of Miami-Dade county population, (c) serve low-income families, and (d) center director agreement to participate. An average of 70% of families with children 2 to 5 years old across centers participated in the project.

A total of 980 parents of 1,211 children enrolled in one of 28 child care centers consented to participate in this study. Of the 1,211 children, 103 were identified by parent report as having a DD. The data presented here are on the assessments of 71 participants who were available at pre- and posttest. There were 21 children in the control group and 50 in the intervention group. To determine whether the child had a DD, parents were asked, "Is your child physically or mentally challenged in any way in his or her ability to do the things most children of the same age do?" The majority of the children had a speech/language delay, followed by behavioral concerns and, to a lesser degree, gross motor delays.

Table 1 reports the demographic characteristics of the study sample by treatment condition. With the exception of child age (children in the control centers were significantly younger than intervention center children by 13 months) and birthplace of the caregiver (intervention center parents were more likely to be foreign born vs. control center parents), there were no baseline demographic or anthropometric differences between intervention and control participants. A total of 50 children with DD who attended one of 12 intervention centers (range = 1-17 children with a DD per center) and a total of 21 children (range = 1-3 children) who attended one of 10 control centers participated in the study. Because the main HC2 study was not exclusively targeting children with DD, this substudy and post hoc analysis includes 22 centers of the original 28 centers, as the other six did not have any children with DD who participated.

Among the children with DD, a slight majority were male (56%) and their mean age was approximately 45 months. The majority of the sample was Cuban (38%), followed by "other" Hispanic (27%) and Haitian (27%). Other ethnicities in the sample included other non-Hispanic Black (7%) and non-Hispanic White (1%). Caregivers who filled out the survey were predominantly mothers (79%) and were born outside of the United States (64%). Most of the sample had languages other than English that were common in the home, with only 24% speaking English only. In addition, the majority of the caregivers had completed high school or GED (54%) or had less than a 12th-grade education (45%).

Procedure

Parent and teacher role modeling. The core of the intervention was the development of a parent and teacher role modeling training curriculum adapted from Project M.O.M (Wasnick, 2008) and Team Nutrition (Levine et al., 2002) regarding messaging on the importance of nutritional gatekeepers. The primary activity was a monthly educational meeting in which nutrition and physical activity were discussed. Key messages were reinforced with monthly newsletters and at-home activities. These trainings were a particularly important piece of the program as the nutritional gatekeeper (i.e., the person buying and supplying food for the children) must engage in healthy lifestyle behaviors and beliefs themselves for childhood obesity prevention programs to achieve long-term success (Campbell & Crawford, 2001; Wilson, Musham, & McLellan, 2004). For young children, the nutritional gatekeeper is most likely the parent, and for those who attend child care, the teachers and center staff. Therefore, the research staff implemented an integrated curriculum with teachers and parents at the child care center. Via role modeling, parents and teachers were encouraged to implement change at the family and center level, rather than the child level.

Table 1. Demographic Characteristics of Control Group and Intervention Children in Healthy Caregivers–Healthy Children.

Characteristic	Children with disabilities (<i>n</i> = 71)	Intervention group (<i>n</i> = 50)	Control group (<i>n</i> = 21)
Sex of child			
Female	31 (44%)	23 (46%)	8 (40%)
Male	39 (56%)	27 (54%)	12 (60%)
Race of child			
Hispanic-Cubans	27 (38%)	19 (38%)	8 (38%)
Other Hispanics	19 (27%)	14 (28%)	5 (24%)
Non-Hispanic Blacks-Haitians	19 (27%)	12 (24%)	7 (33%)
Other non-Hispanic Blacks	5 (7%)	4 (8%)	1 (5%)
Non-Hispanic Whites	1 (1%)	1 (2%)	0 (0%)
Other	0 (0%)	0 (0%)	0 (0%)
Age of child (<i>M</i> months)	45.39 (11.99)	49.18 (7.69)	35.90 (15.40)*
Survey respondent relationship to child			
Mother	56 (80%)	37 (76%)	19 (90%)
Father	13 (19%)	11 (22%)	2 (10%)
Other	1 (1%)	1 (2%)	0 (0%)
Languages spoken in the home			
English only	17 (24%)	10 (20%)	7 (33%)
Spanish only	9 (13%)	6 (12%)	3 (14%)
Creole only	2 (3%)	1 (2%)	1 (5%)
English and Spanish	19 (27%)	15 (30%)	4 (19%)
English and Creole	20 (29%)	15 (30%)	5 (24%)
Other	3 (4%)	2 (4%)	1 (5%)
Caregiver level of education			
Less than 12th grade	31 (45%)	25 (51%)	5 (26%)
Completed high school or GED	37 (54%)	23 (47%)	14 (74%)
Completed education beyond high school	1 (1%)	1 (2%)	0 (0%)
Birthplace of caregiver			
U.S. born	25 (37%)	12 (25%)	13 (65%)**
Foreign born	43(63%)	36 (75%)	7 (35%)
Percentile for age			
PBMI at baseline	62.72 (29.12)	65.08 (29.54)	55.18 (27.32)
PBMI at 6 months	63.75 (28.76)	69.03 (26.39)	51.72 (31.02)
PBMI category			
Normal weight (PBMI < 5) at baseline	45 (71%)	31 (65%)	14 (93%)
Overweight (PBMI ≥ 85 and < 95) at baseline	13 (21%)	12 (25%)	1 (7%)
Obese (PBMI ≥ 95) at baseline	5 (8%)	5 (10%)	0 (0%)
Normal weight (PBMI < 85) at 6 months	42 (71%)	27 (66%)	15 (83%)
Overweight (PBMI ≥ 85 and < 95) at 6 months	8 (14%)	6 (15%)	2 (11%)
Obese (PBMI ≥ 95) at 6 months	9 (15%)	8 (19%)	1 (6%)

Note. PBMI = percent body mass index. GED= General Educaiton Diploma.

*Age of child was statistically different between control and intervention ($p < .001$). **Birthplace of caregiver statistically different between control and intervention ($p < .002$).

The classroom curriculum. The classroom-based curriculum consisted of 20 weekly sessions that were delivered to the teachers by the trained program staff during weekly visits. During these weekly visits, the program staff addressed menu changes and targeted the cognitive, cultural, and environmental barriers to a low-fat, high-fiber diet that included more fruits and vegetables. These weekly visits were designed to assist center staff in problem-solving ways to ensure implementation.

Center-based policies. Center-based policies were implemented to increase healthy eating and physical activity among staff and children. A nutritionist worked with each child care center to ensure that the USDA nutritional requirements were met and modifications were made to the centers' daily menus with equal cost as prior food purchases, while lowering the daily consumption of saturated fats and trans-fatty acids. The beverage policy promoted water as the primary beverage, did not allow juice or sweetened beverages more than 1 time per week, and changed whole milk to 1% milk on the menu. The snack policy promoted fresh fruit and/or vegetables as a substitute for cookies and other high lipid snacks. The physical activity policy promoted child physical activity at least 1 hr per day and screen time less than 2 hr per week. Research staff provided weekly technical assistance to ensure the implementation of the policies, with an emphasis on cultural barriers to implementing healthy nutrition and increasing physical activity among children.

Control Group

Given this was a randomized controlled trial of 28 centers, the control group centers consisted of children from the same community, of the same background, and of the same cultural diversity as the intervention centers. Schools randomized to the control group received a safety curriculum delivered by character "Safety Sam," which provided parents and teachers with home, car, and child seat safety information. They received all the same pre-post measures as the centers in the intervention group. They also received the same incentives as the intervention group to foster involvement and ensure retention/reduce loss to follow up. The safety curriculum was conducted 3 times during the 2010-2011 school year.

Measures

Assessment of demographic variables, anthropometrics, and parent perception were performed. All measures that were not available in Spanish were translated and back translated into English by five translators native to various countries (from Cuba, Dominican Republic, Venezuela, Nicaragua, Puerto Rico) and thus were familiar with the local vernacular of their country. Thirty-five percent of the entire sample were primarily Spanish-speaking and thus completed the measures in Spanish; 65% were primarily English-speaking and completed the measures in English. All measures were administered at the beginning of the school year (pre-intervention, T1) and then 6 months later at the end of the intervention (T2).

Child outcome measures

Anthropometrics. Assessment of body composition included height (by stadiometer) and weight (by digital scale), which was converted to body mass index (BMI; weight in kilograms/height in meters squared) and then to a BMI age- and sex-adjusted BMI percentile and z score (Kuczmarski et al., 2002). Trained research staff asked the children to remove their shoes and any heavy outer clothing prior to measurement and measured weight and height measurements based on U.S. Department of Health and Human Services (HHS; 2008) guidelines for accurate

anthropomorphic measurement (Growth Charts Training). Staff utilized research grade stadiometers and scales and were responsible for taking scales from site to site.

Nutrition and physical activity measures. Child measures included consumption of fruit/vegetables, consumption of JF, and sedentary behavior. These measures were based on questions from the Healthy Kids Checklist, a 32-item rating scale that measures nutrition behaviors and screen time habits at home of both the parent and child (Banna & Townsend, 2011; Townsend & Kaiser, 2007; Townsend, Kaiser, Allen, Joy, & Murphy, 2003). The consumption of fruit/vegetables was measured using five survey questions from the Healthy Kids Checklist, such as “my child eats fruit” and “my child eats __ vegetables at his main meal.” The consumption of JF was measured using eight survey questions, such as “my child eats fast food __ times a week,” “my child drinks soda or sugared drinks with meals,” and “my child eats chips for snacks __ times a day.” Sedentary behavior was measured using four survey questions, such as “my child watches TV __ hours a day” and “my child plays video or computer games __ hours a day.” Items for this measure were selected based on research conducted by Ontai, Ritchie, Williams, Young, and Townsend (2009) as well as Townsend, Young, Ontai, Ritchie, and Williams (2009). The parents reported on the child’s behavior and their own behaviors.

Parent outcome measures

Nutrition measures. Items from the *Fruit and Vegetable Inventory* (Townsend & Kaiser, 2007) were utilized to measure food and vegetable consumption among caregivers. The *Fruit and Vegetable Inventory* contains 13 psychosocial items related to FV intake and the following six constructs: perceived control, self-efficacy for eating healthier, readiness to eat more fruits and vegetables, and perceived diet quality. The measure has been shown to be both a valid and reliable measure and has been field tested in low-income communities (Townsend & Kaiser, 2005; Townsend & Kaiser, 2007). This was administered to the parents and measured their own personal behaviors.

Procedure

Research staff recruited parents at the child care centers. Staff approached the parents during drop off and/or pick up times. Consent forms were attached to the interview packets and parent data were collected during the initial visit. Once consent forms were collected, the research assistants returned to the center within 2 weeks to collect each child’s height and weight. All five research assistants had a master’s degree or were working toward a master’s degree in psychology, were currently employed by the University, and had been trained on how to collect nutrition and physical fitness data through previous projects. Training on interview administration and anthropometric (i.e., BMI) data collection occurred through 2-hr seminars across 3 days consisting of lecture, demonstration, and practice, as well as in vivo observation of interview techniques and ongoing supervision.

Statistical Analyses

Factor scores for children and parents were created using a confirmatory factor analysis with the resulting scores having a mean of zero and a standard deviation of one. These were based on responses to food behavior and sedentary behavior survey questions. Consumption of fruits/vegetables, consumption of JF, and sedentary behavior factors were created for children and consumption of fruits/vegetables and consumption of JF were created for parents. As can be seen in Table 2, all of the factor loadings were positive, indicating that a higher response was

Table 2. Factor Analysis Loading Scores for Nutrition and Physical Activity Items, Healthy Caregivers–Healthy Children.

Item	Child factor loading ^a	Parent/teacher factor loading ^a
Consumption of fruits/vegetables		
Eat vegetables	0.799	0.774
Eat multiple vegetables/day	0.818	0.861
Eat fruits	0.786	0.711
Eat vegetables with main meal	0.702	0.749
Eat fruit for snacks	0.684	0.781
Model fit—CFI	0.967	0.949
Composite reliability	0.872	0.872
Consumption of junk food		
Eat fried foods/times per week	0.573	
Drink sports drinks/times per day	0.602	0.498
Eat fast food/times per week	0.607	
Eat chips for snack/times per day	0.713	
Drink soda/times per day	0.736	0.437
Eat junk food (e.g., candy, cookies)	0.718	
Eat snacks/per day that are junk food	0.711	0.655
Drink soda with meals/times per day	0.712	
Drinks citrus or fruit juice		0.690
Model fit—CFI	0.953	0.917
Composite reliability	0.869	0.662
Sedentary behavior		
Watch TV/hours per day	0.757	
Videogames/hours per day	0.614	
Watch TV during meals	0.576	
Have TV in bedroom	0.559	
Model fit—CFI	0.994	
Composite reliability	0.723	

Note. CFI = comparative fit index.

^aReported value represents the correlation between the item and the factor score.

positively correlated with a higher factor value. Factor analysis was conducted using Mplus (version 7) and full information maximum likelihood was used for missing values.

The children's factor scores were then used as the outcome variable in three general linear mixed models to determine the impact of the intervention on the change from T1 (baseline or beginning of the 2010-2011 school year) to T2 (end of the 2010-2011 school year). For the consumption of fruits/vegetables factor, there were differences at baseline between the treatment and control group, so change scores from T1 to T2 were used as the outcome measure with group (intervention or control) as the main predictor and baseline consumption of fruits/vegetables included as a covariate. For consumption of JF and sedentary behavior factors, the main predictors of interest were group (intervention or control), visit (T1 or T2), and the interaction between group and visit. Model estimated means were calculated for the difference in the intervention group from T1 to T2, the difference in the control group from T1 to T2, and the differences between the treatment and control group.

For the models with the consumption of fruits/vegetables and the consumption of JF as the outcome, an additional mixed model was run including the corresponding parent factor scores nested within intervention group. These models were used to assess the impact of parent factor scores on child factor scores.

Table 3. Child Consumption of Fruits/Vegetables Factor Score as Outcome.

Variable	Fruit/veggies Only child factors (n = 71)		Fruit/veggies Including parent factors (n = 71)	
	β coefficient (SE)	p value	β coefficient (SE)	p value
Intercept	-.37 (0.85)	.67	-.06 (0.71)	.94
Group (intervention)	.17 (0.32)	.60	.05 (0.21)	.80
Baseline child factor score	-.57 (0.14)	<.001	-.55 (0.15)	<.001
Child gender (male)	.005 (0.19)	.98	.06 (0.18)	.73
Age in months	.004 (0.01)	.69	.002 (0.008)	.79
Child ethnicity (Hispanics)	.06 (0.80)	.94	-.16 (0.66)	.81
Child ethnicity (Haitians)	-.42 (0.78)	.59	-.34 (0.68)	.62
Child ethnicity (Blacks)	.001 (0.80)	1	-.17 (0.66)	.80
Child ethnicity (Other)	.13 (0.85)	.88	.266 (0.71)	.71
Baseline parent factor score	—	—	.30 (0.23)	.20
Parent factor (intervention group)	—	—	.47 (0.20)	.02
Parent factor (control group)	—	—	.87 (0.15)	<.001
	Adjusted M (SE)	p value	Adjusted M (SE)	p value
Estimated change in treatment group factor score	-0.11 (0.24)	.65	-0.03 (0.15)	.85
Estimated change in control group factor score	-0.28 (0.30)	.37	-0.13 (0.23)	.58
Estimated difference between treatment and control group	0.17 (0.32)	.60	0.10 (0.21)	.64

As the child care centers were randomized at the center level, the children were not equally distributed among the centers. However, to adjust for this, we included a clustering variable in the models. Statistical significance was determined by a probability level less than 0.05 and list-wise deletion was utilized for participants with any missing values. All of the mixed modes were run in SAS 9.3 (SAS Institute, Inc., Cary, NC).

Results

At baseline, there were no statistically significant differences between the intervention and control group on BMI or with the items of interest (child consumption of fruit/veggies, JF, or sedentary behavior). Table 3 displays the results from the two models with child FV consumption as the outcome. The model estimated change score difference between T1 and T2 for the intervention group was -0.11 and for the control group was -0.28. The model estimated difference in changes scores between the treatment and control group is 0.17. By the point estimates, these indicate that both the control and intervention groups decreased FV consumption between T1 and T2, but the control group decreased more than the intervention group.

In the model with the parent FV consumption as a predictor, baseline FV consumption was not statistically significant ($\beta = .30$ and p value = .20), but change in parent FV consumption was a statistically significant positive predictor of change in child FV consumption for both the treatment and control group, indicating that the greater the change in the parent FV consumption the greater the change of child FV consumption.

Results from the models with child JF consumption and level of screen time behavior as outcomes are displayed in Table 4. The intervention group showed a slight decrease in their JF

consumption by the model estimated value though it is not statistically significant ($M = -0.01$, p value = .94), while the control group increased their JF consumption ($M = 0.33$, p value = .06).

Similarly, the screen time point estimates decreased for the intervention group ($M = -0.02$, p value = .77) and increased for the control group ($M = .05$, p value = .67). While these estimates and the difference between the intervention group and control group ($M = -0.08$, p value = .60) were not statistically significant, they are consistent with the findings from the full sample, which is statistically significant (difference in change between the treatment and control group: $M = -0.11$ and p value = .004).

In the JF consumption model which included parent factors as predictors, the impact of parent's JF consumption was not statistically significant in the intervention group ($\beta = -.09$, p value = .66) but was statistically significant in the control group ($\beta = 1.06$, p value < .001). Results also showed that in the control group, the greater the parent JF consumption, the greater the child's JF consumption.

Models with percent body mass index (PBMI) were run but there was no statistically significant change in PBMI between the intervention and control group.

Discussion

The purpose of this article was to examine the effects of an obesity prevention program on children with DD with regard to improving nutrition and decreasing screen time. In addition, we examined the influence of the parent's nutrition and screen time practices on the children's behaviors. Results reported here show that among preschool-age children with DD, parents have an influence on their child's nutrition and screen time patterns. Specifically, we found that change in parent FV consumption significantly influences change in their child's FV consumption. Conversely, we also found that in preschoolers not receiving a healthy weight intervention, the greater the consumption of JF by parents, the greater consumption of JF by their children.

Increased attention toward prevention of obesity and overweight during early childhood years (and among children with DD in particular) is a critical gap in the field (Bandini, Curtin, Hamad, Tybor, & Must, 2005; Chen et al., 2010) addressed in this study. The Centers for Disease Control and Prevention (CDC) recently released several briefs emphasizing the crucial role that local and regional communities play in invoking steps to help combat obesity among people with disabilities (CDC, 2013). In addition, Rimmer, Rowland, and Yamaki (2007) asserted that an effective national strategy to lower overweight and/or obesity among individuals with disabilities must focus on prevention strategies that begin early in life so that healthy lifestyle habits are established during the developmental period.

While we had a limited sample size, our results are nevertheless promising and support the above suggestions that obesity prevention efforts among children with DD should start early in life. This is an important concept as changes in adult behavior can affect child behavior and behavioral changes that occur early in life can lead to lifelong habits. Overall, the direction of change is consistent with what we found in the full analysis among children without DD (Natale, Messiah, et al., 2014). Specifically, by the point estimates, children in the control group ate less fruit/veggies at T2 than they did at T1 (children in the intervention group also consumed less, but the change was to a much less degree). Children in the intervention group remained stable, in terms of JF consumption; however, children in the control group increased their JF intake. In addition, children in the intervention group slightly decreased their screen time behavior while children in the control group increased their screen time behavior. Sedentary behavior among individuals with developmental disabilities is a growing concern as several studies have reported that people with disabilities are more likely to be idle for longer periods of time (Rimmer, Braddock, & Pitetti, 1996; Rimmer, Rubin, Braddock, & Hedman, 1999; HHS, 2000) and

Table 4. Child Consumption of JF Factor and Sedentary Behavior Score as Outcome.

Variable	JF—only child factors (<i>n</i> = 71)		JF—including parent factors (<i>n</i> = 71)		Sedentary behavior—only child factors (<i>n</i> = 71)	
	β coefficient (SE)	<i>p</i> value	β coefficient (SE)	<i>p</i> value	β coefficient (SE)	<i>p</i> value
Intercept	-.55 (0.49)	.28	-.49 (0.50)	.33	-.5 (0.34)	.16
Parent factor (intervention group)	—	—	-.09 (0.21)	.66	—	—
Parent factor (control group)	—	—	1.06 (0.23)	<.001	—	—
Group (intervention)	.16 (0.26)	.55	.05 (0.24)	.84	.03 (0.17)	.85
Visit (Time 2)	.33 (0.17)	.06	.15 (0.16)	.36	.05 (0.12)	.67
Group $\times$ Visit	-.34 (0.21)	.10	-.16 (0.19)	.41	-.08 (0.14)	.60
Child gender (male)	-.26 (0.13)	.05	-.27 (0.13)	.05	-.002 (0.09)	.98
Child ethnicity (Cubans)	.13 (0.41)	.76	.30 (0.42)	.48	.21 (0.30)	.48
Child ethnicity (Other Hispanics)	.39 (0.38)	.31	.41 (0.39)	.29	.25 (0.27)	.35
Child ethnicity (Haitians)	.19 (0.39)	.62	.25 (0.40)	.54	.29 (0.27)	.30
Child ethnicity (Other Blacks)	.44 (0.39)	.26	.54 (0.40)	.18	.32 (0.27)	.24
Child ethnicity (Other)	.45 (0.59)	.44	.58 (0.59)	.33	.07 (0.43)	.87
Age in months	.01 (0.01)	.20	.01 (0.01)	.22	.007 (0.004)	.12
	Adjusted		Adjusted		Adjusted	
	<i>M</i> (SE)	<i>p</i> value	<i>M</i> (SE)	<i>p</i> value	<i>M</i> (SE)	<i>p</i> value
Intervention Time 1	0.12 (0.17)	.49	0.14 (0.16)	.41	0.03 (0.11)	.77
Intervention Time 2	0.11 (0.17)	.51	0.13 (0.17)	.45	0.01 (0.1)	.93
Intervention change	-0.01 (0.11)	.94	-0.01 (0.10)	.92	-0.02 (0.08)	.77
Control Time 1	-0.04 (0.22)	.87	0.08 (0.21)	.70	-0.001 (0.15)	.995
Control Time 2	0.30 (0.19)	.12	0.23 (0.19)	.24	0.05 (0.11)	.65
Control change	0.33 (0.17)	.06	0.15 (0.16)	.36	0.05 (0.12)	.67
Intervention vs. control change	-0.34 (0.21)	.10	-0.16 (0.19)	.41	-0.08 (0.14)	.60

Note. JF = junk food.

experience substantially more barriers to physical activity participation compared with the general population (Rimmer et al., 1999).

Given that statistically significant changes were not noted for JF consumption or screen time between groups, it is important to recognize that some improvements to the curriculum implementation in these areas may be helpful. Another reason significant changes were not noted could be that the centers did not adhere to the recommend protocol and thus the intervention was not implemented at the expected levels. Therefore, it is also recommended greater attention be made to treatment fidelity through the development of measurement tools that clearly assess the adherence to the multiple components of a robust intervention such as this.

Furthermore, the family and home environment are important in shaping the dietary patterns of children, and if home practices are unhealthy, it can put young children at risk of obesity because they depend on adults for their nutritional needs (Lindsay et al., 2006). Thus, it is important to examine the impact of parent behaviors on child outcomes. We found that parent behavior

was a significant predictor of child behavior; the greater the change of parent FV intake scores from T1 to T2, the greater the increase in the children's FV intake for both the control and intervention group. Similarly, the more JF parents ate in the control group, the more their children ate JF (statistically significant). This is consistent with our findings from the full analysis among children without DD (Natale, Messiah, et al., 2014) suggesting that these are important predictors for children both with and without DD. In addition, others have shown that parental food involvement was strongly correlated with consumption of fruits and vegetables for both parents and children (Brown & Ogden, 2004; Ohly et al., 2013).

As we showed in HC2 with typically developing children (Natale, Messiah, et al., 2014), preschool children's health behaviors are ultimately modified through observational learning and imitation of parents and teachers as they make changes in their eating and physical activity habits (principal underpinnings of SCT). As such, it appears that these same principles hold true for children with DDs. Briefly, SCT states that children learn new behaviors by observing and imitating models such as parents, teachers, and peers. SCT describes specific mediating factors that impact an individual's decision to make health behavior changes including perceived benefits of making the behavior change (positive health benefits), perceived control (who is in charge of food shopping and preparation), and self-efficacy for making changes (including confidence that barriers can be overcome). Our current HC2 curriculum and outcome measures incorporate each of these mediating factors to promote health behavior change in parents and children. Community practitioners working with children with disabilities are encouraged to consider how their practices address the health needs of this population.

Study Limitations

As mentioned previously, the main limitation of this analysis is the limited sample size. To have detected a moderate effect size of 0.50 difference between the groups with a two-tailed alpha of .05 and at 80% power, the sample size would have needed to include at least 64 participants per group. The effect sizes of these analyses ranged from 0.12 to 0.45. Second, the use of self-report nutrition and physical activity measures remains a historic challenge to collecting accurate information. However, in a community-based study such as this, it is the most realistic option. Social desirability is always a concern in self-report data. However, because social desirability and social approval are considered traits, it was reasonable to assume that a randomized controlled trial should address this limitation in that social desirability would be equal across both groups (intervention and control) of the study. In addition, literature suggests that reporting biases may be minimized through survey and questionnaire design. In particular, dietary data biases may be more concentrated in response to questionnaires that are more structured and quantifiable. Our study had a mixture of questionnaires that were structured and less specific to further address this issue. In addition, while the control and intervention group were similar on all demographic characteristics, there were two exceptions, child age and caregiver birthplace. Child age was controlled for in the analysis by adding this as a variable in the hierarchical model. Regarding caregiver birthplace, more children in the intervention group were born outside of the United States. Therefore, cultural factors may have influenced uptake of the intervention. However, it should be noted that while caregiver birthplace was different, the control and intervention families did not report any differences in the languages spoken in the home, and the race of children in both groups was reported as similar, which would suggest against any cultural differences interfering with program results. The low-literacy level of the population was also a limitation which could have affected the reading of the materials that were given to the parents.

To address these limitations, measures and materials were chosen to be simple, at a fifth-grade reading level, with frequent use of graphics to maximize parent comprehension, and information was given orally as well as written. Furthermore, the data were collected in an interview format

with experienced researchers who had extensive training and prior knowledge related to interview techniques and thus were able to quickly gather the needed information to assist with accuracy and in the parent's native language. In addition, as noted above, measures of fidelity should be utilized more closely to ensure delivery of all program components, and future studies should measure fidelity of implementation more closely. Moreover, there were more children in the intervention than in the control group, which was unavoidable given that randomization occurred at the center level rather than individual level. In terms of the control group being significantly younger, age was included in the models to control for that variable. Finally, only one question was used to indicate whether the child had a delay via parent report. Disability status was not substantiated through center records or child care provider report in addition to parental report, a limitation that should be addressed in future research.

Conclusion

Results reported here show that among preschool-age children with DD, parents have an influence on their child's healthy weight nutrition and screen time patterns. Specifically, we found that change in parent FV consumption significantly influenced change in their child's FV consumption. Conversely, we also found that in preschools not receiving a healthy weight intervention, the greater the consumption of JF by parents, the greater consumption of JF by their children. Overall, results imply that preschool-age children with DD benefit from child care center-based healthy weight programs. These findings further reflect the power of parents' behaviors on child behaviors that holds true with typically and nontypically developing children.

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