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FOOD KNOWLEDGE, PREFERENCE AND INTAKE BEHAVIORS AMONG
HISPANIC AND BLACK PRESCHOOLERS FROM LOW-INCOME FAMILIES
BEFORE AND AFTER THE ALL 4 KIDS[®] PROGRAM

By

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ABSTRACT OF THE THESIS

Food knowledge, preference and intake behaviors among Hispanic and Black preschoolers from low-income families before and after the All 4 Kids[®] program

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Objectives: To evaluate the potential influence of the All 4 Kids[®]: Healthy, Happy, Active, Fit program (hereafter referred to as the All 4 Kids[®] program) on preschoolers' snack food knowledge, stated healthy snack preference, snack food intake, and fruit and vegetable availability at home.

Design: Pre- and post-intervention comparison.

Setting: Preschool classrooms.

Participants: A total of 45 three to five year-old Hispanic and Black preschoolers and their caregivers from low-income families.

Intervention: The All 4 Kids[®] was a healthy eating and active living program that consisted of 24 interactive classroom lessons (lasting 30- to 45-minutes each), which were taught three times per week for eight weeks. The program also included weekly information packets for the families and three family events.

Measurements: Demographic (age, race/ethnicity, gender, education, federal assistance program participation) and anthropometric (height, weight, body fat percent) characteristics; preschoolers' snack food knowledge (ability to identify 18 snack foods and to distinguish healthy and unhealthy snack foods); stated healthy snack preference among nine snack pairs; fruit and vegetable availability and preschoolers' caregiver-reported snack food intake frequency at home.

Analyses: Spearman correlation analysis; independent and paired sample t-, McNemar's, Wilcoxon signed-rank, Chi-square, Mann-Whitney U, Fisher's exact, and analysis of variance (ANOVA) tests.

Results: After participating in the program, preschoolers showed improvements in snack food identification, healthy snack identification and stated healthy snack preference ($p < 0.001$). The snack food identification and healthy snack identification sum scores varied by race/ethnicity and age. Healthy snack identification and stated healthy snack preference sum scores were positively correlated before and after the intervention ($p < 0.05$). Most caregivers reported high levels of fruit and vegetable availability and intake frequencies at home before and after the intervention. More than half of the caregivers reported that their preschoolers ate candy or chips at least 1 to 2 times per day before and after the intervention.

Conclusion: The All 4 Kids[®] program was linked to positive outcomes on preschoolers' snack food knowledge and stated healthy snack preference but was not related to changes in the availability of fruits and vegetables and preschoolers' food intake at home.

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I. INTRODUCTION

Obesity prevalence is disproportionately higher among Hispanic and Black versus White preschoolers and among children from families with low (versus high) socioeconomic status.^{1,2} Dietary intake is closely related with body weight. High intake of energy-dense and nutrient-poor foods is positively associated with adiposity.³⁻⁶ In contrast, increasing fruits and vegetables in the diet can be a helpful strategy in improving nutrient density for optimal weight management.^{7,8}

Consistent with the high prevalence of childhood obesity in the United States, increased energy intake, excessive intake of energy-dense and nutrient-poor foods and inadequate intake of fruits and vegetables have been reported.⁹⁻¹¹ In addition, snacking is an important component of children's diet and a contributor to high intake of energy-dense and nutrient-poor foods such as desserts and salty snacks.¹²

Preschool-aged children are prime targets for nutrition interventions since they are at the transition stage from eating nutrient-dense milk and simple food to more complex adult diets.¹³ Theoretically, factors influencing preschoolers' dietary intakes can be examined through the intrapersonal, interpersonal, organizational/institutional, community and macro policy/culture levels of a social ecological model.¹⁴ Because most children at preschool-age in the United States are enrolled in center-based child care programs,¹⁵ child care setting can be a suitable target for interventions at the organizational/institutional level of this theoretical framework.

Based on the literature review of the current study, previously published strategies for improving preschoolers' dietary intake can be generally categorized into three types: food-focused, parent-focused and child-focused strategies. Food-focused strategies put

efforts to improve the taste of healthy foods and to reform the food services in child-care settings.¹⁶⁻¹⁸ Parent-focused strategies are designed for parents in attempts to improve their nutrition awareness, knowledge and skills.¹⁹⁻²¹ Due to the limited influence of food-focused and parent-focused strategies, it is imperative to develop and evaluate child-focused strategies. To date, a few studies have examined the effectiveness of child-focused strategies and have produced mixed results.²²⁻²⁵

It is not fully known whether and to what extent preschoolers can benefit from nutrition education. A few studies demonstrated that preschoolers have the competency to understand and benefit from nutrition-related concepts, but these studies were conducted mostly among children from White families with relatively higher socioeconomic status.²⁶⁻²⁸ A research gap exists in studying the influence of nutrition education programs on minority preschoolers from low-income families. Therefore, this study was conducted among Hispanic and Black preschoolers from low-income families to examine the potential influence of the All 4 Kids[®] program on preschoolers' snack food knowledge, stated healthy snack preference as well as fruit and vegetable availability and food intake at home.

II. REVIEW OF THE LITERATURE

1. Childhood Obesity Prevalence and Disparities

During the past ten years, the prevalence of obesity among 2- to 19-year-old children and adolescents has been stabilized at around 16%, which is three times higher than the rate in 1970s according to the National Health and Nutrition Examination Surveys (NHANES).^{1,29} Though the prevalence of obesity among 2- to 5-year-old children decreased from 13.9% in 2003-2004 to 8.4% in 2011-2012, the obesity rate for Hispanic and Black 3- to 5-year-olds remained as high as 16.7% and 11.3%, respectively.¹ In addition, childhood obesity is disproportionately distributed among children from families with lower social economic status (SES). According to the National Survey of Children's Health, from 2003 to 2007, the obesity rate among 10-to 17-year-old children from low-education households, low-income households and households with unemployed parents increased by 32.6%, 23.4% and 25.9%, respectively, which were higher than the average increase rate of 10.4%.² Early presence of childhood obesity and related disparities indicate that Hispanic and Black preschoolers from families with relatively low SES need to be the focus of obesity prevention.

2. Diet and its Influence on Health

A number of studies have indicated the presence of relationships between dietary intake and body weight. Adiposity has been found to be positively associated with the consumption of sugar sweetened beverages and energy-dense foods.³⁻⁶ In contrast, fruits and vegetables have been reported to have helpful roles in increasing nutrient density of

diets for weight management purposes,^{7, 8} and consumption of fruits and vegetables has been inversely associated with cardiovascular risk factors and metabolic syndrome.^{6, 30}

U.S. Department of Agriculture (USDA) and other national organizations provide guidelines for healthy eating. The Dietary Guidelines for Americans 2010 recommends to increase vegetable, fruit, whole grain and fat-free food intake and to reduce sodium, solid fat and added sugar intake.³¹ Similarly, the American Heart Association and the Academy of Pediatrics suggest parents to provide a wide variety of nutrient-dense foods instead of energy-dense and nutrient-poor foods, and to limit children's snacking during sedentary activities and allow them to self-regulate total caloric intake.^{32, 33} The recommended daily fruit and vegetable intake for preschoolers is 1-1 ½ cups for each food group according to the USDA MyPlate.³⁴

3. Children's Dietary Intake in the United States

Some of the current problems in children's dietary intake include increased energy intake, excessive intake of foods high in solid fats and added sugars, and inadequate consumption of fruits and vegetables. Though children's energy intake has declined since 2004, the energy intake levels among 2- to 5-year-old children and children from low-income families in 2009-2010 still remained significantly higher than the levels in 1989-1991.⁹ For 2- to 6-year-old children, energy intake increased by 109 kcal from 1989 to 2008,¹⁰ along with increased dietary energy density and eating occasions.³⁵ Compared with the 24 kcal increase from fruits, most of the increased energy intake came from foods high in sugars, solid fats and sodium, such as savory snacks (+51

kcal), pizza/calzones (+32 kcal), sweet snacks and candy (+25 kcal) and fruit juice (+18 kcal).¹⁰

The majority of preschoolers in the United States consume inadequate amount of fiber, fruits and vegetables. The mean daily fiber intake of preschool-aged children participated in the 2008 Feeding Infants and Toddlers Study (FITS) was 10 grams, which was below the adequate intake of 19 grams/day.³⁶ Among 400 2- to 5-year-old children, only 17% of participants ate 5 or more servings of fruits and vegetables per day.¹¹ Moreover, French fries and other fried potatoes were the most commonly consumed vegetables among 2- to 3-year-olds.³⁷

As they grow, children seem to eat fruits and vegetables less often and eat unhealthy foods more often. According to the NHANES 1999-2000, 27% of 2- to 3-year-old children ate 5 or more servings of fruits and vegetables per day, while only 13.8% of boys and 9.8% of girls from 8 to 10 years of age consumed 5 or more servings of fruits and vegetables per day.³⁸ The NHANES 2009-2010 data also indicated that for 2- to 5-year-old boys and girls, the mean daily intake of fruit cup equivalents were 1.49 and 1.43, respectively; but for 6- to 11-year-old boys and girls, the daily intake of fruit cup equivalents dropped to 1.03 and 1.20.³⁹ Conversely, the percentage of children who consumed sweetened beverages, desserts, sweets, or salty snacks in a day was higher among 3-year-olds than 2-year-olds according to the 2008 FITS.³⁷ The trends of increasing unhealthy food consumption and decreasing fruit and vegetable intake emphasize the importance of promoting fruit and vegetable consumption at early ages.

In the United States, snacking is an important component of children's dietary intake. On average, snacks contribute 27% of total daily calorie intake among 2- to 18-

year-old children.¹² From 1977 to 2006, the prevalence of snacking increased from 74% to 98% among 2- to 18-year-olds, and preschoolers on average consumed snacks three times per day.¹² Popular snack choices seem to be high in energy density and low in nutrients. The main contributors to calories from snacks have been desserts since 1977.¹² The second main source of snack calories has come from salty snacks such as chips and crackers, which have had the largest calorie increase in the past three decades.¹² Therefore, targeting children's snack intake can be a rewarding strategy to improve their dietary intake.

4. Preschool Years as the Target Age for Interventions

Preschoolers are considered as primary targets for obesity prevention. Researchers have argued that ignoring preschool-aged children as intervention targets means missing the best opportunities for obesity prevention.^{13, 40} It is not only because of the presence of high obesity prevalence in this age group but also because of the dietary transition that preschoolers experience from eating nutrient-dense milk and simple food to more complex adult diets.¹³ Moreover, preschoolers are at the initial stage to form perceptions and develop incipient knowledge about food. It is advisable to provide healthy eating interventions for this age group before the development of unhealthy eating behaviors and habits.

5. Theoretical Framework for Examining the Factors that Influence Preschoolers' Dietary Intake

Various factors influence children's dietary intake. Identifying and understanding these factors is important for designing effective nutrition intervention programs.⁴¹ Social

ecological model, which emphasizes the environmental as well as personal and social factors,⁴² can be utilized to study factors that influence children's dietary intake.

According to the social ecological model, factors that influence children's dietary intake can be grouped into intrapersonal level, interpersonal level, organizational/institutional level, and community and macro level.¹⁴

5.1 Intrapersonal factors

Inherently, children's food intake is influenced by their genetic predispositions.⁴³ Infants' preference for sweet and salty tastes and dislikes for bitter and sour tastes appear within several months after birth.^{44, 45} These inborn taste preferences can make children prefer palatable unhealthful foods and avoid less palatable healthful foods. A study found that preschoolers with high sensitivity to bitterness had significantly lower vegetable intake and preference.⁴⁶ Another heritable factor that influences children's dietary intake is food neophobia.⁴⁷ It becomes particularly prominent through the preschool years when young children experience dietary transition.⁴⁸ Studies have shown that food neophobia was negatively associated with fruit, vegetable and protein intake.^{49, 50} These genetic traits demonstrate intrinsic barriers to healthy eating, which indicates that strategies are needed to manage these predispositions in order to foster healthy eating behaviors.

5.2 Interpersonal factors

Family plays a pivotal role in young children's dietary intake. First, parents directly control home food environments such as food availability and accessibility, and the timing of eating occasions. For example, Ding and colleagues reported that children's

fruit and vegetable intake was positively associated with the availability of fruits and vegetables and negatively associated with the availability of less-healthy foods at home after adjusting for age, sex, race/ethnicity and family income.⁵¹ Second, food intake patterns tend to be similar within families. A study of 396 parent-child dyads (3- to 5-year-old) has shown that children's fruit and vegetable consumption was positively associated with parental fruit and vegetable intake ($p=0.005$) after controlling for parental education, household income and gender of the child.⁵² Third, parental feeding practices also have an impact on children's dietary intake.⁵³⁻⁵⁵ Negative feeding practices such as pressure-to-eat and restriction can lead to the development of aversion to the pressured foods and increased attention to the restricted foods.⁵⁶ Therefore, providing a healthy family food environment and advocating for proper feeding practices are important for children's healthy dietary intake.

5.3 Organizational/institutional factors

Child care centers might be the most important out-of-home settings for preschoolers' dietary intake. According to the National Center for Education Statistics, 76% of 3- to 5-year-old children (8.2 million) participated in at least one weekly non-parental care arrangement in 2012. Among these children, 80% attended center-based arrangements such as Head Start programs, preschools and daycare centers.¹⁵ Preschoolers spent an average of 33 hours per week,⁵⁷ and most of them consumed lunch and snacks in child care centers.⁵⁸ Academy of Nutrition and Dietetics, School Nutrition Association and Society for Nutrition Education and Behavior have affirmed schools as an important partner in health promotion and have posted that nutrition education and

promotion in schools is the key area that should be strengthened.⁵⁹ In recent years, child care settings have been considered as a relatively untapped venue for healthy lifestyle promotion, which have gained attention from researchers and health educators.⁶⁰

5.4 Community and macro level factors

The food environment of a community such as grocery stores, supermarkets and restaurants determines food availability and accessibility and has been shown to be associated with children's dietary intake.⁶¹⁻⁶⁵ Programs, campaigns and policies at regional, state and national levels, such as the Head Start Nutrition Program and the Let's Move! national campaign, can facilitate the promotion of healthy lifestyles among young children.^{66, 67}

6. Strategies to Improve Preschoolers' Dietary Intake

According to the literature reviewed in the current study, previously published strategies to improve preschoolers' dietary intake have focused on food modification, food service improvement, and parents' and children's food-related knowledge, preference and behaviors.

6.1 Food-focused strategies

Food-focused strategies can be divided into food modification and food service improvements in child care settings where foods are prepared and served to preschoolers. Examples of food-focused strategies include providing vegetables with preferred low-fat dip,^{16, 17} modifying snack recipes with added fiber,⁶⁸ reducing the fat content of served

meals and serving additional fruits and vegetables (e.g., before a meal or in larger portion sizes).^{18, 69, 70} All of these strategies have shown positive outcomes in improving preschoolers' dietary intake. However, food-focused strategies may lack influence on preschoolers' food intake outside child care settings.

6.2 Parent-focused strategies

Previously published parent-focused strategies in childhood obesity or healthy lifestyle interventions have targeted parents' nutrition knowledge, food handling skills, and feeding practices and their awareness of children's body weight status. These strategies have shown promising outcomes on BMI reduction in primary settings when exclusively designed for parents of overweight or obese children.⁷¹⁻⁷³ The effectiveness of parent-focused nutrition intervention programs on improving preschoolers' dietary intake remains unclear. For example, the church-based Cooking with the Chef program provided lessons in topics such as menu planning, culinary skills and food label reading for parents of preschool-aged children.¹⁹ Although there was a tendency for a slight increase ($p < 0.096$) in children's fruit intake after the program implementation, the results could have been influenced by the very small sample size ($n=29$).¹⁹

Other parent-focused strategies that were implemented in relatively larger sample sizes have shown mixed results. The school-based Lunch is in the Bag program encouraged parents to pack one serving each of fruits, vegetables and whole grains every day in preschoolers' lunch bags.²⁰ This program showed increased servings of vegetables and whole grains provided by parents ($n=368$) at the end of the 5-week intervention, but preschoolers' dietary intake was not measured.²⁰ Another program, which was eight

months long, targeted mothers with preschool-aged children by providing mail and telephone coaching on parental feeding practices.²¹ Although mothers (n=400) reported improved feeding practices, there were no statistically significant changes in children's intake of sugary beverages, fast food, fruits and vegetables.²¹ These studies suggest that solely targeting parents for improving preschoolers' dietary intake may not be an optimal strategy.

Considering parents' important role in preschoolers' dietary intake, different approaches are needed to explore how to utilize parents' efforts for improving preschoolers' dietary intake. One approach is to involve both parents and children in intervention programs. For instance, the Salud Con La Familia program provided lessons of healthy eating and parenting styles around food and feeding for parents and children.⁷⁴ However, this study and several other studies mentioned the high dropout rates of parents,⁷⁴⁻⁷⁶ which reflected the difficulty in retaining parents' participation in the programs. The alternative strategy of shifting the primary target from parents to children could be promising, since most preschoolers are enrolled in child care and the resources of child care settings can facilitate the nutrition programs.

6.3 Child-focused strategies

The child-focused strategies in nutrition education programs have been implemented mostly in child care settings. These programs have varied in program content, length/intensity, targeted population and outcome measurements and yielded promising but mixed results.

The exclusive influence of nutrition education components on preschoolers' dietary intake has not been clear when these components are embedded in obesity prevention or healthy lifestyle intervention programs. For instance, the Hip-Hop to Health Jr. program incorporated both nutrition and physical activity interventions among Black and Latino preschoolers.^{25, 76, 77} The nutrition component of this program included 20-minute nutrition-related instructional sessions three times per week for 14 weeks on topics such as traffic light diet, the food pyramid and healthy snacks. Reduced fat intake was observed when the program was implemented the first time among Black preschoolers,⁷⁶ but they did not detect any dietary intake changes when they repeated the program among Hispanic children or Black children taught by school teachers.^{25, 77} In the Healthy Start study, significantly increased nutrition knowledge scores and decreased saturated fat intake were reported, but these positive outcomes were found in either food service modification group or combined nutrition education and food service modification group.^{78,79} Therefore, the exclusive influence of nutrition education on preschoolers' food knowledge and intake could not be determined.

The programs that applied nutrition education components alone provided mixed results regarding potential influences on preschoolers' dietary intake. For example, the Color Me Healthy program provided 12 nutrition lessons over a six-week period among 83 4- to 5-year-old children.²⁴ Preschoolers' fruit and vegetable intake during snack time was measured by weighted plate waste and showed statistically significant increase immediately after the program implementation and at 3-month follow-up.²⁴ In contrast, the CATCH study with the similar length/intensity and sample size (n= 75) did not find a

statistically significant increase in preschoolers' fruit and vegetable intake during school breakfast, lunch and snack time.⁸⁰

Earlier studies that examined preschoolers' knowledge change after participating in nutrition education programs also showed mixed results. Gorelick and colleagues reported that preschoolers who received a 6-week nutrition education program had significantly higher scores than the control group in identifying fruits, vegetables and breads and choosing foods that "would help them grow strong."⁸¹ Cason and colleagues also reported similar education effects on 3- to 5.6-year-old Black and White preschoolers' (n=6,102) knowledge in identifying fruits, vegetables and healthy snacks after a 6-week program.⁸² Conversely, nutrition knowledge score change was not observed among preschoolers after participating in a 6-week nutrition education program in another study.⁸³

In addition to the mixed results from aforementioned studies, feasibility of educating preschool-aged children on nutritional concepts is unclear. Some researchers posited that young children who are perceptually driven thinkers may not benefit from abstract nutrition concepts such as healthy and unhealthy foods.⁸⁴ Beyond the widely accepted strategy of repeated exposure for addressing food neophobia,^{85, 86} answers remain pending for what content and topics are appropriate and effective in preschoolers' nutrition education.

Several studies examined preschoolers' incipient knowledge about nutrition. Raman reported that preschoolers from White middle class families linked physiological needs with eating lunch and snacks.²⁷ Similarly, Abramovitz and Birch reported that 5-year-old girls from middle class families were able to define dieting and relate dieting

behaviors with healthy eating and weight management.²⁶ Moreover, among 63 4-year-old children (96% White), those who accurately identified healthy food choices were more likely to select the healthy foods ($p=0.008$).²⁸ The results suggest that intellectual competency to understand nutrition-related information exists among these preschoolers, but whether and to what extent minority children from low-income families can grasp nutrition- and health-related information is unknown.

In terms of teaching nutrition knowledge to preschoolers, most studies did not provide adequate information on how healthy/unhealthy foods were defined.^{24, 79, 87} The common practice has been to introduce the term of “healthy/unhealthy food” and attach these labels to the foods that preschoolers consume.^{88, 89} Healthy food sometimes has been interpreted as “good for you.”⁹⁰ Preschoolers may associate “good” with their taste preferences rather than health value.^{81, 91, 92} According to Piaget’s theory,⁹³ preschoolers are at the preoperational stage and struggle to understand abstract and symbolic information. To improve preschoolers’ understanding of “healthy food,” introducing nutrition concepts with concrete objects as well as with age-appropriate language has been recommended.^{81, 92}

The instruments for assessing preschoolers’ knowledge and preference are important components for nutrition education programs. Some studies examined preschoolers’ abilities to identify food items and choose healthy foods, but these studies were conducted only among White and Black preschoolers.^{81, 82} In addition, most of the previous studies did not examine preschoolers’ food preference of healthy versus unhealthy foods.^{82, 85, 94} Thus, studies are needed to implement an instrument for

examining preschoolers' ability to distinguish healthy and unhealthy foods and whether they prefer the healthy foods over the unhealthy ones.

7. Summary

Childhood obesity is closely related to dietary intake. Large proportions of the child population in the United States have high levels of unhealthy food intakes and do not consume adequate fruits and vegetables. Preschool-age children are at the transition stage regarding their diet, and food intake habits can persist into older ages. Therefore, preschoolers are important targets for fostering lifelong healthy eating habits. In the United States, most preschool-aged children are enrolled in child care centers which are considered to be important settings for nutrition education. Because preschoolers' cognitive abilities are not fully developed, whether or not nutrition education programs can improve their dietary intake is unknown. Though studies have shown that preschool-aged children have the competency to understand and benefit from nutrition education, most of these studies were conducted among children from White families with relatively high socioeconomic status. Since Hispanic and Black children from low-income families have high obesity prevalence, a research gap exists in discovering effective nutrition education strategies for these groups and in determining the potential effect of nutrition education on preschoolers' food knowledge, preference, and food intake behaviors.

8. Aims, Objectives and Hypothesis

The purpose of this study was to examine the potential influence of the All 4 Kids[®] program on preschoolers' snack food knowledge, healthy snack preference, and

caregiver-reported home food availability, and food intake among Hispanic and Black preschoolers from low income families.

The study objectives were to:

- 1) compare preschoolers' ability to identify snack foods before and after the program implementation;
- 2) compare preschoolers' ability to distinguish between healthy and unhealthy snack foods before and after the program implementation;
- 3) examine preschoolers' stated healthy snack preference before and after the program implementation;
- 4) examine caregiver-reported home fruit and vegetable availability before and after the program implementation; and
- 5) examine preschoolers' caregiver-reported snack food intake frequencies at home before and after the program implementation.

It was hypothesized that after participating in the All 4 Kids[®] program,

- 1) a greater number of the preschoolers would correctly identify snack foods;
- 2) a greater number of the preschoolers would correctly identify healthy snacks;
- 3) a greater number of the preschoolers would prefer healthy snacks than unhealthy snacks;
- 4) caregivers would report increased fruit and vegetable availability at home; and
- 5) caregivers would report that preschoolers ate fruit and vegetables more frequently and unhealthy snacks less frequently.

III. METHODS

1. Program Description

The All 4 Kids[®] program was used in this study. All 4 Kids[®], which was developed by the University of Nevada Cooperative Extension (UNCE), is a healthy eating and active living program for preschool-aged children. This preschool-based program lasted for eight weeks and addressed three topics related to obesity prevention: nutrition, physical activity and body image acceptance. Each topic was emphasized in one of the three units of the program although nutrition component was also incorporated into all three units. Consistent with the research objectives, this thesis focused only on the nutrition component of the All 4 Kids[®] program.

The All 4 Kids[®] curriculum consisted of twenty four 30-to 45-minute classroom lessons that were taught three times per week. With the aim to help children distinguish between healthy and unhealthy foods, the concepts of healthy and unhealthy were defined by the effect of foods on specific body parts:

- Healthy foods: foods that help my heart, my muscles and my bones be strong.
- Unhealthy foods: foods that do not help my heart, my muscles and my bones be strong, even if they taste good.

Considering that preschool-aged children may have more decision power for snack foods than what is served during main meals, the All 4 Kids[®] program focused on what to eat at snack time and introduced two terms to represent healthy and unhealthy snacks:

- Go snacks: snacks that can be eaten every day.

- Whoa snacks: snacks that may taste good but should only be eaten once in awhile.

The Go and Whoa snacks were adapted from the National Institute of Health Go, Slow and Whoa food groups.⁹⁵ Preschool-aged children may have difficulties in detecting the subtle difference of the Slow food group. Thus, this study only used the Go and Whoa food categories.⁹²

The components related to the definition of healthy foods (i.e., keeping heart, muscles and bones strong) are shown in Table 1. Nutrition-related concepts and classroom activities from the All 4 Kids[®] curriculum are shown in Table 2.

Table 1. The components related to the definition of healthy foods

Concept:

Energy balance: Food gives the body energy, and physical activity uses energy from food.

Objectives:

- Recognize that eating food gives the body energy.
- Become familiar with body movements as it applies to energy.

Activity:

- ENERGY! Game: Wiggle fingers to represent body being full of sparkling energy. Pretend to eat various fruits and vegetables to give body energy and feel having energy all over the body. Practice various movements such as running and jumping.
-

Table 1. (continued) The components related to the definition of healthy foods

 Concept:

The role of physical activity on the heart: Heart beats faster and uses more energy.

Objectives

- Recognize that being active makes the heart beat faster and uses more energy.
- Demonstrate that exercising our heart helps keep it strong.

Activities:

- Heart Smart Activity: Participate in physical exercise and put hand over heart to feel heart beats.
- The Beats of My Heart: Pump a foam heart toy by squeezing and releasing, and learn that “when we are active, our heart beats faster, and pumps blood faster to the whole body,” “our heart is always beating” and “exercising our heart helps it beat faster and stay strong.”

 Concept:

Muscles in the body

Objectives:

- Recognize various muscles of the body.
- Identify movements that strengthen muscles.

Activity:

- Muscle in Motion: Feel different muscles all over the body such as chest and arms, abdominals and calves, and try several exercises that make muscles strong such as modified push-ups and crunches.
-

Table 1. (continued) The components related to the definition of healthy foods

Concept:

The basic anatomy of the human skeleton

Objective:

- Become familiar with various bones of the body.

Activity:

- Bone Exploration: Take turns identifying the body parts and play the skeleton puzzle together
-

Table 2. Nutrition-related components in the All 4 Kids© curriculum

Concept:

Go and Whoa designations for classifying foods

Objectives:

- Identify Go and Whoa snacks.
- Become familiar with the names of fruits and vegetables.
- Recognize that people like different foods and tastes.
- Choose between healthy and unhealthy snacks.
- Identify some healthy and unhealthy food choices in restaurants.

Activities:

- Go Snacks and Whoa Snacks: Look at the Go snack and Whoa snack cards and answer questions, such as “when you eat XX (the snack shown), is it going to help your heart, muscles and bones?” and “do we need XX every day?”
 - Fruit and Vegetable Demonstration: Try a bite size sample of two fruits and two vegetables and use the Food Face Pictures to present “like it” or “might like it next time,” while engaging in dialogues about exploring the texture and tastes of different foods.
 - Eating the Alphabet: Listen to the Eating the Alphabet book and discuss the foods in the book.
 - Go and Whoa Snack Review: Look at nine healthy and unhealthy snack pairs and answer the question “which snack is healthy?”
-

-
- Go and Whoa in Restaurants: Discuss about Go snacks that can be eaten at home or out at restaurant, and taste the Go snacks that are healthy options in a restaurant.
 - Persona Doll Play: Talk about favorite healthy snacks by doll playing.
 - Shaping Up with Fruits and Veggies: Discuss about the size and shape of each food by using fruit and vegetable models
-

Concept:

Hunger and fullness cues

Objectives:

- Distinguish between hunger and fullness stomach signals.
- Be competent in describing hunger and fullness stomach signals.

Activities:

- Tummy Talks: Listen to the Tummy Talks story and learn to “eat when you’re hungry and stop when you’re full.”
 - Hungry Meter: Observe the hungry meter showing how the tummy is empty and full and what to do when the tummy is empty and full.
-

Families were connected to the program by receiving eight weekly All 4 Kids[©] Family Packs. In each of the All 4 Kids[©] Family Pack, there was a family connection newsletter with corresponding information related to children’s lessons of that week. Most of the All 4 Kids[©] Family Packs provided tools and directions for take-home activities such as smart snack cards and hungry meters. In addition, family members were

invited to participate in three family events – following the completion of the three main topics of the program. During family events, families shared and discussed the concepts learned from the All 4 Kids[®] program, tried healthy snacks and watched children's performance of the dances learned during the All 4 Kids[®] program.

2. Participants and Study Design

This study was conducted at the Mount Zion Child Development Center and Preschool in New Brunswick, New Jersey between January and April 2011. Children enrolled in this school were from low-income, minority families. Children and their caregivers from three classrooms at the preschool were invited to participate. Each classroom included 15 children resulting in a total of 45 participants.

Before the program implementation, the All 4 Kids[®] team from UNCE delivered a three-day training for the Rutgers project director and a one-day training for the Rutgers project personnel on the design, implementation and evaluation of the All 4 Kids[®] program. In addition, the Rutgers project team reviewed the curriculum, demonstration videos, and evaluation tools that were available through an online (Moodle[®]) portal. The All 4 Kids[®] curriculum was taught as a team by two educators from Rutgers, The State University of New Jersey. One of the educators was a community nutrition professional, and the second educator was a nutrition undergraduate student. On a few occasions, a third trained educator (another nutrition undergraduate student) filled in when one of the two primary educators was not available.

The pre-intervention survey (pre-survey) data were collected within two weeks before the start of the All 4 Kids[®] classes. The post-intervention survey (post-survey)

data were collected immediately after the completion of the All 4 Kids[®] classes. In addition to preschoolers, one caregiver (a parent, grandparent, or other caregiver who regularly cared for the child) participated in the pre- and post-surveys. Separate from the program educators, three trained research assistants and the project director conducted the anthropometric measurements and the surveys with caregivers and preschoolers.

Anthropometric measurements were completed only at pre-survey. This study was approved by the Institutional Review Board of Rutgers, The State University of New Jersey. All project personnel completed the training and obtained the certification for the protection of human subjects.

3. Measures

Children's and caregivers' anthropometric and demographic information were collected before the program implementation. Preschoolers' assessments on snack food knowledge and stated healthy snack preference and caregivers' interviews on fruit and vegetable availability and children's food intake frequencies at home were conducted before and after the program implementation. The surveys were conducted in English or Spanish depending on the participant's preference.

3.1 Anthropometric measures

Body weight was measured using a SECA 869 digital scale and height was measured using a SECA 213 portable stadiometer. Caregivers' percent body fat was measured using an Omron body HBF306C hand-held fat monitor. Participants removed their shoes, hats and heavy clothes for the anthropometric measurements. The weight,

height and body fat were measured to the nearest 1/8 inch, 0.2 lb. and 0.1%, respectively. Body mass index (BMI) for adults was calculated using the Omron monitor and by dividing weight by height squared (kg/m^2). Caregivers' BMIs were interpreted according to the Centers for Disease Control and Prevention (CDC) standard weight status categories: underweight (below 18.5), normal (18.5-24.9), overweight (25.0-29.9) and obese (30.0 and above).⁹⁶

Children's weight statuses were estimated by CDC sex-specific BMI-for-age growth charts and were categorized according to the corresponding BMI-for-age percentiles: underweight (less than the 5th percentile), healthy weight (5th percentile to less than the 85th percentile), overweight (85th to less than 95th percentile) and obese (equal to or greater than the 95th percentile).⁹⁷

3.2 Demographic characteristics

Ages of children were calculated by parent-reported date of birth to the day surveyed. Children's and caregivers' races/ethnicities were reported by caregivers (White or Caucasian; Hispanic or Latino; Black or African American; American Indian or Alaskan Native; Native Hawaiian or other Pacific Islander; Asian; multiple races/ethnicities could be selected). Collected caregiver information also included: age, education level (less than 12th grade; high school or equivalent; some college or bachelor's degree), relationship to the child (mother; father; other) and if they ever participated in Supplemental Nutrition Assistance Program (SNAP), the Special Supplemental Nutrition Program for Women, Infants and Children (WIC) and other nutrition classes.

3.3 Assessment of preschoolers' snack food knowledge and stated healthy snack preference

The questionnaire was developed by the UNCE research team which consisted of four experts in nutrition or early childhood education. The instrument for assessing preschoolers' snack food knowledge and stated healthy snack preference was pilot-tested by the UNCE team among 625 low-income parents in Nevada.⁹² Photographs of 30 snack foods typically consumed by¹² or recommended for⁹⁸ preschoolers were shown, and parents were asked to identify the foods that they served as snacks. The most frequently mentioned 15 snacks were chosen for the study instrument. They were milk, apple, carrot, banana, grape, broccoli, soda, French fries, chips, candy, doughnut, cookies, cake, ice cream and chocolate bar. Three new snacks were included and introduced through the program: mango, kiwi fruit and jicama. In total, there were nine healthy and nine unhealthy snacks in the list. These snack foods were randomly selected to form nine healthy and unhealthy snack pairs. The pairs (in the exact sequence that was shown to the preschoolers) were milk/soda, apples/French fries, chips/kiwi fruit, mango/candy, doughnut/carrot, cookies/jicama, banana/cake, grapes/ice cream and chocolate bar/broccoli.

Preschoolers' assessments were conducted in an area near the classroom, where the child felt comfortable and other preschoolers could not hear the content of the assessment. Snack food knowledge was examined by asking preschoolers to identify 18 snack foods and the healthy snacks among nine healthy/unhealthy snack pairs. Stated healthy snack preference was assessed by asking preschoolers to select preferred snacks

among the nine healthy/unhealthy snack pairs. Stated snack preference was examined before healthy snack identification in order to avoid bias. Before the assessment, children were guided to focus on the survey, “Today we are going to talk about snack foods. We eat a snack when it is not time for a meal, like lunch or dinner, but our tummy feels hungry. Do you ever eat snacks? What kind of snacks do you eat or drink after school? I am going to show you a picture of a food, and you tell me what you see in the picture. I am going to write down your answer to help me remember what you share with me today.” Then, for the first part of this survey, the 18 snack foods were shown to the child one at a time. Children scored “1” when they correctly stated the name of the food and scored “0” when they failed to state the correct name (stating the wrong name, telling that they did not know the food or having no response). A snack food identification sum score was calculated by adding up the response scores of 18 snack items, and it ranged from 0 to 18.

For the second part of the survey and to examine preschoolers’ stated healthy snack preference, preschoolers were told, “This time we are going to look at two snacks, and pretend that we are picking one to eat/drink for snack today.” Then, they were asked, “If you could choose one of these foods/drinks to eat/drink for snack today, which one would you choose ___ (the name of the food choice A) or ___ (the name of food choice B)?” Children scored “1” when they chose the healthy food and scored “0” when they chose the unhealthy option or both. A stated healthy snack preference sum score was calculated by adding up the response scores of nine snack pairs, and it ranged from 0 to 9.

In the third section, after being told “I am going to show you the two snack choices again. This time I need your help to decide which snacks are healthy, and help

keep your heart, muscles, and bones strong,” preschoolers were asked, “Which snack is healthy, _____ (the name of the food choice A) or _____ (name of food choice B)?” Children received score of “1” when they correctly identified the healthy food and scored “0” when they chose the unhealthy option or both. A healthy snack identification sum score was calculated by adding up the response scores of 9 snack pairs, and it ranged from 0 to 9.

The three sum scores were grouped into low and high score categories. The mean and median sum scores were different between pre- and post-surveys, and therefore, the same cut-off point could not be selected for the pre- and post-surveys for any of the three outcome measures. For snack food identification sum score, pre-survey mean (10.6) and median (11.0) were close to the 50th percentile (9.0) of the score scale. Similarly, for the healthy snack identification sum score, pre-survey mean (4.4; post-survey mean=6.5) and median (4.0; post-survey median=7.0) were close to the 50th percentile (4.0) of the score scale, as well as the pre- and post-survey means (2.6 and 4.0, respectively) and medians (3.0 and 4.0, respectively) of the healthy snack preference sum score. Thus, the 50th percentile of each score scale was chosen as the cut-off point for low and high sum score categories. The low and high sum score groups of snack food identification were 0-9 and 10-18, respectively; the low and high sum score groups of both healthy snack identification and stated snack preference were 0-4 and 5-9, respectively.

3.4 Caregiver-reported food intake behaviors of preschoolers

Caregivers were interviewed individually in an isolated area at the preschool where others could not hear their answers. When they could not participate in the entire survey at the preschool, their interviews were completed by telephone.

Caregivers' pre- and post-surveys included questions about home fruit and vegetable availability, preschoolers' fruit, vegetable and unhealthy snack intake frequencies at home, and caregivers' beliefs on preschoolers' fruit and vegetable intake. Caregivers were asked to respond to four statements regarding fruit and vegetable availability at home: "I buy fruits," "I buy vegetables," "I keep fruits ready for my child to eat" and "I keep vegetables ready for my child to eat." Their responses were recorded as "never," "now & then," "sometimes," "often" or "always."

Preschoolers' fruit and vegetable intake frequencies at home were assessed by four questions: "My preschooler eats most vegetables," "My preschooler eats most fruits," "My preschooler asks to eat fruits and/or vegetables for snacks" and "My preschooler eats fruit and vegetables." Caregivers' responses were recorded as "never," "now & then," "sometimes," "often" or "always."

Caregivers' beliefs regarding preschoolers' fruit and vegetable intake were assessed by two questions: "My preschooler eats enough fruits to keep him/her healthy" and "My preschooler eats enough vegetables to keep him/her healthy." Caregivers' responses were recorded as "yes," "no" or "unsure."

Preschoolers' unhealthy food intake frequencies were assessed by the questions shown in Table 3.

Table 3. Questions for assessing preschoolers unhealthy snack intake

Question	Response
My preschooler eats too much junk food, like candy and chips.	Never, now & then, sometimes, often, always
My preschooler eats too many sweets.	
My preschooler asks to eat junk food for snack.	
During a typical day, my child eats candy...	Never, 1-2 times, 3-4 times, ≥ 5
During a typical day, my child eats chips...	times
In a typical week, on average, my child drinks soda...	Never, 1-3 days, 4-6 days, everyday

4. Statistical Analyses

The data were analyzed by using IBM SPSS Statistics for Windows (Version 21.0, Armonk, NY: IBM Corp). Descriptive analyses were performed for every variable. The pre- and post-survey comparisons of the percentages of correct and incorrect answers on preschoolers' snack food knowledge (snack food identification and healthy snack identification) and stated healthy snack preference were completed using McNemar's test. The pre- and post-survey difference in snack food identification sum scores was examined using paired sample t-test because the Shapiro-Wilk test indicated that pre- and post-survey scores were normally distributed. The pre- and post-survey differences in healthy snack identification and stated healthy snack preference sum scores were compared using the Wilcoxon signed-rank test since the scores were not normally

distributed. In addition, pre- and post-survey differences in the low and high sum score groups were compared using McNemar's test.

Preschoolers' snack food knowledge and stated healthy snack preference sum scores by gender, race/ethnicity and BMI-for-age percentile were compared using Mann-Whitney U test separately for pre- and post-surveys. The comparisons of preschoolers' snack food knowledge and healthy snack preference sum scores by age were done using analysis of variance (ANOVA) test with Bonferroni adjustment.

The relationships between preschoolers' snack food identification, healthy snack identification and stated healthy snack preference sum scores were explored using Spearman correlation. Cross-tabulations between low and high categories of healthy snack identification and stated healthy snack preference sum scores were examined using Fisher's exact test at pre- and post-surveys separately.

The pre-and post-survey comparisons of caregiver-reported fruit and vegetable availability and preschoolers' food intake frequencies at home were examined using Wilcoxon signed-rank test. The significance level for all tests was set at a two-sided value of 0.05.

IV. RESULTS

1. Demographic and Anthropometric Characteristics of Preschoolers

A total of 45 preschoolers participated in the All 4 Kids[®] program and completed the snack food knowledge and healthy snack preference assessment at pre- and post-surveys (Table 4). There were a few more girls than boys. Children's ages ranged from three to five years and with a mean of 3.9 ± 0.8 years. The majority of participating preschoolers (71.1%) were Hispanics and 24.4% were Blacks. About one third of the children were either overweight or obese.

Table 4. Characteristics of preschoolers (n=45)

Characteristics	n (%)	Mean±SD
Gender		
Male	20 (44.4)	
Female	25 (55.6)	
Age		
		3.9±0.8
3	12 (26.7)	
4	23 (51.1)	
5	10 (22.2)	
Race/ethnicity		
Hispanic	32 (71.1)	
Black	11 (24.4)	
Mixed ^a	2 (4.4)	
Weight status^b		
BMI-for-age percentile		68.3±26.6
Underweight	2 (4.4)	
Normal weight	28 (62.2)	
Overweight	7 (15.6)	
Obese	8 (17.8)	

a. Mixed refers to a biracial heritage of Black and Hispanic.

b. BMI (body mass index) percentile-for-age was calculated from 2000 CDC BMI-for-age growth charts.⁹⁷

2. Demographic and Anthropometric Characteristics of Caregivers

Among the 45 participating caregivers (Table 4), nearly three-quarters were mothers. Slightly more than one quarter of caregivers reported not completing high school. A majority of them (77.8%) reported participating in one or more federal assistance programs such as SNAP or WIC. Three quarters of caregivers were either overweight or obese.

Table 5. Characteristics of caregivers (n=45)

Characteristics	n (%)	Mean±SD
Gender		
Male	12 (26.7)	
Female	33 (73.3)	
Age		32.0 ±7.8
Relationship to the study child		
Mother	32 (71.1)	
Father	11 (24.4)	
Other	2 (4.4)	
Race/ethnicity		
Hispanic	31 (68.9)	
Black	11 (24.4)	
Mixed	2 (4.4)	

Table 5. (continued) Characteristics of caregivers (n=45)

Characteristics	n (%)	Mean±SD
Education		
< 12 th grade	13 (28.9)	
High school/GED	19 (42.2)	
Some college	12 (26.7)	
≥ Bachelor's degree	1 (2.2)	
Federal assistance program participation		
SNAP	21 (46.7)	
WIC	30 (66.7)	
Other nutrition classes	1 (2.2)	
BMI		28.5±4.9
Normal (18.5-24.9)	10 (25.0)	
Overweight (25.0-29.9)	16 (40.0)	
Obese (>30)	14 (35.0)	
Body fat %		30.3 ±6.9

GED: General Education Development which certifies high school equivalency;

SNAP: Supplemental Nutrition Assistance Program; WIC: the Special Supplemental Nutrition Program for Women, Infants and Children.

3. Preschoolers' Food Knowledge and Preference

Preschoolers' food knowledge was represented by each preschooler's ability to state the names of 18 snack foods and their ability to identify the healthy snacks among nine healthy-unhealthy snack pairs. Preschoolers' healthy snack preferences were determined by their stated selection among nine healthy-unhealthy snack pairs.

3.1 Snack food identification

At pre-survey, the proportions of children who correctly identified the snack foods ranged from 0% to 95.6% (Table 6). The least identified snack foods were jicama (n=0) and kiwi fruit (n=3). There were nine snacks that more than two-thirds of the children correctly identified, and only three of these were healthy snacks: apple, banana and carrot. After the program implementation, the proportions of children who correctly stated the names of 18 snack foods increased for all foods and ranged from 35.6% to 100%. The number of children who correctly identified jicama and kiwi fruit increased to 16 and 23, respectively.

Table 6. Snack food identification at pre-survey and post-survey among 45 preschoolers

Snack foods	Pre		Post		p-value ^b
	Correct ^a	Incorrect ^a	Correct	Incorrect	
	n (%)	n (%)	n (%)	n (%)	
Milk	23 (51.1)	22 (48.9)	43 (95.6)	2 (4.4)	0.000
Apples	41 (91.1)	4 (8.9)	42 (93.3)	3 (6.7)	1.000
Kiwi fruit	3 (6.7)	42 (93.3)	23 (51.1)	22 (48.9)	0.000
Mango	11 (24.4)	34(75.6)	28 (62.2)	17 (37.8)	0.000
Carrots	32 (71.1)	13 (28.9)	41 (91.1)	4 (8.9)	0.022
Jicama	0	45 (100)	16 (35.6)	29 (64.4)	0.000
Banana	43 (95.6)	2 (4.4)	45 (100)	0	0.500
Grapes	26 (57.8)	19 (42.2)	29 (64.4)	16 (35.6)	0.549
Broccoli	24 (53.3)	21 (46.7)	34 (75.6)	11 (24.4)	0.006

a. Correct: stating the name of the food correctly; incorrect: stating the wrong name, telling that they do not know the food or having no response.

b. Based on McNemar's test comparing the differences between pre-survey and post-survey results.

Table 6. (continued) Snack food identification at pre-survey and post-survey among 45 preschoolers

Snack foods	Pre		Post		p-value ^b
	Correct ^a n (%)	Incorrect ^a n (%)	Correct ^a n (%)	Incorrect ^a n (%)	
Soda	33 (73.3)	12 (26.7)	45 (100)	0	0.000
French fries	35 (77.8)	10 (22.2)	36 (80.0)	9 (20.0)	1.000
Potato chips	13 (28.9)	32 (71.1)	26 (57.8)	19 (42.2)	0.000
Candy	43 (95.6)	2 (4.4)	44 (97.8)	1 (2.2)	1.000
Doughnuts	24 (53.3)	21 (46.7)	33 (73.3)	12 (26.7)	0.012
Cookies	38 (84.4)	7 (15.6)	43 (95.6)	2 (4.4)	0.063
Cake	34 (75.6)	11 (24.4)	41 (91.1)	4 (8.9)	0.065
Ice-cream	22 (48.9)	23 (51.1)	36 (80.0)	9 (20.0)	0.001
Chocolate bar	32 (71.1)	13 (28.9)	39 (86.7)	6 (13.3)	0.118

a. Correct: stating the name of the food correctly; incorrect: stating the wrong name, telling that they do not know the food or having no response.

b. Based on McNemar's test comparing the differences between pre-survey and post-survey results.

Preschoolers' average sum score of identifying the 18 snack foods increased from 10.6 ± 2.9 at pre-survey to 14.3 ± 2.6 at post-survey ($p < 0.001$). When low and high categories of snack food identification sum scores were examined (Table 7), significantly more children had high snack identification sum scores at post-survey than at pre-survey (43 vs. 29, respectively; $p < 0.001$).

Table 7. Crosstabulation of snack identification sum scores at pre-survey and post-survey among 45 preschoolers

		Pre sum score		Total n (%)
		Low ^a n (%)	High ^a n (%)	
Post sum score	Low ^a	2 (12.5)	0 (0.0)	2 (4.4)
	High ^a	14 (87.5)	29 (100.0)	43 (95.6)
Total		16 (100.0)	29 (100.0)	45 (100.0)
p-value ^b			<0.001	

a. Low score: 0 to 9; high score: 10 to 18.

b. Based on McNemar's test comparing the differences between pre-survey and post-survey results.

The mean snack identification sum scores by demographic and anthropometric characteristics were examined separately for each of the pre- and post-surveys. The results showed that the mean scores were not significantly different between girls and boys and between children with BMI-for-age <85th percentile and $\geq 85^{\text{th}}$ percentile at both pre- and post-surveys (Table 8). Statistically significant differences were found by

race/ethnicity and age groups. Black/mixed race preschoolers had significantly higher snack food identification sum scores than that of Hispanic preschoolers at pre-survey, but this difference was not statistically significant at post-survey. In addition, five-year-olds performed significantly better than three-year-olds at both pre- and post-surveys.

Table 8. Comparisons of preschoolers' snack food identification sum scores by demographic and anthropometric characteristics

	Pre		Post	
	Mean±SD	p-value	Mean±SD	p-value
Gender:				
Male	10.2±2.4	0.428 ^a	13.8±2.7	0.373 ^a
Female	10.9±3.3		14.7±2.6	
Race/ethnicity:				
Hispanic	9.8±2.7	0.003 ^a	13.8±2.7	0.082 ^a
Black/mixed	12.6±2.5		15.5±2.1	
Age:				
3 (vs.5)	8.4±2.2	0.003 ^b	12.6±3.0	0.011 ^b
4 (vs.3)	11.0±2.9	0.026 ^b	14.6±2.3	0.081 ^b
5 (vs.4)	12.4±2.3	0.447 ^b	15.8±1.9	0.561 ^b
BMI-for-age percentile:				
<85 th percentile	10.1±3.0	0.113 ^a	13.9±2.8	0.184 ^a
≥85 th percentile	11.5±2.6		15.0±2.1	

a. Based on Mann-Whitney U test comparing the differences at pre- and post-surveys separately.

b. Based on ANOVA comparing the differences between age groups at pre- and post-surveys separately. The significance level was set to 0.017 by Bonferroni correction.

3.2 Healthy snack identification

At pre-survey, the proportions of children who correctly identified healthy snacks among nine snack pairs ranged from 33.3% to 66.7% (Table 9). The lowest proportion was reported for the pair of cookies/jicama. There were only three healthy snacks correctly identified by more than half of the preschoolers: milk (66.7%), mango (51.1%) and banana (60.0%). After the program implementation, proportions of children who correctly identified the healthy snacks ranged from 64.4% to 82.2%. Thirty one (68.9%) children correctly identified jicama as a healthy food at post-survey. Although there was a general increase in healthy snack identification for every snack pair, increases were statistically significant only for apple, kiwi fruit, carrot, jicama and broccoli.

Table 9. Healthy snack identification at pre-survey and post-survey among 45 preschoolers

Snack pairs	Pre		Post		p-value ^a
	Correct	Incorrect	Correct	Incorrect	
	n (%)	n (%)	n (%)	n (%)	
Milk/soda	30 (66.7)	15 (33.3)	34 (75.6)	11 (24.4)	0.424
Apples/French fries	21 (46.7)	24 (53.3)	37 (82.2)	8 (17.8)	0.000
Kiwi fruit/potato chips	22 (48.9)	23 (51.1)	33 (73.3)	12 (26.7)	0.027
Mango/candy	23 (51.1)	22 (48.9)	29 (64.4)	16 (35.6)	0.238
Carrots/ doughnut	16 (35.6)	29 (64.4)	34 (75.6)	11 (24.4)	0.000
Jicama/cookies	15 (33.3)	30 (66.7)	31 (68.9)	14 (31.1)	0.001
Banana/cake	27 (60.0)	18 (40.0)	34 (75.6)	11 (24.4)	0.167
Grapes/ice cream	22 (48.9)	23 (51.1)	30 (66.7)	15 (33.3)	0.096
Broccoli/chocolate bar	22 (48.9)	23 (51.1)	33 (73.3)	12 (26.7)	0.003

a. Based on McNemar's test comparing the differences between pre-survey and post-survey results.

The healthy snack identification sum score increased from 4.4 ± 2.5 at pre-survey to 6.5 ± 2.5 at post-survey ($p < 0.001$). An examination of low and high categories of healthy snack identification sum scores showed that significantly more children obtained high healthy snack identification sum scores at post-survey than at pre-survey (34 vs. 18, respectively; $p < 0.001$), (Table 10).

Table 10. Crosstabulation of healthy snack identification sum scores at pre-survey and post-survey among 45 preschoolers

		Pre sum score		Total n (%)
		Low ^a n (%)	High ^a n (%)	
Post sum score	Low ^a	11 (40.7)	0 (0.0)	11(24.4)
	High ^a	16 (59.3)	18 (100.0)	34 (75.6)
Total		27 (100.0)	18 (100.0)	45 (100.0)
p-value ^b		<0.001		

a. Low score: 0 to 4; high score: 5 to 9.

b. Based on McNemar's test comparing the differences between pre-survey and post-survey results.

There were no statistically significant differences in the healthy snack identification sum scores by gender and by BMI-for-age percentiles at pre-and post-surveys (Table 11). Similar to snack identification sum scores, statistically significant differences were found within race/ethnicity and age groups. Black/mixed race preschoolers had significantly higher healthy snack identification sum scores than that of Hispanic preschoolers at pre-survey ($p=0.008$) and post-survey ($p=0.030$). Although there was no statistically significant difference in the healthy snack identification sum scores between age groups at pre-survey, 4-year-olds and 5-year-olds had significantly higher healthy snack identification sum scores than 3-year-olds at post-survey.

Table 11. Comparisons of preschoolers' healthy snack identification sum scores by demographic and anthropometric characteristics

	Pre		Post	
	Mean±SD	p-value	Mean±SD	p-value
Gender:				
Male	4.8±2.5	0.338 ^a	6.3±2.8	0.646 ^a
Female	4.1±2.6		6.8±2.3	
Race/ethnicity:				
Hispanic	3.8±2.2	0.008 ^a	6.0±2.7	0.030 ^a
Black/mixed	6.4±2.7		8.0±1.3	
Age:				
3 (vs.5)	3.8±1.1	0.173 ^b	4.8±1.9	0.003 ^b
4 (vs.3)	4.1±2.4	1.000 ^b	6.8±2.6	0.048 ^b
5 (vs.4)	5.8±3.5	0.238 ^b	8.2±1.8	0.323 ^b
BMI-for-age percentile:				
<85 th percentile	4.2±2.4	0.444 ^a	6.4±2.6	0.511 ^a
≥85 th percentile	4.9±2.8		6.9±2.5	

a. Based on Mann-Whitney U test comparing the differences at pre- and post-surveys separately.

b. Based on ANOVA comparing the differences between age groups at pre- and post-surveys separately. The significance level was set to 0.017 by Bonferroni correction.

3.3 Stated healthy snack preference

At pre-survey, proportions of children who stated preference for healthy snacks ranged from 17.8% to 55.6% (Table 12). Milk and banana were the only two healthy snack foods selected by more than half of the children, and jicama and mango were the least preferred snacks. After the program implementation, there was a general increase in stated healthy snack preference. Proportions of children who stated preference for healthy snacks ranged from 42.2% to 66.7% at post-survey. Significantly more preschoolers improved their stated healthy snack preference for apple, kiwi fruit, mango, carrot and jicama.

Table 12. Stated healthy snacks preference at pre-survey and post-survey among 45 preschoolers

Snack pairs	Pre		Post		p-value ^a
	Correct	Incorrect	Correct	Incorrect	
	n (%)	n (%)	n (%)	n (%)	
Milk/soda	24 (53.3)	21 (46.7)	27 (60.0)	18 (40.0)	0.629
Apples/French fries	15 (33.3)	30 (66.7)	29 (64.4)	16 (35.6)	0.001
Kiwi fruit/potato chips	19 (42.2)	26 (57.8)	28 (62.2)	17 (37.8)	0.021
Mango/candy	9 (20.0)	36 (80.0)	24 (53.3)	21 (46.7)	0.000
Carrots/ doughnut	11 (24.4)	34 (75.6)	24 (53.3)	21 (46.7)	0.002
Jicama/cookies	8 (17.8)	37 (82.2)	19 (42.2)	26 (57.8)	0.003
Banana/cake	25 (55.6)	20 (44.4)	30 (66.7)	15 (33.3)	0.332
Grapes/ice cream	20 (44.4)	25 (55.6)	23 (51.1)	22 (48.9)	0.503
Broccoli/chocolate bar	12 (26.7)	33 (73.3)	16 (35.6)	29 (64.4)	0.227

a. Based on McNemar's test comparing the difference between pre-survey and post-survey results

The stated healthy snack preference sum score increased from 3.2 ± 1.9 at pre-survey to 4.9 ± 2.8 at post-survey ($p < 0.001$). When low and high categories of stated healthy snack preference sum scores were examined (Table 13), significantly more children had high stated healthy snack preference sum scores at post-survey than at pre-survey (22 vs. 8, respectively; $p < 0.001$).

Table 13. Crosstabulation of stated healthy snack preference sum scores at pre-survey and post-survey among 45 preschoolers

		Pre sum score		Total n (%)
		Low ^a n(%)	High ^a n(%)	
Post sum score	Low ^a	22 (59.5%)	1 (12.5%)	23 (51.1%)
	High ^a	15 (40.5%)	7 (87.5%)	22 (48.9%)
Total		37 (100.0%)	8 (100.0%)	45 (100.0%)
p-value ^a		<0.001		

a. Low score: 0 to 4; high score: 5 to 9.

b. Based on McNemar's test comparing the differences between pre-survey and post-survey results

There were no statistically significant differences in the stated healthy snack preference sum scores by gender, age and BMI-for-age percentiles (Table 14). The stated healthy snack preference sum scores were significantly higher among Black/mixed race children than Hispanic children at pre-survey ($p=0.042$) and post-survey ($p=0.025$).

Table 14. Comparisons of preschoolers' stated healthy snack preference sum scores by demographic and anthropometric characteristics

	Pre		Post	
	Mean±SD	p-value	Mean±SD	p-value
Gender:				
Male	3.4±2.0	0.724 ^a	4.8±3.0	0.746 ^a
Female	3.0±1.8		5.0±2.7	
Race/ethnicity:				
Hispanic	2.8±1.4	0.042 ^a	4.3±2.8	0.025 ^a
Black/mixed	4.2±2.8		6.1±2.6	
Age:				
3 (vs.5)	3.3±1.4	1.000 ^b	3.8±1.5	0.234 ^b
4 (vs.3)	2.7±1.5	1.000 ^b	5.0±3.0	0.594 ^b
5 (vs.4)	4.1±2.8	0.152 ^b	5.9±3.2	1.000 ^b
BMI-for-age percentile:				
<85 th percentile	3.3±1.6	0.189 ^a	4.6±2.8	0.306 ^a
≥85 th percentile	2.8±2.3		5.5±2.7	

a. Based on Mann-Whitney U test comparing the differences at pre- and post-surveys separately.

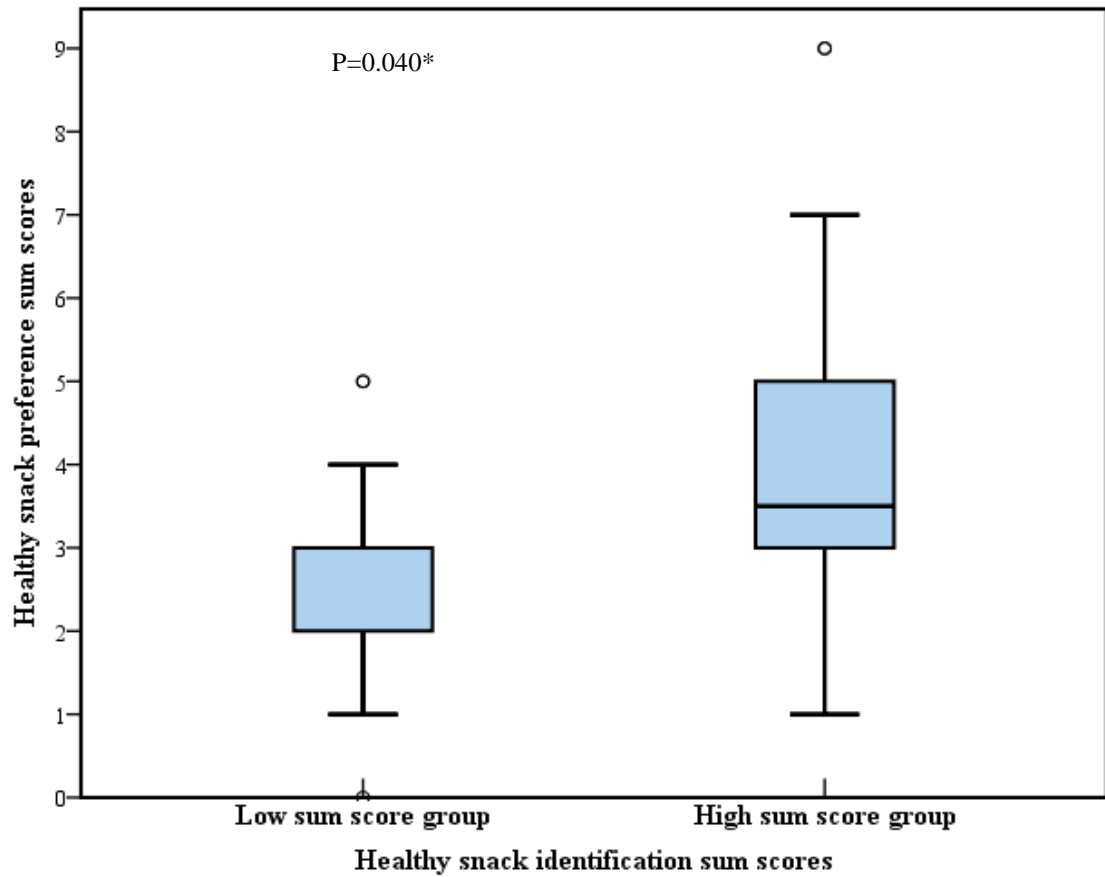
b. Based on ANOVA comparing the differences between age groups at pre- and post-surveys separately. The significance level was set to 0.017 by Bonferroni correction.

3.4 Correlations between preschoolers' snack food knowledge and stated healthy snack preference

Spearman correlation analyses revealed that the preschoolers' snack food identification sum score was not significantly correlated with the healthy snack identification sum score ($\rho=0.281$, $p=0.062$) and stated healthy snack preference sum score ($\rho=0.125$, $p=0.413$) at pre-survey, but these correlations were statistically significant at post-survey ($\rho=0.506$, $p<0.001$; $\rho=0.410$, $p=0.005$, respectively). Because only two preschoolers received low snack identification sum scores at post-survey, the low versus high score group differences were not examined.

Spearman correlation analyses of the pre-survey data revealed that healthy snack identification sum score was correlated with stated healthy snack preference sum scores ($\rho=0.424$, $p=0.004$). When preschoolers were divided into low and high healthy snack identification sum score groups, it was found that preschoolers from high versus low healthy snack identification sum score group had significantly higher stated healthy snack preference sum scores (Figure 1). In addition, most preschoolers with high stated healthy snack preference sum scores were from the high healthy snack identification sum score group (Table 15).

Figure 1. The boxplot of preschoolers' stated healthy snack preference sum scores by healthy snack identification sum score groups at pre-survey



* Low (0 to 4) and high (5 to 9) score groups were compared by Mann-Whitney U

Table 15. Crosstabulation of healthy snack identification sum scores and stated healthy snack preference sum scores at pre-survey among 45 preschoolers

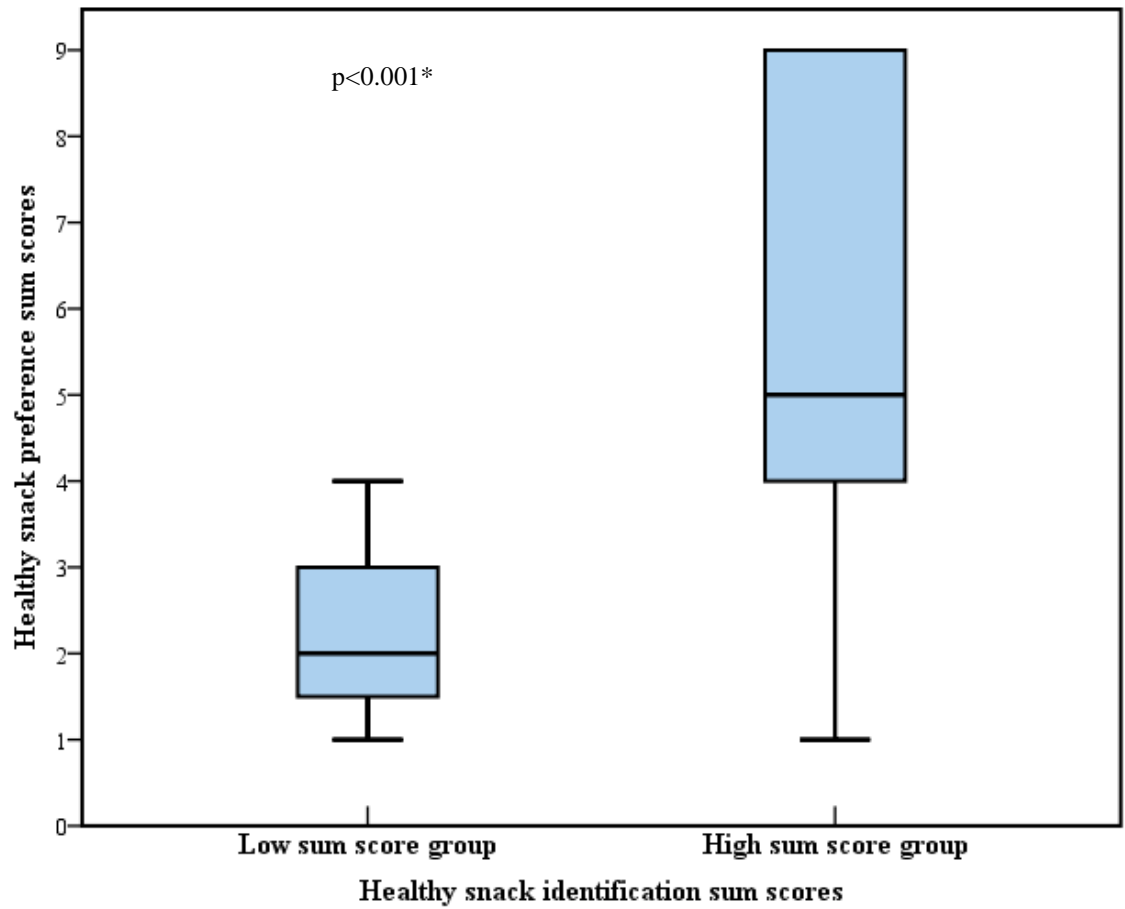
		Healthy snack identification		Total n (%)
		Low ^a n (%)	High ^a n (%)	
Stated healthy snack preference	Low ^a	25 (92.6%)	12 (66.7%)	37 (82.2%)
	High ^a	2 (7.4%)	6 (33.3%)	8 (17.8%)
Total		27 (100.0%)	18 (100.0%)	45 (100.0%)
p-value ^b		0.045		

a. Low score: 0 to 4; high score: 5 to 9.

b. Compared by Fisher's exact test.

After the program implementation, the correlation between healthy snack identification sum scores and stated healthy snack preference sum scores became stronger ($\rho=0.730$, $p<0.001$). When preschoolers were divided into low and high healthy snack identification sum score groups, it was found that preschoolers from the high versus low snack identification sum score group had significantly higher stated healthy snack preference sum scores (Figure 2). In addition, all of the preschoolers with high stated healthy snack preference sum scores were from high healthy snack identification sum score group (Table 16).

Figure 2. The boxplot of preschoolers' stated healthy snack preference sum scores by healthy snack identification sum score groups at post-survey



* Low (0 to 4) and high (5 to 9) score groups were compared by Mann-Whitney U

Table 16. Crosstabulation of healthy snack identification sum scores and stated healthy snack preference sum scores at post-survey among 45 preschoolers

	Healthy snack identification		Total n (%)	
	Low ^a	High ^a		
	n (%)	n (%)		
Stated healthy	Low ^a	11 (100.0%)	12 (35.3%)	23 (51.1%)
snack preference	High ^a	0 (0.0%)	22 (64.7%)	22 (48.9%)
	Total	11 (100.0%)	34 (100.0%)	45 (100.0%)
	p-value ^b		0.000	

a. Low score: 0 to 4; high score: 5 to 9.

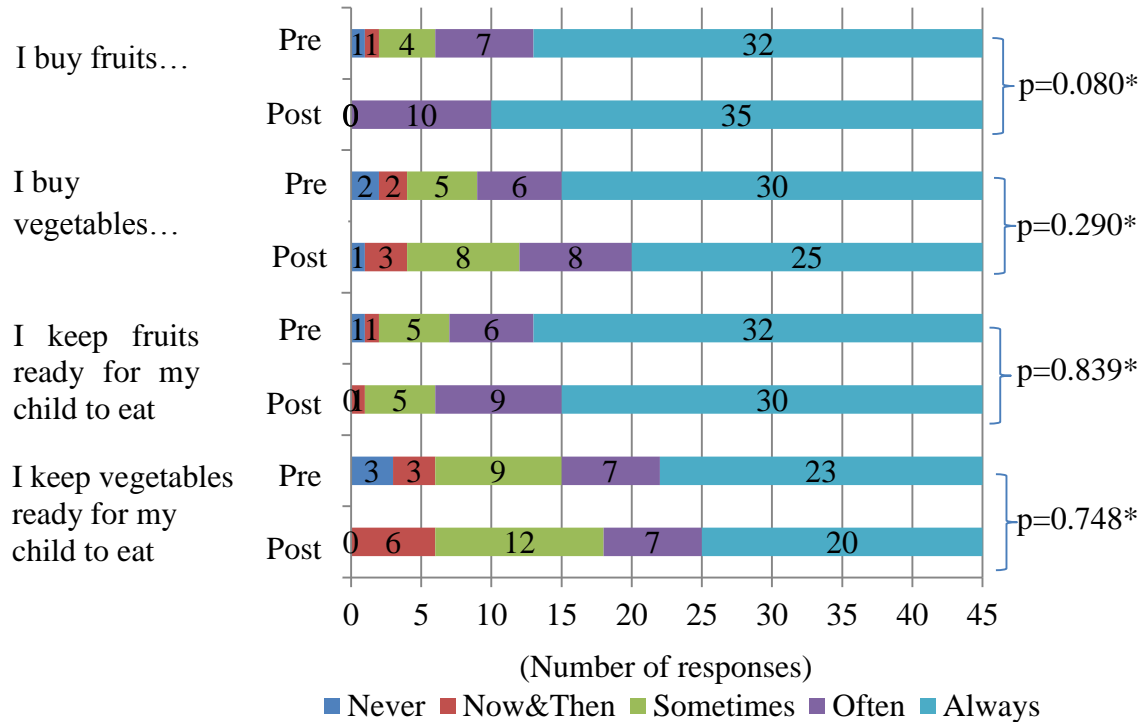
b. Compared by Fisher's exact test.

4. Caregiver-reported Home Fruit and Vegetable Availability at Home

At both pre- and post-surveys, the majority of parents reported that they often or always purchased fruits and vegetables and kept fruits and vegetables ready for their children to eat (Figure 3). There were only a few caregivers who never or now & then bought fruits or vegetables and kept fruits or vegetables for their children to eat. The number of caregivers who reported that they often or always bought fruits slightly increased from pre-survey to post-survey ($p=0.080$).

Regarding the availability of fruits and vegetables at home, fewer caregivers reported that they often or always bought vegetables versus fruits (pre: 39 versus 36 and post: 45 versus 33), and kept vegetables ready for their children to eat (pre: 38 versus 30 and post: 39 versus 27).

Figure 3. Caregiver-reported fruit and vegetable availability at home during pre- and post-surveys



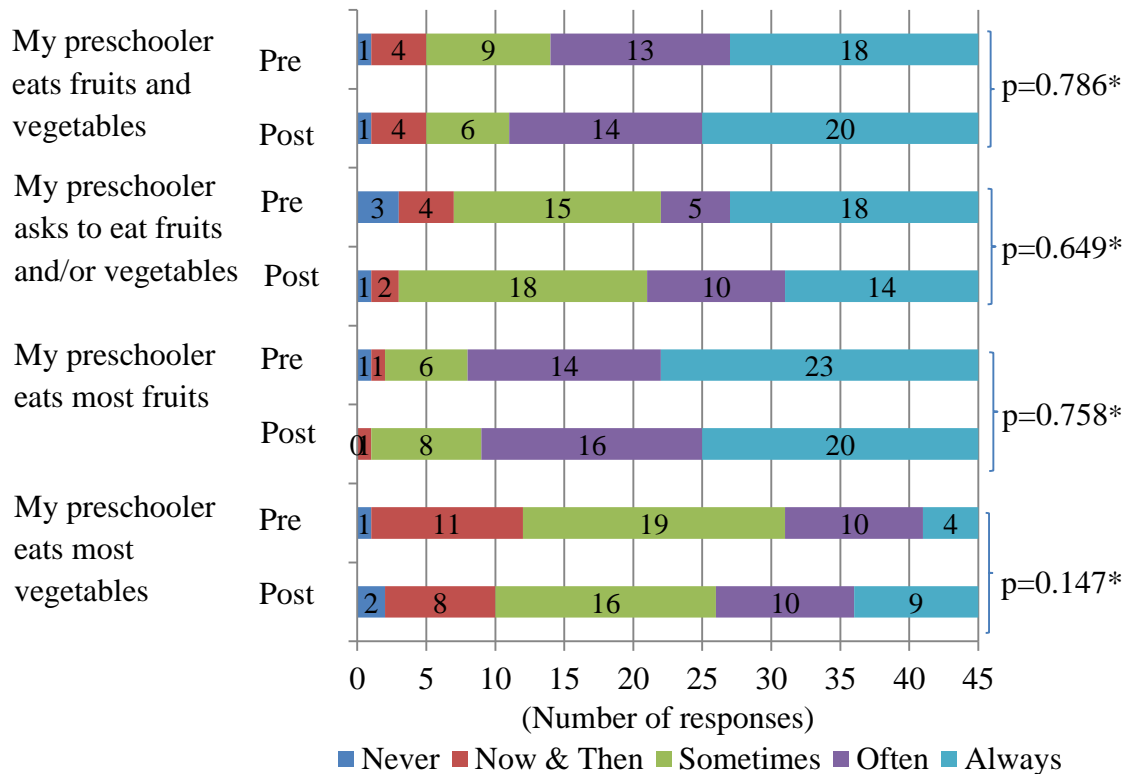
*Pre-and post-survey differences were compared by Wilcoxon signed-rank test.

5. Preschoolers' Fruit and Vegetable Intake at Home and Caregivers' Beliefs on Preschoolers' Fruit and Vegetable Intake

The majority of caregivers reported that their preschoolers often or always ate fruits and vegetables at home (pre: n=31, 69%; post: n=34, 76%) and asked to eat fruits or vegetables for snacks (pre: n=23, 51%; post: n=24, 53%) (Figure 4). While the majority of the caregivers reported that their preschoolers often or always ate most fruits (pre: n=37, 82%, post: n=36, 80%), fewer caregivers reported that their preschoolers often or always ate most vegetables (pre: n=14, 31%; post: n=19, 42%). Caregivers'

responses on preschoolers' fruit and vegetable intake were not significantly different between pre-survey and post-survey.

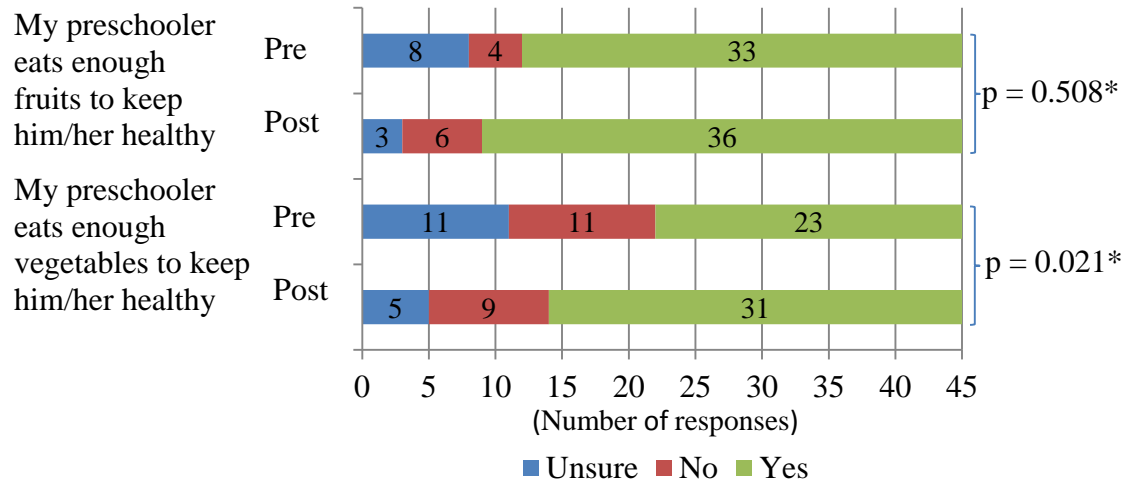
Figure 4. Preschoolers' fruit and vegetable intake reported by caregivers at pre- and post-surveys



*Pre-and post-survey differences were compared by Wilcoxon signed-rank test.

The majority of caregivers believed that their preschoolers ate enough fruits to keep them healthy (pre: n=33, 73%; post: n=36, 80%), and there was no statistically significant difference between pre- and post-surveys (Figure 5). Significantly more caregivers stated that their preschoolers ate enough vegetables to stay healthy at post-survey than at pre-survey.

Figure 5. Caregivers' beliefs on preschoolers' fruit and vegetable intake at pre- and post-surveys



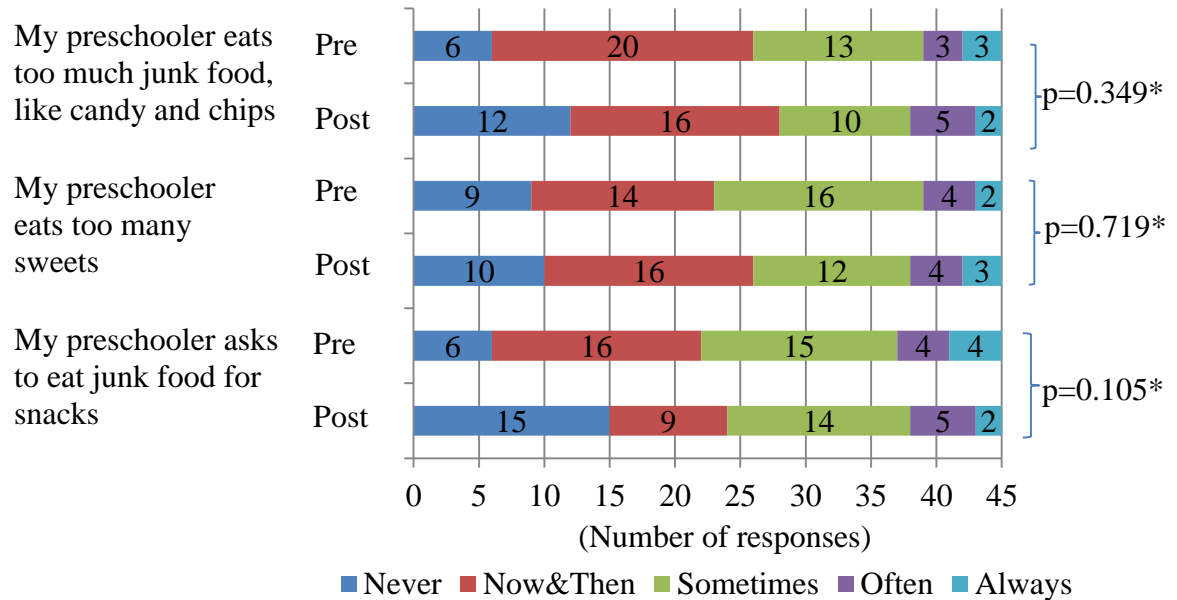
*Pre-and post-survey differences were compared by Wilcoxon signed-rank test.

6. Preschoolers' Unhealthy Food Intake Frequencies at Home

About half of caregivers reported that their preschoolers never or now & then ate too much junk food or sweets or asked to eat junk food for snacks (Figure 6). There were only a few caregivers who reported that their preschoolers often or always ate too much junk food or sweets or asked to eat junk food for snacks at both pre- and post-surveys.

There were no statistically significant differences in preschoolers' unhealthy food intake between pre- and post-surveys.

Figure 6. Preschoolers' unhealthy snack food intake reported by caregivers at pre- and post-surveys

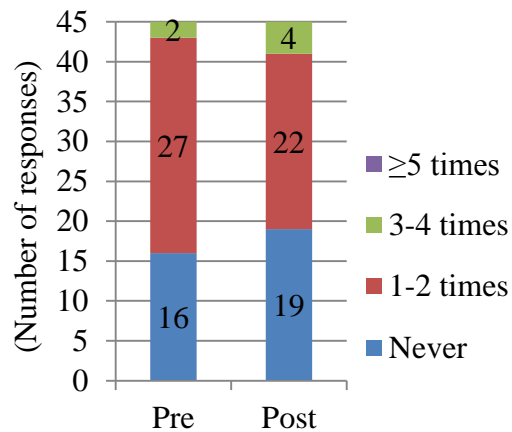


*Pre-and post-survey differences were compared by Wilcoxon signed-rank test.

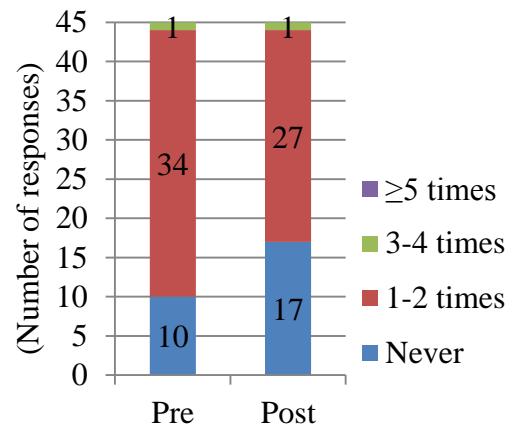
Caregivers' reports on preschoolers' intake of three typical unhealthy snacks at both pre- and post-surveys indicated that 64% (pre) to 58% (post) of preschoolers ate candy at least 1-2 times on a typical day; 78% (pre) to 62% (post) of them ate chips at least 1-2 times on a typical day and 49% (pre) to 44% (post) of them drank soda at least 1-3 days during a typical week (Figure 7). Although fewer caregivers reported that their preschoolers consumed candy, chips and soda at post-survey than at pre-survey, the differences were not statistically significant.

Figure 7. Preschoolers' candy, chips and soda intake reported by caregivers at pre- and post-surveys

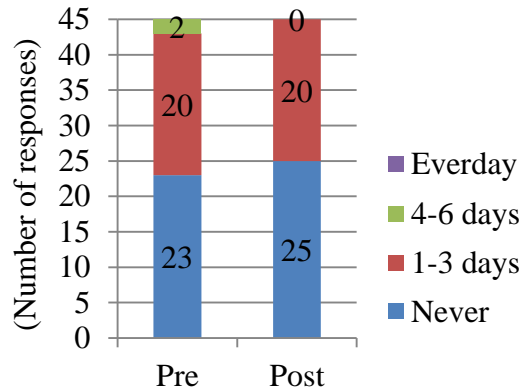
During a typical day, my child eats candy... (p=0.739*)



During a typical day, my child eats chips... (p=0.052*)



In a typical week, on average, my child drinks soda... (p=0.152*)



*Pre- and post-survey differences were compared by Wilcoxon signed-rank test.

V. DISCUSSION

This study examined the potential influence of the All 4 Kids[®] program on preschoolers' snack food knowledge and stated healthy snack preference. It also explored preschoolers' food intake frequencies and the provision of fruit and vegetable at home before and after the program implementation. The participants of this study were Hispanic and Black children from low-income families.

The results indicated that after participating in the All 4 Kids[®] program, preschooler's ability to identify snack foods increased significantly. Similar results were reported in two earlier studies. Gorelick and colleagues reported that preschoolers who participated in 12 food and nutrition classroom activities had significantly higher vegetable and fruit identification scores than the control group.⁸¹ Cason and colleagues also reported significantly higher fruit and vegetable identification scores among preschoolers after attending 12 nutrition lessons.⁸² The majority of the participants in these older studies were White and Black preschoolers. The results of current study among Hispanic and Black children from low-income families are new additions to the literature and indicate that children in these at-risk population subgroups can benefit from nutrition education programs to improve their food knowledge.

Preschoolers in the current study also significantly improved their healthy snack identification scores after participating in the program. This finding supports the appropriateness of the teaching strategies. These strategies were to connect the abstract concepts of healthy/unhealthy foods with a concrete idea of the impact on body parts and to label healthy versus unhealthy foods as "Go" versus "Whoa" snacks. Similar improvements in preschoolers' food knowledge were reported previous studies that used

similar strategies to introduce the concepts of healthy/unhealthy foods. For example, Bannon and colleagues introduced the concept of healthy eating as “if you choose to eat healthy foods like apples you will have more energy to play and be active, especially with your friends” to 5-year-old, mostly White, preschoolers.⁸⁸ Galst and colleagues taught 3- to 6-year-old preschoolers that snacks with added sugar could lead to tooth decay.⁹¹ Two previous programs used similar terms of “Go and grow food” and “Slow foods.” One of these studies reported a significant improvement in preschoolers’ healthy food knowledge,⁷⁸ but the other study did not examine food knowledge change.⁷⁶ In addition, some of the nutrition education programs that reported positive changes in preschoolers’ nutrition knowledge scores did not clarify how healthy or unhealthy foods were defined.^{69, 82, 87, 94} Therefore, teaching strategies of the current study are useful additions for designing future preschool nutrition education programs.

In addition to increased snack food knowledge, the All 4 Kids[®] program participation was also linked to improvements on preschoolers’ stated healthy snack preference. Many of the previous studies asked preschoolers how much they liked a specific food item one at a time.^{88, 94, 99} To the author’s knowledge, the approach in examining preschoolers’ preferences by asking them to select between the healthy and unhealthy snack pairs in the current study was a new contribution to the literature. This method can help predict which snack the preschooler would choose when both healthy and unhealthy snacks are present.

However, the question remains whether preschoolers could apply healthy/unhealthy food concepts beyond the curriculum and outside classroom. This question was explored in a study, by Linebarger et al., where preschoolers were able to

recall education content from healthy eating videos and transferred their knowledge to novel situations.⁸⁹ Because current study only tested preschoolers' nutrition knowledge and preferences based on the All 4 Kids[®] curriculum, their ability to apply healthy/unhealthy food concepts to other foods and eating occasions needs further exploration.

In the current study, the influence of the All 4 Kids[®] program was examined immediately after the program implementation. Interestingly, a 2.5-year nutrition education program showed that children's fruit and vegetable knowledge scores remained significantly higher than the control group, but a decaying effect was found in children's fruit and vegetable intake at school at one year follow up after the intervention.⁹⁴ This finding raises the question whether and how long the All 4 Kids[®] program could keep a positive effect on preschoolers' food knowledge and preference. Thus, a follow-up study will need to examine the changes in the long-term effect of the All 4 Kids[®] program.

In the current study, the Black/mixed race/ethnicity group consistently performed better than the Hispanic children in terms of healthy snack identification and healthy snack preference sum scores. The racial/ethnic differences in preschoolers' food knowledge and preference were not compared in most of the previous studies.^{79, 81, 83, 88, 94,}
¹⁰⁰ To the author's knowledge, only Cason and colleagues examined the racial/ethnic variations in fruit and vegetable identification scores between Black and White preschoolers, but they did not detect a statistically significant difference.⁸² Although both Hispanic and Black preschoolers in the current study improved their knowledge scores after participating in the program, language limitations of Hispanic children and their

families could be underlying these racial/ethnic differences and should be further studied in future research.

In this study, older preschoolers had significantly higher food knowledge scores than younger preschoolers, but these differences were significant only between three and five year-olds. A similar, slightly positive trend by age has been reported in a preschool nutrition education program among 6102 participants.⁸² It is possible that older preschoolers might have learned more from the All 4 Kids[®] program than younger preschoolers.

This study detected a positive correlation between preschoolers' healthy snack identification and stated healthy snack preference sum scores. As nutrition knowledge and healthy eating were promoted simultaneously throughout the All 4 Kids[®] program, it cannot be concluded that preschoolers improved their healthy snack preference because of their increased food knowledge. However, another nutrition education program, which intentionally avoided commenting on food intake behaviors, found a significant increase in preschoolers' vegetable intake after teaching children the nutrition concepts of food diversity, nutrients and digestion.¹⁰⁰ These findings suggest that improving children's nutrition knowledge probably can facilitate the development of healthy eating habits among preschoolers.

The current study did not find statistically significant changes in the availability of fruits and vegetables at home. At both pre- and post-surveys, the majority of caregivers reported that they often or always bought and kept fruits/vegetables ready for their children to eat. In contrast, Piziak and colleagues reported that parents significantly increased daily fruit and vegetable servings at home after their preschoolers played a

pictorial nutrition game over a school year.²² These differences could be coming from the differences in intervention content, length and assessment methods used in the two studies.

In the current study, most of the caregivers reported that their preschoolers often or always ate most fruits, but the number of children who often or always ate most vegetables (as reported by caregivers) was substantially lower. A similar finding was reported in the High 5 for Kids study; vegetable intake was significantly lower than fruit intake among both normal weight and overweight children at pre-and post-surveys.¹⁰¹ In addition, the results from a three-year nutrition intervention indicated that preschoolers' preference for vegetables were constantly lower than their fruit preference.⁹⁴ Both fruits and vegetables are important for a healthful diet, and considering that vegetables are less preferred by young children, additional efforts are needed for promoting vegetable intake.

Nearly half or more than half of the caregivers in the current study reported that their preschoolers never or now and then ate too much energy-dense and nutrient-poor foods. However, most of them also reported that their preschoolers consumed candy or chips at least 1-2 times on a typical day. This may be an indication of unawareness about or acceptance of frequent intake of energy-dense and nutrient-poor foods and suggests that caregivers may need to be informed about the appropriate levels of food intake.

The two main limitations of this study were the small sample size and the absence of the control group. Only 45 preschoolers and their caregivers participated in the current study. Since there was a race/ethnicity difference in snack food knowledge and stated healthy snack preference sum scores, a larger sample size will be needed to examine this disparity in further detail. Since there was no control group, the possibility that

preschoolers could learn from the survey content as well as from other sources cannot be eliminated. In addition, this study could not determine whether preschoolers' stated healthy snack preference reflected their actual food intake since the food intake was not directly measured.

Another limitation was that this study did not examine preschoolers' language competency. Although the surveys were completed in participants' preferred language, the lessons were taught in English, and preschoolers' language abilities could influence their overall performance. Social desirability could have also influenced the study results. Though research assistants who conducted the surveys were not involved in the teaching process, preschoolers might have given answers that they thought were favored by the examiners.

Because of the cross-sectional design of the study other possible confounding variables could not be eliminated and causality cannot be inferred from the study results. Also, this program was conducted only among Black and Hispanic preschoolers from low-income families so that the results cannot be generalized to other populations.

VI. CONCLUSIONS

This study demonstrated that after participating in the All 4 Kids[®] program, preschoolers significantly improved their snack food identification and healthy food identification abilities, and stated preference for healthy snacks. Thus, the nutrition education component of the All 4 Kids[®] program appeared to be appropriate and effective among Hispanic and Black preschoolers from low-income families. The positive correlation between snack food knowledge and stated healthy snack preference indicated that accumulating nutrition knowledge at young ages could be a promising strategy for fostering healthy eating habits. However, no significant changes were found in fruit and vegetable provision and preschoolers' food intake frequencies at home as reported by caregivers. Further studies are needed to examine the influence of the All 4 Kids[®] program on preschoolers' and caregivers' food-related behaviors such as preschoolers' actual food intake and the program's long-term effects.

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