

6-19-2014

Does Nutrition Education Influence Snack Choices of Preschoolers?

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Recommended Citation

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Does Nutrition Education Influence Snack Choices of Preschoolers?

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B.S. University of Connecticut, 2012

A Thesis

Submitted in Partial Fulfillment of the

Requirements for the Degree of

Masters of Science

At the

University of Connecticut

2014

APPROVAL PAGE

Masters of Science Thesis

Does Nutrition Education Influence Snack Choices of Preschoolers?

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Acknowledgements

First off I would like to acknowledge my major advisor, Dr. Amy Mobley. Her guidance and patience with me throughout this process had been extremely appreciative. She helped me learn a lot about myself as well as instilling confidence in my abilities to succeed. I would also like to thank my committee members for helping me through this process and providing me feedback to put forth my best work.

Lastly, my lab members for their guidance and support, and to the Mansfield Discovery Depot Center for agreeing to be a host site for this project. Without the staff and families at the preschool, this project would not have been such a success.

Supported by Cooperative State Research, Education, and Extension Service, United States Department of Agriculture, under Award 2010- 85215-20662.

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ABSTRACT

Objective: To determine the impact of a nutrition education program on preschoolers' snack choices when offered one healthy (grapes) or one unhealthy food (cookies).

Methods: This pre/post test experimental study included children ages 3-5 years old (n=45) from one preschool. Each child within a classroom (10-20 children) received the same nutrition education program (*All 4 Kids*) intervention (9, 30 minute lessons) taught by one registered dietitian over 2-weeks. Pre and post assessments included a snack knowledge and preference questionnaire and an observed snack selection trial to test the impact of the intervention. Children's height and weight were measured and body mass index z-scores calculated. Parental reports of child's food preferences, child demographics and other related variables were collected at baseline.

Results: Overall, preschool children did not significantly improve ($p>0.05$) their snack choice between a healthy and unhealthy choice after the nutrition education program. However, there was significant improvement in reported preferences of healthier snacks ($p=0.03$) and the ability to distinguish them ($p=0.03$) from other snacks. Children who were younger ($p=0.003$) or who had higher nutrition knowledge scores ($p=0.002$) were more likely to select the healthy snack after the intervention.

Conclusions and Implications: A short nutrition education program improves preschool children's knowledge but does not translate to healthier snack selections for all children. More nutrition education at an earlier age may be needed. Future research should investigate the optimal duration of a nutrition education program and what other external influences (parents, childcare) are most influential on snack choice and obesity risk.

CHAPTER ONE. INTRODUCTION

Obesity has become a major public health concern threatening the physical and economic health of our nation. There are many reasons contributing to this rising concern but poor diet and lack of physical activity have universally been highly associated with an increased risk of obesity¹. There is evidence showing that excessive weight gain in the first few years of life can alter metabolic, neural, and behavioral systems in ways that increase obesity risks later in life². Data from the National Health and Nutrition Examination Survey (NHANES) (1976–1980 and 2003–2006) indicate that the prevalence of obesity in children aged 2–5 years increased from 5.0% to 12.4%¹. More recently, in 2013 it was reported that one in eight preschool-aged children was obese³.

Recent research suggests that the propensity toward becoming obese occurs in the first few years of life as feeding patterns, dietary habits, behavioral habits, and parental feeding practices are established⁴. During this same time parents' working habits and responsibilities often leave children under the supervision of unrelated adults, such as teachers or other caretakers for a large portion of the day. By the age of 3, many children are enrolled in preschool or daycare, and eat meals under the influence of others. During preschool and throughout the first five years of life, children's preferences for foods are still forming⁵. These preferences are influenced by a multitude of factors.

Young children's dietary choices are driven primarily by taste, but by middle school, children are able to draw connections between food and health, and consequences and actions⁶. While age-appropriate nutrition education has proven effective in increasing a child's knowledge and

preference for healthy foods, the impact of education on actual dietary behavior change requires further exploration ⁷. Starting nutrition education early is critical but the effects might not be evident until children are older. In a study conducted with 6102 preschool children enrolled in the US Department of Agriculture (USDA) Food Stamp Nutrition Education Program (FSNEP), trained staff delivered a series of 12 nutrition lessons every 2 weeks using fun and easy-to-implement components from other nutrition education programs ⁸. The lessons were aimed at enabling students to identify healthy snack foods like fruits and vegetables, increase willingness to taste, as well as to actually consume, fruits and vegetables, and adopt behaviors that contribute to healthy food choices ⁸. After pre/post tests that measured snack identification, snack choices and healthy snack consumption, willingness to taste foods, and eating behaviors, it was found that knowledge increased from pretest to posttest. The children exhibited a willingness to taste foods and increased consumption of healthier foods such as fruits, vegetables, and meats ⁸. This supports the theory that if children are educated about the benefits of healthier foods and encouraged to practice choosing healthier options, there is a higher probability that when asked at home, children will opt for the same healthier option ⁹.

Preschool is often the first place that children are introduced to behaviors that differ from those they are familiar with at home, therefore, this setting becomes an ideal place to introduce new and healthy eating behaviors ¹⁰. During infancy and early childhood, behaviors are just being learned and adopted. It is often easier to adopt new behaviors than to change existing ones ². Therefore, adopting healthy behaviors before practicing unhealthy patterns have been established is critical for preschool-aged children. The surrounding environment becomes an important influence on adopted behaviors. It is proposed that when surrounded by peers and older role

models, children may more likely breach the walls of comfort by tasting new foods and overcoming neophobia, or fears of new foods ¹¹.

Young children are accepting of most foods, so exposure to healthy foods such as fruits and vegetables becomes critical in order to enhance the familiarity of these foods and thus, increase the chance of consumption ¹². Fruit and vegetables are key in preventing major illnesses such as cardiovascular disease and certain cancers ¹³. Children are not achieving the recommended serving size of fruits and vegetables. Specifically, it was found that children in childcare consume only one third of a serving of fruit and one quarter of a serving of vegetables per day ¹³. Given that, children consume half to three quarters of their daily caloric intake in childcare centers, it is imperative that these facilities offer foods that support calories coming from healthy sources ¹⁴. If food choices are unhealthy, children develop unhealthy eating habits and increase their risk for obesity. This makes preschool children an important target group for interventions aimed at enhancing healthy eating behaviors, healthy food choices, and healthy weight.

Research shows that children's eating behaviors are established by the end of the preschool period and remain stable thereafter ¹⁵ and children who are overweight or obese as preschoolers are five times more likely to be overweight or obese as adults ³. Novel approaches and early interventions are needed to prevent childhood obesity. Health behavior theories or models such as the Social Ecological Model of Health Behavior (Figure 1) and the Social Cognitive Theory (SCT) may help provide a better understanding and possible strategies for preventing childhood obesity. The SCT relies on the construct of self-efficacy and its relationship to personal, environmental, and behavioral factors that influence health behaviors ¹⁶. This theory underlines

the *All 4 Kids* Program, a childhood obesity prevention program based in a childcare center. The *All 4 Kids* program previously demonstrated effectiveness in improving children's abilities to distinguish healthy from unhealthy snacks and to actually increase children's reported preference for healthy snacks⁷. The Social Ecological Model of Health Behavior considers several levels of varying influence on behaviors and more specifically, the childhood obesity risk. Although the most powerful level of influence on a preschooler's snack choice is still unknown, an early childcare setting offers an ideal place to examine the strength of these possible influences¹⁷.

A recent report indicated that obesity significantly declined in children aged 2-5 years between 2003-2004 and 2011-2012¹⁸. Specifically, cities with obesity prevention programs and children who participate in federal nutrition programs have shown improvements in weight and obesity prevalence¹⁸. Despite these improvements, efforts must continue to be made to identify effective programs to ensure that these trends continue moving in a positive direction. While recent reports reveal a drop in obesity rates among some preschool age children, much work remains to be done to address the various factors that play a role in the development of obesity during early childhood.

The primary aim of this study was to determine if a nutrition education program can favorably influence preschoolers' snack choices. The secondary aim was to determine what child characteristics (age, BMI z-score, gender, ethnicity, race, preferences, knowledge) are associated with choosing a healthy snack over an unhealthy snack. It was hypothesized that children who are educated about healthy snack choices will improve their ability to identify healthy versus unhealthy snacks, and will be more likely to choose, and to eat, the healthier snack when given

the choice between a healthy and a less healthy snack. It was also believed that children who are older, non-Hispanic, white, female, normal weight, with higher nutrition knowledge scores, and higher preferences for healthy snacks will be more likely to choose the healthier snack option.

CHAPTER TWO. LITERATURE REVIEW

2.1. Childhood Obesity

Obesity is a public health priority that is attributed to a complex set of factors. Over the past 20 years social, economic, cultural, biological, and environmental factors have contributed to the millions of individuals in our world today who are either overweight or are obese¹⁹. Obesity can have detrimental effects on one's health ranging from digestive disorders and other short-term complications to long-term complications such as, diabetes and cardiovascular disease¹. Since 1960, the prevalence of adult obesity has nearly tripled and more alarmingly, since 1970, the prevalence of childhood obesity has more than tripled²⁰. Childhood obesity is of concern because it is shown to track into adulthood with various health consequences²¹. Recently, it has been shown that about one in eight preschoolers in the United States are obese³. It is imperative that the nation focuses resources to reduce childhood obesity.

Worldwide, the prevalence of childhood obesity rose from 4.2% in 1990 to 6.7% in 2010, and is predicted to reach 9.1% by 2020 if attempts to change the trends keep failing²². Not all attempts have gone unrecognized.

2.2 Childhood Obesity Risk Factors

Overweight and obesity are defined as “abnormal or excessive fat accumulation that presents a risk to health”²³. Body mass index (BMI), a measurement of body fatness calculated using the

child's height (m²) and weight (kg), is used to determine childhood overweight and obesity²⁴. Once plotted on a corresponding growth chart, children with BMI values between the 85th and 95th percentiles are considered overweight, whereas those at or above the 95th percentile of the sex-specific BMI growth charts are categorized as obese²⁴. The development of obesity is so multifaceted that it makes it increasingly difficult to combat.

The treatment of obesity is complex with a range of personal, familial, community, and environmental factors that contribute to its complexity²¹. The association of risk factors with childhood obesity manifests itself differently in children of different developmental stages²⁵. However, preventing the development of obesogenic behaviors early in life is critical as preschool aged children may be more amenable to changing behaviors than older children²⁶. Teaching healthy dietary behaviors to children at a young age may hold more promise in increasing the chance that new dietary behaviors will be permanently adopted. Despite this hypothesis, there has been little attention given to food choices for children in childcare settings²⁶. In six studies conducted in individuals up to five years of age, only two were successful at changing adiposity measures, and none of the studies manipulated the childcare environment despite beliefs that environmental changes are necessary to alter obesity-related behaviors²⁶. Evidence of environmental changes impacting food selection was previously observed in a study with students who significantly improved their diets when healthier food options were made available in school cafeterias²⁷. If healthy behaviors are to be adopted by children, the environments (e.g. food options) need to be conducive to supporting these behaviors. Healthy foods must be available, proper food choices should be modeled by older adults, and education should support healthy behavioral habits.

Many factors play a role in the development of obesity and obesity-related diseases. Some risk factors are hereditary, and therefore, harder to alter, but others are modifiable. Data has shown that additive genetic effects can explain for a variation in infant body weight; genetics affect metabolism and behavior, two factors that have a large impact on energy balance²⁸. There is evidence of body weight increasing from 65% at 12 months to 95% at 36 months due to genetic effects²⁸. In addition to genetics, home environments provide a framework for eating habits and activity patterns²⁸. If children live in an unhealthy eating environment, many choices are out of their control, making change harder to establish, and thus, reinforcing unhealthy habits.

Most modifiable risk factors include food choices, engaging in physical activity, and adopting a sedentary lifestyle²⁹. Several eating behaviors have been associated with the risk of obesity in children. These include inadequate intake of fruits and vegetables, paired with an increase in consumption of dietary fat and sugar sweetened beverages. According to previous research, 80-90% of children ages 4 to 13 years old were consuming less than the recommended number of servings of fruits and vegetables³⁰. With 64-88% children ages 2-9 years old scoring in the “poor” and “needs improvement” range for diet quality, according to the Healthy Eating Index (HEI), it is evident that food choices of children are low in nutrients and result in high intakes of low nutrient-dense foods possibly causing higher calorie consumption³⁰. A Korean study with children ages 7-9 years old concluded that eating rapidly, overeating, and infrequent family meals were all factors associated with preadolescent risk for becoming overweight or obese³¹. This creates a situation where children may need to be educated on proper eating behaviors and food choices, and need to have enough self-confidence that they can properly change their eating

habits³⁰.

Teaching children about healthy foods and the benefits of physical activity at a young age is critical in providing an opportunity for them to establish healthier lifestyles. Research shows that after education, preschool-aged children chose to replace the less healthy options such as candy and chips, for healthier snacks such as fruits and vegetables³². However, despite successes in the classroom, it is difficult to monitor what happens when children are in the home. A parents' eating behaviors and the eating environment in the home, such as how strict or how involved a parent is in a child's eating, can be significant factors in the development of obesity in a child³³. Specific nutrients (e.g. fat) and foods (e.g. fruits and vegetables), as well as increased portion sizes and patterns of eating such as high amounts of snacking, have been positively associated with a child's overweight status²⁵. The length of time children sleep and parent BMI are other factors that have been identified as posing significant risk for the development of childhood obesity³⁴. However, there is not one *single* factor that has an overwhelming influence on a child's weight status, but rather a combination of many social and environmental influences³⁴.

2.3. Role of Childcare Centers in Preschool Children's Health

Childcare centers have become an important focus for obesity prevention programs, and currently offer the best opportunity for obesity prevention². It is estimated that children spend on average, 25 hours per week in child-care facilities³⁵. In 2001, it was recorded that 8.6 million (73%) preschool children ages 3-5 participated in at least 1 weekly non-parental care arrangement³⁶, and more recently, that number has increased to 9 million children attending childcare¹⁴. This allows for opportunities to challenge family food habits and teach children health lessons they might not otherwise receive.

Early childhood is a critical time for adopting healthy eating and increasing physical activity¹⁷. Childcare centers can be ideal places to teach children about healthy lifestyle habits and introduce children to a variety of healthy foods¹⁷. A child's taste buds are highly sensitive at the preschool age, so introducing healthy foods like fruits and vegetables is critical³⁷. Foods consistent with the Dietary Guidelines for Americans (DGA) should be served in childcare centers; those children in part-time programs should receive one-third of their daily nutrient requirements, while those in full-time care should receive foods and beverages that meet one half to two thirds of their daily needs¹⁴. Children should increase fruits, vegetables, whole grains, and low-fat dairy, while limiting high fat, high sodium and high sugar foods and beverages¹⁴. Childhood diets are significant determinants of adult diets³⁸ and childhood obesity remains one of the strongest predictors for obesity in adulthood⁴.

In addition to schools offering healthier food options for children to eat, there have been numerous attempts in preschools to encourage students to bring healthier snacks, and some schools have reported positive impacts on eating behaviors as a result of nutrition education interventions¹⁰. A study conducted by De Bock et al found that after a nutrition education program was introduced, children increased their consumption of fruits and vegetables significantly¹⁰. Often, children have never tried fresh fruits and vegetables simply because they do not have access to them and their parents do not consume them²¹. This discrepancy in behaviors and habits can be due to several factors such as cultural, community, socioeconomic status and/or education status of the parents²¹. A study cohort conducted in Massachusetts working with 1116 mother-child pairs found that by age 7, overweight and obesity prevalence in

black and Hispanic children was almost double that of white children³⁹. These racial and ethnic disparities were partly explained by socioeconomic factors and the prevalence of parental obesity, factors that have shown to hold strong influences during infancy and early childhood³⁹. These racial and ethnic inequities must be addressed. It is hypothesized that if these differences are acknowledged, the disparities in childhood obesity rates could be attenuated as well³⁹. It is the responsibility of the individuals who children admire, such as teachers or parents, to be role models and present children with opportunities to eat healthier foods while encouraging them to acquire a taste for them.

New studies show that the obesity trends among children ages 2 to 5 years old are declining and, although there is not one driving factor responsible for this decline, one plausible explanation is that many child-care centers have started to improve their nutrition and physical activity standards¹⁸. If schools and childcare centers change their dietary policies, the impact on the individual could be large enough to see dietary behavioral changes.

2.4. Fruit and Vegetable Consumption by Children

Fruits and vegetables are the food group most likely to be consumed in inadequate amounts by children²⁵. In 2012, it was reported that preschool-aged children ate less than the recommended amount of fruits and vegetables by 31.5% and 80.3% respectively⁴⁰. One possible explanation is that the sweetness of fruit resulted in higher consumption by children, whereas the bitter taste of many vegetables often requires repeated exposure, positive role modeling, and learned experiences¹³. Unfortunately, French fries were reported as the most commonly consumed vegetable by children and adolescents⁴¹.

An increase in fruit and vegetable consumption has been associated with showing a reduced risk of health problems later in life, as well as improvements in cognitive development and social adjustment⁴². The nutrients available in fruits and vegetables are vital to the health of children because they are low in calories, high in fiber, and result in higher satiety²⁵. Fruit and vegetable consumption has been shown to prevent excessive weight gain and reduce the risk of various chronic diseases⁴³.

In a study conducted in 4 Mexican elementary schools, a nutrition education intervention was delivered that focused on lowering consumption of high-fat food and soft drinks as well as increasing physical activity and consumption of fruits and vegetables. The intervention included parent and school staff education and participation, and after six months, it was found that positive changes, including increases in vegetable consumption, were made⁴⁴. Environmental change, especially education, is key in changing eating patterns such as consumption of fruits and vegetables⁴⁴. Encouraging children to try fresh fruits and vegetables, and to have them continue to eat fresh fruits and vegetables, remains a challenge. In a another study following the effects of positive reinforcement for fruit and vegetable consumption by children, child preferences remained high for both foods two weeks after the program, but seven months later, preferences returned to baseline⁴².

Another preschool nutrition education program named *Color Me Healthy*, recorded and compared the changes in fruit and vegetable consumption before and after an educational program was introduced⁴¹. The content of the program emphasized the colors of fruits and vegetables, and provided children with corresponding taste tests. The program increased

exposure to different foods and gave the children a chance to develop new tastes for various fruits and vegetables. Ultimately, this program was successful in increasing consumption of fruits by 31.2% and vegetables by 24.2% up to 1 week after the program. Most noticeable was the consistent increase in consumption of fruits by 20.8% and vegetables by 33.1% up to 3 months after the delivery of the program ⁴¹. This result offers encouragement and hope for the possibilities that nutrition education may have significant long-term effects on the eating habits of children.

Preschool-aged children are susceptible to changes in their tastes and food preferences, so it is important to test strategies that will increase their willingness to try different foods. It has been noted that girls eat fruits and vegetables more frequently than boys, and in general, fruits are more accepted and willingly tried than vegetables ⁴². It may take children up to sixteen repeated exposures to accept one new food ⁴⁵. Often times, parents get discouraged when their children deny trying these foods so they give up after three to five tries ⁴⁶. This significantly limits a child's chances of accepting new foods, and causes parents to provide foods preferred by the children thus reinforcing a child's desire for those foods ⁴⁶. Therefore, working with childcare facilities to create educational programs that encourage fruit and vegetable consumption is critical.

2.5. Influences on Young Children's Dietary Selections

From as early as conception, a child is exposed to a variety of different foods that can influence food choices and food preferences throughout life ⁴⁷. The average child is exposed to 40,000 food advertisements per year, 72% of which are for unhealthy foods such as candy, cereal and fast food ²⁹. It has been estimated that American preschool children viewed an average of 1,354

food advertisements per half-hour of television programming²⁹. These media exposures present a strong influence on eating for many children²⁹. Preferences formed at age 2.9 have been highly correlated with preferences at age 8, and continue their influence into adulthood²⁹. Too often children have already developed poor eating habits by the time they reach adolescence. Once preferences for unhealthy foods are formed, it is difficult to change those preferences towards healthier foods. Weight problems that arise within the first few years of life tend to persist into later years¹⁵. This makes it increasingly difficult to change habits once they are established, making early intervention a key factor in prevention efforts.

The quality of snack choices may be difficult to change even in young children because snack food is everywhere, and snacks are eaten everywhere, in school, at home, on the go, and at almost any time of day. In recent years snacking has increased by 30% and now accounts for nearly 25% of the total caloric intake of children⁴⁸. In a study with 81 children ages 3-5 years old, interviewers asked children to play the role of caregiver to a doll by providing the doll with breakfast, lunch, and snack. Children were also asked to sort plastic food models into three categories: healthy, unhealthy, and unsure. It was found that the children that had a good grasp on healthy eating applied their knowledge to meals but not to snacks²⁹. This finding offers insight into the need to educate children about how to recognize healthy versus unhealthy snack foods. Children must be taught to understand the importance of healthy snacking as it relates a healthy body.

The rise in obesity has been paralleled by the rise in the food industry's budget for marketing to children⁴⁹. Placing common cartoon characters on food packaging has become a marketing

strategy to appeal to children. However, to the contrary, there is evidence of this marketing strategy being successful when promoting healthy foods to children⁴⁹. For example, in a study conducted in New Haven, CT with 40 4-to-6 year-old children and their parents, children were presented with two choices of 1 of 3 foods; graham crackers, gummy fruit snacks, and baby carrots. The foods were identical in size, packaging, and servings except one had a sticker of a common cartoon character on the packaging. Children were then asked which food tasted better, how much they liked the food, and which of the foods he or she would pick. After all three snacks were offered, it was concluded that children preferred the snacks with the cartoon character on it. Even the children who didn't prefer the taste of the food with the cartoon character still indicated a preference for foods in packages with cartoon characters over foods in plain packages for snack choices⁴⁹.

In addition to marketing, older adults and peers can offer similar influences over children's food selections. Children observe, and are sensitive to, how others react when trying a new food. They may decide from someone else's reaction whether they want to try it or not⁵⁰. In a study that observed the effect of modeling on a child's food preferences and willingness to try a new food, it was revealed that children prefer to try foods that have been eaten by children of the same age and gender, and who showed positive responses to those foods⁵⁰. Children model the behaviors of others who portray similar characteristics to themselves, and who show pleasure with the behavior in question.

Above all other influences, taste has been confirmed as the largest influence on what snacks children choose⁵¹. Taste preferences drive food choices and preferences for healthier foods,

particularly vegetables, are often low¹². Younger children choose foods based on texture and taste, whereas understanding of health emerges as children grow older¹². This finding underscores the importance of introducing children to healthy foods at a young age so that they develop a higher probability of liking the foods before they are even taught about the impact of those foods on their health. In a recent study, it was found that children ages 21 to 24 months old had a higher willingness to taste foods that were highlighted in picture books that were read to them every night for two weeks than those foods not featured in the books⁴⁶. The books featured two familiar foods (sweet corn and strawberries) and two unfamiliar foods (radishes and lychees). After a two-week time period, children were asked to taste each of 4 foods, two of which had been introduced to them in the book readings and two were unfamiliar. Consistent with neophobic eating patterns in which children are scared to try new foods, these children were more willing to taste foods that were expected to be familiar to them⁴⁶. Interestingly, children tasted foods that were unfamiliar to them if they had been introduced to them in the picture books or not⁴⁶. This suggests that children with prior exposure to healthy foods develop a familiarity and positive attitude towards them and will be more inclined to taste them over foods that are never introduced.

2.6. Social Cognitive Theory and Interventions with Preschool Children

A 2004 study published in the *Journal of Nutrition Education and Behavior*, sought to improve children (ages 5-10 years old) and adolescent's (ages 11-18 years old) dietary self-efficacy using the Social Cognitive Theory (SCT) as the intervention framework. Questionnaires assessed personal ability to choose water or juice instead of "pop," fruit instead of candy, vegetables instead of chips, baked instead of fried foods, and low fat instead of high-fat milk¹⁶. After a 7-

month after-school education intervention provided monthly and complete with lessons on healthy foods, opportunities to choose healthy foods, and chances to see healthy food options being eaten, it was found that dietary self-efficacy was improved for children ages 5-10 years old, especially in overweight children, but was not as successful for adolescents ages 11-18 years old¹⁶. This study reinforces the idea that children at a younger age are more amenable to changing their dietary habits, and that education drawing upon aspects of the SCT could be an effective way to explore areas of influence on encouraging healthy behaviors.

Theories such as the SCT work to elicit behavior changes through creating mediators (e.g. self-efficacy) to elicit behavioral outcomes from applied intervention. The SCT is built upon the underlying idea that behavior changes are influenced by a combination of personal factors, environmental factors, and individual behavioral characteristics⁵². An educational program “Choice, Control, Change” was used to determine the impact of nutrition education on obesity-related behaviors in a study conducted in ten low-income middle schools in New York City. The goal of the program was to give middle school students the tools and skills to set goals aimed at becoming responsible for increasing activity and navigating their way through the food system, in which body size is a result of interactions between biology, environment, and behavior⁶. It was found that students decreased certain obesity-related behaviors such as consumption of sugar-sweetened beverages and packaged snacks, but didn’t change consumption of fruits and vegetables. The mixed results are consistent with the literature, but overall, the self-motivation and self-efficacy served as a positive mediator to behavioral changes⁶.

CHAPTER THREE. Does Nutrition Education Influence Snack Choices of Preschoolers?

3.1 ABSTRACT

Objective: To determine the impact of a nutrition education program on preschoolers' snack choices when offered one healthy (grapes) or one unhealthy food (cookies).

Methods: This pre/post test experimental study included children ages 3-5 years old (n=45) from one preschool. Each child within a classroom (10-20 children) received the same nutrition education program (*All 4 Kids*) intervention (9, 30 minute lessons) taught by one registered dietitian over 2-weeks. Pre and post assessments included a snack knowledge and preference questionnaire and an observed snack selection trial to test the impact of the intervention.

Children's height and weight were measured and body mass index z-scores calculated. Parental reports of child's food preferences, child demographics and other related variables were collected at baseline.

Results: Overall, preschool children did not significantly improve ($p>0.05$) their snack choice between a healthy and unhealthy choice after the nutrition education program. However, there was significant improvement in reported preferences of healthier snacks ($p=0.03$) and the ability to distinguish them ($p=0.03$) from other snacks. Children who were younger ($p=0.003$) or who had higher nutrition knowledge scores ($p=0.002$) were more likely to select the healthy snack after the intervention.

Conclusions and Implications: A short nutrition education program improves preschool children's knowledge but does not translate to healthier snack selections for all children. More nutrition education at an earlier age may be needed. Future research should investigate the optimal duration of a nutrition education program and what other external influences (parents,

childcare) are most influential on snack choice and obesity risk.

3.2. INTRODUCTION

Obesity has become a major public health concern threatening the physical and economic health of our nation. There are many reasons contributing to this rising concern but poor diet and lack of physical activity have universally been highly associated with an increased risk of obesity¹. There is evidence showing that excessive weight gain in the first few years of life can alter metabolic, neural, and behavioral systems in ways that increase obesity risks later in life². Data from the National Health and Nutrition Examination Survey (NHANES) (1976–1980 and 2003–2006) indicate that the prevalence of obesity in children aged 2–5 years increased from 5.0% to 12.4%¹. More recently, in 2013 it was reported that one in eight preschool-aged children was obese¹.

Recent research suggests that the propensity toward becoming obese occurs in the first few years of life as feeding patterns, dietary habits, behavioral habits, and parental feeding practices are established⁴. During this same time parents' working habits and responsibilities often leave children under the supervision of unrelated adults, such as teachers or other caretakers for a large portion of the day. By the age of 3, many children are enrolled in preschool or daycare, and eat meals under the influence of others. During preschool and throughout the first five years of life, children's preferences for foods are still forming⁵. These preferences are influenced by a multitude of factors.

Young children's dietary choices are driven primarily by taste, but by middle school, children are able to draw connections between food and health, and consequences and actions ⁶. While age-appropriate nutrition education has proven effective in increasing a child's knowledge and preference for healthy foods, the impact of education on actual dietary behavior change requires further exploration ⁷. Starting nutrition education early is critical but the effects might not be evident until children are older. In a study conducted with 6102 preschool-aged children enrolled in the US Department of Agriculture (USDA) Food Stamp Nutrition Education Program (FSNEP), trained staff delivered a series of 12 nutrition lessons every 2 weeks using fun and easy-to-implement components from other nutrition education programs ⁸. The lessons were aimed at enabling students to identify healthy snack foods like fruits and vegetables, increase willingness to taste, as well as to actually consume, fruits and vegetables, and adopt behaviors that contribute to healthy food choices ⁸. After pre/post tests that measured snack identification, snack choices and healthy snack consumption, willingness to taste foods, and eating behaviors, it was found that knowledge increased from pretest to posttest. The children exhibited a willingness to taste foods and increased consumption of healthier foods such as fruits, vegetables, and meats ⁸. This supports the theory that if children are educated about the benefits of healthier foods and encouraged to practice choosing healthier options, there is a higher probability that when asked at home, children will opt for the same healthier option ⁹.

Because children may spend a majority of their days and, therefore, eat a majority of their meals away from home, an educational intervention in a preschool setting may help encourage children to choose healthy snacks at school with the hopes that these behaviors will then translate to the home environment. Preschool is often the first place that children are introduced to behaviors

that differ from those they are familiar with at home, therefore, this setting becomes an ideal place to introduce new and healthy eating behaviors ¹⁰. During infancy and early childhood, behaviors are just being learned and adopted. It is often easier to adopt new behaviors than to change existing ones ². Therefore, adopting healthy behaviors before practicing unhealthy patterns have been learned is critical for preschool-aged children. The surrounding environment becomes an important influence on adopted behaviors. It is proposed that when surrounded by peers and older role models, children may more likely breach the walls of comfort by tasting new foods and overcoming neophobias, or fears of new foods ¹¹.

Young children are accepting of most foods, so exposure to healthy foods such as fruits and vegetables becomes critical in order to enhance the familiarity of these foods and thus, increase the chance of consumption ¹². Fruits and vegetables are key in preventing major illnesses such as cardiovascular disease and certain cancers ¹³. Children are not currently achieving the recommended serving size of fruits and vegetables. Specifically, it was found that children in childcare consume only one third of a serving of fruit and one quarter of a serving of vegetables per day ¹³. Given that, children consume half to three quarters of their daily caloric intake in childcare centers, it is imperative that these facilities offer foods that support calories coming from healthy sources ¹⁴. If food choices are unhealthy, children develop unhealthy eating habits and increase their risks for obesity. This makes preschool children an important target group for interventions aimed at enhancing healthy eating behaviors, healthy food choices, and healthy weight.

Research shows that children's eating behaviors are established by the end of the preschool

period and remain stable thereafter¹⁵ and children who are overweight or obese as preschoolers are five times more likely to be overweight or obese as adults³. Novel approaches and early interventions are needed to prevent childhood obesity. Health behavior theories or models such as the Social Ecological Model of Health Behavior (Figure 2) and the SCT may help provide a better understanding and possible strategies for preventing childhood obesity. The SCT relies on the construct of self-efficacy and its relationship to personal, environmental, and behavioral factors that influence health behaviors¹⁶. This theory underlines the *All 4 Kids* Program, a childhood obesity prevention program based in a childcare center. The *All 4 Kids* program demonstrated effectiveness in improving children's abilities to distinguish healthy from unhealthy snacks and to actually increase children's reported preference for healthy snacks⁷. The Social Ecological Model of Health Behavior considers several levels of varying influence on behaviors and more specifically, the childhood obesity risk. Although the most powerful level of influence on a preschooler's snack choice is still unknown, an early childcare setting offers an ideal place to examine the strength of these possible influences¹⁷.

A recent report revealed that obesity significantly declined in children aged 2-5 years between 2003-2004 and 2011-2012¹⁸. Specifically, cities with obesity prevention programs and children who participate in federal nutrition programs have shown improvements in weight and obesity prevalence¹⁸. Despite these improvements, efforts must continue to be made to identify effective programs to ensure that these trends continue moving in a positive direction. While recent reports reveal a drop in obesity rates among some preschool age children, much work remains to be done to address the various factors that play a role in the development of obesity during early childhood.

The primary aim of this study was to determine if a nutrition education program can favorably influence preschoolers' snack choices. The secondary aim was to determine what child characteristics (age, BMI z-score, gender, ethnicity, race, preferences, knowledge) are associated with choosing a healthy snack over an unhealthy snack. It was hypothesized that children who are educated about healthy snack choices will improve their ability to identify healthy versus unhealthy snacks, and will be more likely to choose, and to eat, the healthier snack when given the choice between a healthy and a less healthy snack. It was also believed that children who are older, non-Hispanic, white, female, normal weight, with higher nutrition knowledge scores, and higher preferences for healthy snacks will be more likely to choose the healthier snack option.

3.3. METHODS

3.3.1. Study Design

This experimental study employed a traditional pre/post design (Figure 1) at one preschool site (Mansfield Discovery Depot) with each individual child (ages 3-5 years old) serving as his or her control during the summer and fall of 2013. Each child within a classroom (10-20 children) received the same nutrition program (All 4 Kids) intervention (9, 30 minute interactive lessons) taught by one registered dietitian over a 2-week period (Appendix P).

3.3.2. Participants and Recruitment

The study was approved by the University of Connecticut Institutional Review Board (IRB) for Human Subjects (Appendix A & B). Informed (written) consent (Appendix C & D) was obtained by at least one parent/guardian for each child participating in the project prior to any

data collection. Research assistants helped recruit children from preschool families during pick up hours and information sessions at the preschool using study recruitment flyers (Appendix E). Criteria to be eligible in the study included having a preschool aged child (ages 3-5 years old) enrolled at the preschool. A minimum of 50 families with at least one child between ages 3 and 5 years old were to be recruited via parents for the study. Sample size (effect size=between .3 and .4; alpha=0.05, power=0.8) was determined based on using a paired t-test to measure the pre/post impact from the nutrition education curriculum on preschoolers snack food choices. Up to 10 additional children were to be recruited to account for possible attrition or incomplete data. A total of 70 children were enrolled in the project. Once enrolled, each child received a study code to identify them. If parents did not provide consent (n=3), children were still invited to participate in the program without having any data collected on them. Food allergies were noted before any snacks were provided.

3.3.3. Measures and Data Collection Procedures

Several assessments were conducted at pre and post with the children by one main trained graduate assistant (Table 1). Children's ability to identify certain snack foods and indicate their knowledge and preference for certain snacks was assessed using the Preschool Snack Selection (PSS) tool (Appendix L) which was previously tested in a similar preschool population ⁷. The PSS utilized snack cards that displayed pictures of the foods that were taught in the education program (Appendix M). It was administered at both pre and post. Children were weighed and measured at baseline to determine body mass index (BMI)-for-age and to calculate BMI z-scores (Appendix I). Stadiometer and scale, models SECA 217 SECA 869 respectively, were used to take measurements and the "Child and Teen BMI Calculator" on the Centers for Disease Control

and Prevention (CDC) website was used to calculate BMI for each child⁵³ and a pediatric calculator for BMI z-scores with z-scores based on CDC data for gender and age⁵⁴.

A letter was sent home asking parents to complete several baseline-only questionnaires and to return them to the preschool center (Appendix F). These items included a demographics form (Appendix H), snack preference questionnaire (for child and parent) (Appendix J) (Appendix K) and the Healthy Kids questionnaire (Appendix O). The demographics form included questions about the parent's level of education and race and ethnicity, as well as the number of children they have that are of preschool-age (ages 3-5). The snack preference questionnaire was adopted from the "Preschool Adapted Liking Survey (PALS)," as a way to measure preschooler's dietary behaviors with the assumption that what is liked/disliked drives what is consumed⁵⁵. This form used emoticons on a scale from "like" to "dislike." The form was modified to reflect the 18 foods in the All 4 Kids unit in order to gather an understanding of preschooler's likes and dislikes of the foods being introduced to them. There were two versions of the questionnaire, both to be filled out by the parent/guardian. One survey reported child preferences, and one reflected parent preferences.

The Healthy Kids questionnaire assessed shopping behaviors, the home food environment, and child nutrition and physical activity behaviors, such as frequency of watching television or playing outside. This questionnaire was previously validated to use with parents of preschool age children⁵⁶.

Before and after the intervention, snack trials were performed with each child. Children were lined up outside the classroom and, one by one each child was walked into the room and asked to choose between two snack options- grapes cut into halves (approximately half a cup) or two small chocolate chip cookies (Figure 4). Once a snack was chosen, each child would enter their classroom to consume their chosen snack. Children were given a nametag to wear that reflected their assigned ID number given at the time of consent. Each child's snack choice and amount consumed were recorded by one of two observers on a snack trial recording form (Appendix N).

Grapes and cookies were the snacks options to represent the "healthy" and "unhealthy" snack categories at pre and post intervention. These snacks were chosen because they were previously provided by the preschool prior to the program as routine snack choices, so familiarity or allergies and other health complications were not issues. Furthermore, these snack choices were both sweet foods so individual preferences were higher. On a scale from 0-7, the mean (standard deviation) preference score for cookies was 5.9 (1.1) and 6.0 (1.1) for grapes. Both were not statistically different ($p=0.64$) from one another, so the chance of selection was evenly distributed.

3.3.4. Study Intervention

The All 4 Kids program is a previously tested program for preschool children focused on teaching children about healthy eating and active living with the long-term goal of preventing obesity⁵⁷. It draws upon the Socio-ecological model (Figure 1) and obesogenic ecological model (Figure 3) to portray idea that the home and surrounding environments (i.e. schools) have direct influences on children's risk for obesity⁵⁷. All 4 Kids is a 3 unit, 24-lesson program that covers being active, eating healthy, and accepting everyone at any size⁷. This study implemented one

unit, “Eat Smart”, that focused on nutrition and distinguishing between healthy and unhealthy snack foods. *Healthy foods*, labeled “Go” foods, were identified as foods that help keep one’s heart, muscles, and bones strong; whereas, *unhealthy foods*, labeled “Whoa” foods, do not help keep one’s heart, muscles, and bones strong⁷. A total of 9, 30-minute lessons were taught by a registered dietitian 4-5 days a week over 2 weeks (Appendix P). Teacher connections (Appendix Q) were given to each teacher and newsletters were sent home to parents (Appendix R) as a way to review the lessons provided. Attendance was taken daily for each child.

3.3.6. Data Analysis

Data analyses were conducted using SPSS Statistics (version 21.0, 2012, IBM, Armonk, NY). Statistical level of significance was set at 5% ($P < 0.05$). In order to draw conclusions from the available data, children with missing data from pre or post snack trials, as well as children who attended 4 lessons or fewer, were excluded from analysis, leaving 45 observations to be analyzed. Because of the small sample size, nonparametric tests were used for the majority of the analyses. Initial analysis utilized McNemar’s chi square test in order to compare children’s snack choices before and after the intervention. The Wilcoxon rank sum test was used to determine if children’s knowledge of and preferences for healthy snack choices improved after the intervention. Additional analyses were performed to determine if child characteristics such as age, gender, ethnicity, race, BMI z-score and snack preference scores were associated with snack choices after the intervention. In order to test whether children’s post snack choices varied with respect to age or BMI z-score, independent two sample t-tests were performed, as the response was continuous. Due to the number of cell counts being less than 5, Fisher’s exact test was conducted to determine if children’s post snack choices varied with respect to gender, race or

ethnicity. McNemar's test for paired data determined if parent's perception of child's snack preferences matched the actual choice made by the child. However, since the preference scale ranged from 0-7, a new code was created to match the type of numerical coding already being used. When a parent marked preference of cookies greater than that of grapes, the choice got a score of "1." All others received a "2." Then this newly created variable was compared to actual choices of children post program. The Wilcoxon Mann Whitney test was conducted to determine if the snack knowledge and preference assessment scores differed between children that chose grapes versus those who chose cookies.

3.4 RESULTS

3.4.1. Participants

A total of 45 children were used as the study sample and demographic surveys were completed by parents of preschool aged children who provided consent for their children in this study. Demographic information such as education level, race/ethnicity, and number of children was self-reported by the survey participants (Table 2). The children were all between the ages of 3 and 5 years old.

3.4.2. Intervention Results

After delivery of the All 4 Kids nutrition education program, it was concluded that a majority of children did not change their snack choice for the better (Table 3). Initial analysis indicated that there was very little difference in the number of children who actually changed their snack choice (Table 3). Only 20% children switched their snack choice from cookies to grapes. Out of the entire study sample, only 24% of children chose grapes in the posttest snack trial, whereas

76% chose cookies. However, initial analysis showed that at post intervention, children scored higher on their ability to identify the healthier of two snacks, as well as verbally stating a higher preference for the healthier of two snack options (Table 4).

Further analysis was conducted in order to determine if there was anything characteristically different between those children who opted for cookies at posttest versus those children who opted for grapes at posttest. Tests were run to compare those children against non-modifiable variables such as age, BMI z-score, and gender, as well as modifiable variables such as food preference and knowledge. A Wilcoxon Mann Whitney test revealed that the only significant relationship was between posttest snack choice and age. On average, children who were younger by 8 months were more likely ($p=0.003$) to choose the healthy snack choice (grapes) after the intervention (Table 5). Children who chose grapes posttest were also the ones who had higher increases in knowledge of healthy versus unhealthy snack foods (Table 6). It was also confirmed that the parent's perception of their child's snack preferences matched the actual snack choice of the child ($p=0.481$).

3.5. DISCUSSION

Previous research has shown that nutrition education can increase knowledge of healthier foods in preschool age children. In a study conducted with 65 3rd grade students in Illinois, knowledge about nutrition increased after the CATCH nutrition curriculum was implemented⁵⁸. The nutrition curriculum included 2, 30-minute nutrition education lessons and a farm tour. Similarly to the current study, this program utilized the concepts of “go,” “slow,” and “whoa” to help younger children distinguish between healthy and unhealthy food options, and both before and

after the intervention, children were assessed on their knowledge of healthy and unhealthy foods⁵⁹. It was found that children's nutrition-related knowledge increased after the intervention was implemented⁵⁸. The current study confirms these findings. Specifically, after the *All 4 Kids* 'Eat Smart' nutrition education intervention, children were able to identify healthier snack foods when shown pictures of two snack options and, expressed an increased interest in their stated preferences for healthier snack food options compared to less healthy foods. However, when children were asked to actually *choose* between a healthy snack (grapes) and an unhealthy snack (cookies) during snack time, a majority of the preschool-aged children chose the unhealthy snack option even after their knowledge and preferences for healthier snacks improved.

Nutrition education is important and useful, yet it may not be sufficient in actually changing dietary selection behaviors in young children even as young as 3 years. However, it is well supported that taste and familiarity drive young children's food choices and they may not be inclined to diverge from these preferences⁶⁰. Children under the age of 9 are more driven by taste than by the consideration of health⁶¹ and it is understood that taste has the largest influence on what snacks children choose⁵¹. Perception of taste and healthfulness of a food could also be a factor. In a study of 9 and 10 year old children, there was evidence that children believed if a food tasted good, it must not be good for them but if the food tasted bad, it must be good for them⁶¹.

When examining the study results more closely, children who chose the healthier snack option (grapes) after the nutrition education program did not differ by BMI z-score, gender, ethnicity, race, or food preference scores for certain snack foods. It was hypothesized that children who

were female, white, with healthy BMI z-scores and higher preferences for healthy snacks (e.g. grapes) would be more likely to choose the healthy snack at post intervention. However, children with lower BMI z-scores were not more likely to choose a healthy snack as originally hypothesized. Previous research and reports have indicated mixed results as it relates to a child's BMI and his or her food preferences. For instance, in a study conducted in Europe with 1696 children ages 6-9 years old in which parents reported child intakes of high- and low-fat foods as well as natural versus sugar-sweetened foods, it was found that overweight and obesity in children was positively associated with a higher fat and sweet food preference⁶². However, it is also reported that when it relates to snack food choices of children, food choice is not an independent determinant of weight gain in children⁶³. These findings suggest that snack food choices might not have an impact on child weight status, but child weight status might determine what foods children have preferences for.

When examining the association of gender with a child's snack choices in previous studies of children between the ages of 4 and 16 years old, girls were more likely to select or indicate preference for fruits and vegetables compared to boys^{64 65}. However, other studies have found mixed results when examining gender differences in food preferences or eating patterns⁶⁶.

In a previous study conducted with young children (2-5 years old), researchers investigated the consumption of snack foods and offered healthy snacks in order to determine if changing the shape of the food would increase consumption⁶⁷. After results of snack choice were analyzed, it was found that caloric intake, as well as higher consumption of banana bread, was higher for Caucasian students compared to Asian students⁶⁷. This finding could be explained by different

dietary patterns and dietary behaviors of various ethnic backgrounds. However, a garden-based education program for 97 first grade students in California failed to find any differences in vegetables consumption among different ethnicities⁵⁹. Over 50% of students were willing to taste the raw vegetables presented to them regardless of ethnicity⁵⁹. These findings indicate that results are also mixed as it relates to racial and ethnic differences in dietary consumption patterns in young children.

When investigating a child's preference for certain snack foods, as reported by his or her parent, children who chose a healthy snack (grapes) did not reportedly have a higher preference for those healthy snacks. This finding may be explained in two ways: 1) food preference may not be a strong predictor of a young child's food choices or 2) parents' perceptions of a young child's snack preferences may be inaccurate. Findings on child preferences have been mixed. For children, preference trumps all and at the top of the list for what children want to eat are fat and sugar⁶⁸. This is a common finding and often relates to genetics and environment⁶⁹ but it has also been found that when children are asked about their foods preferences, fruit is often rated highly⁶⁵. The current study challenges the idea that children's preferences predict food choices, since preferences were reported high for grapes but majority still chose cookies. It also questions whether parents necessarily know what foods their children like. Parents are unlikely to introduce their children to foods they themselves dislikes, and often just give the child what they think they like and accept most readily⁶⁵. Overall, preschool age may be too soon to detect differences in snack food choices as it relates to gender, body mass index, race, and food preferences.

While there were no differences in snack choices by preschool age children according to gender, race, BMI z-score or stated snack preferences, there were differences in snack choices by child age and nutrition knowledge at post intervention. Previous research has revealed children's tendency to dislike new foods declines with age⁶⁵. In a study in which researchers used a preference questionnaire with students in grades 3rd through 12th, it was observed that the high school children preferred more vegetable and meat based dishes, whereas younger children in elementary school preferred fruits and starches⁶⁹. This supports the findings in the current study in which younger children chose the fruit as a snack. It has also been reported that as children moved from elementary to middle school, their consumption of fruits, vegetables, breakfast, and milk decreased while soft-drink consumption increased⁶⁹. This finding supports the idea that nutrition education must occur when children are young and have preferences for sweeter foods like fruits.

Nutrition knowledge was the second factor that was associated with a higher likelihood of children choosing a healthy snack. Yet, to be effective in changing behavior, interventions targeting dietary behavior change in preschool age children may require a minimum amount of time before changes in food choices are observed. In a recent study with preschoolers, children were read five age-appropriate books about nutrition and food each week for approximately three months. At the end of the 3 months, children in the intervention group had more than doubled their voluntary intake of vegetables⁷⁰. However, while positive results were noted after 3 months, a 3-month program in a preschool may not be feasible or realistic in terms of staff time and scheduling. Another study included slightly older children in kindergarten and first grade students who participated in an after-school nutrition education program for four weeks⁷¹. The

results revealed that the children who received the nutrition program for four weeks chose healthier snack options both, immediately after the instruction, as well as during a 4-month follow-up⁷¹. This indicates that at least 4 weeks may be needed for a nutrition education intervention to be effective in younger children.

Several other factors should be considered as it relates to food choices of young children. The socio-ecological model of health behavior change (Figure 1) depicts several levels of influence such as parents, peers, childcare environment among others that may need to be addressed individually or in combination to better understand and change children's snack choices. An article by Frazier et al revealed that there is a causal effect between peer influence and modeling on a child's food preferences and willingness to try a new food⁵⁰. It was found that children prefer foods that they see other children of the same age and gender who show positive responses to the foods they eat⁵⁰. Children may look up to others who they identify with and will often model similar behaviors.

Similarly, Wyse et al found that children increased their consumption of fruits and vegetables when parents consumption increased, as well as when the availability of foods in the house was high³⁸. To the contrary, parents might be inclined to purchase and offer foods that they know their child likes, such as cookies, instead of serving foods known to be disliked or introducing new foods because they fear that they will be refused⁷².

Another study investigated the impact of altering food environments within a school, and evaluated the impact that food offerings and participation in school lunch program had on

children's eating behavior⁷³. It was found that if fruits and vegetables were available, children ate healthier, however, if these healthier food options were competing with less healthy foods such as chips and ice cream, students chose the unhealthy foods, ultimately undermining the effects of healthier school meals⁷³.

While the snack choices in the childcare environment were controlled in the current study and peer influences were eliminated, there was minimal outreach and education to the parents and no manipulation of the home environment. These factors, among others not measured in the current study, all may play a role in a young child's ultimate snack choice decisions. With the goal to reduce childhood obesity, multiple levels of intervention should be included such as education about healthy eating and reduction of sedentary behaviors, as well as family involvement in all interventions⁴⁴.

3.5.1. Strengths and Limitations

One of the main strengths of this study is the fact that all assessments and data collection occurred in the same preschool and in the same three preschool classrooms. Another strength included the controlled nature of snack selection. There was minimal-to-no influence by other preschoolers or teachers and/or staff at the preschool when children were being asked to select a snack for snack time. Finally, the researcher conducting the assessments was different than the one who taught the education program preventing bias. The short duration made it feasible, cost-effective, and undistruptive to the regular school schedule.

The study does have a few limitations. One of the major limitations is the study sample size.

Having recruited as many as 70 children, there were only 46 complete data sets. The duration of the intervention was very short and relied on some self reported information from parents, thus the results might not be as accurate as they might have been with more education and more time to affect children's tastes for different foods being introduced. During the snack trials, as the children chose a snack, the snacks were not replaced to reflect a constant number of offerings. This could have showed children what snacks were being selected, and possibly influenced decisions. Another limitation was that it was not asked what snacks the children ate at home or what foods parents provided the children at home to see if the snack availability matched the snacks being offered at the preschool.

3.5.2. IMPLICATIONS FOR RESEARCH AND PRACTICE

Future research should investigate the minimal amount of nutrition education time needed to change snack choice behaviors of preschool students to reflect the knowledge they acquire. It is also important to investigate what education targets (e.g. family, food environment) are needed to significantly change preschooler's snack decisions, as well as at what age children start to care about health and the nutrients they put in their bodies. If children are not responsive to education at a young age, it might be beneficial to follow-up in order to see if the knowledge acquired has any effect at an older age. Because there are a variety of factors that play a role in children's eating behaviors, interventions that target multiple levels of influence should be investigated.

3.6. CONCLUSIONS

Results from this study revealed that despite gains in nutrition knowledge, children are still less

inclined to choose to eat a healthier snack option when offered the choice between a healthy snack and an unhealthy snack. This confirms the study published in 2010 that claimed that taste had the largest influence on what snacks children chose⁵¹. If children under the age of 9 are driven more by taste than by the consideration of health, then improvements in education alone might not translate into behaviors until children reach an older age⁶¹. It is also known that children's food preferences are highly predictive of their intake, and parents often do not offer kids foods that they disliked themselves⁶⁵. This implies the need to include families and home food environments as targets of interventions aimed at improving children's food preferences.

Table 1. Intervention Measurement Tools

Assessment	Instrument	Assessment of	Pre	Post
Weight, height, BMI	Stadiometer; SECA scale	Child	X	
Demographics	Demographic Form	Child and parent	X	
Food and activity habits	Healthy Kids Questionnaire	Child and parent habits (by parent)	X	X
Snack Preferences of child and parent	Snack Preference Questionnaire *	Child (by parent) and parent	X	
Preschool Snack Selection (PSS)**	PSS questionnaire	Child	X	X
Snack Trial Selection and Consumption	Snack Trial Form	Child	X	X

*55

** Designed and tested for All 4 Kids Program

Table 2. Demographic information for preschool age children

Characteristic	Mean	SD
Age (months)	49.7	8.6
Body Mass Index z-score	0.47	0.67
	n	%
Gender	n=45	
Female	28	62
Male	17	38
Body Mass Index Categories	n=43	
Underweight	0	0
Normal	35	81
Overweight	7	16
Obese	1	2
Race	n=37	
White	25	68
Black or African American	2	5
Asian	10	27
Ethnicity	n=38	
Latino or Hispanic	3	8
Non-Hispanic or non-Latino	35	92

Table 3. Comparison of preschoolers' snack selections at pre versus post intervention

		Post Snack Choice n (%)		Total
		Cookies	Grapes	
Pre Snack Choice n (%)	Cookies	28(80)	7(20)	35
	Grapes	6(60)	4(40)	10
Total		34	11	45

McNemar's χ^2 $p > 0.05$

Table 4. Comparison Between Pre- and Post-Study Mean Sum Scores for Preschool Snack Selection Assessment

Variable	Pre	Post	p-value
Knowledge Sum Scores [mean (SD)]	5.0 (3.7)	5.4 (3.8)	0.03
Preference Sum Scores [mean (SD)]	2.7 (2.3)	3.4 (3.2)	0.03

Wilcoxon signed rank sum

Table 5. Differences in characteristics of preschoolers who choose a healthy snack versus an unhealthy snack after a nutrition education program

Child Characteristics	n	Chose healthy snack choice (grapes)	Chose unhealthy snack choice (cookies)	p-value
Age (mean months \pm SD)	43	43.2 \pm 8.9	51.9 \pm 7.4	0.003
BMI Z-score (mean \pm SD)	43	0.29 \pm 0.8	0.53 \pm 0.6	0.30
Gender [n (%)]				0.28
Male	17	4 (24)	13 (76)	
Female	28	7 (25)	21 (75)	
Ethnicity [n (%)]				0.41
Hispanic or Latino	3	1 (33)	2 (67)	
Non-Hispanic or Latino	35	7 (20)	28 (80)	
Race [n (%)]				0.19
White	23	4 (17)	19 (83)	
Black or African American	2	0 (0)	2 (100)	
Asian	12	3 (25)	9 (75)	

Independent two sample t-test (age, BMI z-score)

Fisher's Exact Test (gender, race, ethnicity)

Table 6. Difference in Snack Knowledge and Preference Assessment Scores between preschoolers who chose a healthy snack versus an unhealthy snack after a nutrition education program

	Chose healthy snack (grapes)	Chose unhealthy snack (cookies)	p-value
Knowledge Snack Score Mean (SD) Difference (Post-Pre)	2.091	0.1875	0.002
Preference Snack Score Mean (SD) Difference (Post-Pre)	-0.091	0.906	0.428

Wilcoxon Mann Whitney

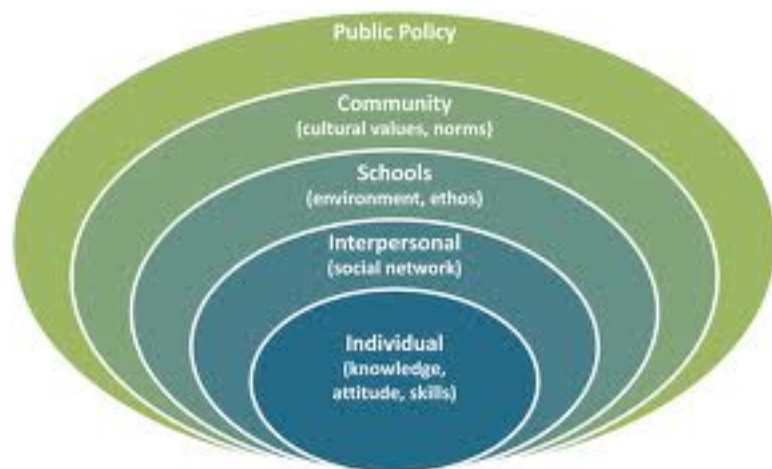


Figure 1. Social ecological model of health behavior

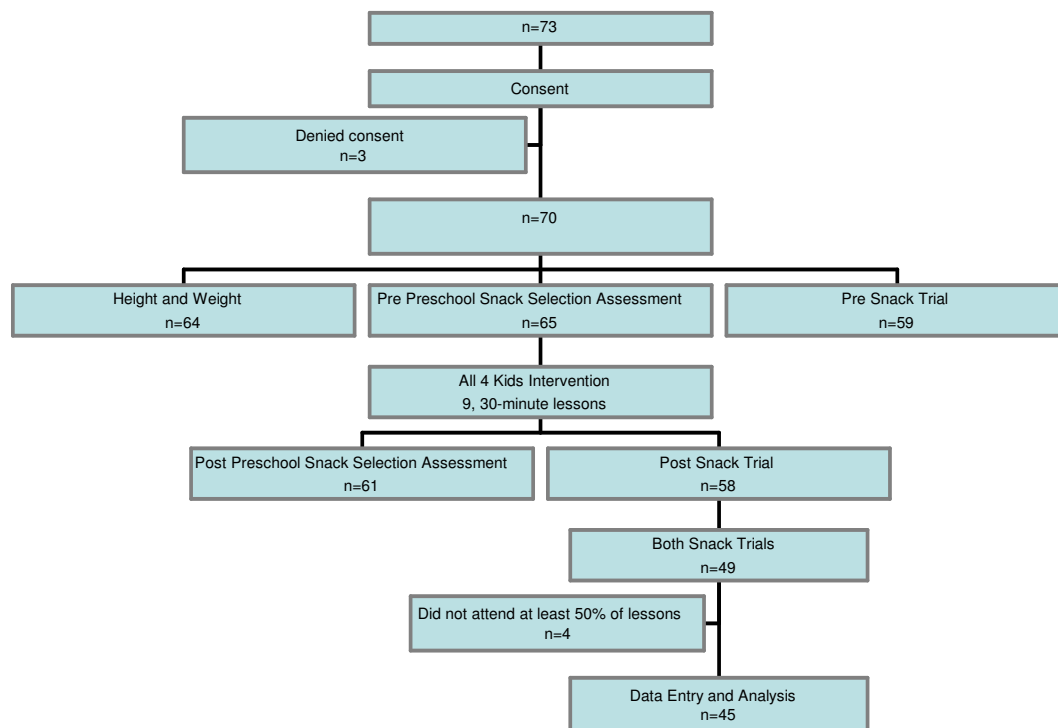


Figure 2. Study Design



Figure 3. Obesogenic ecological model



Figure 4. Snack choices (grapes and cookies)

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