A HEALTHY SNACKING INTERVENTION IN PRESCHOOL-AGED CHILDREN

by

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ABSTRACT

Snacking is a child dietary behavior that has been increasing with snack foods often characterized as energy-dense, nutrient poor foods. While observational data demonstrate a strong relationship between snacking and poor diet quality in children, few interventions have been conducted and even less have taken a family-based approach. Based on the complexity of snacking, the relationship to poor diet quality of children, and need to include the parent, a family-based snacking intervention targeting these areas is warranted. Thus, the purpose of this study was to determine if a healthy snacking intervention in preschool-aged children has an impact on dietary intake.

Seven children were enrolled in the study and six had complete measures at baseline and five weeks. Child characteristics were not significantly different between SNACKING and CONTROL at baseline. A healthy snacking intervention had no significant effect on diet quality as compared to control. Children consumed 2.1 ± 0.6 snacks per day at baseline. When snacks were centered around two based on AAP recommendations, there was a significant effect of condition by time interaction ($p = 0.06$) where the SNACKING group decreased snacks and CONTROL increased snacks. There was no significant effect for total energy intake however there was a reduction in total energy intake from baseline to five weeks in the SNACKING group compared to CONTROL. The healthy snacking interaction had a significant main effect for condition for the layered yogurt dip on liking ($p = 0.008$). There were no

significant correlations between parenting styles and diet quality, however, there was significance associated with the feeding practice, concern for child weight, which was signicantly associated with diet quality at five weeks ($B = 5.5$ ($\beta = 0.95$), $p = 0.03$; $R^2 = 0.963$, $p = 0.04$). Overall effect size for z-BMI for the sample from baseline to five weeks was $d = 0.195$.

Given the small sample size for this study it is difficult to conclude the impact of a snacking intervention. However, there was a condition by time interaction for number of snacks per day, and although not significant, a decrease in total energy intake in the SNACKING group. This is part of an ongoing study and it is the intention that significant results will be found at study end especially with current preliminary findings.

Chapter 1

INTRODUCTION

Childhood overweight and obesity is a public health issue for the United States. Current prevalence of overweight and obesity in children (2-19 years-old) is 31.8%.[1] Overweight and obesity is determined utilizing age and sex specific body mass index (BMI) percentiles from the Centers for Disease Control and Prevention growth charts.[2] A BMI at or above the 85th percentile categorizes a child as overweight and a BMI at or above the 95th percentile classifies a child as obese.[2] Overweight and obesity during childhood has both short and long-term health implications. Children with overweight and obesity are at risk for developing high blood pressure,[3] high cholesterol,[3] type II diabetes,[3] sleep apnea,[4] asthma,[5] joint problems,[5-6] and psychological stress including social, physical, and emotional issues.[5,8] In addition, children with overweight and obesity are more likely to be overweight or obese in adulthood further increasing risk for heart disease,[9-10] diabetes,[10] metabolic syndrome[4] and cancer.[9,11-12]

The associated health risks in childhood and lasting implications into adulthood are of major concern for children with overweight and obesity. Intervening during young childhood can be crucial to prevent overweight and obesity and its associated co-morbidities. In particular, the preschool years are a time during which children develop eating habits and food preferences.[13] In young children habits and preferences can be learned through observations of their parent's behaviors as indicated by the Social Learning Theory.[14] The development of healthy eating habits

are important because children have relatively high nutrient needs for growth and development.[15] The increased prevalence of overweight and obesity indicates that children are consuming excessive energy intake above and beyond what is needed for growth, and unfortunately, the excessive intake is often of poor nutrient quality.[28-30]

Within the diet, snacking is one particular eating behavior that has become more frequent and contributes to a larger proportion of energy intake in children.[17] Currently, no specific recommendations for the number of snacks or types of food to be consumed for a snack in children exists.[16] Further, snacking is a behavior that occurs at home and away from home, but has not been well defined. Most definitions characterize snacking as an eating occasion between meals or defines snacking based on the type of food (e.g. ice cream).[16] Most often "snack foods" are energy-dense, nutrient-poor, and of varying portion sizes.[17-18, 22-23]

Observational studies have shown increases in snacking episodes,[17-18, 22-24] but few interventions have been conducted to determine the impact of a snacking intervention on diet quality in children. Previous studies have primarily targeted children in child care settings or schools with limited involvement of a parent. Due to the role parents have as the gatekeepers of food and in shaping eating habits of young children, interventions involving young children should also target the parent. Targeting the parent or primary care taker in addition to the child is essential for the prevention of overweight and obesity in children.

Chapter 2

REVIEW OF THE LITERATURE

2.1 Dietary Recommendations for Preschool Children

Dietary recommendations for the general public are determined by the Dietary Guidelines for Americans (DGA).[24] These guidelines are updated every five years and include the latest scientific evidence to make recommendations for a healthy diet for the prevention of chronic diseases like obesity.[24] The DGA recommendations focus on helping the public achieve and maintain healthy weights while consuming adequate nutrients. The 2015-2020 DGA's are designed to promote healthy eating patterns that include a variety of vegetables (dark green, red and orange, legumes, starchy, and other), fruits (whole), grains (with half as whole grains), fat-free and low-fat dairy (milk, yogurt, cheese and soy), a variety of protein (lean meats, poultry, eggs, seafood, nuts, seeds, and soy) and oils.[24] In addition, it is recommended that saturated fats, *trans* fats, added sugars and sodium be limited to achieve a healthy diet.[24] The DGA recommendations are pictorially represented through MyPlate.[25] Recommendations for total energy intake for preschool-aged children ranges from 1,000 calories (2 year-old boys and girls) to 1,600 calories (5 year-old, boys) per day.[25] While daily energy recommendations and guidance for how to achieve a healthy diet are provided, these recommendations do not specifically address the allocation of energy or servings from food groups to meals and snacks.

Recommendations for the types of food to include in a meal have been suggested through MyPlate, but foods for snacks have been less defined. Within the

scientific literature several definitions of snacking exist including: nutritional profiling, time of food consumption, food clusters, hybrid definitions, self-designation by consumers and eating frequency.[16] Nutritional profiling is based on quality and consumption, time of food consumption is defined by set meal times and food consumed out of these parameters is determined to be a snack, food clusters are considered meals, hybrid definitions are based on nutritional classifications and temporal patterns, self-designation by consumers is a definition determined by individual report of meals and snacks, and finally, eating frequency is where the consumption of snacks is proportional to eating occasions throughout the day.[16] Similar to self-designation, parents often have their own definitions of snacks for their child.

Parents provide and define snacks given to their children in a variety of ways. In one study, snacks were defined and provided to children based on the types of food, portion size, time, location, and purpose.[45, 69] Types of snack foods included fruits, vegetables, baked goods, cookies, crackers, and dairy.[45, 69] In terms of portion size, parents defined snacks as "something little."[45, 69] Time included the proximity of an eating occasion to meals and snacks, and defined as anything outside the typical breakfast, lunch, and dinner eating episodes.[45,69] Time also included how long it takes to prepare food, something that was quick to prepare was often described as a snack.[45,69] Location referred to where food was eaten; when food was eaten at the table it was identified as a meal versus anything away from the table was characterized as a snack.[45, 69] Finally, the purpose of snacking was generally defined as "holding"

the child over until meal time.[45, 69] Parents often define a child's eating occasion because meals and snacks are terms that are ambiguous to preschoolers.[66] Based on an absent standardized definition of snacking, different parent perceptions of snacking and children unable to distinguish categories of eating, it has been suggested that researchers clearly state the chosen definition of snacking in the methods section.[27]

In addition to the DGAs and extant literature, the American Academy of Pediatrics (AAP) provides dietary guidance for parents on eating. Specifically, the AAP provides guidance for preschool children with overweight and obesity. These recommendations include not leaving food available on countertops for children to grab, limiting snacks to two per day, and to provide healthy options.[26] Healthy options were defined by the AAP as foods including fruits, low fat cheeses, and peanut butter instead of candy and chips.[26] The AAP discourages frequent consumption of energy-dense foods like desserts, ice cream, candy, and chips and instead encourages parents to focus on limiting, not eliminating.[26]

Dietary recommendations like those outlined by the DGA are provided to achieve and maintain a healthy weight, to ensure adequate nutrients, and to reduce the risk for chronic diseases.[24] The AAP built upon the DGA recommendations to provide specific guidance to parents of children with overweight and obesity. Together these recommendations focus on energy intake and adequate nutrient intake, an aspect of diet quality. In addition to adhering to energy intake recommendations for weight management, better diet quality is essential for the prevention of chronic disease.

2.2 Child Diet Quality

Diet quality is defined as the adherence to a diet that consists of vegetables, fruits, whole grains, low fat dairy, fish, and unsaturated fatty acids.[46] Diet quality can be assessed by individual food groups (e.g. fruits, vegetables) or overall diet through measures such as the Healthy Eating Index (HEI).[28] The HEI is a reliable and validated measure used to assess diet quality.[28] The HEI compares an individual's diet to the DGA through a scoring mechanism focused on adequacy (dietary components to increase) and moderation (dietary components to decrease).[28] On a more detailed level, a total score is achieved based on twelve components: total fruit, whole fruit, total vegetables, greens and beans, whole grains, dairy, total protein foods, seafood and plant proteins, fatty acids, refined grains, sodium and empty calories (solids fats, alcohol, and added sugars).[28] The HEI is based on a score range from 0-100 with a higher HEI score indicating better diet quality.[28]

In children, the HEI has been used to assess total diet within a day and individual meals (e.g. lunch). Nationally representative data from the National Health and Nutrition Examination Survey (NHANES) from 2005-2010 showed that HEI scores of children 4-18 years had an average score of 50, indicating poor overall diet quality.[46] Hiza and colleagues[29] found that children had met the maximum level for HEI in total grains and close to the maximum for milk, meat and beans when assessing total diet. Comparing diet quality in younger children to older children, children aged 2-5 years had higher scores of total fruit, whole fruit, and calories from solid fats and added sugars compared to older children (6-17 years).[29] In addition these young

children had lower scores for meat and beans, and oil.[29] Similar to the study using NHANES data to assess the diet quality for the total diet, Jose Romo-Palafox and colleagues[30] assessed lunch of preschool children and found that the mean HEI-2010 score was 58 out of 100. Based on the outcomes of these two studies a single meal (lunch) had a higher HEI score on average, but it was similar to the HEI scores for the overall diet.[46] When looking at key food groups Jose Romo-Palafox and colleagues[30] found that 80% of lunches did not provide or the children did not consume the recommended number of vegetables. In addition to the low quantity of vegetables, approximately 60%-70% of lunches had higher quantities than the recommended amounts of refined grains, sodium and saturated fat.[30] These studies indicate that children are not meeting dietary recommendations and their diet would be qualified as poor dietary quality.

Comparing adolescents with obesity that were considered metabolically healthy to adolescents with obesity at risk for cardiometabolic complications showed that metabolically healthy adolescents with obesity had higher HEI scores (HEI Total Score = 55.2 ± 1.2) compared to adolescents with obesity at risk for cardiometabolic complications (HEI Total Score = 47.8 ± 2.6).[47] The metabolically healthy adolescents had higher consumption of milk and reduced consumption of solid fats and added sugars.[47] Regardless of the methodology used to measure diet quality, the majority of results indicate young children, and specifically children with overweight and obesity, have poor diet quality contradicting what is recommended. This is

particularly evident due to the increase in consumption of energy-dense, nutrient-poor foods in which snacking may be a major contributing factor to these types of foods.

2.3 Snacking Behaviors in Preschool-Aged Children

As diet quality has decreased, snacking behavior has increased particularly among the preschool-aged population, and too often snack foods consist of energy-dense, nutrient-poor foods. Blaine and colleagues[70] conducted parent surveys addressing reasons for providing children snacks and compared responses to child dietary recommendations. Children who were offered snacks for non-nutritive reasons (i.e., rewards) had lower adherence to dietary recommendations.[70] In addition to the association between poor diet quality and obesity, snacking behavior has also been linked to a higher BMI.[32] In a review of snacking behavior, which consisted of snacking patterns (availability of snacks and location of eating) in relation to dietary intake and BMI status, two longitudinal studies within this review showed that a greater percentage of energy consumed from snacks was associated with higher BMI in children aged five to nine.[32] Additionally, Musher-Eizenman and colleagues[66] found that when children were shown pictures of events throughout a typical day (i.e., play dates, movie theater, and sporting events) BMI was positively correlated ($r = 0.53$, $p<.05$) with preschoolers who indicated consuming food at these events.

Snacking, defined as self-designation by consumers, has greatly increased from 74% of children in 1977-1978 to 98% in 2003-2006.[17] In addition during this time period (1977-2006) children aged 2-6 years old were found to consume the highest number of snacks per day.[17] Simultaneous to an increase in overall snacking

behavior, portion sizes have also increased from 1977-1978 to 2003-2006.[18] Larger portion sizes of foods like soft drinks and salty snack foods were associated with higher energy intakes and this was equal to an increase of 184-272 kcal/day for children 2-18 years old.[17,23] Similarly, Wang and colleagues[68] found that snacks contributed 460 kcal/day or about 25% of daily energy intake in children aged 4-8 years old using 2009-2012 NHANES data.

Another review analyzed snacking behavior in children and found energy from snacks contributed approximately 37% of total energy intake, but only provided 15%-30% of micronutrients indicating snacking may be a contributing factor to poor diet quality.[37] Specifically, 40% of added sugar intake was from snacks, which is the equivalent of 12 teaspoons per day of sugar for children 2-5 years-old and eighteen teaspoons per day for children aged 6-11.[37] A nationally representative study examined 20 year trends between 1989 and 2008 using data from NHANES and the Continuing Survey of Food Intake by Individuals (CSFII) in preschool children and found an increase in the consumption of foods high in sugars, solid fats, and sodium.[20] The foods that contributed the most to added calories were savory snacks, pizza/calzones, sweet snacks and candy, Mexican dishes and fruit juice.[19-21] Similarly, consumption of sugar sweetened beverages in this age group also increased. On average 2-5 year old's consumed an average of 15.5 ounces or 176 calories of sugar sweetened beverages per day.[22]

Snacking is a behavior that has increased in children and it is a behavior that can occur at home or away from home, including child care settings. At home, parents

are considered to be the gatekeepers of food, and therefore, have great influence over the availability, frequency, and amount of food consumed.[13] Most research investigating snacking behaviors has occurred in child care centers or schools. Child care centers are generally under the regulation of the Child and Adult Care Food Program (CACFP) sponsored by the United States Department of Agriculture. For meals and snacks provided by child care centers associated with CACFP to be reimbursable there are guidelines on the specific food groups to be served and serving sizes of each food group.[48] To be reimbursed for snacks, the CACFP requires the snack to include two of five food groups including: milk, fruit, vegetable, grains, or a meat or meat alternates which includes cheese, eggs, beans, peanut butter, or yogurt.[48, 71] These guidelines were recently updated to include five components separating fruits and vegetables.[71] All child care centers must be in compliance with the new CACFP standards by October 2017.[71]

In an evaluation of child care centers and snack offerings in Ohio, it was found that fruits, vegetables, and meat/beans were rarely offered as snacks; however, 100% fruit juice was included as part of snacks three times per week in over one-third of the centers studied.[33] In addition to 100% fruit juice served as snacks, the additional items served for snacks at least three days per week at the centers were mostly composed of sweet and salty foods like animal crackers, fruit gummy snacks, and pretzels.[33] This trend is similar to that observed in other child care centers across the United States.[34-35] It has been shown that children who attended child care full time are also

consuming excess energy intake from sweet and salty snacks and sugar sweetened beverages away from the child care center as well.[36]

Observational data demonstrates the growing trend in snacking behavior particularly among preschool-aged children. While these data have shown an increase in snacking behavior, few interventions have been developed focused on snacking in preschool children.

2.4 Snacking Interventions in Children

Many studies have focused on modifying overall dietary behavior in children, but few have specifically targeted snacking behavior. Even less have directly involved parents who are the primary decision makers concerning food choice and availability.[43, 45] Cason and colleagues[38] examined pre-and post-changes in a preschooler's ability to identify nutritious snack foods, fruits, and vegetables through nutrition education using the multiple intelligences theory. Nutrition education lessons were 40 minutes in length every two weeks delivered to a group of 18 children.[38] Lessons included reading a book about healthy snacking, fruits and vegetables, the Food Guide Pyramid and tasting foods.[38] Compared to the pre-evaluation, children were able to identify more healthy snacks, fruits, and vegetables at post evaluation.[38] Parents were not actively involved in the educational lessons, but did report on their child's eating habits for the pre-and post-assessment. Based on the surveys, post-evaluation showed that children increased consumption of fruits, vegetables, dairy, meat, and bread and decreased foods containing fats, oils, and sweets.[38] Sigman-Grant and colleagues,[39] conducted a similar study using pre-and

post-evaluation after implementing a nutrition education program. The intervention was delivered over a period of nine weeks with 24 lessons at Head Start Centers in Nevada with generalizability confirmed in Oklahoma, New Jersey and Connecticut.[39] Lessons were developed based on a number of learning theories including Bandura's Social Learning, Piaget and Inhelder's Stages of Cognitive Development and Vygotsky's Zone of Proximal Development.[39] During the nutrition education program children were continuously exposed to 18 photographs of food and asked to categorize them as "Go" or "Whoa" foods.[39] "Go" foods were healthy and "Whoa" foods were unhealthy. The 18 foods the children were exposed to were chosen at the start of the program based on parent selection from a list of 30 snack foods typically consumed and recommended for preschoolers.[39] Parents were asked which foods from this list they most frequently provided for snacks.[39] The 15 most frequently mentioned across families were used in the program which ultimately included six healthy ("Go") and nine unhealthy ("Whoa") snack foods.[39] Jicama, kiwi, and yogurt which were used in a taste test were added to the six healthy food group for a total of 18 foods.[39]

Building upon the concept of preschooler's ability to identify healthy snack choices while at child care settings, Joseph and colleagues[40] examined if child characteristics (e.g., BMI z-score, gender, race, age, etc.) were associated with a child's selection of snack. The two snack options used included a healthy option (grapes) and an unhealthy option (chocolate chip cookies).[40] A pre/post intervention design included nine, 30-minute lessons every day for two weeks.[40] Before the intervention and after the intervention children were offered the healthy snack option

or unhealthy snack option individually in a separate room.[40] The intervention was similar to the study discussed previously by Sigman-Grant and collegues[39] which focused on preschoolers ability to identify foods, stated verbal preference, and ability to distinguish healthy ("Go") and unhealthy ("Whoa") foods in an individual interview conducted before and after intervention lessons.[40] After the intervention, it was found that children were able to identify the healthier snack option and state a verbal preference for the healthier option (grapes) but the majority of children did not significantly change their snack choice to the healthier option.[40] When examining child characteristics, BMI z-score was higher in the group that did not alter their snack choice to the healthier option (BMI z-score for children who chose healthy snack choice 0.29 ± 0.8 versus those who chose unhealthy snack 0.53 ± 0.6) although this was not significant likely due to the small sample size (n=45).[40] Parents were not involved in educational lessons.[40]

Another approach was designed to offer a variety of fruits and vegetables "family style" during snack time.[41] It was hypothesized that providing a variety of either vegetables or fruits to preschool children as a snack would increase their selection and intake.[41] This intervention is different than the others listed above in that while children had choices, all the choices were "healthy" as they were defined in the context of fruits and vegetables in contrast to previous studies that focused on a choice of a healthy snack versus an unhealthy snack. Gripshover and Markman[42] also conducted a randomized controlled trial investigating how knowledge guides preschool children's reasoning about food and body interactions, prerequisites for a

child's understanding of food as a source of nutrition, and a strategy for teaching children that foods are a source of nutrients. Through this experiment, researchers wanted to determine if children would increase vegetables at snack time.[42] The intervention group was read books that included topics of dietary variety, digestion, food categories (food groups), microscopic nutrients, nutrients and biological function zero to two times per week for 10-12 weeks, while the control group was not read any books.[42] Books were read during snack time with a fifteen minute structured interview in small groups to assess children's grasp of content.[42] Diet was assessed by observation at snack time where small groups were served fruit, cheese, and crackers before the reading.[42] After the reading, vegetables were added to the snack choice and by observation, number of vegetable pieces was recorded.[42] The intervention group was found to have a significant increase in vegetable intake compared to control group.[42]

Few interventions focused on snacking have been conducted using a rigorous study design and even less have included the parent. However, due to the integral role parents have in influencing their child's diet, interventions targeting weight management in children have shown family-based treatment is the most successful model in which both the parent and child are targeted and working toward the same goal.[49]

2.5 Family-based Dietary Interventions

Family-based interventions have been shown to be efficacious for weight management of children.[58] Birch and Ventura[50] concluded in a review of literature

that school based interventions have little success with approximately fifty percent of interventions producing a significant behavior change when working with children alone. Birch and Ventura[50] demonstrated in an ecological framework a child's weight status is influenced by the child's family, community, and demographic characteristics. They also concluded that parents provide a child with genes and environment which impact eating behaviors and weight status.[50] They concluded that interventions should include both parents and families in homes and childcare settings, and this will likely have a greater impact on child eating behavior rather than targeting the child alone.[50]

Parents shape a child's food environment at a young age and play a pivotal role in dietary behaviors.[43] Factors that contribute to parent's food environment include cultural, ethnic, and socioeconomic practices.[43] In addition to control of the food environment and decisions concerning food, parenting styles and practices also impact child eating and weight status.[44] Parenting styles and practices may have many influencing factors on child weight status and eating behavior,[44] including snacking.

Due to the influence of parenting styles and behaviors it has been recommended to measure these aspects as part of dietary interventions to understand the role parenting styles and practices play in relationship to a child's eating behavior.[65]

2.6 Literature Review Summary

Childhood overweight and obesity is a public health concern in the United States with 22.8% of preschool-aged children (2-5 years-old) identified as overweight

or obese.[1] Children with overweight and obesity are more likely to have a negative health trajectory[5-7] with lasting health implications over the lifecourse.[12] For these reasons, it is imperative to identify interventions that can prevent overweight and obesity in children. Research has shown that children's diet quality is poor[30-36] and that portion sizes and snacking are on the rise, all factors that contribute to excess energy intake.[17-23]

Snacking is one aspect of a child's diet that has been increasing with snack foods often characterized as energy-dense, nutrient-poor foods. While observational data demonstrate a strong relationship between snacking and poor diet quality in children, few interventions have been conducted and even less have taken a family-based approach. Based on the complexity of snacking, the relationship to poor diet quality of children, and need to include the parent, a family-based snacking intervention targeting these areas is warranted.

Chapter 3

AIMS

The primary aim of this research is to determine if a healthy snacking intervention in preschool-aged children has an impact on dietary intake. This goal will be achieved by comparing a five week healthy snacking intervention (SNACKING) to a control condition (CONTROL).

3.1 Specific Aims

Primary Aim 1: To determine if SNACKING compared to CONTROL improves diet quality in preschool-aged children.

H1: Children in the SNACKING condition will have greater improvement in diet quality after five weeks compared to CONTROL.

Primary Aim 2: To investigate whether SNACKING reduces the number of snacks consumed in preschool-aged children compared to CONTROL.

H2: Children in the SNACKING condition will have a greater decrease in the number of snacks after five weeks compared to CONTROL.

Primary Aim 3: To examine the effect of SNACKING on total energy intake in preschool-aged children compared to CONTROL.

H3a: Children in the SNACKING condition will have a greater reduction in total energy intake from baseline to five weeks compared to CONTROL.

3.1.1 Secondary Aims.

Secondary Aim 1: To determine if SNACKING impacts child liking of healthy snacks compared to CONTROL

Ha: We hypothesize children in the SNACKING condition will have a greater liking of snack foods at five weeks compared to CONTROL.

3.1.2 Exploratory Aims:

Relationship between parenting styles and parent feeding practices and diet quality will be explored. Due to the length of the study it is not anticipated anthropometrics will change; however, effect sizes using Cohen's *d* will be calculated between conditions.

Chapter 4

METHODS

4.1 Study Design

This pilot, 2 x 2 randomized controlled trial, with a between-subject factor of condition (SNACKING vs. CONTROL) and a within-subject factor of time (baseline vs. five weeks) was designed to test the impact of a snacking intervention on dietary intake in preschool children at risk for obesity. The study was conducted from July 2016 to December 2016 at the University of Delaware and a local YMCA. Children and their parents were randomly assigned to one of two conditions: 1) a healthy snacking intervention (SNACKING); or 2) a control condition (CONTROL). Primary outcomes of the study were to determine if snacking as measured by diet quality, snacking frequency, and total energy intake changed due to the exposure of a healthy snacking intervention. A secondary outcome, liking of healthy snacks, was measured using a hedonic scale. Parenting practices and feedings styles in addition to anthropometric outcomes were also explored.

4.2 Participants

This study was conducted through the University of Delaware's Energy Balance and Nutrition Laboratory. Families were recruited through direct mail, flyers posted in the local community (e.g. Craig's List), University listservs, and in-person recruitment at child care centers and the local YMCA. To be eligible, participants had to be preschool aged (3-6 years-old) and at risk for overweight or obesity (based on a parent with overweight or obesity [BMI $\geq$25 kg/m^2]) who consumed $\geq$3 snacks per day. Additional eligibility included: a primary caretaker who was $\geq$18 years-old and willing to participate in the research study; the parent and child could read, speak, and

understand English; and the family had transportation. Exclusion criteria included a child participating in a current weight loss program or taking medication to aid with weight loss; the child spent <50% of their time at the participating parent's home; the child had a medical condition that impacted growth (e.g. Prader Willi); the family planned on moving out of the Newark area before conclusion of the study; or the family was unable to attend pre-scheduled sessions.

Of the 39 parents recruited, seven were eligible, completed informed consent and assent, and were enrolled in the study. Thirty-one were ineligible due to: time constraints (n=11), did not consume ≥3 snacks per day (n=2), transportation to the University of Delaware (n=1), parent BMI <25 kg/m^2 (n=5), food allergies (n=2), child was not between the ages of 3-6 years (n=1), and not interested (n=8). In addition one child did not provide informed assent. The study was approved by the University of Delaware Institutional Review Board.

Upon completion of a baseline assessment, seven families were randomized using a random number generator to SNACKING (n = 4) or CONTROL (n=3). Randomization occurred within two cohorts of families based on location of intervention delivery (University of Delaware or YMCA).

4.3 Intervention

Healthy Snacking Intervention (SNACKING). Children and their parents attended five, 45-minute sessions. Each session provided education on a behavioral strategy (self-monitoring, parental modeling, stimulus control in the home environment, problem solving) and education about a specific food group (vegetables, fruits, grains, protein, and dairy) from MyPlate.[25] Parents and children also prepared a healthy snack corresponding to the food group being discussed in the session. A family-based

approach was employed, and both the parent and child were encouraged to achieve a goal of no more than two snacks per day and only one serving of snack at each snacking episode. Each week parents self-monitored all snacks consumed by the parent and child on a snack record. Each week the snack records were turned in to the interventionist and feedback was provided to the parent and child the following week about their progress toward meeting the goal of no more than two snacks per day. Sessions were delivered on the University of Delaware campus and at a local YMCA.

Control (CONTROL). Children and their parents in the CONTROL condition received a weekly recipe in the mail. The weekly recipe was the same one prepared in the SNACKING condition.

4.4 Measures

Demographics. The demographic questionnaire obtained basic personal information (e.g., age, gender, race, education level) for the parent and child at baseline only.

Dietary Intake. Three-day (two weekdays, one weekend day) food records were used to assess dietary quality using the Healthy Eating Index (HEI-2010),[28] number of snacks consumed per day, and energy intake at baseline and five weeks. Caretakers were asked to record their child's dietary intake, as children do not have the cognitive ability to accurately complete a self-report questionnaire.[59] Caretakers received two-dimensional food models to help with the identification of portion sizes. If a child was under the supervision of another adult during this time, the caretaker was asked to obtain information about the child's intake from the supervising adult.

Each food record was entered into the 2015 Nutrition Data System for Research (NDS-R) software developed by the Nutrition Coordinating Center, University of Minnesota, Minneapolis, Minnesota. Output data from NDS-R was used to calculate HEI-2010 scores, obtain the number of snacks consumed each day, and total energy intake. Data from diet records were averaged across the three days for analysis.

The HEI-2010 evaluates diet quality based on adherence to the 2010 Dietary Guidelines for Americans.[28,51-53] The HEI-2010 score is derived from 12 components, including nine adequacy components (total fruit, whole fruit, total vegetables, greens and beans, whole grains, dairy, total protein foods, seafood and plant proteins, fatty acids), and three moderation components (refined grains, sodium, and empty calories).[28,52] Higher scores for each component represents better diet quality with moderation components thus being reverse scored. HEI-2010 score ranges from 0-100.

A snack was self-defined by the parent. The number of snacks reported each day were summed and averaged across the three days. If two snacks were consumed less than 15 minutes apart, they were averaged and counted as one snacking occasion. Snacks included both food and beverage intake greater than five kilocalories per serving.

Liking of Snack Foods. The liking of snack foods (prepared in the SNACKING condition and recipe provided to families in the CONTROL condition) was assessed

using a 3-point Likert-type scale, anchored with faces showing an expression of like ("yummy"), dislike, ("yucky"), and neutrality ("just okay").[54-56] At each assessment children were asked to eat a three-gram sample of each snack and asked to identify the snack as "yummy" "yucky" or "just okay." Liking of snack foods was conceptualized as continuous variable similar to Birch,[55-56] whereby like was coded as three, dislike was coded as one, and neutrality was coded as two.

Child Feeding Questionnaire. The Child Feeding Questionnaire (CFQ) which measures caretaker attitudes, beliefs, and practices around child feeding was completed at baseline only. This 31-item questionnaire has been validated for preschool to middle childhood.[57] Three questions were removed due to age of the children resulting in a 28-item questionnaire focused on the seven factors: perceived responsibility (three items), perceived parent weight (four items), perceived child weight (three items), concerns about child weight (three items), restriction (eight items), pressure to eat (four items), and monitoring (three items). Responses are based on five point Likert scale responses. Scores for each question are summed and divided by the number of questions in each domain. Each domain score ranges from zero to five. This questionnaire was completed at baseline only.

Parenting Styles and Dimensions Questionnaire. The Parenting Styles and Dimensions Questionnaire (PDSQ), is a validated, 57-item questionnaire, that uses three scales to measure authoritarian, authoritative and permissive parenting styles.[58-60]

Responses are based on a five point Likert scale anchored with "never" to "always." This questionnaire was completed at baseline only.

Physical Activity: A hip-mounted triaxial accelerometer (ActiGraph wGT3X with heart capture, ActiGraph, LLC) was worn for three days (two weekdays and one weekend day) to objectively capture physical activity. Only wear time greater than ten hours per day is included in analysis. Physical activity was reported in terms of average total minutes of moderate to vigorous physical activity over the three days. The ActiGraph is a small (4.6cm x 3.3cm x 1.5cm) device (weight 19 grams) worn on an elastic belt that clips around the waist and has been validated in preschool-aged children.[64]

Anthropometrics. Weight, height, BMI, BMI z-score and BMI percentile are anthropometric measures that were used to assess growth at baseline and five weeks. Caretaker and child height and weight were measured with shoes removed, using standard procedures.[61] Weight was measured to 0.1 lb using an electronic scale (SECA 874) and height was measured to the 0.125 inch using a portable stadiometer (SECA 213). Height and weight measures were used to calculate BMI (kg/m^2) which was used to assess weight status for parents and used to calculate BMI z-score for children by standardizing the BMI value in relation to the population mean and standard deviation for the child's age and sex.[62] Each child's BMI was also plotted on the 2000 CDC BMI-for-age growth chart to determine BMI percentile.

Evaluation. At conclusion of the intervention, parents were asked to complete an evaluation questionnaire. The evaluation focused on identifying if parents prepared the snack recipes provided. In addition, the evaluation obtained additional open-ended feedback from parents in the SNACKING condition about liking of the program and suggestions for changes for future implementation.

Compliance. Treatment attendance was recorded for the SNACKING condition. Self-monitoring can be predictive of behavior change,[63] thus, in the SNACKING condition, self-monitoring adherence was evaluated by the number of snack records for the parent and child returned to the interventionist over the course of the intervention.

4.5 Data Analysis

Data was assessed for skewness, kurtosis, and extreme outliers. Descriptive statistics were used to analyze baseline characteristics overall and between conditions (SNACKING vs. CONTROL) with independent t-tests used for continuous data (e.g., age, weight, height, z-BMI) and Chi-square for categorical data (e.g., gender, race/ethnicity, income). At baseline only two children wore the ActiGraph belt and only one child had adequate (≥10 hours per day) wear time for three days. Due to missing data physical activity was not included in subsequent analyses. Statistically significant differences in characteristics for the child or participating parent between conditions at baseline will used as covariates in subsequent analyses. All analyses were conducted at a significance level of alpha < 0.05. Statistical analysis was completed using SPSS version 23.0 (IBM Corporation).

To assess primary aim one and the dependent variable of interest, diet quality, a linear mixed factor analysis of variance (ANOVA) with a between-subject factor of condition (SNACKING vs. CONTROL) and a within-subject factor of time (baseline vs. five weeks) was used. Main effects of condition, time, and a condition by time interaction were assessed. For primary aim two and three similar models were run as in primary aim one. The dependent variable for primary aim two was the number of snacks consumed centered around two snacks per day based on the recommendations from the AAP. Primary aim three investigated the dependent variable, average total energy intake.

To assess the secondary aim, the same linear mixed factor ANOVA was used except the dependent variable of interest was liking of snack foods, conceptualized as continuous variable similar to Birch.[54-56] To assess the exploratory aim, looking at the relationship between parenting styles and diet quality, and parent feeding practices and diet quality, correlations between baseline diet quality and parenting measures were analyzed. Second, a linear regression model adjusted for baseline diet quality was conducted. In addition, an effect size for z-BMI occurring across time was calculated with Cohen's *d*, using condition means and standard deviations at baseline and five weeks.

Evaluation questions pertinent to both conditions (e.g. if recipes were made at home) were analyzed using an independent t-test to compare responses between SNACKING and CONTROL conditions. Lastly, descriptive statistics were used to

report findings from the evaluation questionnaire for compliance with attendance and self-monitoring in the SNACKING condition.

Chapter 5

RESULTS

5.1 Normality and Distributions of Variables

Continuous dependent variables including diet quality, number of snacks centered around two, energy intake and liking of snacks were tested for normality using the Shapiro-Wilk W test. The null hypothesis of the Shapiro-Wilk W test is that data come from a normal distribution and therefore a $p < 0.05$ indicates non-normal data. All data were normally distributed. One participant had only one dietary record and the energy intake was an outlier (greater than three standard deviations from the mean). Dietary data for this participant were removed from analyses for dietary-related analyses.

5.2 Baseline Characteristics of Child

Child demographic and anthropometric characteristics at baseline for the overall sample and by condition (CONTROL or SNACKING) are summarized in **Table A.1**. Seven children participated in the program (SNACKING n=4; CONTROL n=3). On average for the overall sample, children were 53.4 ± 6.6 months, the majority of children were White (57.1%), all were non-Hispanic/Latino, and 57.1% were males. Based on child anthropometrics, average BMI percentile was 59.9 ± 28.3, and average BMI-z score was 0.37 ± 0.92. There were no child demographic or anthropometric variables significantly ($p < 0.05$) different between conditions.

5.3 Baseline Characteristics of Parent

Parent demographic and anthropometric characteristics at baseline for the overall sample and by condition (CONTROL or SNACKING) are summarized in **Table A.2**. Seven parents participated in the program (SNACKING n=4; CONTROL n=3). On average, parents were 35.4 ± 5.9 years, 100% were female and 100% identified as the participating child's mother. The majority of the parents identified as White (57.1%) and 100% were not Hispanic/Latino. All parents had a minimum of vocational training or some college and 57.1% were a college graduate. Five of the seven (71.4%) were married and all parents indicated there was another caregiver for the child. Parents reported 4.1 ± 1.9 individuals living in the household and 71.4% had an annual household income between $50,0000 to $99,9999. Based on parent anthropometrics average BMI was 35.9 ± 4.5 kg/m^2. One (14.3%) was classified as overweight and 6 (85.7%) were classified as obese at baseline.

At baseline only the age of the other caregiver was significantly different between conditions (SNACKING = 42.3 ± 2.5 years vs. CONTROL = 33 ± 3.5 years; $p < 0.01$). No other parent demographic or anthropometric varibles were significantly ($p < 0.05$) different between conditions.

5.4 Impact of a Snacking Intervention on Diet Quality

To assess primary aim one (to determine if SNACKING compared to CONTROL improves diet quality in preschool-aged children), a linear mixed factor analysis of variance (ANOVA) with between-subject factor of condition (SNACKING vs. CONTROL) and a within-subject factor of time (baseline vs. five weeks) was

conducted. The baseline HEI total score was 67.1 ± 7.9 with no significant difference between condition (SNACKING 64.5 ± 7.3 vs. CONTROL 72.3 ± 8.3, p = 0.30). Similarly at five weeks HEI total score was 68.9 ± 8.4 with no significant difference between condition (SNACKING 67.0 ± 10.0 vs. CONTROL 72.6 ± 3.5, p = 0.50). At baseline there were significant differences between component scores of greens and beans (p = 0.00) and total protein (p = 0.02) between conditions. Component scores did not significantly differ at five weeks (**Table A.3**). There was no significant main effect of condition (SNACKING vs. CONTROL, p = 0.28), time (baseline vs. five weeks, p = 0.78), or a condition by time interaction (p = 0.83).

5.5 Impact of a Snacking Intervention on Number of Snacks Consumed Daily

To assess primary aim two (to investigate whether SNACKING reduces the number of snacks consumed in preschool-aged children compared to CONTROL), a linear mixed factor ANOVA with between-subject factor of condition (SNACKING vs. CONTROL) and a within-subject factor of time (baseline vs. five weeks) with the number of snacks consumed centered around two snacks per day was used. Overall children consumed 2.1 ± 0.6 snacks per day at baseline and 1.7 ± 0.5 snacks per day at five weeks. Centered around the recommendation of no more than two snacks per day overall children consumed 0.1 ± 0.6 snacks per day at baseline and -0.3 ± 0.5 snacks per day at five weeks. There was not a signficiant main effect of condition (p = 1.0) or time (p = 0.09). There was a significant condition x time interaction (p = 0.02) where the number of snacks centered around two decreased in SNACKING and increased in CONTROL (**Figure B.1**).

5.6 Impact of a Snacking Intervention on Energy Intake

To assess primary aim three (to examine the effect of SNACKING on total energy intake in preschool-aged children compared to CONTROL), a linear mixed factor ANOVA with between-subject factor of condition (SNACKING vs. CONTROL) and a within-subject factor of time (baseline vs. five weeks) was used. At baseline on average children consumed 1591 ± 286 kcals/day with no significant differences between conditions (SNACKING 1717 ± 259 kcals/day vs. CONTROL 1338 ± 126 kcals/day, $p = 0.13$). At five weeks on average children consumed 1278 ± 233 kcals/day with no significant differences between conditions (SNACKING 1231 ± 240 kcals/day vs. CONTROL 1374 ± 269 kcals/day, $p = 0.54$). There was no significant main effect of condition ($p = 0.56$), time ($p = 0.08$), or significant interaction of condition x time interaction ($p = 0.06$). While there was not a significant condition x time interaction, total energy intake for SNACKING decreased from 1717 ± 259 kcals/day at baseline to 1231 ± 240 kcals/day at five weeks (-487 kcal/day) and CONTROL stayed similar 1338 ± 126 kcals/day at baseline to 1374 ± 269 kcals/day at five weeks (+ 36 kcal/day).

5.7 Impact of a Snacking Intervention on Liking

To assess the secondary aim (to determine if SNACKING impacts child liking of healthy snacks compared to CONTROL), a linear mixed factor ANOVA with between-subject factor of condition (SNACKING vs. CONTROL) and a within-subject factor of time (baseline vs. five weeks) was conducted. Overall, the most liked snack at baseline was the layered yogurt dip and fruit kabobs with six of the seven

(85.7%) and five of the seven (71.4%) respectively reporting "yummy." The roasted chickpeas were the most disliked with four of the seven (57.1%) reporting "yucky." At five weeks, the roasted chickpeas stayed the least liked snack with only two of seven children (28.6%) identifying the snack as "yummy." One child refused to try all the snacks at the five week assessment. There was no significant main effect of condition or time, or a condition x time interaction for liking of fruit kabobs, Greek salad kabobs, energy bars, and chickpeas from baseline to five weeks (**Table A.4**). For the layered yogurt dip, there was a significant main effect for condition ($p = 0.008$) but not for time ($p = 0.18$) or a condition x time interaction ($p = 0.18$).

5.8 Associations between Parenting Styles and Feeding Practices and Dietary Quality

Each dimension of parenting (authoritative, authoritarian, permissive) is viewed independent of the other dimensions. Thus, parents reported a strong authoritative parenting style (105.0 ± 10.5), and weaker authoritarian (41.9 ± 7.8) and permissive styles (33.6 ± 5.9). **Table A.5** summarizes the Parenting Styles and Dimensions Questionnaire scores for each dimension and the Pearson correlations. Pearsons correlations between parenting styles (authoritative, authoritarian, and permissive) and diet quality (as measured by total HEI score) were not significant.

Mean scores for each factor from the Child Feeding Questionniare (responsibility, perceived parent weight, perceived child weight, concern for child weight, restrict, pressure, and monitor) are shown in **Table A.6.** There were no significant correlations between parent feeding practices (responsibility, perceived

parent weight, perceived child weight, concern for child weight, restrict, pressure, and monitor) and diet quality (as measured by total HEI).

Due to limited degrees of freedom based on the small sample size (n = 6) linear regression models adjusted for baseline diet quality were run for each parenting style and parent feeding practice individually. None of the parenting styles were signficinatly associated with diet quality at five weeks. Of the parent feeding practices, only 'concern for child weight' was significantly associated with diet quality at five weeks (B = 5.5 (β = 0.95), p = 0.03; R^2 = 0.963, p = 0.04).

5.9 Changes in Child z-BMI

Minimal changes in zBMI were expected. The effect size for the overall sample from baseline to five weeks was d = 0.195. There was a medium effect size in the CONTROL condition (d = 0.44) and a very small effect size in the SNACKING condition (d = 0.02). z-BMI increased in CONTROL from -0.30 ± 0.41 at baseline to -0.15 ± 0.11 at five weeks and remained nearly the same in the SNACKING condition (baseline = 0.88 ± 0.90; five weeks: 0.90 ± 0.90).

5.10 Evaluation

For both SNACKING and CONTROL an evaluation questionnaire was provided to gain insight on the frequency in which parents made the snack at home, who ate the snack at home and intent to make the recipe again (**Table A.7**) For roasted chickpeas and layered yogurt dip, no parents in the CONTROL group made the recipe at home. For fruit kabobs, Greek salad kabobs, and energy bars, one parent made the recipes at home from CONTROL group. For the SNACKING group (n = 4),

one parent made the layered yogurt dip at home, three parents made the roasted chickpeas, two made the energy bars, one made the Greek salad kabobs and two made the fruit kabobs. When asked if parents would make the recipe again, for the SNACKING group (n = 4), one said no to Greek salad kabobs, one indicated no to the energy bars, all others indicated they would make the snack again. For the CONTROL group (n = 2), one indicated no to the Greek salad kabobs, two reported no to energy bars, for roasted chickpeas and layered yogurt dip, one reported no intention for making the recipe.

5.11 Compliance

Of the families randomized to the SNACKING condition (n = 4), one family attended all five sessions, two families attended four of the five sessions and one family did not attend any sessions. Three of the four families attended sessions and each parent and child turned in four (out of five possible) snack dairies.

Chapter 6

DISCUSSION

The overall aim of this study was to determine if a healthy snacking intervention in preschool-aged children had an impact on dietary intake, specifically diet quality, frequency of snacking and energy intake.

The overall total HEI score for children was relatively poor (Baseline = 67.1 ± 7.9; five weeks = 68.9 ± 8.4). Findings were similar, but slightly higher as compared to other studies examing diet quality in children.[30, 46-47] While not significant both the CONTROL and SNACKING condition had improvement in diet quality over time. A longer intervention may have promoted greater changes in dietary quality or overall dietary quality may require greater changes to the diet whereby both meals and snacks are targeted. Further investigation is needed to also understand the incremental benefit of HEI score on health.

Snacking has been found to be increasing[17], but quantification of snacking episodes is difficult due to lack of definition.[16] We found a significant condition by time interaction due to the number of reported snacks for the CONTROL group increasing over time and the number of snacks in the SNACKING condition decreasing. This significant result is a positive indication that a healthy snacking intervention may help children reduce the number of snacks consumed per day. Despite a significant interaction, the number of snacks per day were low and the changes equated to less than one snack which may not have a meaningful impact on dietary quality and energy intake. Further, the number of snacks consumed at baseline

(2.1 ± 0.6) based on the three day dietary records was less than that self-reported during screening for initial eligibility which was ≥ 3 snacks/day. Consuming less than three snacks at baseline likely limited the magnitude of change.

Energy intake recommendations for preschool-aged children ranges from 1,000 calories (2 year-old boys and girls) to 1,600 calories (5 year-old, boys).[25] On average children consumed 1591 ± 286 kcal/day at baseline, with a range between 1249 and 2059 kcal/day. Based on recommendations, at baseline, three girls and three boys consumed more than recommended amount. Average daily energy intake decreased over time (-312 kcal/day) likely due to a decrease in total energy intake in the SNACKING condition (-487 kcal/day). In contrast, the CONTROL condition actually increased by 36 kcal/day. As the magnitude of frequency of snacks was small, the difference in energy intake may not be attributable to this change. However, the difference between the conditions could be attributable to simply being enrolled in an intervention (receiving attention) versus the control condition (did not receive attention).

Research shows that repeated exposures increase children's liking of foods, specifically vegetables.[55-56, 72] Anzman-Frasca and collegues[72] found that preschool children's liking of vegtables increased after the sixth exposure. Results from this study did not find that a healthy snacking intervention increased liking of healthy snacks except for the yogurt layered dip. While children in the SNACKING condition were exposed to the healthy snack during the intervention, the children in the CONTROL condition were not. CONTROL group exposure occurred at baseline and

only if the parent made snacks at home (one parent made three out of the five snacks), this limited exposure may not have been enough to change liking.

Parenting styles and parent feeding practices have been shown to be associated with dietary behaviors in children. An authoritative parenting style has been associated with healthier children (4-12 years-old) and considered to be protective against obesity.[73] Furthermore, restrive or controlling feeding practices, particularly restriction of unhealthy foods and pressure to eat healthy foods has been associated with higher child BMI.[73] While outcomes showed parents had a strong authoritative parenting style, it was not significantly associated with HEI scores. Interestingly, concern for child weight was significantly assocated with diet quality such that for every predicted unit increase in concern for child weight HEI score increased by 5.5 units.

This was an obesity prevention study that recruited children with a parent who were identified as overweight or obese (BMI $\geq 25 kg/m^2$). As expected due to the short length of the study child zBMI did not change significantly. Overall a small effect size ($d = 0.195$) was found over time with a medium effect size (d = 0.44) in the CONTROL condition and a very small effect size in the SNACKING condition (d = 0.02). While the effect size was larger in the CONTROL group this was because zBMI actually increased while zBMI of the SNACKING condition stayed nearly the same, an important finding for obesity prevention. These results are all preliminary and data are part of a larger ongoing study. All data will be re-analyzed with a larger sample; however, preliminary outcomes are promising.

The prevalence of snacking particularly in children has been identified as an eating behavior that contributes to excess energy intake. To our knowledge this is one of the first interventions developed to specifically target snacking behaviors that also included the parent. This study is not without limitations. While this study is part of an ongoing study, the current study is limited by the small sample size. Energy expenditure data was also not collected due to poor adherence with activity belts. As changes in physical activity could alter energy needs accounting for these data would be important from an energy balance perspective. Furthermore, dietary data was self reported which could be biased as parents may have over- or under-reported.

Chapter 7

CONCLUSION

Overweight and obesity in children is a public health concern and is associated with poor health outcomes. Interventions that support healthy dietary behaviors to promote a healthy weight across the life course should begin in young children when childrens behaviors are being developed. As parents are the considered to be the gatekeepers of food, inclusions of parents in interventions is important. A healthy snacking intervention for children and their parents with overweight or obesity appears to produce changes in HEI scores with increases noted from baseline to five weeks, number of snacks decreased in SNACKING group while increased in CONTROL group, total energy intake was decreased in the SNACKING group while staying relatively the same for CONTROL group, liking wasn't impacted but could use additional exposure to produce an effect and concern for child weight was associated with an increase in HEI score. Identifying successful interventions that can be implemented in the home environment are needed to help children achieve and maintain a healthy weight.

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Appendix A

TABLES

Table A.1 Baseline Demographic and Anthropometric Characteristics of Child

	Overall (n=7)	CONTROL (n=3)	SNACKING (n=4)	P-value[a]
Age, months (M±SD)	53.4 ± 6.6	51.6 ± 6.5	54.7 ± 7.3	0.59
Sex (n, %)				0.05
Female	3 (42.9%)	0 (100%)	3 (75%)	
Male	4 (57.1%)	3 (100%)	1 (25%)	
Race (n, %)				
American Indian or Alaskan Native	0 (0%)	-	-	-
Asian	1 (14.3%)	0 (0%)	1 (25%)	0.35
Black or African American	2 (28.6%)	2 (66.7%)	0 (0%)	0.05
Native Hawaiian or other Pacific Islander	0 (0%)	-	-	-
White	4 (57.1%)	1 (33.3%)	3 (75%)	0.27
Other	1 (14.3%)	0 (0%)	1 (25%)	0.35
Ethnicity (n, %)				
Not Hispanic or Latino	7 (100%)	-	-	-
Anthropometrics (M±SD)				
Weight (kg)	17.5 ± 1.6	16.9 ± 1.9	18.0 ± 1.5	0.41
Height (cm)	104.2 ± 4.6	105.2 ± 7.7	103.4 ± 0.75	0.73
BMI percentile	59.9 ± 28.3	38.9 ± 14.9	75.5 ± 26.2	0.09
BMI-z score	0.37 ± 0.92	-0.30 ± 0.41	0.88 ± 0.90	0.09

M±SD: mean ± standard deviation; n: frequency; BMI: body mass index.

[a]: P values indicate significance of difference between CONTROL and SNACKING.

Table A.2 Baseline Demographic and Anthropometric Characteristics of Parent				
	OVERALL (n=7)	**CONTROL (n=3)**	**SNACKING (n=4)**	**P-value[a]**
Age, years (M±SD)	35.4 ± 5.9	30.7 ± 5.0	39.0 ± 3.7	0.05
Sex (n, %)				
Female	7 (100%)	-	-	-
Relationship to child (n, %)				
Mother	7 (100%)	-	-	-
Race (n, %)				
American Indian or Alaskan Native	0 (0%)	-	-	-
Asian	1 (14.3%)	0 (0%)	1 (14.3%)	0.35
Black or African American	2 (28.6%)	2 (66.7%)	0 (0%)	0.05
Native Hawaiian or other Pacific Islander	0 (0%)	-	-	-
White	4 (57.1%)	1 (33.3%)	3 (75%)	0.27
Ethnicity (n, %)				
Not Hispanic or Latino	7 (100%)	-	-	-
Marital Status (n, %)				0.05
Married	5 (71.4%)	1 (33.3%)	4 (100%)	
Not Married (living with significant other)	2 (28.6%)	2 (66.7%)	0 (0%)	
Highest Level of Education (n, %)				0.65
Vocational Training or Some College	2 (28.6%)	1 (33.3%)	1 (25%)	
College Graduate	4 (57.1%)	2 (66.7%)	2 (50%)	
Graduate or Professional Degree	1 (14.3%)	0 (0%)	1 (25%)	
Other Caregiver (n, %)				
Yes	7 (100%)	-	-	-
Other Caregiver Sex (n, %)				
Male	7 (100%)	-	-	-
Other Caregiver Age, years (M±SD)	38.3 ± 5.6	33.0 ± 3.5	42.3 ± 2.5	<0.01
Other Caregiver: Relationship (n, %)				0.14
Husband	4 (57.1%)	1 (33.3%)	3 (75%)	
Partner	2 (28.6%)	2 (66.7%)	0 (0%)	
Father	1 (14.3%)	0 (0%)	1 (25%)	
Other Caregiver Highest Level of Ed. (n, %)				0.23
Vocational Training or Some College	3 (42.9%)	1 (33.3%)	2 (50%)	
College Graduate	1 (14.3%)	1 (33.3%)	0 (0%)	
Graduate or Professional Degree	3 (42.9%)	1 (33.3%)	2 (50%)	
Number in Household (M±SD)	4.1 ± 1.9	4.0 ± 0.0	4.3 ± 2.6	0.09
Household Income (n, %)				0.41
$50,000-99,999 (6-7)	5 (71.4%)	2 (66.7%)	3 (75%)	
$100,000-149,999 (8-9)	0 (0%)	0 (0%)	0 (0%)	
≥ $150,000 (10-12)	2 (28.6%)	1 (33.3%)	1 (25%)	

Anthropometrics (M±SD)				
Height (m)	1.6 ± 0.07	1.6 ± 0.04	1.6 ± 0.10	0.97
Weight (kg)	90.8 ± 17.0	81.7 ± 13.3	97.6 ± 17.7	0.26
BMI (kg/m^2)	35.9 ± 4.5	32.3 ± 4.1	38.5 ± 2.8	0.06

M±SD: mean ± standard deviation; n: frequency; BMI: body mass index.

[a]: P values indicate significance of difference between CONTROL and SNACKING.

Table A.3 Child Dietary Quality as Measured by the Healthy Eating Index, 2010 at Baseline and Five Weeks: SNACKING vs. CONTROL (M±SD)

	Overall (n=6)	**CONTROL (n=2)**	**SNACKING (n=4)**	**p-value[a]**
Baseline				
Total Fruit	3.7 ± 1.7	4.7 ± 0.35	3.2 ± 1.8	0.32
Whole Fruit	4.4 ± 1.0	5.0 ± 0.0	4.1 ± 1.2	0.36
Total Vegetables	3.8 ± 1.1	4.6 ± 0.63	3.4 ± 1.2	0.29
Greens and Beans	1.3 ± 2.2	4.0 ± 1.4	0.0 ± 0.0	0.00
Whole Grains	7.6 ± 3.6	6.0 ± 5.6	8.4 ± 3.0	0.51
Dairy	8.8 ± 2.1	10.0 ± 0.0	8.2 ± 2.5	0.40
Total Protein Foods	3.5 ± 1.3	5.0 ± 0.0	2.8 ± 0.78	0.02
Seafood and Plant Proteins	2.2 ± 1.9	1.2 ± 1.7	2.7 ± 2.0	0.41
Fatty Acids	2.8 ± 3.7	2.5 ± 0.93	2.9 ± 4.8	0.92
Refined Grains	7.1 ± 2.3	7.7 ± 0.12	6.8 ± 3.0	0.72
Sodium	4.9 ± 3.9	1.6 ± 2.3	6.5 ± 3.6	0.16
Empty Calories	16.9 ± 6.0	20.0 ± 0.0	15.4 ± 7.2	0.44
Total HEI	67.1 ± 7.9	72.3 ± 8.3	64.5 ± 7.3	0.30
	Overall (n=6)	**CONTROL (n=2)**	**SNACKING (n=4)**	**p-value[a]**
Five Weeks				
Total Fruit	3.6 ± 1.8	5.0 ± 0.0	2.9 ± 1.9	0.21
Whole Fruit	4.2 ± 1.3	5.0 ± 0.0	3.8 ± 1.4	0.33
Total Vegetables	4.5 ± 0.79	5.0 ± 0.02	4.2 ± 0.88	0.30
Greens and Beans	1.6 ± 2.3	2.7 ± 3.3	1.1 ± 2.1	0.51
Whole Grains	5.8 ± 3.2	5.5 ± 3.5	5.9 ± 3.6	0.92
Dairy	8.8 ± 1.7	8.5 ± 13.0	8.9 ± 2.0	0.80
Total Protein Foods	4.1 ± 0.94	4.8 ± 0.25	3.7 ± 1.0	0.20
Seafood and Plant Proteins	2.0 ± 2.5	2.5 ± 3.5	1.8 ± 2.4	0.78
Fatty Acids	3.2 ± 2.1	2.7 ± 1.5	3.4 ± 2.5	0.73
Refined Grains	8.1 ± 1.5	8.4 ± 0.84	7.9 ± 1.9	0.78
Sodium	5.9 ± 2.3	3.8 ± 1.2	6.9 ± 2.0	0.13
Empty Calories	17.2 ± 3.7	18.8 ± 0.55	16.4 ± 4.5	0.53
Total HEI	68.9 ± 8.4	72.6 ± 3.5	67.0 ± 10.0	0.50

M±SD: mean ± standard deviation; n: frequency; kcal: kilocalorie; HEI: Healthy Eating Index.

[a]: P values indicate significance of difference between CONTROL and SNACKING.

Table A.4 Child Liking of Snack Foods at Baseline and Five Weeks: SNACKING vs. CONTROL (M±SD)

	CONTROL (n=3)	**SNACKING** (n=4)	**Condition[b]**	**Time[c]**	**Condition x Time[d]**
Fruit Kabobs[a]			0.79	0.79	0.24
Baseline	2.5 ± 0.71	3.0 ± 0.0			
Five Weeks	3.0 ± 0.0	2.7 ± 0.58			
Greek Salad Kabobs			0.56	0.19	0.77
Baseline	2.5± 0.71	2.3 ± 1.0			
Five Weeks	2.0 ± 1.4	3.0 ± 0.0			
Energy Bars			0.09	0.84	0.34
Baseline	2.5± 0.71	2.3 ± 1.0			
Five Weeks	1.5 ± 0.71	3.0 ± 0.0			
Roasted Chickpeas			0.24	0.54	0.54
Baseline	2.0 ± 1.4	1.5 ± 0.58			
Five Weeks	2.0 ± 1.4	2.0 ± 0.82			
Layered Yogurt Dip			0.01	0.18	0.18
Baseline	2.5 ± 0.71	3.0 ± 0.0			
Five Weeks	2.0 ± 0.0	3.0 ± 0.0			

[a]: n = 5; M±SD: mean ± standard deviation; n: frequency.

[b]: P values indicate significance of differences between CONTROL and SNACKING.

[c]: P values indicate significance of differences between baseline and five weeks.

[d]: P values indicate significance of differences for a condition x time interaction.

Table A.5 Parenting Styles Questionnaire Characteristics and Correlations with Total HEI Score at Baseline (M±SD)

	Overall Score (n=7)	Pearson Correlations	P-value[b]
Authoritative	105.0 ± 10.5	0.12	0.76
Authoritarian	41.9 ± 7.8	0.25	0.64
Permissive	33.6 ± 5.9[a]	-0.48	0.52

M±SD: mean ± standard deviation

[a]: Missing data; n=5

[b]: P-values indicate significance for Pearson correlation between Parenting Styles and Dimension Questionnaire score and Healthy Eating Index-2010 score.

.

Table A.6 Child Feeding Questionnaire Characteristics and Correlations with Total HEI Score at Baseline (M±SD)

	Overall Score (n=7)	Pearson Correlation	P-value[a]
Perceived responsibility	4.3 ± 0.76	-0.16	0.80
Perceived parent weight	3.6 ± 0.52	-0.77	0.13
Perceived child weight	3.0 ± 0.0	-	-
Concerns for child weight	2.0 ± 1.4	-0.61	0.28
Restriction	3.4 ± 0.73	-0.44	0.46
Pressure to eat	2.7 ± 0.74	0.23	0.71
Monitoring	3.9 ± 0.96	0.04	0.95

[a]: P values indicate significance for Pearson correlation between Child Feeding Questionnaire score and Healthy Eating Index-2010.

Table A.7 Parent Evaluation of Recipes at Five Weeks: SNACKING vs. CONTROL (n=6)

	Fruit Kabobs		**Greek Salad Kabobs**		**Energy Bars**		**Roasted Chickpeas**		**Layered Yogurt Dip**	
	S[a]	**C[b]**	**S**	**C**	**S**	**C**	**S**	**C**	**S**	**C**
Times Made										
0	2(50%)	1(50%)	3(75%)	1(50%)	2(50%)	1(50%)	1(25%)	2(100%)	3(75%)	2(100%)
1-2	2(50%)	1(50%)	1(25%)	1(50%)	2(50%)	1(50%)	1(25%)		1(25%)	
3-4							2(50%)			
Ate snack?										
Child	1(25%)	0(0%)	1(25%)	1(50%)	2(50%)	0(0%)	2 (50%)	0 (0%)	0 (0%)	0 (0%)
Me	1(25%)	0(0%)	1(25%)	0(0%)	2(50%)	0(0%)	2 (50%)	0 (0%)	0 (0%)	0 (0%)
Family	2(50%)	1(50%)	0(0%)	0(0%)	1(25%)	1(25%)	3 (75%)	0 (0 %)	1 (25%)	0 (0%)
Remake										
Yes	3(75%)	1(50%)	2(50%)	1(50%)	3(75%)	0(0%)	4(100%)	1(50%)	2 (50%)	1 (50%)
No			1(25%)	1(50%)	1(25%)	2(100%)	0(0%)	1(50%)	0 (0%)	1 (50%)
No answer			1(25%)						2 (50%)	

[S]: SNACKING group.

[C]: CONTROL group.

Appendix B

FIGURES

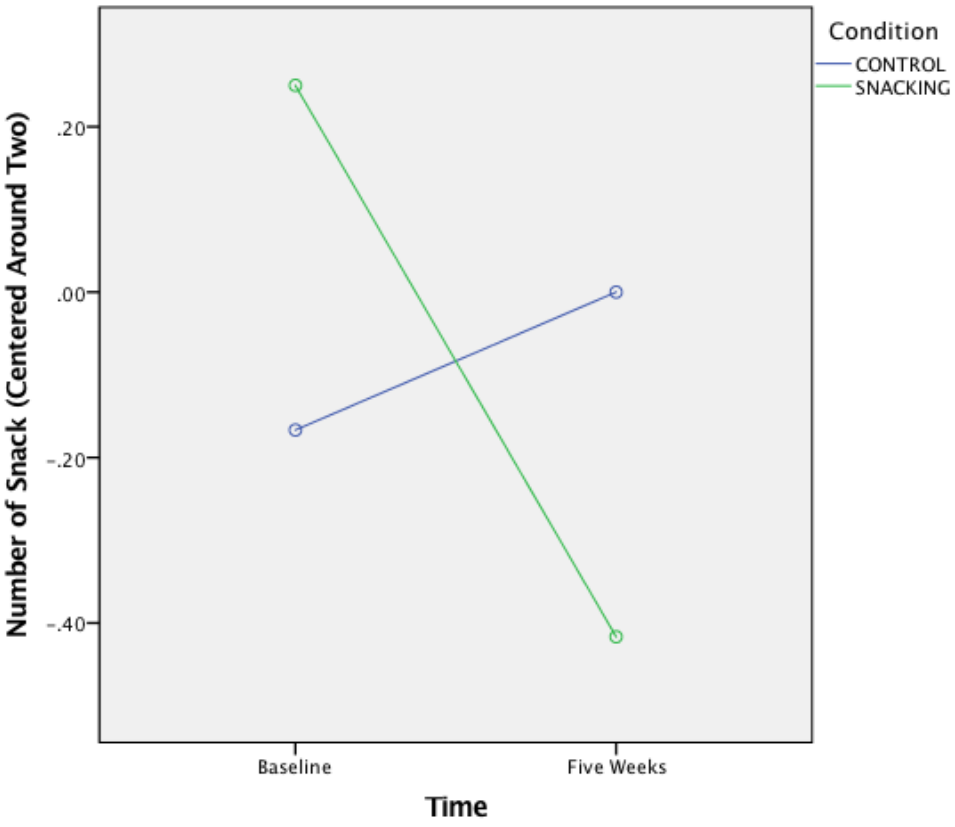

Figure B.1 Condition by Time Interaction for Number of Snacks Centered Around Two

Appendix C

INSTITUTIONAL REVIEW BOARD APPROVAL LETTER

RESEARCH OFFICE

210 Hullihen Hall
University of Delaware
Newark, Delaware 19716-1551
Ph: 302/831-2136
Fax: 302/831-2828

DATE: June 1, 2016

TO: Amanda Kopetsky, RD
FROM: University of Delaware IRB

STUDY TITLE: [906934-1] Snacking Healthfully in Preschoolers (SHiP)

SUBMISSION TYPE: New Project

ACTION: APPROVED
APPROVAL DATE: June 1, 2016
EXPIRATION DATE: May 31, 2017
REVIEW TYPE: Expedited Review

REVIEW CATEGORY: Expedited review category # *(4),(7)*

Research with Children. Subpart D Determination 45 CFR 46.404

Thank you for your submission of New Project materials for this research study. The University of Delaware IRB has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a study design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This submission has received Expedited Review based on the applicable federal regulation.

Please remember that informed consent is a process beginning with a description of the study and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the study via a dialogue between the researcher and research participant. Federal regulations require each participant receive a copy of the signed consent document.

Please note that any revision to previously approved materials must be approved by this office prior to initiation. Please use the appropriate revision forms for this procedure.

All SERIOUS and UNEXPECTED adverse events must be reported to this office. Please use the appropriate adverse event forms for this procedure. All sponsor reporting requirements should also be followed.

Please report all NON-COMPLIANCE issues or COMPLAINTS regarding this study to this office.

Please note that all research records must be retained for a minimum of three years.

Based on the risks, this project requires Continuing Review by this office on an annual basis. Please use the appropriate renewal forms for this procedure.