# The Effects of Access and Education on Preschool Children's Fruit and Vegetable Intake

Dissertation

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By

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**Abstract**

Inadequate fruit and vegetable (F &V) intake is associated with obesity and untoward health outcomes in children, particularly those from low resourced communities. The aim of this study was to investigate the impact of novel implementation and assessment methods for increasing access and intake of fruits and vegetables (F&V) in children and to determine if supplemental nutrition education (SNAP- Ed) can augment the effects of increased access.

A cluster randomized control method was used to randomize 209 Head Start preschool children by classrooms into 1 of 3 groups: Treatment A (control), Treatment B (produce/access), and Treatment C (produce/access and child nutrition education). Produce was provided weekly at each Head Start site to treatment B and C classrooms. Nutrition education, which was done for 30 minutes, was provided in treatment C classrooms weekly by SNAP-Ed personnel. Outcomes measured, done at baseline and at the study end included carotenoid levels as performed using a BioPhotonic™ Scanner/ Ramen Spectroscopy and validated self-report questionnaires. The questionnaire included questions on the fruit and vegetable intake of the subjects, availability, and use of the fruits and vegetables provided.

Final scan numbers consisted of 209 children. Treatment C (access/education) had 82 subjects, Treatment B (access) contained 61 subjects, and Cluster A (Control) had 66 subjects. Average cluster carotenoid change scores (Ramen Units – RU) were positive

for all groups: Cluster C = 7837 RU; Cluster B = 5050 RU; Control = 2622 RU. Differences in change scores were significant ($p < .000$) between Cluster C (produce/access with education) and Control.

Using novel intervention and assessment techniques, fruit and vegetable access plus nutrition education significantly improved carotenoid levels among children compared to those who received access only or neither access or education.

This study demonstrated a relationship between self-reported fruit and vegetable intake and quantitative BioPhotonic™ Scanner scores. Scanner scores were increased in both the access and the access with education clusters. Additionally, the self-reported intakes of fruits and vegetables were reported to have increased in both the children as well as their parents. This intake increase was most notable between the access with education cluster versus the control cluster, although significance was also noted between the access cluster and the control cluster as shown in ANOVA testing.

This approach of providing fruits and vegetables to low resourced families helps to demonstrate the importance of education supplementing the provisions of fruits and vegetables. Subjects who were provided with information on how to prepare and use such provisions appeared more inclined to utilize the items, resulting in an increased carotenoid level as evidenced by said scan score results. Results of this study will be useful to demonstrate the importance of education along with produce provisions for those in need. Taste testing, hands-on experiential learning, recipe and newsletter type educational information was shown to change the behavior and consumption in this group of Head Start families receiving such interventions.

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## Publications

Chandler, C, Spires, C and Smith, E. (2015)."Times of Change: a Proactive Response from Extension for Improving SNAP-Ed Management." *Journal of National Extension Association of Family and Consumer Sciences*.  7: 3.

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## Fields of Study

Major Field: Agriculture and Extension Education

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## Chapter 1: Introduction

Children's life expectancy is at risk of being shortened as a result of the obesity epidemic, with the current generation of children potentially being the first generation to succumb at an earlier age than their parents (Lee, Pilli, Gebremariam, Keims, Davis, Vijan, Freed, Herman, & Gurney, 2009). According to World Health Organization reports, childhood obesity is one of the most serious public health challenges of the 21st century. It is reported by the Centers for Disease Control and Prevention (CDC) that the prevalence of childhood obesity has increased at an alarming rate (www.CDC.gov>obesity>data). Globally, in 2013 the number of children under the age of five who were overweight was estimated to be over forty-two million (World Health Organization, n.d.).

Fruit and vegetable consumption is associated with a reduction in risk of chronic disease, including some types of cancers and heart disease (Boeing, Bechtold, Bub, Ellinger, Haller, Kroke, Leschik-Bonnet, Muller, Obermiller, Schulze, Stehle, & Watzi, 2012). According to Rerksuppaphol and Rerksuppaphol (2006), inverse correlations were shown in epidemiological studies between fruits and vegetables and the risk of a number of diseases. These diseases include: cardiovascular disease, various cancers, insulin resistance, age-related macular degeneration, and other chronic diseases. Greater intakes of fruits and vegetables are a useful strategy in decreasing obesity, as well as in the prevention and reduction of unhealthy body weights of children. Despite these known benefits, the CDC Vitalsigns report utilizing data collected between 2007 through 2010 indicated that nine out of ten children did not consume enough vegetables (Kim, 2014). According to Whitley, Matwiejczk, and Hones (2015), 3% of children from ages four to eight met national vegetable intake guidelines. In the Journal of the Academy of Nutrition and Dietetics, Williams, Cates, Blitstein, Hersey, Gabor, Ball, Kosa, Wilson, Olson, and Singh (2014) state that 5.3% of boys and 9.8% of girls, age four to eight, consume the recommended daily amount of fruits and vegetables.

"Schools are essential to early exposure to good nutrition and provide a blueprint for healthy eating that can last a lifetime," said Kevin Concannon, the United States Department of Agriculture (USDA) Under Secretary for Food, Nutrition, and Consumer Services. "USDA is focused on improving childhood nutrition and empowering schools with the tools they need to continue to meet our improved meal standards. Good nutrition and a healthy lifestyle are critical contributors to a child's overall success and to readiness to learn the curriculum that our schools teach every day" (CDC, 2014, p. 1). In the U. S., sixty percent of preschool children are in center based child-care school type programs (Williams et al., 2014).

Experiences with food at a young age may affect lifelong food choices and overall health and wellbeing (Kim, 2014). Researchers have postulated that by offering appealing and accessible fruits and vegetables at every opportunity, in addition to using hands-on learning techniques, such as growing, tasting, and preparation of fruits and vegetables, preschool children will be well positioned to improve their fruit and vegetable intake (Williams et al., 2014). Establishing long term healthy eating patterns, utilizing access and education, beginning with young children is postulated to be a worthwhile investment.

Many school systems, including Head Start Preschools, have implemented nutrition education programs, either through their current staff or through outside agency partnerships, in an attempt to proactively offer awareness, knowledge, and skill based concepts to students. A challenge that school systems and those offering such programs incur is whether this education is changing if and how their students make healthy choices post-intervention. This concept and challenge of moving beyond knowledge, awareness, and skills into applied behavior change is a pursuit of current funders, legislators, and program implementers.

A brief overview of the significance of preschool settings as an optimal location to begin education aimed at preventative methods proposed to thwart the growing national concern of obesity and chronic disease is presented. This overview of preschool settings is followed by a brief overview of the study variables. The problem statement, purpose and objectives, theoretical framework and conceptual model, and research questions follow. Chapter 1 concludes with significance, limitations, contributions of the research and project pursued, and definitions of terms.

## Head Start/Preschool Settings

Routine food choices of preschool age children are commonly determined by adult caregivers and families. Preschool age is a timeframe in which unique opportunities exist to influence food acceptance and preferences (United States

Department of Agriculture, 2016b). This could potentially influence children's long term health and lifespan. The United States Department of Agriculture suggests that fruit and vegetable variety introduced through positive and engaging activities may increase the chance that children as young as preschool age will taste and consume a variety of health promoting fruits and vegetables (United States Department of Agriculture, 2016b).

In Ohio, Head Start preschools are regulated under the Ohio Department of Education and must comply with the policies and procedures of the Child and Adult Care Food Program (CACFP). These procedures have recently been revised and updated to include more fruits and vegetables, whole grains, low fat dairy products, as well as appropriate portion sizes and snacks for developmental age and growth of the children (United States Department of Agriculture, 2016a). Children are offered and encouraged to increase healthy choices through family style meals and snacks that align with the USDA MyPlate recommendations and the 2015 US Dietary Guidelines. Therefore, children are offered foods while in the Head Start setting that fit into the current US Dietary Guideline recommendations. Researchers and practitioners suspect these healthy choices may not transfer into the child's home environment, resulting in overall low intakes of fruits and vegetables in the preschool child's daily diet.

Ohio Heartland Community Action Commission Head Start in Marion County, Ohio, the location for this project, has approximately three hundred children and families enrolled during any given school year. The poverty rate in Marion County of 19.08% is higher than the Ohio state poverty rate at 15.93%. Marion County has a total of 11,588 persons on Supplemental Nutrition Assistance Program (SNAP) (Ohio Department of Job and Family Services, 2016). In Marion County, 16.28% of those on SNAP fall into the zero to five year old age range (Ohio Department of Job and Family Services, 2016). The combined poverty rate and percentage of young children who fall into this category in Marion County create an environment that is well positioned for information gathering and further study of the Head Start population.

Knowledge and intention of vegetable and fruit intake are occasionally self-reported or qualitatively measured in low socio-economic preschool children, but the actual behavior of increasing children's intake of fruits and vegetables is not quantitatively measured, leading to a gap in knowledge about the true behavior change and difference that education and access may make. Prior research (Tatlow-Golden, Hennessey, Dean, & Hollywood, 2013; Gorelick & Clark, 1995; Whitley et al., 2015) has shown that education does improve knowledge and intention to change behaviors related to nutrition in the lower socio-economic population, including preschool children. The literature describes ideas where fictional characters, dolls, and take home vegetables have been used to assess young children's ability to identify healthy foods and aid in their potential intake and knowledge about healthy growth and bodies (Tatlow-Golden et al., 2013; Gorelick & Clark, 1995; Whitley et al., 2015). Wardle, Herrera, Cooke and Gibson (2003) conducted research and discovered that frequent exposure to vegetables has been shown to have a positive effect on children's acceptance of these foods.

The gaps in the current literature (Aguilar, Wengreen, Lefevre, Madden, & Gast, 2014) show that knowledge and intention have been measured sporadically in preschool children regarding fruit, vegetable, and healthy intakes, but behavior change and true application of the knowledge have rarely been investigated and are more difficult to measure. Children are difficult to gather reliable intake information from, and other than invasive serum measures, few valid and reliable quantitative methods have been available to show a relationship between interventions or treatments and impacts and behavior changes (Aguilar et al., 2014).

## Access of Produce

Access is defined by the United States Department of Agriculture (USDA) as the availability of fresh and healthy foods to one's diet. These healthy foods, per the USDA "Healthy Food Access Document", can contribute to improved diets and a decrease in obesity and other diet-related diseases. Food access is more than just the presence of grocery stores in one's community, but also the ability of the households to purchase and afford foods. Affordability of such foods is closely related to both employment rates and job quality (United States Department of Agriculture, n.d.)

Specifically, access in Marion County has been broken down and displayed on a Mid-Ohio Food Bank infographic (Mid-Ohio Food Bank, 2014). Marion County had a population in 2014 of 66,238 persons of which 12,718 fell below the poverty line (Mid-Ohio Food Bank, 2014). Of those that fell below the poverty line, 30.2% were seventeen years of age and younger. Mid-Ohio Food Bank provided Marion County 3,054 meals per day, or a total of 1,115,777 meals in 2014 (Mid-Ohio Food Bank, 2014). Mid-Ohio Food Bank documented that the need for SNAP increased in 2014, despite a decrease in funding for nutrition assistance. Statewide, local economies were shown to have lost $26,357,740 in monthly SNAP benefits (Mid-Ohio Food Bank, 2014).

## Education/SNAP-Ed

Public Health educational programmatic approaches that could be supported and facilitated to enhance outcomes beyond knowledge towards behavior change include: 1) using desired outcomes, including long term and sustained behavior change as the basis of program development and implementation; 2) utilizing theoretical foundations and behavior change models for content creation, delivery, and evaluation; and 3) working collaboratively with others in the Public Health and the health and wellness community to enact multifaceted programming efforts, evoking an action of the knowledge shared (Rimer & Glanz, 2005).

Hoelscher, Evans, Parcel, and Kelder (2002) listed factors that could lead to successful outcomes when programming. These factors included: being behaviorally based, using theory or theories for the developmental framework, including an environmental component, delivering an adequate number of lessons, and emphasizing developmentally appropriate strategies. Contento, Balch, Bronner, Lytle, Maloney, Olson, and Swadener (1995) discussed the number of lessons or hours necessary to convert messages beyond knowledge alone into behavior change. Contento, et al. (1985) research pointed to approximately fifty hours of nutrition education for the majority of people to enact behavior changes following an educational intervention.

Share Our Strength (S.O.S.) (2016), a federal non-profit agency, published information that contained a list of items compiled from a consensus of nutrition experts on what constituted effective nutrition education. S.O.S. defined effective nutrition education as education that moves one beyond knowledge into the behavior that leads to change and is sustainable. S.O.S.'s list includes: 1) a focus on behaviors, not knowledge; 2) active participation in the offered nutrition education (Norris, 2003); 3) taking barriers, motivations, needs, perceptions, and desires of the targeted groups into consideration (Haynes-Maslow, Parsons, Wheeler, & Leone, 2013); 4) self–assessment and feedback (Share our Strength, 2016); and 5) application of appropriate theoretical framework.

Required policy of the Community Child and Adult Care Food Program (CACFP) includes nutrition education in the classroom once per week. This includes food-related activities that are considered developmentally appropriate. The CACFP policy includes a list of such activities and experiences including:

- Physical activity
- Activities that connect how food relates to good health
- Discussion of the daily menu, unusual or different foods offered in the classroom for meals or snacks
- Activities that examine food's texture, taste, shape, size, or color
- Activities that focus on cultural foods and their preparation and similarities
- Food preparation or tasting appropriate to the age and development of the children

• Meal service skill building including setting the table, preparing foods and cleaning up after a meal (United States Department of Agriculture, 2016a).

Demands on the classroom teachers often make it a challenge to meet the requirements of providing impactful nutrition education weekly in their classrooms. One possible partnership solution to this requirement is collaboration with agencies or partners such as the Ohio Supplemental Nutrition Assistance Program Education (SNAP-Ed) program to deliver nutrition education.

Supplemental Nutrition Assistance Program Education (SNAP-Ed) is an obesity prevention and reduction nutrition education program that serves a wide variety of audiences including Head Start preschools. One key strategy for tackling Ohio's obesity and health issues is to reach low income persons where they live, learn, work, and play, who are eligible to receive SNAP benefits or other means tested federal assistance through the SNAP-Ed program. Access to adequate nutrition is often a concern for Ohio's families at risk of hunger and chronic disease. SNAP-Ed focuses on education for participants with diet related risk factors, helping to prevent, postpone, or reduce obesity and other chronic disease through improvement in nutrition, healthy eating, and active living (Supplemental Nutrition Assistance Program Education, n.d.).

The mission of The Ohio State University Extension SNAP-Ed Program is to improve the likelihood that persons eligible for SNAP benefits in Ohio will make healthy food choices within a limited budget and choose physically active lifestyles consistent with the current Dietary Guidelines for Americans and the USDA food guidance. SNAP-Ed's vision includes expanding its reach and strengthening its outcomes throughout the entire community by implementing Policy, System, and Environmental changes (Supplemental Nutrition Assistance Program Education, n.d.).

## Problem Context and Statement

Childhood obesity, increased obesity-related disease prevalence, as well as the threat of children's life expectancy being cut short as a result of obesity are all frightening concerns. As resources continue to increase for combating these concerns through the implementation of prevention and reduction techniques, the need to examine and assess successful interventions is paramount. Determining the impacts and benefits of these programs and activities is crucial for continued funding of programs, and more importantly, to affect the behavior changes needed to make a difference in lives, health, and wellbeing.

Ohio's SNAP-Ed program has received increased funding to not only implement such obesity prevention and reduction programs, but also to document behavior changes at the individual level and beyond. Using the Socio-Ecological Model as a guide to making environmental changes through the use of fruit and vegetable access in tandem with education, has the potential to be a promising practice. The preschool arena is receiving both increased time and financial resources to combat childhood obesity through Ohio's SNAP-Ed program; therefore determining the success and impact of these efforts is all the more necessary to justify continued funding and strong, impactful, programming.

Qualitative methods of assessment and 24 hour recalls have been utilized sporadically with preschool children and their families. These methods are unable to reliably determine behavior changes due to the inaccuracies in children's recall and their innate desire to please the evaluator. Thus far, quantitative approaches have been limited to serum draws, which are expensive and invasive. The problem is that the current method of program evaluation utilized for determining successful behavioral changes, of preschool children's fruit and vegetable intakes, as a result of nutrition programs and interventions is lacking. Therefore, further research utilizing new technology to provide reliable quantitative data should be considered.

## Purpose and Objectives

The purpose of this study was to examine fruit and vegetable (F&V) intake in children and their parents and explore methods for improving intake of these fruits and vegetables. Specific research questions are:

Research question 1: Does weekly F&V access, accompanied by nutrition education, change children's fruit and vegetable consumption?

Research question 2: Does providing weekly F&V access change parent's provision of fruits and vegetable in the home and their consumption of F&V?

Research question 3: Are skin carotenoid levels correlated with self-reported intake of F&V?

Hypothesis 1: Weekly F&V access, accompanied by nutrition education, changes children's fruit and vegetable consumption.

Hypothesis 2: Weekly F&V access changes parent's provision of fruits and vegetables in the home and their consumption of F&V.

Hypothesis 3: Skin carotenoid levels will change in correlation with self-reported intake of F&V.

## Theoretical Framework and Conceptual Model

The theoretical framework is based on the theory that children of low socio-economic status are reported to have diets consisting of few fruits and vegetables, and families of these children frequently report the inability to purchase, procure, and/or prepare fruits and vegetables on a regular basis. Factors such as nutrition information needs and preferred methods of information delivery, ways to reduce barriers, as well as influences that encourage or reinforce behaviors were considered in selecting theoretical underpinnings leading to program delivery.

Formative researchers have noted that low-income persons struggle with six major community-level barriers in overcoming lack of access to fruits and vegetables (Haynes-Maslow, Parsons, Wheeler, & Leone, 2013). Barriers reported include: cost, transportation, quality, variety, changing food environments, and changing societal norms on food. Cost was cited four times more frequently than all other barriers in this research (Haynes-Maslow et al., 2013). Interventions to affect families' attitudes, subjective norms, and behavior control may increase the amount of fruits and vegetables they eat.

Behavior change and sustainability, as the ultimate objectives in health interventions, form the foundation for this study. Examining the health intervention of access to fruits and vegetables, as well as access with nutrition education, the researcher sought to examine if intention to change, and actual changes, in the consumption of fruits and vegetables, were being made following program delivery. Examination of the study samples' predicted behavior and intention of performing these behaviors may potentially set the stage for actual behavior change in those that participated in this program.

**Theory of Planned Behavior**

The Theory of Planned Behavior (TPB) has been shown to be useful for understanding a wide variety of health behaviors, including health related decision making behaviors in children (Fila & Smith, 2006). An extension of the Theory of Reasoned Action, the TPB incorporates a third construct known as perceived behavioral control (Fila & Smith, 2006). The TPB explores the relationship between behavior and beliefs, attitudes, and intentions. Behavior intention is the most important determinant of behavior. It is said that a person's attitude influences behavior intention and beliefs about whether individuals who are important to the person approve or disapprove of a behavior. This is known as subjective norm (Rimer & Glanz, 2005).

An additional construct, enhancing the original Theory of Reasoned Action, is known as perceived behavioral control. Perceived behavioral control involves people's beliefs that they control a particular behavior. It is believed that a person might try harder to perform a behavior if they feel they have a higher degree of control over that behavior. Many examples in the literature use the Theory of Planned Behavior as their theoretical foundation. The TPB postulates that attitude, subjective norms, and perceived behavioral control predict intention.

Intention, when coupled with perceived behavioral control, predicts actual behavior (Peters & Templin, 2010). Intention is directly driven by the three major constructs; beliefs and attitudes, subjective norms, and perceived behavioral control, with the idea that the stronger the intention, the more likely a person will be to perform the behavior (Fila & Smith, 2006). Identifying attitudes that promote healthful eating is grounded in the theoretical foundation of the Theory of Planned Behavior (Fila & Smith, 2006). Those attitudes include the consumption of fruits and vegetables, identifying who or what promotes healthful dietary behavior, and examining to what extent children perceive control over their dietary behavior.

According to Ajzen, who generated the idea of the TPB, human behavior is influenced by attitudes and self-efficacy in addition to the social norms that surround the behavior (Carter, 2011). Carter (2011) discussed how the Theory of Planned Behavior is an important concept in program development. Targeting beliefs and the attitudes and perceptions associated with those beliefs, can affect intention to adopt a particular behavior. Behavior intention increases as the person develops a more positive attitude toward and more confidence in their ability to perform a behavior. In addition, as feedback from important people in their social sphere increases, the intention to perform a behavior of interest increases (Carter, 2011). Increased intention to change and control over a particular behavior leads to the increased likelihood of behavior adoption (Carter, 2011).

Research in multiple areas, including health education, has successfully utilized the TPB in planning and intervention. Riebl, MacDougal, Hill, Estabrooks, Dunsmore, Savla, Frisard, Dietrich, and Davy (2015) grounded their study regarding beverage choices of adolescents and their parents in the TPB. Gordon (2008) described the TPB and its interface with the exercise domain in urban college students. Kim, Reicks, and Sjoberg (2006) used the TBP to predict dairy consumption in older adults.

An example of the TPB in use is from a study conducted by Pawlak and Malinauskas in 2008. The authors (Pawlak & Malinauskas, 2008) conducted research to identify specific beliefs regarding eating two cups of fruit per day among ninth grade youth attending public high schools in eastern North Carolina. An open-ended survey, developed from theory principles in the literature, measured the variables of the TBP including attitude, subjective norms, and perceived behavioral control. An interesting finding from the research was that friends had a greater impact than the influence of parents regarding fruit intake. These findings suggest that peer leaders may have a significant influence on intentions to eat fruits in the teen population (Pawlak &Malinauskas, 2008).

The major independent variables in this study, the provision and dissemination of fruits and vegetables (access) and the addition of education, were the constructs of the Theory of Planned Behavior (TPB) which were used to potentially predict the intention to consume fruits and vegetables leading to the behavior change and sustained behavior change of intake of the produce. TPB constructs include behavioral beliefs, normative beliefs, and cognitive beliefs. Figure 1.1, the conceptual framework, shows the logical relationship of the measures of dependent, independent, and external variables derived from the literature review and the TPB constructs.

The conceptual framework was derived from the review of the literature and examination of the most common barriers that were noted to lead to inadequate fruit and vegetable intake. Cost of purchasing fruits and vegetables was one of the most common barriers shown from focus group and survey responses. Due to the factor of perceived behavioral control being a concept that is critical in the TBP leading to intention of performing behavior, those participants in treatment groups 1 and 2 that received produce did not face the barrier of cost and thus should have a stronger perceived behavioral control.

The treatment group which received both access of produce and education should, per this model, have the strongest attitude change as well as the increased cognitive knowledge about preparation of the produce. During the education sessions, the children saw the produce prepared as easy snacks or side dishes for meals. The children received recipes and tips for parent use of the produce at home. This group and the education they received should have aligned with the improved attitude and preparation concepts that are indicated on the conceptual model.

Additionally, the concept of normative belief, in which children would perceive approval of those important to them, is an important factor in the TPB. In the preschool age group, the literature points to parents and teachers as those persons most often perceived as important to young children.  Parents and teachers should be helping role model and approve of the behavior of fruit and vegetable intake thus improving the likelihood of intention of behavior as noted in the TBP conceptual model.  This is outlined in the conceptual model of the Theory of Planned Behavior (Figure 1).

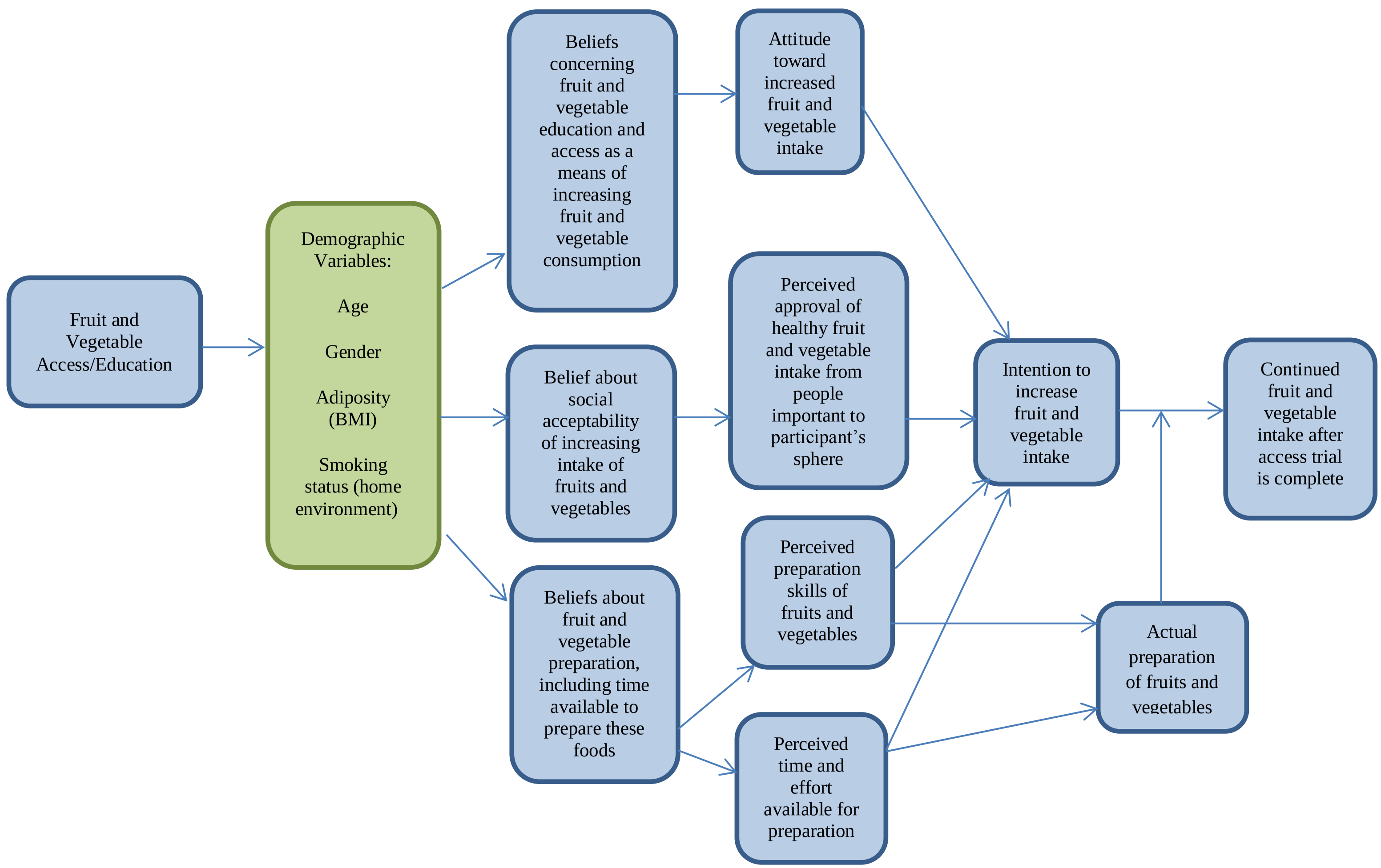


**Figure 1.1: Conceptual Model Showing Utilization of the Theory of Planned Behavior to improve fruit and vegetable consumption (Azjen, 2006).**

## Need for the Study

Benefits of this research include: providing quantitative data to assist agencies in justifying funding for programs, assistance in securing additional funding, improving the diets of children and their families through the inclusion of additional fruits and vegetables, and potentially ultimately reducing the childhood obesity rate and incidence of obesity- related diseases. Unlike other studies, this investigation will provide a quantitative measure of fruit and vegetable intake. Also, understanding the differential impact of access and access plus education could potentially help determine the most beneficial and effective means for improving sustained fruit and vegetable intake among children.

The goal is that with replication, the access and education model can be one that is customary in Head Starts and other school sites throughout the state of Ohio. A longer term benefit of increasing fruit and vegetable intake and reducing obesity may lead to a reduction in overall medical costs.

## Assumptions

The researcher made the following assumptions:

1) Caregivers will fully understand the questions and respond truthfully to the questions. They will not respond based on how they believe the researchers want them to respond, but will respond honestly.

2) The children will try the food tasting of fruits and vegetables in the classroom/educational sessions. Willingness to taste may be influenced by peer pressure/role modeling.
3) The children who are in the educational treatment group will participate in the SNAP-Ed activities.
4) Change is difficult. Participants may resist and not fully embrace the consumption of the produce.
5) The Head Start staff will be cooperative due to their belief in the importance of healthy eating and improved access to produce.
6) The sample chosen for the study are often mobile. This may result in an increased attrition rate.
7) The Availability Survey- Fruit, Juice, & Vegetables At Home questionnaire was completed by the child's parent or guardian. As with all self-reported questionnaires inaccuracies such as under-reporting or over -reporting of fruits and vegetables available or consumed is possible.
8) The values determined for use to analyze the data quantitatively that were collected from the Availability Survey-Fruit, Juice, &Vegetables At Home questionnaire were determined by Dr. Gail Kaye, Assistant Professor in the College of Public Health in conjunction with a biostatistician. Additionally, a review of similar use of this type of a questionnaire in the literature was referenced and used for comparison. These determined values were assumed to accurately reflect the information collected in its use for analysis.

9) Even though family sizes vary, an equal amount of produce will be sent home and be assumed that all members of the family will consume that produce.

## Limitations

One limitation noted was that it was not possible to blind the participants or study team to the treatments. The various treatment groups were aware of which subjects received produce, which participants received education, and which were control. Likewise, the research team also knew what each group received after the randomization had been established.

A second limitation was that not all subjects were willing to participate in the research. Due to this limitation, generalizability may not be possible. Preschool/Head Start families are a difficult group to recruit and retain in these types of studies (Wagmiller & Adelman, 2009).

Another limitation is that the self-reported Availability Survey-Fruit, Juice, &Vegetables At Home questionnaire, which was completed by the parent or guardian, may have been completed inaccurate. Parents or guardians may have under-reported or over- reported their or their child’s availability or consumption of the produce listed.

An additional limitation was that children or parents were excluded if a medical issue prohibited them from participating in the study. Parents of children who were unable to eat solid foods were asked not to participate in the study.

## Definition of Terms

### Constitutive Definitions

**Attitudes** – The degree to which a person's behavior of interest is considered to have a favorable or unfavorable evaluation of that behavior. Attitudes entail a consideration of the outcomes of performing the behavior (Ajzen, 2006).

**Behavioral intention** – Behavioral intention is the motivational factors that influence a given behavior. The stronger the intention to perform the behavior, the more likely the behavior will be performed (Ajzen, 2006).

**Biomarkers**- key molecular or cellular event that links a specific environmental exposure to a health outcome (National Institute of Health, n.d.).

**Carotenoids**- groups of red, orange, or yellow pigments found in plants and certain animal tissues (Collins English Dictionary, 2012). Carotenoids are classified as antioxidants, which are suggested to play a role in preventing such maladies as heart disease, cancer, age-related eye disease, and all-cause mortality (Scarmo, Henebery, Peracchio, Cartmel, Lin, Ermakov, Gellerman, Bernstein, Duffy, & Mayne, 2012). Additionally, carotenoids help to support normal vision, helping one's eyes adjust to lower levels of light. Carotenoids promote growth and health of cells and tissues, provide protection from infections by keeping the skin and tissues healthy, as well as help regulate the immune system (Duyff, 2012). A prospective cohort study conducted by Colditz, Branch, Lipnick, Willett, Rosner, Posner, et al., (1985) documented lower five-year mortality rates in 1,271 elderly subjects who had higher intakes of high carotenoid vegetables. Colditz et al., (1985) also showed the trend of decreased cancer risk for those consuming high carotenoid foods was significant at p=.026. Carotenoids are found in many foods. The greatest amount of carotene can be found in: sweet potatoes, carrots, pumpkin, collards, kale, turnip greens, spinach, romaine lettuce, red bell peppers, and apricots (Duyff, 2012).

**Carotenoid serum draws**- Fluid consisting of plasma, blood cells, and platelets (blood) that is circulated by the heart through the vertebrate vascular system is drawn. Blood is then examined through protocols to determine a level of carotene in the sample of blood (National Institute of Health, 2015).

**Center based child care programs**- a service involving care for other people's children (Boston University, n.d.).

**Ohio Supplemental Nutrition Assistance Program Education (SNAP-Ed)** - a nutrition education program serving low-income adults and youth throughout Ohio. Ohio SNAP-Ed is a partnership between the Ohio Department of Job and Family Services and Ohio State University Extension. The program goal is to improve the likelihood that families and individuals who receive food assistance benefits (SNAP benefits) make healthy food choices and choose active lifestyles.

Schools where fifty percent or more of the students qualify for free/reduced lunch are eligible for SNAP-Ed nutrition education programs at no cost to the school district (Supplemental Nutrition Assistance Program Education, n.d.).

**Perceived behavioral control -** The ease or difficulty of performing the behavior of interest is defined as perceived behavioral control. This varies across situations and actions, which results in a person having varying perceptions of behavioral control dependent on the situation. This construct of the theory was added later, and created the shift from the Theory of Reasoned Action to the Theory of Planned Behavior (Ajzen, 2006).

**Perceived power** – This is defined as the perceived presence of factors that may facilitate or impede performance of a behavior. This contributes to a person's perceived behavioral control over each of those factors (Ajzen, 2006).

**Resonance Ramen Spectroscopy Scanner (RRS) -** a non-invasive, sensitive monitoring technology utilized to measure carotenoids in living tissue. The plant pigment carotenoid is responsible for orange, yellow, and red coloring (Scarmo et al., 2012).

This non-invasive monitoring technology uses visible LED light. Carotenoid concentration is measured by examining scattered light patterns in the form of a spectral fingerprint of the carotenoid molecules, which are based on their unique molecular structure and vibrational energy levels (Scarmo et al., 2012). The unique structure is explained as an alternating carbon double and single bond (Scarmo et al., 2012).

**Social norms** - This refers to the customary codes of behavior in a group of people or of the larger cultural context. Social norms are considered normative or standard (Ajzen, 2006).

**Socio-Ecological Model**- A four-level model; this model considers the complex interplay between individual, relationship, community, and societal factors (Centers for Disease Control and Prevention, n.d.).

**Subjective norms** - The belief about whether most people approve or disapprove of a behavior is defined as subjective norms. Subjective norms relate to a person's beliefs about whether peers and people of importance to the person think he or she should engage in the behavior of interest (Ajzen, 2006).

**Twenty-four hour recalls**- A retrospective method of diet assessment. Individuals are interviewed about their food and beverage consumption during the previous day or the preceding 24 hours. Validity is questionable due to recall issues and possible attempts of wanting to please the researcher (Raina, 2013).

## Operational Definitions

**Carotenoid Skin Score and Index-** The Resonance Ramen Spectroscopy/ BioPhotonic Scanner™ is used to obtain a carotenoid skin score which is highly correlated with the amount of carotene consumed (Aguilar, Wengreen, Lefevre, Madden, & Gast, 2014). The palm of the hand is the preferred body site for Resonance Raman scanning due to the Stratum Corneum. This is the outer skin tissue layer where the carotenoids concentrate. It is relatively thick, which leads to less variation in the melanin content among different races and ethnicities.

For the purpose of scoring carotene levels and creating the Carotenoid Score Index, the visible light spectral fingerprint that the RRS "sees" has been broken down into numerical ranges. The scoring ranges of the RRS are based on the measurements of over 1,300 individuals, who had a wide range or variety of diets (Pharmanex, 2003). The scoring range representing a high presence of carotenoids is the 50,000 to 59,000 range, the 40,000 to 49,000 range represents a very good presence of carotenoids, 30,000 to 39,000 is a good range of carotenoids detected in the skin, the 20,000 to 29,000 range is a moderate amount of carotenoids, and the 10,000 to 19,000 range represents a low result (Pharmanex, 2003). These index scores may vary between individuals based on lifestyle factors such as diet, physical activity, exposure to the sun, and toxins, for example cigarette smoke (Pharmanex, 2003).

The spectrograph is equipped with a linear charge device array, which allows the movement of the electric charge to be converted to a digital value and then interface with a tablet for data acquisition, processing, and display (Scarmo et al., 2012). Each subject's palm of their hand is scanned two times for reliability, unless the two scores are more than 2,000 Ramen units apart, at which time a third scan will be performed. Each scan takes approximately thirty seconds to complete (Scarmo et al., 2012). The two or three (in the situation that a third scan is needed) scores will be added together and averaged to obtain a value for each child's scans (Scarmo et al., 2012).

**Availability Survey-Fruit, Juice, & Vegetables At Home-**The Availability Survey- Fruit, Juice, &Vegetables At Home questionnaire (Hearn, Baranowski, Baranowski, Doyle, Smith, Lin, & Resnicow, 1998) or survey was administered at the same time as the Resonance Ramen Spectroscopy scan measurement was performed. The survey was given at baseline and at the conclusion of the program intervention.

## Chapter 2: Review of Literature

### Introduction

Chapter 2 begins with a brief overview of the study audience and previous research that has been conducted with that audience emphasizing the concerns of inadequate fruit and vegetable consumption. The barriers that low socio-economic families may face in regards to inadequate consumption of produce will be addressed. Research relevant to the variables of interest in this study will be presented including education, access, and preschool parent and child relationships in regard to such concepts as offering produce and role modeling the consumption of produce.

The USDA Economic Research Service studied the potential economic impact that dietary deficiencies caused by inadequate consumption of healthful foods such as fruits and vegetables have on individuals and society. It was noted that low-income Americans had higher levels of dietary deficiencies when compared to Americans with higher incomes. The federal government conducted research on subsidizing healthy foods or taxing less healthful foods. Data revealed that the average individual receiving Supplemental Nutrition Assistance Program (SNAP) ate smaller amounts of produce than their counterparts not eligible for SNAP. Daily intakes of those on SNAP were .96 cup of fruit and 1.43 cups of vegetables. According to CDC Vitalsigns data collected over a three year period (2007 -2010), nine out of ten children do not consume enough vegetables (Kim, 2014).

Knowledge and intention of vegetable and fruit intake are occasionally qualitatively measured or quantitatively reported via self-report in low socio-economic preschool children. However, the actual behavior of increasing intakes of fruits and vegetables is not often objectively, quantitatively measured, leading to a gap in knowledge about the true behavior change and difference that education and access may make. The literature has a plethora of information regarding self-reported knowledge attainment and intention following nutrition interventions with children, including some studies involving preschool children. Prior research has shown that education can potentially improve knowledge and intention to change behaviors related to nutrition in the lower socio-economic population, including preschool children.

## Nutrition Education and Preschool Children

The literature points to studies, such as one published in Appetite, conducted by Tatlow-Golden, Hennessy, Dean, and Hollywood, (2013) that examined young children's evaluation of various foods and drinks as healthy, and the relationship with socioeconomic status, family eating habits, and children's television viewing. One hundred seventy two children age three to five and their parents from diverse socioeconomic settings in Ireland were included in this study. Data gathered from the families showed that of 55 percent of the children were from socio-disadvantaged families. A healthy eating scale was used to assess the number of times per week the parents and their children ate certain foods. A character named “Mabel Mouse” was used as the model for the children. The children were urged to feed the character healthier foods to make the mouse stronger, bigger, and healthier (Tatlow-Golden et al., 2013). Minutes of television watched during the week and weekend were also collected.

Results demonstrated that children had very high levels of ability to identify healthy foods, although their ability to identify unhealthy foods was not as strong. The children were able to convey that healthy foods were important for growth and health. The ability to determine healthy and unhealthy food was not related to the family’s socioeconomic status, parent or children’s home eating habits, or children’s television viewing (Tatlow-Golden et al., 2013).

Chi-square results, on the identification of healthy foods, improved as the children’s age increased from three to five years of age. The same situation applied for children being able to state a correct explanation of why the food was healthy. Forty-one percent of three year olds gave an explanation about the healthy food, 68 percent of four year olds, and 95 percent of five year olds. Overall, all children were not as proficient at identifying unhealthy foods (Tatlow-Golden et al., 2013).

Education level and socioeconomic status were a variable examined in this research. Significant findings were shown for parents of lower socioeconomic status who reported that their children watched significantly more television and had significantly less healthy diets than children in families with a higher economic status. Additionally, the parents themselves also had significantly less healthy diets when compared to parents with higher incomes or more years of education (Tatlow-Golden et al., 2013). Results highlighted the importance of examining young children's response patterns, as the findings suggested the importance of teaching children about foods that were healthy as well as those that were less healthy during the preschool years (Tatlow-Golden et al., 2013).

The work by Gorelick and Clark (1985) also looked at preschool children's knowledge of healthy foods, using a doll to assess healthy options, following an educational intervention. After a pilot study, 20 classrooms of preschool children were randomly assigned to treatment or control groups. Evaluation included pre-and post-tests of 187 children's understanding of nutrition topics. Subjects showed overall significant improvement on the project developed test that measured knowledge in the area of food and nutrition. The group that was exposed to treatment showed highly significant improvement in their scores in five of the seven sections of the post- test or an average improvement of 12.8 points (Gorelick & Clark, 1985).

Niemeier, Stastny, Tande, Hektner, and Hwang, (2010) conducted and implemented an educational experience for preschool children to increase knowledge of fruits and vegetables. Nineteen preschool children from a childcare setting received the multi-dimensional nutrition program over a four week period, which introduced and emphasized six fruits and vegetables. Each food was added to the menu at the childcare center each day at one of the meals or snacks. Throughout the study period an innovative, interactive poster featuring a wagon was filled by the children with pictures of the foods they studied. This provided continual access and reinforced the message about the foods introduced, discussed, and tasted.

Pre-and post-assessments of the children's knowledge of the foods, including additional unhealthy options not discussed, were assessed though individual interviews used to measure knowledge. The scoring for the knowledge interview was done by allowing one point for a correct answer and no points for an incorrect answer. A significant increase from pre -to post- assessment was noted, with the mean score increasing from 3.5 (+ or – 1.8) to 5.9 (+ or – 1.9). Conclusions were drawn from this educational implementation that a combination of nutrition education, repeated exposure to fruits and vegetables, and an environment that supports consumption seem to support increased intake and knowledge of healthy foods such as fruits and vegetables (Niemeier et al., 2010).

In 2014, Williams et al. evaluated the effect of a nutrition education program on preschool children attending child-care, citing the gap in research that examines the link between classroom nutrition education and the home consumption dietary behaviors of these children. Twenty-four New York child care centers serving low income children were involved in this study, with the childcare centers randomly assigned to either the intervention or control arm of the study.

The intervention arm of the study consisted of nutrition education in classrooms, parent classes, and weekly parent newsletters. A baseline survey, completed via mail or phone, and a survey at the conclusion of the program, including observed consumption, were completed by 1,143 parents. A sample size calculation was utilized to assure adequate sample size for this study.

A significant impact on children's at-home daily consumption of vegetables (0.12 cups) and use of low-fat/fat-free milk (39 percent increase) was shown as a result of this program. Also significant was the increase in the frequency of child-initiated vegetable snacking (0.3 days). The conclusions drawn from this large sample and study of children, parents, and teachers resulted in significantly increased vegetable and low-fat/fat-free milk consumption in low-income preschoolers. The authors concluded that the use of multilevel messages targeted at the preschool children and families as well as teachers of this audience seemed to shape and impact both policies and practices (Williams et al., 2014).

Anliker, Laus, Samonds, and Beal (1990) conducted research looking at the nutrition-related knowledge and attitudes of preschool children. The impact of messages that parents give their children and how they might influence the child's knowledge or choices was also examined.

In the Anliker, et al., (1990) study, 104 mothers of three and one half year old children completed questionnaires while children were interviewed to determine their level of nutrition knowledge. These children and their families were enrolled in the longitudinal Western Massachusetts Growth Study.

The children showed significant levels of nutrition knowledge in the areas of food groups, food transformations, food origins, and energy balance. In a role-playing situation, where a doll would be growing big and strong, children were able to show some ability to judge relative food values, with more children selecting foods of higher nutrient density over lower nutrient dense foods.

Topics derived from open-ended questions from the mothers included: passive and non-verbal, example, discouragement or encouragement, general nutrition, specific nutrition, physical, bribes and rewards, and authoritarian messages. A correlation was shown between the children's nutrition knowledge scores and the quality and specificity of the nutrition-related messages that the parents gave about foods. A significant level of nutrition awareness among young children, as well as the importance of early parent – child communication was highlighted in the article (Anliker et al., 1990).

In 2015, Whitely et al. conducted research to determine if a program titled *Vegie Fun for Everyone* used in Australian preschools resulted in positive attitudes towards vegetables as well as an increase in food literacy. Written policy in Australia required all four year olds to attend preschool, allowing for the Whitely et al., (2015) study to have the capacity to reach and program to an entire population of four year olds. Approximately 300 preschool children in seven low socioeconomic preschool settings were reached with programming based on Piaget's Cognitive Development Theory.

One hundred twenty-two parents completed a written questionnaire within one month after the completion of the program. The descriptive study had the mission of being utilized for information gathering and program improvement (Whitely et al., 2015). The low-literacy questionnaire was constructed by a team of preschool staff, parents, and dietitians. The questionnaire consisted of eight questions using a Likert-type scale with a five-point face scale.

Results of the program included over 70 percent of the children asking for and eating more vegetables as a result of the programming. Preschool educators had a 90 percent rate of approval with witnessing children's attitude and willingness to try and eat more vegetables per their responses to a survey. As a result of this programming, preschool teachers and parents reported and observed more self-directed tasting and improved attitude toward trying vegetables and asking for and eating more vegetables (Whitely et al., 2015).

Fitzgibbon, Stolley, Schiffer, Van Horn, KaufferChristoffel, and Dyer, (2005) performed a randomized control trial to examine the use of a culturally proficient nutrition and physical activity intervention in twelve Head Start programs in Chicago, Illinois. This study was continued for a two year period. The follow-ups on the 409 children consisted of an investigation of body mass index (BMI) changes in the children after the 14 week intervention occurred in the Head Start classrooms. Intake, physical activity frequency, and television viewing information were all collected from the parents of the children (Fitzgibbon et al. 2005). The control group also received education, but their topics concerned health and safety issues such as the use of seat belts over the same fourteen week time period.

The results showed that those children that had the *Hip-Hop to Health* intervention had significantly smaller increases in BMI compared to the non-intervention group. This was true at both the one and two year follow-up measures. The conclusion of this two year study was that the *Hip-Hop to Health Jr. Program* was shown to be effective in preschool children, resulting in reductions of their BMIs. A promising approach to prevention of preschool children's weight concerns was addressed in this study (Fitzgibbon et al., 2005).

Behavior change and true application of the knowledge have rarely been investigated in preschool children and their parents, and children are much more difficult to assess. Children are difficult to gather reliable intake information from, and other than invasive serum measures, few valid and reliable quantitative methods, beyond self-report, have been available to show proof of impact and behavior change (Aguilar, Wengreen, Lefevre, Madden, & Gast, 2014).

## Nutrition Education/ School Age Children

Frequent exposure to vegetables has been shown to have a positive effect on children's acceptance of these foods (Wardle, Herrera, Cooke, & Gibson, 2003). In 2003, Wardle et al. examined the difference that exposure or reward made on acceptance, consumption, and likability of vegetables for children. Forty-nine elementary school children in London, age five to seven, were randomly assigned to an exposure group, a reward group, or a control group. The exposure and reward groups were offered red peppers during eight sessions over a two week period. Those in the reward group were shown a sticker and told they would receive one if they ate one piece of pepper.

The children were directed to taste sweet red peppers and indicate if they liked the vegetable on a scale of one to five using faces for their scale. Consumption was measured by the researchers via counting the number of pieces of pepper eaten by the students at each session. Results showed that those in the exposure group liked, ranked, and consumed more of the "target" vegetable than either the reward or control group. The exposure group showed a significant increase across all three measured outcomes which included: liking, ranking, and consuming. Students also increased their intake as the sessions took place, increasing their consumption each day. The conclusion in this study was that the promising strategy of promoting acceptance and liking of previously rejected or unfamiliar foods may be reversed with repeated exposure (Wardle et al., 2003).

Prelip, Kinsler, Thai, Erausquin, and Slusser (2012) conducted research to examine the impact of a multi-component nutrition education program and its effect on student knowledge, attitudes, and behaviors as they relate to the consumption of fruits and vegetables. In this quasi-experimental research, 399 low-income third, fourth and fifth-grade students from six schools in the Los Angeles Unified School District were involved in the interventions. Three intervention group arms were categorized for this study.

The Intervention Plus arm consisted of four components, including a parent nutrition education component. Interactive activities involved bringing chefs and farmers to school, art, theatrical performances that had a nutrition theme, and the Harvest of the Month program. The Intervention arm consisted of two components which did not include the parent component. The third arm was the control group. A pre/post design was used to measure the results from the interventions. Several outcomes were measured including: fruit and vegetable consumption, knowledge of food groups, attitudes and beliefs towards fruits and vegetables, and parent/teacher influence on students' attitudes toward fruits and vegetables.

Results showed the Intervention Plus group had positive changes in knowledge, attitudes, and beliefs toward vegetables. Additionally, the teacher influence on students' fruit and vegetable attitudes was improved, per the data, in the Intervention Plus group. Despite the need for more research in this area, this large multi-component intervention did show that positive outcomes such as improved attitudes and knowledge can be shown and documented (Prelip et al., 2012).

He, Beynon, Sangster, Bouck, St Onge, Stewart, Khoshaba, Horbul, and Chircoski, (2009) conducted a cluster-randomized study examining the influence of a Canadian health promotion program. A total of 1,277 fifth through eighth grade children from 26 schools in Northern Canada were included in this study. The He et al., (2009) study looked at psychosocial variables, as well as fruit and vegetable consumption patterns in these children involved in the *Northern Fruit and Vegetable Pilot Program* (NFVPP). The He et al., study consisted of three intervention arms. These were 1) free fruit and vegetable snacks and a twenty one week enhanced nutrition education program, 2) free fruit and vegetable snacks alone, and 3) the control group.

The Pro-Children Questionnaire was used to determine both the primary and secondary outcome measures, which were the children's fruit and vegetable consumption and the differences in awareness, knowledge, self-efficacy, preference, intention, and willingness to increase the fruits and vegetables eaten. Data from the 24 hour recalls was coded manually.

The results showed that the intervention group one, with the free snacks and education, consumed more fruits and vegetables than their control counterparts by .49

servings per day. The group two interventions of free fruits and vegetables only, also consumed more fruits and vegetables than the control group by .42 servings per day. Unlike the first intervention group, the findings of group two were not significant.

Preferences for certain fruits and vegetables shifted from" never having tried it" to" like it" for both the first and second intervention groups. In conclusion, the NFVPP was shown to result in increased consumption of fruits and vegetables, as well as favorable preference of the fruits and vegetables (He et al., 2009).

## Reasoning for Inadequate Intake in Low-Income Populations

In 2013, Haynes-Maslow, Parsons, Wheeler, and Leone performed a qualitative study using focus groups to examine community level characteristics and how they affect individual level dietary behaviors by studying attitudes and beliefs about purchasing, preparing, and eating fruits and vegetables. Focus group discussions were conducted with low income populations in two North Carolina counties. A total of eight focus group discussions were conducted over a four month period, which included a total of 68 low income participants. Focus group sessions were transcribed verbatim using the Socio-Ecological Model (SEM) of health as a guide in this process. Focus was on the third level of the SEM, also known as the community level. A code book was used, memos were written to summarize findings during the analysis phase, and saturation was reached through a comparison of the findings (Haynes-Maslow et al., 2013).

Six major community level barriers to fruit and vegetable consumption were discovered as a result of these focus groups. Most of these barriers were commonly cited in past work, which was done more at the individual level. The barriers included cost, transportation, quality, variety, changing food environment, and changing societal norms on food. Cost was cited as the most common and extensive barrier four times more often than other barriers by the focus group participants. The authors concluded with the suggestion that policymakers should consider supporting programs that decrease cost and increase supply of high quality fruits and vegetables for low-income communities (Haynes-Maslow et al., 2013).

In 2010, Hildebrand and Shriver conducted a study examining the Transtheoretical Model of Behavior Change stage in 94 parents, who were described as low-income African American parents of children enrolled in an urban Head Start program. Parents were classified with regard to increasing fruit and vegetable use with their children and differences in fruit and vegetable decision making. A fruit and vegetable survey was administered to the families, followed by focus groups with questions based on the findings from the initial survey. Self-efficacy, behavioral, and cognitive strategies regarding fruit and vegetable use were examined from the data collected (Hildebrand& Shriver, 2010).

In this mixed method two phase study (Hildebrand & Shriver, 2010), Chi-square tests of significance were used to assess distribution of parents into stages of change for increasing fruit and vegetable availability. Results showed that 21 percent of the parents were in the pre-contemplation/contemplation stage, 25 percent in the preparation stage, and 54 percent in the action/maintenance stage. The findings indicated that those parents in the action/maintenance stage served significantly more fruits and vegetables daily and used behavioral processes more often than those in the contemplation stage.

Factors that were generated from the survey and focus groups showed that decisions on purchasing fruits and vegetables were similar to findings in past literature. Consistent with past findings were cost, shelf-life, and convenience to prepare, as well as what is culturally accepted as social norms. Understanding and knowing the target audiences' readiness and stage of interest was noted in this article as a crucial step in changing behaviors. Finally, the importance of understanding what educational message could lead to success at particular stages of change was emphasized (Hildebrand & Shriver, 2010).

In 2011, Wyse, Campbell, Nathan, and Wolfenden conducted research to look at the characteristics of home food environment as having an influence on fruit and vegetable consumption. The Wyse, et al., (2011) study took place with a sample of 396 parents of three to five year old preschool children from Australian preschools. The methodology used in the study was a cross-sectional telephone survey where information was collected using a valid and reliable subscale of the Children's Dietary Questionnaire. Data was gathered to show the connection between the children's fruit and vegetable intake and the home food environment; looking at such items as role-modeling and fruit and vegetable availability (Wyse et al., 2011).

Multiple regression analysis using generalized linear mixed models was utilized for data analysis. Parental education and income, along with gender of the children, were controlled and adjusted to determine the correlation between children's fruit and vegetable consumption and the home environmental variables. A positive association between children's fruit and vegetable consumption and parental intake was noted. Additionally, a positive association was noted in accessibility and the number of times daily that parents provided fruits and vegetables to their children. This study identified characteristics that may be considered modifiable within the home food environment (Wyse et al., 2011).

In 1998, Hearn et al. conducted research on home availability and accessibility, as well as school lunch availability of fruits and vegetables, and the effects that were noted on consumption. Baseline data from two different school sample nutrition education projects were examined and relationships between availability and accessibility and consumption of fruits and vegetables were determined in this research. One sample was taken from third grade students and their parents from a large southeastern urban community, as well as its surrounding counties. Thirteen families were drawn from the group to form the sample that was interviewed and studied. Availability, accessibility, and preferences, as well as seven day food intakes were gathered via telephone interviews (Hearn, et al., 1998).

Data was also collected from 45 schools and the students that attended. The information gathered in these schools were seven day food records of the fruits and vegetables eaten at school lunch only. Mixed method analyses, including regression, were used to test the relationship of the demographic characteristics studied versus the fruits and vegetables eaten. The results show tentative support for the idea that fruit and vegetable availability and accessibility, at home and in schools, is related to the intakes of fruits and vegetables. Of note was that the availability and accessibility reported by parents seemed to correspond to the student's food consumption. Much emphasis was given in this article of the findings and implications for health education, parent communication, and school lunch modifications (Hearn et al., 1998).

Reed (1996) conducted focus groups to try to determine what constitutes a desirable and impactful nutrition program for low-income mothers of preschool children. Twenty mothers of children in southeastern Louisiana agreed to participate in the focus groups. The mothers were divided into groups of three for the activity group process, which was based on Krueger's focus group methodology. The PRECEDE-PROCEED model and the Social Cognitive Theory were used as a basis for the questions and transcription. PRECEDE-PROCEED examines three topics including: predisposing factors, enabling factors, and reinforcing factors (Reed, 1996).

Several topics that were categorized under predisposing were related to knowledge needs and attitudes. Topics raised under the predisposing category included: serving size for preschool children, information on food labels, information on making meals less stressful, ways to deal with picky eaters, and waste and cost of foods not being eaten due to unacceptance by the children. Under the enabling factors, some of the ideas stated were: the need for printed menus, recipes, pantry lists, and grocery lists containing healthy foods, better communication tips for interacting with their children at mealtimes, and important sources for nutrition information.

Finally, under reinforcing factors topics listed included good taste, visually appealing, low cost, easily prepared recipes that could be made in fifteen minutes or less, and peer and teacher influence to encourage children to try new foods. Also, reinforcement of fewer visits to the physician and dentist were noted by the mothers as an important outcome of nutrition programming. The author concluded that targeting all environments of the preschool child including their home, school, and neighborhood are necessary to have success in modifying diets so that they better align with the Dietary Guidelines (Reed, 1996).

In 2013, Campbell, Abbott, Spence, Crawford, McNaughton, and Ball, conducted research to examine if maternal nutrition knowledge was associated with child intake of food and drink items likely to increase obesity risk. Additionally, when a relationship existed between the maternal knowledge and the intake, assessing whether this association was mediated by home food availability (HFA) was also addressed. Five hundred thirty six children and mothers from Australia were included in this study. The families, who all had at least one child in the five to twelve year old age range, were of low socio-economic status. These mothers provided information on their child's diet, home food availability, and nutrition knowledge as well as demographic characteristics (Campbell et al., 2013).

Assessment of Campbell et al., (2013) hypothesis was done by assessing the associations between nutrition knowledge and HFA, and between HFA and child food intake (adjusting for nutrition knowledge and the age of the child). Frequencies and linear regression were used in the assessment of these factors. Maternal knowledge of nutrition was shown to be significantly and directly associated with child consumption of fruits, vegetables, and cake and inversely associated with their child's consumption of salty snacks and soft drinks. Maternal nutrition knowledge was also directly associated with home availability of fruits and vegetables. This research points to the importance of maternal nutrition knowledge and its impact on consumption (Campbell et al., 2013).

White, Wilson, Burns, Blum-Kemelor, Singh, Race, Soto, and Lockett, (2011) conducted research which examined and tested the use of nutritional messages and their supporting content with low-income mothers for use with theory-based interventions addressing fruit and vegetable consumption as well as child-feeding practice. Ninety-five low income mothers with children ages two to five, from eight states, were included in the model used, which consisted of six formative and six evaluative focus groups. The formative focus groups explored the message concepts and preferences for the concepts, while the evaluative focus groups tested the messages for both preferences and comprehension. Seven generated and audience-tested messages, found to be convincing and believable, were yielded from these focus groups.

A previous idea that was believed to be valid was confirmed in this research. It was shown that mothers have a significant influence on the diets of young children, such as the idea of role modeling, and the positive eating behaviors and healthful eating habits, such as family meal time and fruit and vegetable consumption that children develop. Looking at what effect these messages might potentially have on the child's future nutrition habits, including their independence and skills related to nutrition, is an important first step and foundation toward creating programming and interventions with this population (White et al., 2011).

Vereecken and Maes (2009) investigated and assessed the dietary habits of Flemish preschoolers while also examining the associations of these habits with both sociodemographic characteristics and the nutritional knowledge and attitudes of the mothers. The sample in this study was 862 parents of preschoolers from 46 schools. The parents completed a questionnaire including sociodemographic characteristics, a food – frequency questionnaire to assess children's dietary intake, and a nutritional knowledge and attitude questionnaire. Parents were asked to complete frequency consumption patterns for the previous three months on seventy-seven food categories or groups. Using a range, parents were asked to indicate the number of days a week the foods were consumed and the amounts of those foods (Vereecken & Maes, 2009).

Regression analysis showed a lower dietary adequacy in children of mothers with low and medium levels of education, medium-ranked occupation, and lower levels of both nutritional knowledge and food-related health attitude. The highest excess score, or consumption of foods with lower nutritional quality, was found in children of mothers with low education level, without a job, with three or more children, of age less than thirty years, and possessing lower levels of nutritional knowledge and attitudes scores for health and taste. The authors postulated that an understanding of the association of the dietary adequacy and excess scores in comparison to sociodemographic backgrounds should allow practitioners to develop better-tailored nutrition interventions. The associations with the mothers' nutritional knowledge and their attitudes support the inclusion of knowledge and influencing attitudes in dietary interventions (Vereecken & Maes, 2009).

Savoie-Roskos, Durward, Jeweks and LeBlanc (2016) discovered that participants, all of whom received SNAP, had a positive relationship between food security and fruit and vegetable intakes when incentivized at a Farmer's Market. Fifty-four adults, who received SNAP, benefited from a dollar-per- dollar match of produce at the market. A pre/ post-test design was used to measure food security and produce consumption of the participants. The 6-item Behavior Risk Factor Surveillance System questionnaire was utilized to measure the fruit and vegetable intake and the US Household Food Security Survey Module was used to measure the food security variable. Participants who received the matching incentives showed a significant increase in select vegetables and in self-assessed food security (Savoie-Roskos et al., 2016).

The *Food Dudes* (Morrill, Madden, Wengreen, Fargo, & Aguilar, 2015) program objective was to increase in-school fruit and vegetable consumption. This study examined a potential barrier to the implementation to the *Food Dudes* program by looking at praise versus prize versus a control group. A randomized controlled trial with three groups (i.e., prize, praise, and control) was conducted to determine their effect on fruit and vegetable consumption. Lunch tray photos were used as an assessment tool. In total, 2,292 students attending six elementary schools participated. Students attending the *Food Dudes* schools consumed more fruit and vegetable than control schools, with larger differences in prize schools (92 percent difference) than praise schools (50 percent difference) (Morrill et al., 2015).

The research team (Morrill et al., 2015) followed the students longitudinally and found that at three months the *Food Dudes* schools consumed 46 percent more fruits and vegetables than control schools, with no difference between prize and praise schools. At the six month follow-up, only prize schools consumed more fruit and vegetable than control schools (0.12 cups more per child, 42.9% difference). Conclusions from the Morrill et al., (2015) study showed that the social praise proved an inadequate substitute for prizes within this particular program. Program-related increases in fruit and vegetable consumption decreased after the intervention. The results underscored the need to generate low-cost, long-term interventions to maintain and make habitual consumption of recommended levels of fruit and vegetable (Morrill et al., 2015).

## Evaluation of Nutrition Education

Those that implement and fund nutrition education and food assistance programs desire and expect outcome measures and reliable and valid data showing that behavior change is occurring and being sustained as a result of their efforts and resources. Measuring outcomes has created confusion and presented challenges. The literature suggests that research, such as those highlighted below, has been conducted to measure outcomes in various methods although most results are self-reported.

Cade, Frear, and Greenwood (2005) conducted research to develop a simple and concise tool that could be used to assess diets of children aged three to seven years old. A 24 hour food checklist was compared to a 24 hour food diary to determine usability and validity. One hundred eighty children along with their families and teachers or observers in the schools completed the 24 hour diary recalls and food checklists. The correlations comparing the 24 hour diary with the food check-off tool was high for both foods and nutrients. Misclassification was "much less than would be expected by chance" per the authors. The evaluation of the food checklist was positive per the parent and teacher feedback evaluation information. Parents felt the checklist was easy and quick to complete. The article conclusion stated that the CADET checklist is a good fit for rapid collection of food and nutrient information for children. The tool performed better than many other food-frequency questionnaires and did well when compared to the 24 hour diary (Cade et al., 2005).

In 2011, Zarnowiecki, Dollman, and Sinn conducted research to discover a simple and reliable tool with face validity to measure young children's nutrition knowledge. One hundred ninety two, five to six year old children from randomly selected schools, were assessed regarding their ability to correctly identify healthy versus not as healthy foods. The tool used was known as the Healthy Food Knowledge Activity (HFKA). It was a photo-based tool composed of thirty healthy and unhealthy foods and drinks. This tool was created to identify areas of nutrition education that show a need for increased attention in future programming. The measurement tool showed good test-retest reliability in a pilot study of thirteen children. Following this pilot study, a full scale study showed that the children had results that were well distributed with acceptable skewness and kurtosis statistics. The HFKA was shown, in the Zarnowiecki et al., (2011) study, to be a useful tool for identifying young children's knowledge of healthy and unhealthy foods. The results can help focus future programming to effectively target content for various age ranges and enhance current knowledge and outcomes of nutrition programs (Zarnowiecki et al., 2011).

Geller, Dzewaltowski, Rosenkranz, and Karteroliotis (2009) conducted research with the purpose of developing a scale that could be used to assess children's self-efficacy and a proxy efficacy for fruits and vegetable consumption.  The Geller et al., (2009) study took place in a Midwestern town where 184 elementary-aged children from seven after-school programs completed questionnaires regarding their intake of fruits and vegetables.  The questions also looked at the children's ability to get others to act in their interest so that they could obtain and thus increase their fruit and vegetable intakes.  In the 61 item questionnaire, the ideas of self-efficacy expectation for fruit and vegetable consumption were examined, as well as the proxy-efficacy to influence parents to make fruits and vegetables available and the proxy efficacy influence of school staff to influence fruit and vegetable availability (Geller et al., 2009).

Exploratory factor analysis and criterion validity analyses were used to breakdown and analyze the available data.  The students who perceived that fruit and vegetable consumption opportunities existed were shown to have greater self-efficacy expectations and greater proxy efficacy to influence after school staff compared to those students who did not perceive fruit and vegetable consumption opportunities existed.  Socio-economic status and diversity also seemed to have an effect on self-proxy with regards to the children's parents.  Those children who attended schools with a higher socio-economic status (SES) and less diversity scored with a higher confidence rating in being able to influence their parents to make fruits and vegetables more readily available than children of lower SES and in schools with higher diversity (Geller et al., 2009).

Harnack, Oakes, French, Rydell, Farah, and Taylor, (2012) conducted a randomized crossover design study to evaluate the effects of two serving strategies on fruit, vegetable, and energy intake among preschool children. The two strategies included: serving fruits and vegetables in advance of other menu items, and serving meals portioned by providers as opposed to self-service family style. Fifty- three preschool children from an urban Head Start in Minneapolis, Minnesota were included in this sample. This research took place over a six week period with two weeks of each type of intervention included. Intake was observed and recorded by trained observers during the lunch meal for the six week timeframe (Harnack et al., 2012).

Results showed that fruit intake was significantly higher when fruits and vegetables were served prior to the other items served at the meal. Fruits and vegetables were served five minutes prior to the other meal items. Some nutrients, found in the fruits and vegetables, were also found to be higher when those foods were served prior to the other meal items. Those included Vitamin A and folate. No benefit was shown for the provider served portioning of plates. The study results implied that traditional family meal style remains a superior method for use in preschool settings, although offering fruits and vegetables prior to serving the other foods, as little as five minutes prior, may have benefit to intake and nutritional consumption of these foods (Harnack et al., 2012).

Burrows, Warren, Colyvas, Garg, and Collins (2009) conducted research to examine the comparative validity of a food frequency questionnaire completed by parents reporting child fruit and vegetable intake compared to plasma carotenoid concentrations.

Ninety-three children from Australia, aged five to twelve, from a range of weight categories were assessed. A 137 question semi-quantitative fruit and vegetable questionnaire and plasma carotenoid laboratory measurements were utilized. Significantly lower levels of all plasma were found among overweight and obese children when compared to healthy weight children. The conclusion of this study was that parental reports of children's carotenoid intakes using a fruit and vegetable questionnaire can be utilized to provide a relative validation of fruit and vegetable intake. The final recommendation was that weight should be considered a potential confounder in all statistical analysis (Burrows et al., 2009).

## Theory of Planned Behavior

Success has been shown in the literature when nutrition education and physical activity education intervention are grounded in the Theory of Planned Behavior. The theory explores the relationship between behavior and beliefs, attitudes, and intentions. Behavior intention is the most important determinant of behavior. It is said that a person's attitude influences behavior intention and beliefs about whether individuals who are important to the person approve or disapprove of a behavior. This is known as subjective norm (Rimer & Glanz, 2005). An additional construct, enhancing the original Theory of Reasoned Action, is known as perceived behavioral control. Perceived behavioral control involves people's beliefs that they control a particular behavior. It is believed that people might try harder to perform a behavior if they feel they have a high degree of control over that behavior.  Many examples in the literature use the Theory of Planned Behavior as their theoretical foundation.

Pawlak and Malinauskas (2008) conducted research to identify specific beliefs regarding eating 2 cups of fruit per day among ninth grade youth attending public high schools in eastern North Carolina.  The Pawlak and Malinauskas (2008) study was grounded in the Theory of Planned Behavior (TPB).  An open-ended survey, developed from theory principles in the literature, measured the variables of the TBP via pilot testing.  After the pilot study, the instrument created was then administered to 157 students from two schools.

Attitude, subjective norms, and perceived behavioral control significantly predicted intention to eat fruits, accounting for 55 percent of the variance.  Attitude was the greatest predictor of intention to eat fruit among those in the study.  Students also indicated that obtaining adequate amounts of nutrients was an advantage of eating fruits. Another interesting finding from the research was that friends had a greater impact than the influence of parents, regarding fruit intake.  These findings suggest that peer leaders may have a significant influence on intentions to eat fruits in the teen population (Pawlak &Malinauskas, 2008).

Another study utilized the Theory of Planned Behavior to explain older adults' intention to consume dairy products and consumption of dairy products (Kim, Reicks, & Sjoberg, 2006).  The Kim et al., (2006) study examined the factors that compose the premise of the Theory of Planned Behavior which includes: attitudes, subjective norms, and perceived behavioral control.  One hundred sixty-two older adults completed a questionnaire. Predicting intention is delineated as the most important attribute for behavior change. Questionnaire outcomes resulted in a slightly more important factor of attitudes toward eating dairy products followed by the perceived behavioral control factor in terms of predicated intention. The study results point to the use of the Theory of Planned Behavior in the explanation of older adults' dairy consumption. The research emphasizes the focus on nutrition education and how it can be improved and modified to reflect these findings, which should allow for stronger content dissemination and impact (Kim, et al., 2006).

Using the Theory of Planned Behavior as a foundation, another study was conducted to assess exercise intention among racially and ethnically diverse college students (Gordon, 2008). Both motivation and intention of students to engage in exercise as well as determining if the Theory of Behavior explains intention were the objectives of this study. The relevant variables were the Theory of Planned Behavior constructs which include: behavioral beliefs, normative beliefs, and control beliefs. When the three constructs were combined they formed a measure of intention to exercise. Two hundred twenty five students participated in this study. Results showed that there were significant differences between black and Hispanic students in regards to normative beliefs and attitude toward exercising. The Hispanic students were more likely to rate physical activity for thirty minutes per day as beneficial and perceive friends as approving of them being physically active as a positive belief (Gordon, 2008).

The Riebl et al., (2015) research seeks to evaluate the effectiveness of the Theory of Planned Behavior (TPB) in understanding and predicting adolescents' sugar sweetened beverage consumption (Riebl et al., 2015). Consideration and identification of the constructs of most importance when evaluating sugar sweetened beverage intake in adolescents were considered. Additionally, the authors wanted to determine whether and how adolescents' beverage choices were influenced by parents' reactions to their beverage choices. One hundred teens were recruited for this study where 24 hour dietary recalls and a questionnaire on specific Theory of Planned Behavior concepts regarding sugar sweetened beverages was administered. Parents were also included and asked to complete a Theory of Planned Behavior questionnaire. The Theory of Planned Behavior explained a small but significant amount of variance in adolescents' sugar sweetened beverage consumption. Parents, in addition to friends, were shown to influence adolescents’ intentions and sugar sweetened beverages consumption (Riebel et al., 2015).

## Resonance Ramen Spectroscopy as a Measurement Tool

Measurement with a quantitative BioPhotonic Scanner™ to measure improvement in carotenoid or Ramen scores after produce and education have been provided is a concept that is innovative yet could have great potential. Coupling scanner scores with parent availability and intake responses may supply needed data and documentation of behavior change and impact. Literature and studies involving the scanner, examining validation and feasibility follow.

Zidichouski, Mastaloudis, Poole, Reading, and Smidt (2009) conducted research to test the hypothesis that the Ramen Spectroscopic technology is a valid, quantitative, and reliable methodology for use in assessing carotenoid status by comparison of this method to the serum high-performance liquid chromatography (HPLC) methodology. Establishing and comparing the reliability of the two methods was the objective of the Zidichouski et al., (2009) research. Three hundred seventy two subjects were assessed in this study. All the subjects had three blood samples and three Raman Spectroscopy scan measurements done over an eight day period with at least 48 hours between measurements.

Consistent positive correlations were shown in the measurements of the three separate same–day correlation plots of serum versus Ramen Spectroscopy skin measures. Overall, estimates of the line of best fit from analysis of covariance using the three samples yielded a Pearson correlation of 0.81. Ramen Spectroscopy was shown to accurately measure total carotenoids in human skin in this study. The RSS technology was shown to be a valid and reliable noninvasive method to rapidly measure carotenoid nutritional status in human subjects (Zidichouski et al., 2009).

Rerksuppaphol and Rerksuppaphol (2006) conducted research assessing the relationship between fruit and vegetable intake and skin carotenoid levels measured by the Resonance Raman Spectroscopy (RRS). The Rerksuppaphol and Rerksuppaphol (2006) study involved 29 healthy volunteers from Thailand. Demographic data was recorded, fruit and vegetable intakes were collected, and skin carotenoid levels were measured by Raman Spectroscopy. These measures were reported as Skin Carotenoid Scores (SCS). Data collected was categorized into three groups, a low intake group, a medium intake, and a high intake group.

The authors found a significantly positive association between fruit and vegetable intake and Skin Carotenoid Scores.  Although participants who consumed large amounts of fruits and vegetables tended to have a lower Body Mass Index than those who consumed lower intakes of fruits and vegetables, the findings were not significant.  The authors postulated that these results may have looked differently with a larger sample size.  Using the Ramen Spectroscopy was found to be useful in showing that the correlation between fruit and vegetable intake and skin carotenoid levels was strongly associated.  The authors suggested that the RRS could serve as a non-invasive replacement for the invasive laboratory technique often used for carotenoid measurements (Rerksuppaphol & Rerksuppaphol, 2006).

In 2015, Aguilar, Wengreen, and Dew conducted research to examine the effect of a carotenoid juice versus a placebo juice on the Resonance Ramen Spectroscopy scan score changes over an eight week time period.  The study sample was composed of 58 children, ages five to seventeen, from Cache County, Utah.  Children were randomized into three groups after baseline health questionnaires and demographics were collected and examined for exclusion criteria.  Groups were then separated into 1) high carotenoid juice (n=18), 2) low carotenoid juice (n=18), or 3) a placebo (n=22).  Juice doses were determined as high and low based on the child's weight and the placebo juice was designed to resemble the carotenoid juice in appearance and consistency which allowed the participants and researchers to be blinded to the assignments.  The students in the study had Resonance Ramen Spectroscopy scans performed at baseline and weeks 2, 4, 6, and 8, along with fruit and vegetable frequency questionnaires at baseline and weeks 4 and 8, and three 24 hour recalls that were averaged (Aguilar et al., 2015).

Repeated analysis of variance was used to assess group differences in skin carotenoid status over the weeks the study was conducted. The high-dose and the low-dose groups had skin scan scores that were significantly increased at each measurement check. The high-dose group had a higher scan result than the low-dose group although not by a significant amount. Scan scores and fruit and vegetable questionnaires were highly correlated in this study (Aguilar et al., 2015).

Aguilar et al. (2014) conducted research to examine the correlation between serum carotenoids and skin carotenoids measured by the use of a Resonance Raman Spectroscopy (RRS). The intent was to measure skin RRS validity against high-performance liquid chromatography to determine whether RRS could be utilized as a biomarker of fruit and vegetable intake in children. The Aguilar et al., (2014) study was a cross-sectional study of 45 healthy children in Utah from five to seventeen years of age. Each child provided three blood samples and three skin RRS measurements over a four week period. Average estimates of three dietary food frequencies and 24 hour recalls were also compared to these measures. Levels of skin and serum carotenoids were highly correlated. Results of these comparisons showed an increase in the RRS intensity per every unit of increase in total fruits and vegetables recorded from the food frequency questionnaire and the total fruits and vegetables assessed from the 24 hour recall.

The Aguilar et al., (2014) study, which was one of the first studies to examine the correlations between skin and serum carotenoids among children, showed a strong correlation between the skin carotenoid levels measured on the children's palm and the estimates of intake from the 24 hour recalls, fruit and vegetable intake surveys, and the serum levels. The study validated the RRS as a valid biomarker for use in measuring children's fruit and vegetable intakes (Aguilar et al., 2014).

Scarmo et al. (2012) examined the feasibility of using the Resonance Ramen Spectroscopy (RRS) to describe inter-individual variability of both skin carotenoid status and factors associated with this biomarker in the preschool population. This cross-sectional study was conducted with 381 economically disadvantaged preschool children. Children had their skin carotenoid status assessed, as well as their fruit and vegetable consumption assessed, by a brief parent/guardian completed food frequency screener and a liking survey.

Multiple regression analysis showed a positive association between the RRS and the fruit/vegetable consumption. Additionally, a positive association between the RRS score and the fruit and vegetable preferences of the children was described. The carotenoid status of the youngest children, those with greater adiposity, and those on the Supplemental Nutrition Assistance Program was lower than the older preschool children, those with a lower Body Mass Index, and those who were not currently receiving SNAP assistance. Further research was suggested by the authors for utilizing the RRS biomarker in young children (Scarmo et al., 2012).

Reed, Aguilar, and Allen (2015) completed research to determine the effect of a known amount of carotenoid level, from a developed and produced Breakfast Bite, on skin carotenoid concentration levels among children. The Breakfast Bites were developed in the nutrition science laboratory at Utah State University. Each Breakfast Bite contained 4.3 milligrams of carotenoids per 120 grams, with a total of 366 calories. The Reed et al., (2015) research study was completed with 46 children age five to seventeen that were randomized to receive the high carotenoid Breakfast Bites or a placebo.

The BioPhotonic Scanner™ was used at baseline and the youth were rescanned every two weeks alongside completion of a food frequency questionnaire which was offered at baseline, mid-point, and at the conclusion of the intervention. The participants were weighed and assessed for compliance with their prescribed bites. Consistent consumption of the 4.3 milligrams of carotenoid in a high-carotenoid baked product significantly increased skin carotenoid levels over the six week period among children (Reed et al., 2015).

Jahns, L., Johnson, L.K., Mayne, S.T., Cartmel, B., Picklo, M.J., Ermakov, I.V., Gellerman, W., and Whigham, L.D. (2014) conducted a controlled feeding intervention using both RRS scanner measurements and blood carotenoid concentrations as a method of measuring different feeding phases. Twenty nine subjects participated in a four phase feeding research intervention. Phase one (6 weeks) consisted of a restricted carotenoid diet or depletion phase. During phase two (8 weeks) participants were provided a high carotenoid diet, averaging 62 mg. mixed carotenoids/day. The third phase (6 weeks) was another depletion or restriction phase. The final phase was a repletion or return to the participant's normal diet (Jahns, et al., 2014).

Results of the various phases showed: a decrease of skin and plasma carotenoid values of 36% and 30% respectively from baseline to the end of the first phase. The high carotenoid diet (phase 2) lead to an average increase of 264% carotenoid by the end of the six week phase as measured by both skin and serum levels. The third phase or depletion phase resulted in a return to baseline by the middle of the phase for the serum levels and the end of the phase for the scan levels. The carotenoid levels remained elevated in the skin for a longer period due to the idea of the skin, which acts as a storage medium, having a longer half-life than the blood carotenoids. The participants had continuing decreasing carotenoid measures until week 25 at which time the carotenoid levels started to increase slightly (Jahns, et al., 2014).

# Chapter 3: Procedures of the Study

## Introduction

The purpose of this study was to determine if providing fruit and vegetable (F&V) access with and without nutrition education would impact consumption of produce in children and their parents. Produce access for Head Start preschool children and their families was provided for randomized treatment groups. In addition to the Availability Survey- Fruit, Juice and Vegetables At Home questionnaire, a BioPhotonic Scanner™ was utilized on all children at baseline and following the intervention period.

## Population and Sample

Purposive sampling was the method chosen for this study. Participants were drawn from the population of preschool age children attending Ohio Heartland CAC Head Start, which was comprised of low socio-economic children, in Marion County, Ohio. A census was used which contained all locations of the Head State sites in Marion County, Ohio. Children from other low socio-economic preschool sites in Marion County, Ohio, were not included in the sample selected. These children were commonly three to five years of age. A parent or guardian of these children was also included in the study. The study contained four Head Start centers with approximately 290 children in 17 classrooms and their parents or guardians, (480 total participants) for approximately

70 children and their parent or guardian per intervention cluster. Children or parents were excluded if a medical issue prohibited them from participating in the study. Children who were unable to eat solid foods were asked not to participate in this study. Children with chronic diseases, such as diabetes, were excluded from the study, as children with chronic diseases are known to have reduced carotenoid concentrations (Aguilar et al., 2014). The number of participants in the study was designed for a power of .80 with a significance of .05 and a Cohen's d of .5. The sample size calculated for this power was 64 subjects per cluster or a total of 192 subjects (Johnson & Christensen, 2012).

**Study Design**

A site cluster randomized experimental research design was used to execute this study. According to Campbell and Stanley (1963) the design of this study can be classified as an experimental pretest-posttest control group design.

**Methodology/Process**

Site clusters were randomly assigned to one of the treatment or control groups. The study had three research arms, with each arm having approximately one hundred and forty subjects (70 children and 70 parents or guardians). After consents were signed, a pre- study questionnaire to determine fruit &vegetable (F&V) availability and consumption was administered to the parents as a baseline measure. After random assignment, all children were scanned with a non-invasive carotenoid scanner, resulting in a carotenoid or Ramen scan score.  During an eight week period, the access with education group (treatment 1) received weekly take home fruits and vegetables, education for the children, and supplemental materials, such as newsletters and recipes, for the families about the produce being provided.  The access group (treatment 2) received the take home weekly fruits and vegetables, without the educational intervention.  Finally, the control group did not receive either the produce or education during the eight weeks. Eight weeks was the selected time chosen for this study after review of the literature and based on the average amount of time generally stated to observe Ramen Score changes in subjects.  The most commonly used timeframe noted for Ramen Score changes was a six to eight week period (Aguilar, et al., 2014).  The control group was a waitlist control group.  The group received education following the study.  The control group was measured for comparison purposes.  All children were re-scanned at the conclusion of the study.  A post study Availability Survey- Fruit, Juice, and Vegetables At Home questionnaire was administered to all parents at the end of the eight weeks.

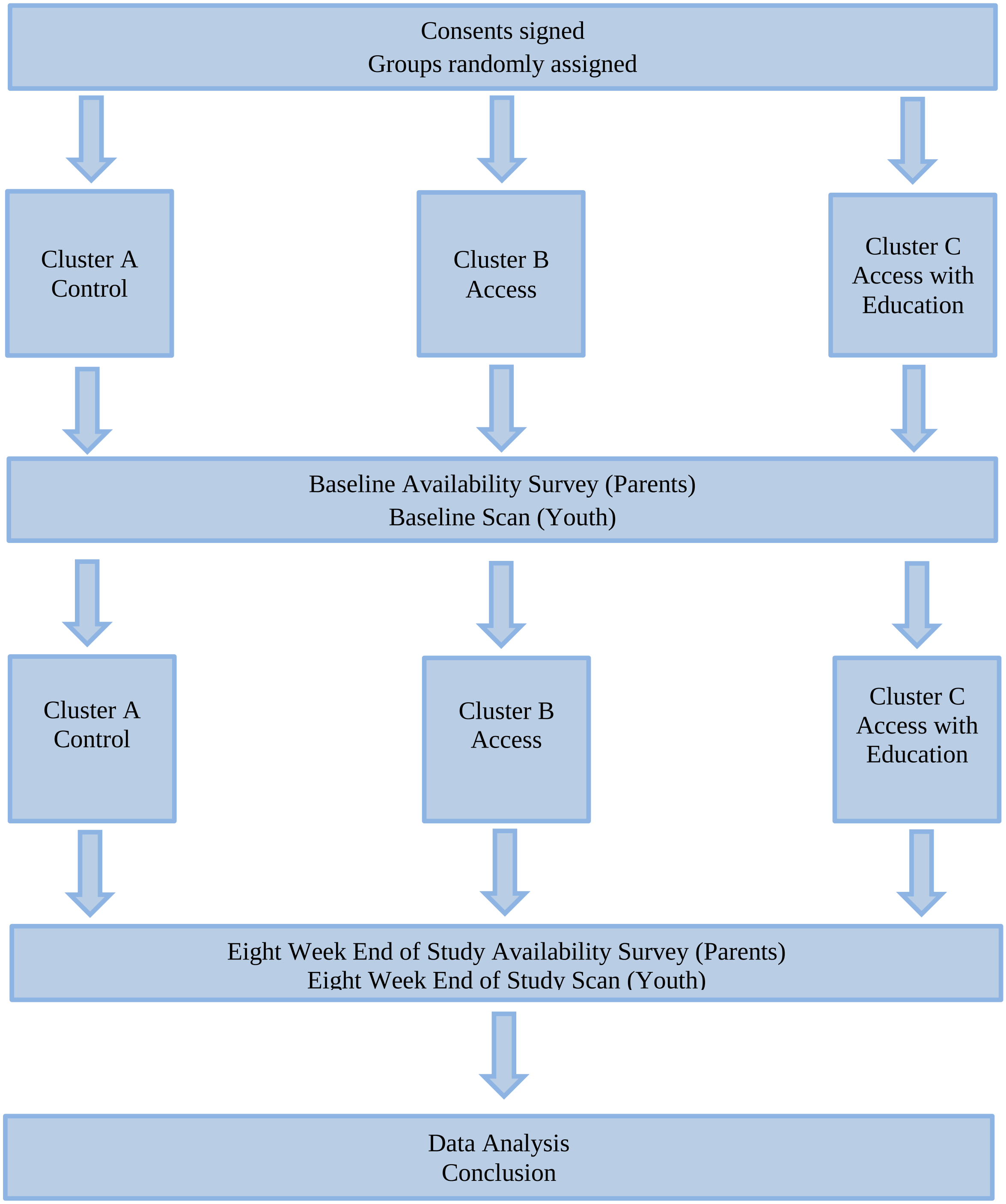


**Figure 3.1: Study Arm Diagram**

## Instrumentation/ Methodology

Utilizing a novel tool known as the Resonance Ramen Spectroscopy/ BioPhotonic Scanner™ in tandem with the Availability Survey-Fruit, Juice, and Vegetables At Home questionnaire (Hearn, et al., 1998), the research team measured the changes in skin carotenoid status and collected the responses of the availability and intake questions in children and their parent or guardian over an eight week period. During this time, fruit and vegetable access or access and education were provided to intervention groups dependent on their assignment. The Availability Survey –Fruit, Juice, and Vegetables At Home questionnaire (Hearn et al., 1998) was conducted during an eight week period (at the beginning and end of the study period) to augment the research data obtained from the scanner. Barriers such as cost, transportation, and access to fruits and vegetables, along with the theoretical foundation, the Theory of Planned Behavior, were considered and addressed in the study design (Haynes-Maslow et al., 2013).

The items and questions included in the pre-test and post-test Availability Survey-Fruit, Juice, and Vegetables At Home questionnaire (Appendix A) were generated and based on questions taken from a validated instrument generated by Hearn et al. (1998). The questions were assessed by the comparison of the interviewers' observations of the subjects' or parents' home inventory shelves. A panel of experts from the field of Public Health, Nutrition, Nursing, Agricultural Extension Education, and a researcher from Utah State University working with the measurement tool of interest, reviewed this instrument to establish content validity. Using the Theory of Planned Behavior as a foundation, attitude, subjective norms, and perceived behavioral control were factors considered in the question selection and construction.

The second measurement tool utilized in the research study was the Resonance Ramen Spectroscopy scanner (RRS), specifically the BioPhotonic Scanner™, which measures carotenoids levels. Carotenoids are an excellent measure of fruit and vegetable consumption. Studies have concluded feasibility and validity of the RRS as a possible replacement to invasive methods, such as serum laboratory measures (Rerksuppaphol &Rerksuppaphol, 2006; Scarmo et al., 2012).

## Validity

### Availability Survey-Fruit, Juice, and Vegetables At Home

The Availability Survey-Fruit, Juice, and Vegetables At Home questionnaire was located within the Compendium of Surveys for Fruit and Vegetable Consumption and Physical Activity (California Department of Public Health, 2012). The instruments were a compilation generated by The Network for a Healthy California's Research and Evaluation Unit, housed in the California Department of Public Health. Details on the validation of the instruments are provided, as well as which instruments could be modified while retaining validity within the compilation **(**California Department of Public Health, 2012).

The questions included in the instrument have been validated by Hearn et al. (1998). Validity was documented by interviewers observing the shelf inventories reported by parents of young children. The shelf inventories versus parent's reported intakes were shown to be statistically significant at $p<.05$ of the Cohen kappa. The measurement of validity showed agreement between the shelf inventories and the parent intake reports. The narrative regarding the validity also stated that additional fruits and vegetables or juices could be added to the list without affecting the validity of the study.

The changes to the survey, beyond the addition of fruits and vegetables that are commonly offered by a food bank or pantry, included an additional column asking about the number of times each week that the fruits and vegetables listed were consumed by a parent and their preschool child. This included consumption at home and away from home. Additionally, a question was asked about other produce markets or pantries that the family utilized. Finally, a follow-up question asking about the use of the produce sent home was added to the post-questionnaire.

**Resonance Ramen Spectroscopy**

Resonance Ramen Spectroscopy, the other measure performed on all children was the BioPhotonic Scanner™. A number of peer-reviewed studies have been conducted, which have shown the validity and reliability of the Resonance Ramen Spectroscopy/ BioPhotonic Scanner™. Mayne, Cartmel, Scarmo, Jahns, Ermakov, and Gellermann, (2013) examined the reproducibility, validity, and feasibility for use in field settings, as well as factors that may have an effect on the biomarker. This research group (Mayne et al., 2013) performed a controlled feeding study in which skin carotenoid status was examined in response to different dietary interventions. A carotenoid depletion phase was followed by a high fruit and vegetable diet, which was followed by another depletion diet phase. Results of the study showed that carotenoid levels did decrease during depletion and increased during the high-carotenoid feeding time. The results of the RRS scanning were similar to the plasma results, although the rates of decrease were faster in the plasma levels versus the skin results (Mayne et al., 2013).

Aguilar et al. (2014) found that levels of skin and serum carotenoids were highly correlated, leading to the conclusion that skin carotenoids were useful as valid biomarkers of fruit and vegetable intake in children. In their cross-sectional study, Aguilar et al., (2014) compared three blood samples from 45 healthy children, ages five to seventeen, to three skin palm measurements over a four week period. Results of their research showed a correlation between the serum and skin measurements of $R^2 = 0.62$; at a $P < 0.001$.

Ermakov and Gellermann (2010) drew correlation conclusions through the use of heel skin as opposed to the palm of the subjects when using the RRS. In their study, (Ermakov & Gellermann, 2012) a small group of eight subjects had a resulting correlation between the gold standard of carotenoid measurement, the serum measurement, versus the RRS measures on the heel of the subjects, resulting in a highly significant correlation coefficient. A coefficient of $R^2 = 0.95$ was shown in their work (Ermakov & Gellermann, 2010).

Finally, Scarmo et al. (2012) conducted a cross-sectional study of 381 economically disadvantaged preschool children showing a high positive association with fruit and vegetable consumption and the measured RRS. Multiple regression analysis was utilized in the Scarmo et al., (2012) study which resulted in lower carotenoid status among younger children, those who participated in the SNAP program, and those with a higher level of adiposity.

## Reliability

Reliability was established based on a combination of previous findings in the literature as well as intentional procedural methods. These methods provided improved consistency and instruction for and from both the key research personnel helping with data collection and by conferring with experts who had used the BioPhotonic Scanner™ / Resonance Ramen Spectroscopy scanner (RRS) frequently and successfully. The two instruments and technique utilized in this study will be discussed in relation to their respective reliability.

### Availability Survey-Fruit, Juice, and Vegetables At Home

Reliability of the Availability Survey-Fruit, Juice, and Vegetables At Home questionnaire results came from earlier research conducted by Cullen, Baranowski, Rittenberry, Cosart, Hebert, and de Moor, (2001). Three items were considered for possible deletion because of low correlations and/or low variability including "Applesauce," "Other juice" and "Other Vegetables". However, the researchers decided to retain these items because the "other" categories might be useful in identifying cultural/geographical differences in fruits/vegetable availability and since item removal did not significantly change the internal consistence of the scale. The scale's internal consistency (α = .84), inter-rater reliability (r = .60) and test /re-test reliability (r = .82) were all acceptable (Cullen et al., 2001).

A pilot group of preschool parents (n=10) completed the Availability Survey-Fruit, Juice, and Vegetables At Home questionnaire (Cullen et al., 2001) to determine reliability per the test /re-test reliability method. The questionnaire was administered twice, three weeks apart, to determine the correlation between the two questionnaires.

Additionally, fruit and vegetable surveys were utilized in many studies in the literature. Other questionnaires have examined children's intake using parents as reporters. This same concept was included and utilized as a portion of the Availability Survey-Fruit, Juice, and Vegetables At Home questionnaire. Prior to inclusion, the idea was assessed and reviewed in the literature for validity and reliability. One example of the literature that was reviewed included a modified version of the Beverage and Snack Questionnaire (BSQ). The BSQ asked children, or the parents of the younger children, about frequency of fruit and vegetable intake, both at school and away from school, during the past week (Aguilar et al., 2015; Neuhouser, Lund, & Johnson, 2009). The BSQ was administered on two occasions, two weeks apart, to measure test /re-test reliability. Using frequency per week data, the test /re-test reliability coefficients were r=0.85 for fruits and vegetables consumed. The authors concluded that the easy-to-administer nineteen item questionnaire captured data on fruit and vegetables intake equally as well as the lengthier and more expensive food records.

Asking parents of the children about the fruits and vegetables that their children consume was an important component of this research. Accuracy of parents as reporter is frequently questioned. Linneman, Hessler, Nanney, Steger-May, Huynh, and Haire-Joshu, (2004) examined the accuracy of parents as reporters of their preschoolers' fruit and vegetable consumption. Observations of meals were compared with phone surveys examining recall of intakes. Results showed parents recalled their child's intake of fruit and vegetables at a kappa equal to 0.59 to 0.61 (Linneman et al., 2004).

**Resonance Ramen Spectroscopy**

Reliability of the BioPhotonic Scanner™ / Resonance Ramen Spectroscopy has been documented in the literature in two different ways. One way was to obtain three scans on each subject, using the average of the three scan scores (Scarmo et al., 2012; Zidichouski, Mastaloudis, Poole, Reading, & Smidt, 2009). Alternatively, reliability was assured by obtaining two scan scores and assessing if the scores differed by more than 2000 units. When the difference was more than 2,000 units, a third measure would then be obtained and the two scores that fell within 2,000 units would then be averaged for a final score (Aguilar et al., 2015). This technique for reliability was the technique chosen for this study.

## Data Collection Procedure

Participants were drawn from the population of preschool age children attending Ohio Heartland CAC Head Start, which was comprised of low socio-economic children, in Marion County, Ohio. The study contained 4 Head Start centers with approximately 290 children in 17 classrooms and their parents or guardians, (600 total participants) for approximately 100 children and their parent or guardian per intervention arm. There were two intervention arms and one control arm in the study.

Consents and demographics were collected at the Ohio Heartland CAC Marion, Ohio, Head Start locations. The consents were collected at various meetings with parents present, such as orientations or when parents were dropping off or picking up their children. The Body Mass Indexes (BMI) of the children was recorded from the Head Start database, known as ChildPlus. BMIs were calculated on all children as they enter the Head Start system each school year. Permission to obtain these values was requested on the parental consent. Head Start site locations were considered a cluster and were randomized prior to the start of data collection. The Availability Survey- Fruit, Juice, and Vegetables At Home questionnaire and the Resonance Ramen Spectroscopy/BioPhotonic Scanner™ were administrated prior to the study beginning (baseline) and at week eight of the study to all parents, and children, respectively.

Children in the classrooms were scanned during their class time. One by one, students were taken aside and a scan of the palm of each child for approximately thirty seconds per scan was performed. The scanning procedure was performed twice, and if the values were more than 2000 units apart, a third scan was completed and the average of the two scan scores that were within 2000 Ramen units of each other was calculated for use (Aguilar et al., 2015).

The risk to children was minimal. Consent was obtained from the parents, assent was obtained from children aged 4-5, and no parent or child was coerced to participate in the study. The RRS/BioPhotonic Scanner™ has been documented in the literature to be safe and risk free. The BioPhotonic Scanner™ measured carotenoid levels in the skin of the palm. For the RSS measurement, a small area of the palm of the hand was exposed to a low-energy colored LED light, which penetrated the outer most layers of the skin. Carotenoids present in the exposed area reflected light back in a different color, which could be detected by the scanner. The more the color changed, the more carotenoids that were present (Aguilar et al., 2015).

To ensure confidentiality, subjects' data and demographic information were filed with each parent coded by an identification number correlated to a classroom list. The child's scan score was paired with their parent's survey and added in the "researcher only" section at the end of the parent's Availability Survey-Fruit, Juice, and Vegetables At Home questionnaire. All information on the subject and their child was on one document. Names were not tied to any of the results collected, eliminating the chance of confidentially being breeched.

The timeline for data collection, starting after the IRB approval, was: consent collection began mid-August 2016, followed by survey collection from parents or guardians. Scanning of all consented children began the third week of September and was concluded the first week of October. The first week of produce distribution began the second week of October and continued through the first week of December. After the produce distribution was completed, post-intervention scanning of all children and post-intervention survey collection from parents began. Final scans were completed the third week of December. The final collection date for the post-intervention surveys from parents or guardians was January 27th. Surveys were distributed three times, both pre-intervention and post-intervention, in an attempt to collect as many responses as possible. All data will be stored in a locked cabinet in the office of the researcher and will be retained for five years past the analysis of the study.

## Data Analysis

Descriptive statistics of the subjects within and between each group were collected. Investigators examined the gender of the subjects, age in years of the subjects, the body mass index of the subjects, and the ethnicity of the subjects. Central tendency and summary statistics such as means, medians, standard deviations, and range of values were calculated on the subjects and groups (Giuliano & Polanowicz, 2008). Pictorially depicting these measures, with such items as a frequency histogram, were completed at this stage (Boushey, Harris, Bruemmer, &Archer, 2008).

The scoring ranges of the Resonance Ramen Spectroscopy/ BioPhotonic Scanner™ are based on the measurements of over 1,300 individuals who had a wide range or variety of diets (Pharmanex, 2003). The scoring range representing a high presence of carotenoids is the 50,000- 59,000 range, a very good presence is the 40,000-49,000 range, the 30,000-39,000 range represents a good presence of carotenoids, 20,000-29,000 is the moderate range of carotenoids detected in the skin, and the10,000-19,000 range is low amounts of carotenoid results. This is known as the Carotenoid Score Index or Ramen score (Pharmanex, 2003). These index scores may vary between individuals based on lifestyle factors such diet, physical activity, and toxins such as cigarette smoke (Pharmanex, 2003). The impact of physical activity and smoking in the child’s home on this study was minimal since what was being measured was the change in individual carotenoid levels over time and not the actual carotenoid value or score.

As the scanner scores were performed and recorded at the beginning and conclusion of the study, the results were assessed and examined looking for changes in values from the baseline, as well as changes between the groups of control versus access and access with education treatment groups. The use of inferential statistics, including t-tests and ANOVA with post hoc (Tukey), were used to determine specific group significance, and determine significance and differences among groups (Johnson & Christensen, 2012; Boushey et al., 2008). A p-value of <.05 (a priori) was used to determine statistical significance.

**Examination of the data for fit with assumptions for t-Tests**

Prior to running the data, the data should be examined to assess fit with the main assumptions for t-testing (Agner & Cano, 2014).

1. Comparison done between two means is the first assumption that needs to be examined. This data does fit this assumption as the mean of pre and post scan scores are compared.
2. The second assumption is that interval or ratio data is used to compute a t-test. This data set used is the change in beginning pre and post scan scores. The scales of measurement for the dependent variable can be justified as ratio.
3. The third assumption is that random sampling is used. A sample distribution of t is used. This occurs when examining the distribution of t values that

would be obtained if a value of t were calculated for each sample among all possible random samples of a given size from some population.

4. Normal distribution is the next assumption that has to be met for the t-test to be performed. The test used had equal variances assumed which correlates with this assumption requirement.
5. Equal variances are the final assumption. This is stated in the Statistical table and thus would be a true assumption as well.

The scales of measure for the independent variable in this set of data would be the nominal scale. The intervention or treatment has three positions in which the participants were randomly placed, control, access, or access and education. This was coded in SPSS version 24 allowing the comparison to be clearly made.

**Assumptions for ANOVA are:**

1. Populations are normally distributed.
    a. Although there are unequal size groups, which violates homogeneity (in this analysis, a subset using a random sampling was done to harmonize the group sizes), the sample size was large enough at 209 for this assumption to be met. The sample size is much greater than 25, which is considered the minimum standard sample size.

2. Population variances are equal.

    a. Since there are an equal number of variables with the variances, they are assumed to be equal.  For this reason, this assumption has also been met.

# Chapter 4: Results and Findings

## Purpose and Objectives

The purpose of this study was to examine fruit and vegetable (F&V) intake in children and their parents and explore methods for improving intake of these fruits and vegetables.

Specific research questions explored:

Research question 1: Does weekly F&V access, accompanied by nutrition education, change children's fruit and vegetable consumption?

Research question 2: Does providing weekly F&V access change parent's provision of fruits and vegetable in the home and their consumption of F&V?

Research question 3: Are skin carotenoid levels correlated with self-reported intake of F&V?

Hypothesis 1: Weekly F&V access, accompanied by nutrition education, changes children's fruit and vegetable consumption.

Hypothesis 2: Weekly F&V access changes parent's provision of fruits and vegetables in the home and their consumption of F&V.

Hypothesis 3: Skin carotenoid levels will change in correlation with self-reported intake of F&V.

## Need for the Study

Benefits of this research include: providing quantitative data to assist agencies in justifying funding for programs, assistance in securing additional funding, improving the diets of children and their families through the inclusion of additional fruits and vegetables, and potentially ultimately reducing the childhood obesity rate and incidence of obesity- related diseases.  Unlike other studies, this investigation will provide a quantitative measure of fruit and vegetable intake.  Also, understanding the differential impact of access and access plus education could potentially help determine the most beneficial and effective means for improving sustained fruit and vegetable intake among children.

A goal is that with replication, the access and education model can be one that is customary in Head Starts and other school sites throughout the state of Ohio.  A longer term benefit of increasing F&V intake and reducing obesity is that this may lead to a reduction in overall medical costs.

## Limitations

One limitation of the research was that it was not possible to blind the participants or research team to the treatments.  The various treatment groups were aware of which subjects received produce, which participants received access and education, and which were control.  One lead teacher at the site where all other classes received education made mention of the fact that her class did not receive education.  She commented on this during scanning time periods, questioning whether this would influence her class's scan scores.  Bus drivers, who didn't know to which group students belonged, were asked questions by the parents about how to prepare items that were distributed on their bus route, such as squash.

A second limitation was that not all subjects were willing to participate in the research.  Due to this limitation, generalizability was not possible.  Preschool/Head Start families are a difficult group to recruit and retain in these types of studies.  It was discovered that these families are frequently transient (13% attrition rate from consent to final scan) and difficult to get to participate and attend class functions.  The first parent meeting of the year, which historically has a good turnout rate, per the Director of the program, had six families in attendance.  The Family Advocates were anticipating or expecting over 100 families to attend this first parent event.  Due to the transient nature of the families, when the family relocates the children are frequently moved from one Head Start location to another or withdrawn from the program.  For example, some children were moved from the control cluster to an access or access and education cluster or vice versa.

Another limitation is that the self-reported Availability Survey-Fruit, Juice, &Vegetables At Home questionnaire, which were completed by the parent or guardian, may have been completed inaccurately.  Parents or guardians may have under -reported or over- reported their or their child's availability or consumption of the produce listed.  The questionnaire may not have been fully understood by those completing it.  Literacy may have been a concern for some subjects when completing the questionnaire.  Many questionnaires were incomplete or directions were not followed when filling in numbers of items eaten or number of items available in their home.

An additional limitation was that children or parents were excluded if a medical issue prohibited them from participating in the study. Parents of children who were unable to eat solid foods were asked not to participate in the study.

Completion rates of the pre and post questionnaire were a limitation of the study. The questionnaires were sent to all parents three times. It was voluntary to complete the questionnaire and no incentives were used beyond the F/V given to those participants in the access and access and education groups.

Attendance rate of the children in the study was another study limitation. The children must be accompanied to the bus for both pick up and drop off by an adult. If an adult was unable to accompany the child, the child was unable to be in attendance that particular day. It was not uncommon to attempt to scan children for several days and not be able to do so due to their chronic absence.

Below is a description of the research subjects. This is followed by sections presenting the findings of the statistics and data analysis for each of the three research null and alternative hypothesis.

## Study Respondents: Demographics

The study census population frame included 289 Head Start children. Parents of 240 children agreed to participate in the research study and signed parental permission consent forms as well as participant consents to participate in the study. Response rate for overall consented participants was 83%. The number of attempted children's scans was 230 with 4 children not able to be scanned after repeated attempts. This resulted in the initial number of children being scanned at 226. The attrition rate from the initial consented (240) to the completed initial scan (226) was 5.8%. The initial scan was done at the beginning of the study. After the eight week intervention the final or post scans were completed. The final number of children scanned in the post scan period was 209. Attrition rate when comparing those initially scanned versus those who were scanned at post scan was 7.5%.

All but 4 children that were not scanned were withdrawn from the Head Start Program. The 4 children that were unable to be scanned had excessive absenteeism and after five attempts were dropped from the study. The remaining children not scanned, both from the original consent process and the final scan process, were withdrawn from the Head Start Program, thus unable to be scanned due to no longer being enrolled in the school.

Additional examination of 5 children (10%) who were not consented and therefore did not participate in the study showed that demographics including age, ethnicity/race, socio-economic status, and gender mirrored the current study participants. Therefore, it could be deduced that the current study participants were no different than those who elected not to participate in the study.

The breakdown of the 31 children that were withdrawn included: 10 who were withdrawn from Head Start prior to the initial scanning, 4 were not present in school after multiple attempts therefore were unable to be scanned, and 17 who were scanned initially but withdrew prior to the final round of scanning.

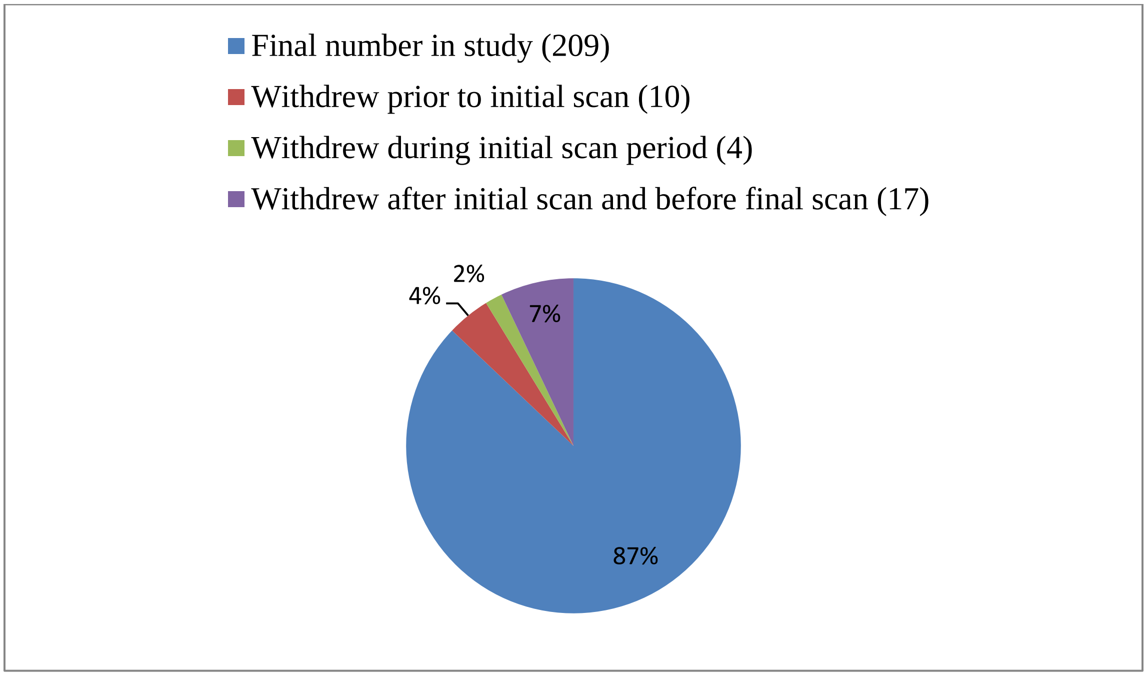


**Figure 4.1: Status of Initial 240 Consented Participants**

A cluster randomized control design was used to implement this study.  Division into three study clusters included:  one control cluster, one access cluster, and one access with education cluster.  These clusters were labeled as: A (control), B (access only) and C (access with education) respectively.  Looking at the attrition rate per cluster reveals: 9 children (29%) of the 31 withdrawn were from cluster A, 13(42%) of the total 31 withdrawn were from cluster B and 9 (29%) were from cluster C.

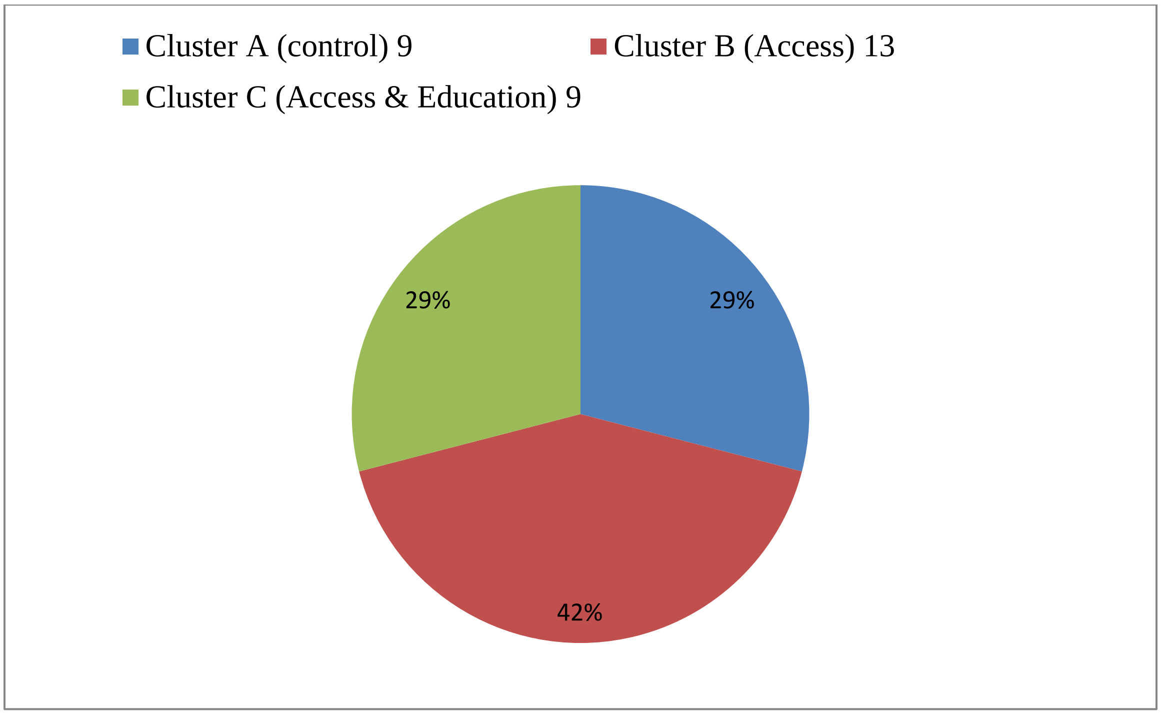


**Figure 4.2: Participant Withdrawal by Cluster**

Total final number of children scanned per cluster was: 66 (31.6%) from cluster A, 61 (29.2%) from cluster B, and 82 (39.2%) from cluster C.

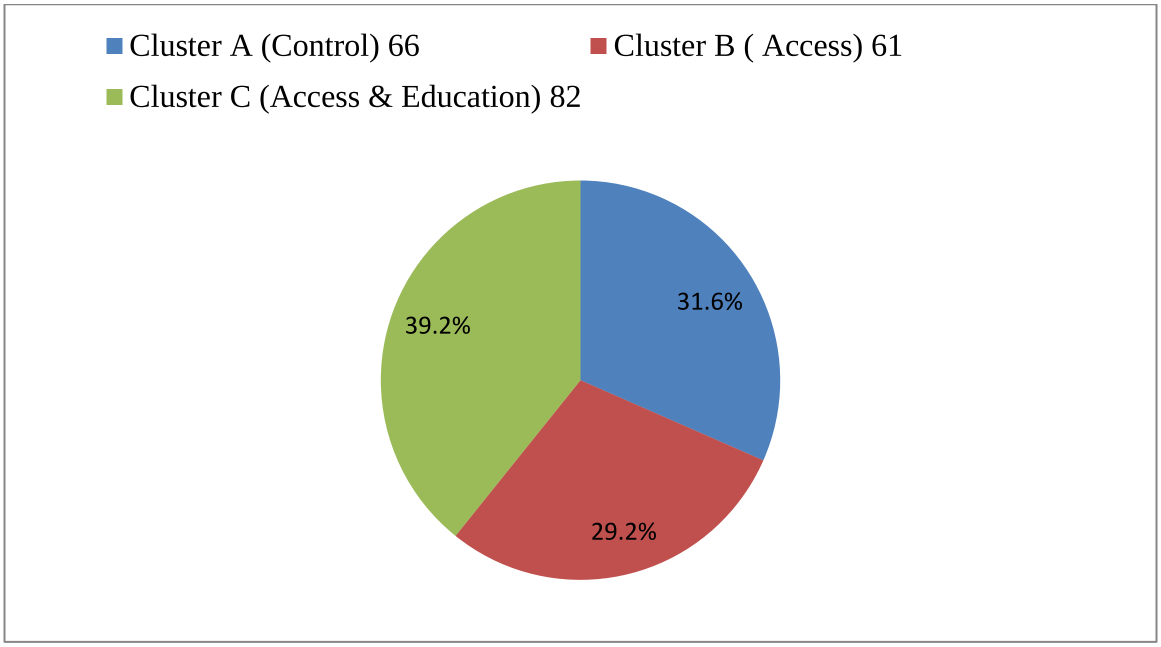


**Figure 4.3: Population by Cluster**

Demographics, obtained from the Head Start database known as ChildPlus, for children participating, included gender, race or ethnicity, and Body Mass Index.

**Gender**

Cluster A (control) consisted of 36 females (55%) and 30 males (45 %). Cluster B (access only) consisted of 34 females (54%) and 27 males (46%). The third cluster (access and education) had 37 females (45%) and 45 males (55%).

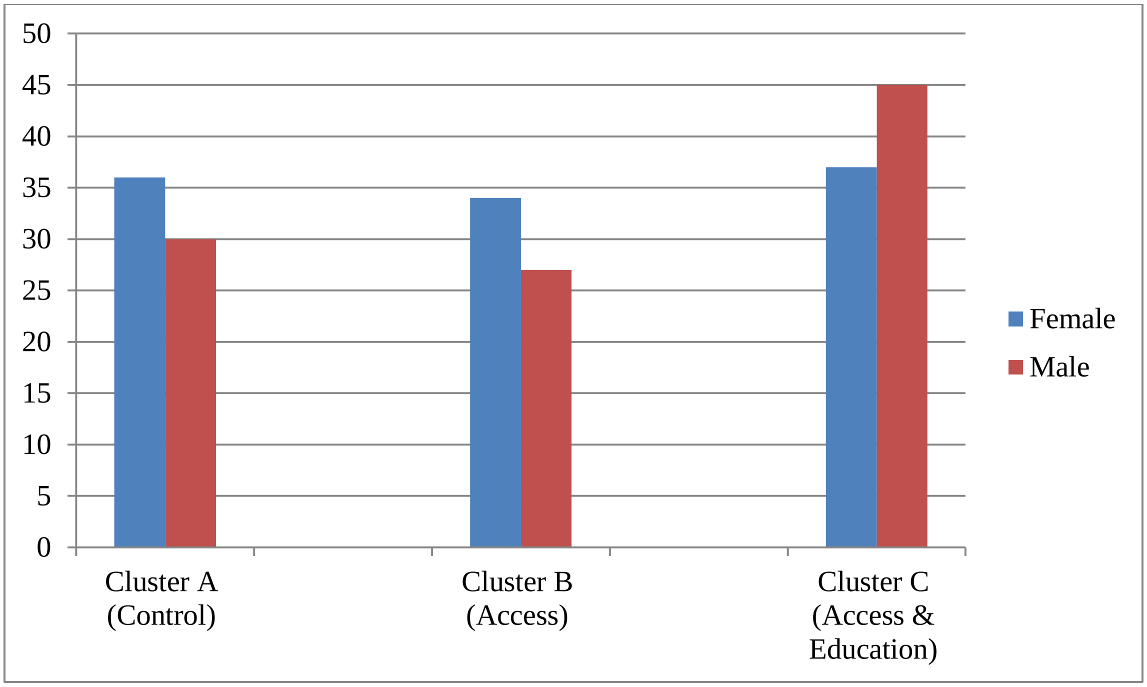


**Figure 4.4: Participant Gender by Cluster**

Overall male to female ratio was 107 females (51%) and 102 males (49%).

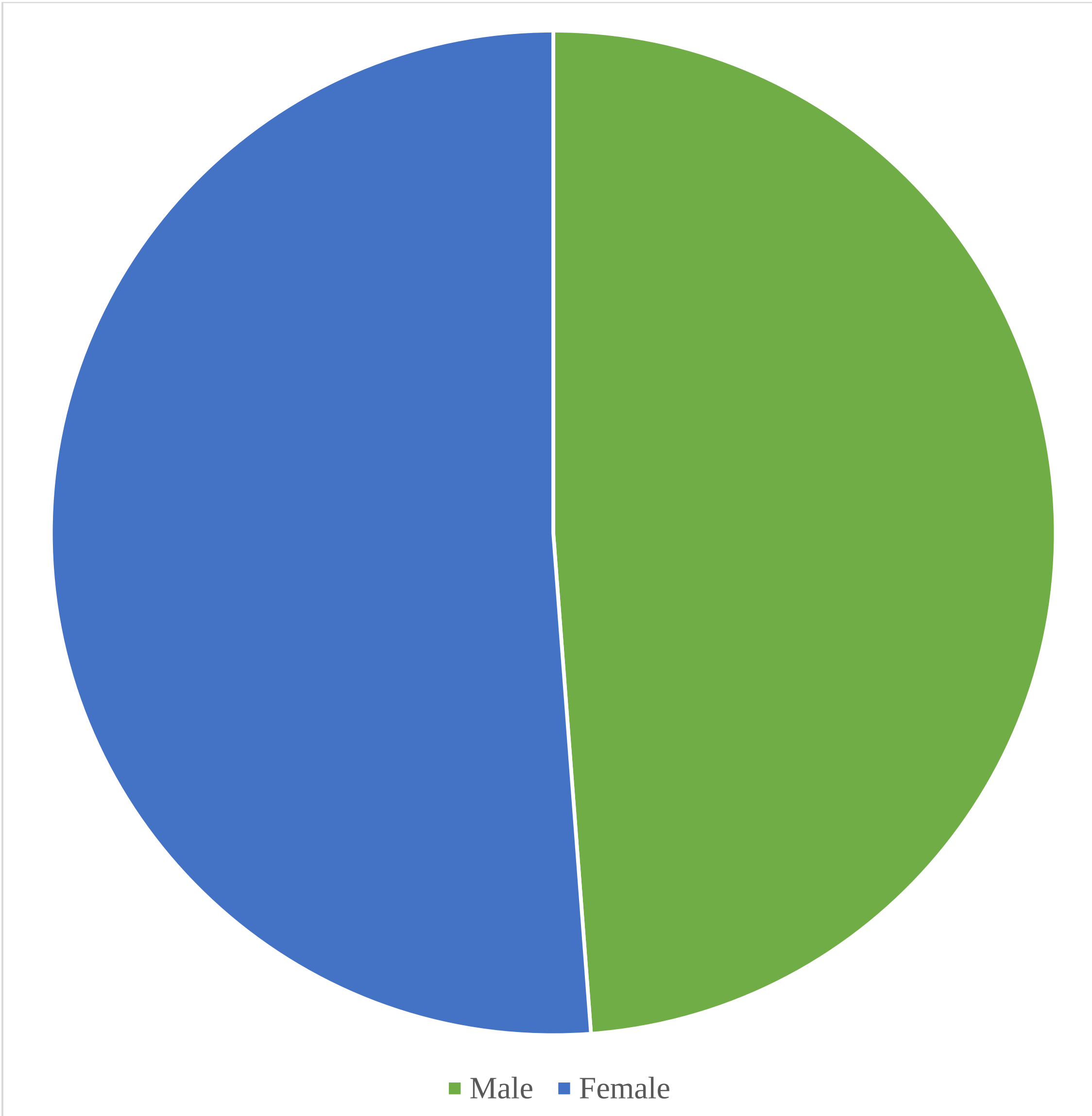


**Figure 4.5: Gender Breakdown of All Participants**

**Age**

All clusters combined had a total of 80 (38.3%) three year old children, 116 (55.5%) four year old children, and 13 (6.2%) five year old children in the study sample.

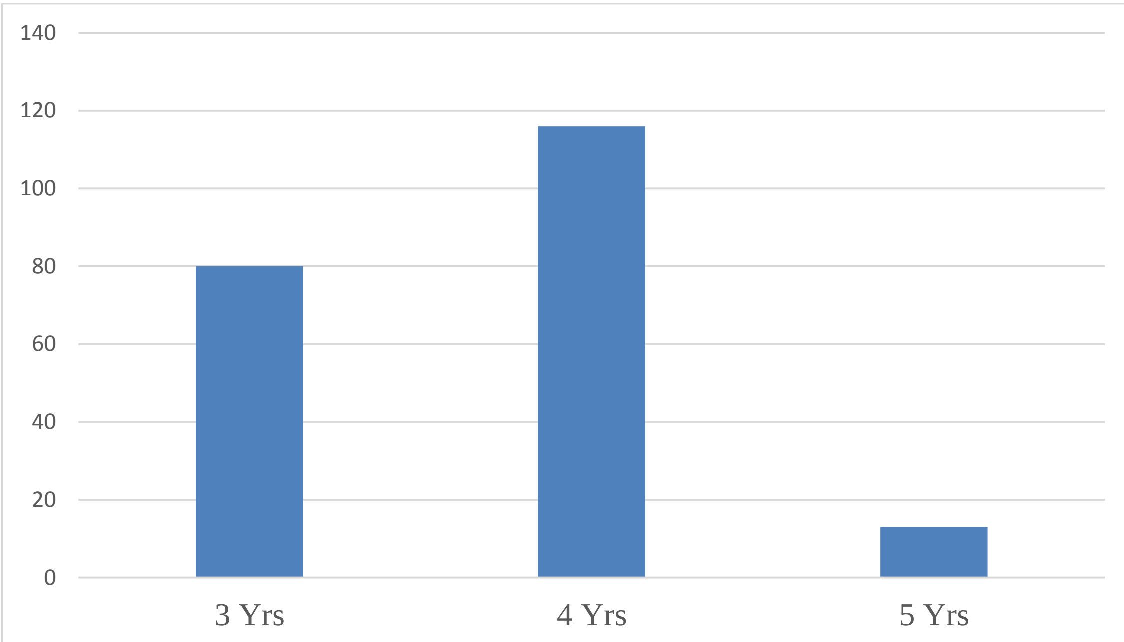


**Figure 4.6: Breakdown of Age of All Participants**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 80 | 38.3 | 38.3 | 38.3 |
| | 4 | 116 | 55.5 | 55.5 | 93.8 |
| | 5 | 13 | 6.2 | 6.2 | 100.0 |
| | Total | 209 | 100.0 | 100.0 | |

**Table 4.1: Age of All Participants Combined**

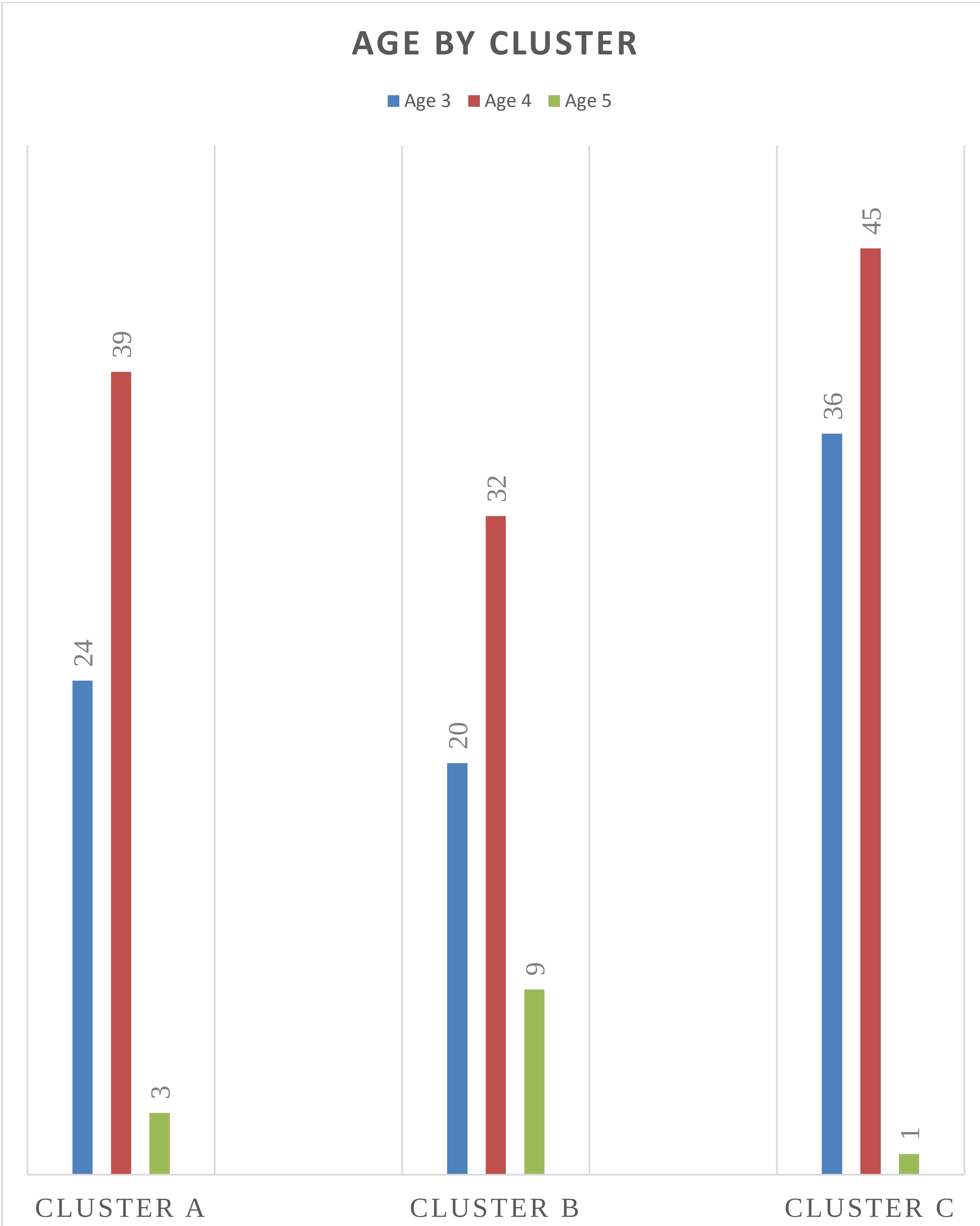


**Figure 4.7: Age of Participants by Cluster**

Cluster A (control) included 24 (36.4%) 3 year old children, 39 (59.1%) 4 year old children, and 3 (4.5%) 5 year old children.

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 24 | 36.4 | 36.4 | 36.4 |
| | 4 | 39 | 59.1 | 59.1 | 95.5 |
| | 5 | 3 | 4.5 | 4.5 | 100.0 |
| | Total | 66 | 100.0 | 100.0 | |

**Table 4.2: Age of Cluster A Participants**

Cluster B's (access only) break down was:  20 (32.8%) 3 year old children, 32 (52.5%) 4 year old children, and 9 (14.8%) 5 year old children.

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 20 | 32.8 | 32.8 | 32.8 |
| | 4 | 32 | 52.5 | 52.5 | 85.2 |
| | 5 | 9 | 14.8 | 14.8 | 100.0 |
| | Total | 61 | 100.0 | 100.0 | |

**Table 4.3: Age of Cluster B Participants**

Cluster C (access and education) had 35 (43.9%) 3 year old children, 44(54.9%) 4 year old children and 1 (1.2%) 5 year old.

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 3 | 36 | 43.9 | 43.9 | 43.9 |
| | 4 | 45 | 54.9 | 54.9 | 98.8 |
| | 5 | 1 | 1.2 | 1.2 | 100.0 |
| | Total | 82 | 100.0 | 100.0 | |

**Table 4.4: Age of Cluster C Participants**

**Race/ Ethnicity**

A summary of the descriptive statistics for race/ethnicity demographic variables are found in the tables/charts below.  Starting with the overall group breakdown and then moving into the breakdown of each individual cluster.  There were 9 (4.3%) Hispanic children, 152 (72.7%) white children, 36 (17.2%) multi, and 12 (5.7%) black children in the study sample.

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Black | 12 | 5.7 | 5.7 | 5.7 |
| | Hispanic | 9 | 4.3 | 4.3 | 10.0 |
| | Multi | 36 | 17.2 | 17.2 | 27.3 |
| | White | 152 | 72.7 | 72.7 | 100.0 |
| | Total | 209 | 100.0 | 100.0 | |

**Table 4.5: Race/ Ethnicity of All Participants Combined**

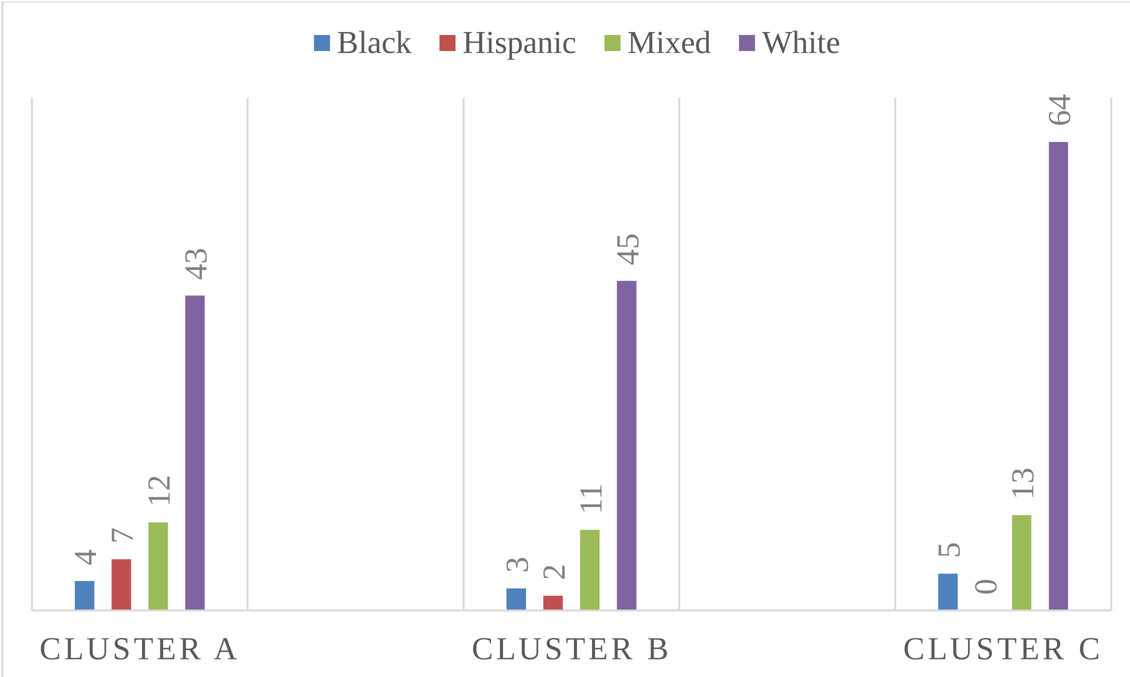


**Figure 4.8: Race/ Ethnicity by Cluster**

Cluster A (control) had a race/ethnicity of the children scanned of: 7(10.6%) Hispanic children, 43 (65.2%) white children, 12 (18.2%) multi, and 4 (6.1%) black.

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Black | 4 | 6.1 | 6.1 | 6.1 |
| | Hispanic | 7 | 10.6 | 10.6 | 16.7 |
| | Multi | 12 | 18.2 | 18.2 | 34.8 |
| | White | 43 | 65.2 | 65.2 | 100.0 |
| | Total | 66 | 100.0 | 100.0 | |

**Table 4.6: Race/ Ethnicity of Cluster A Participants**

Cluster B (access) distribution was:  2 (3.3%) were Hispanic, 45 (73.8%) were white, 11 (18%) were multi, and 3 (4.9%) were black.

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Black | 3 | 4.9 | 4.9 | 4.9 |
| | Hispanic | 2 | 3.3 | 3.3 | 8.2 |
| | Multi | 11 | 18.0 | 18.0 | 26.2 |
| | White | 45 | 73.8 | 73.8 | 100.0 |
| | Total | 61 | 100.0 | 100.0 | |

**Table 4.7: Race/ Ethnicity of Cluster B Participants**

Cluster C (access and education) had no Hispanic children, 64 (78%) white children, 13 (15.9%) multi and 5 (6.1%) were black.

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Black | 5 | 6.1 | 6.1 | 6.1 |
| | Multi | 13 | 15.9 | 15.9 | 22.0 |
| | White | 64 | 78.0 | 78.0 | 100.0 |
| | Total | 82 | 100.0 | 100.0 | |

**Table 4.8: Race/ Ethnicity of Cluster C Participants**

## Dependent and Independent Variables

The dependent variable, the F/V intake of children and parent or guardian, is quantitative in nature as it is depicted by numbers representing an amount or count.  The dependent variable, the variable that is measured both pre and post intervention, is the consumption of high carotenoid F/V products as measured by the Pharmanex Biophotonic Scanner™ resulting in a Ramen Score and an Availability Survey-Fruit, Juice, &Vegetables At Home questionnaire given to the parents pre and post intervention. Numeric and dichotomous responses were collected from the questionnaire. The independent variable, or the variable that is manipulated in this data, is access to produce and access to produce and education.

**Research Hypothesis 1**

Null Hypothesis 1: Weekly F&V access, accompanied by nutrition education, does not change children's fruit and vegetable consumption.

The null hypothesis was: H0: $\mu1=\mu2$

Alternative Hypothesis 1: Weekly F& V access, accompanied by nutrition education, does change children's fruit and vegetable consumption.

The alternative hypothesis was: H1 $\mu1\neq \mu2$

**RRS Measurement Tool Utilized**

The measurement tool utilized in the research study that provided support in answering this hypothesis was the Resonance Ramen Spectroscopy scanner (RRS), specifically the BioPhotonic Scanner™, which measures carotenoids levels. Carotenoids are an excellent measure of fruit and vegetable consumption. Studies have concluded feasibility and validity of the RRS as a viable replacement to invasive methods, such as serum laboratory measures (Rerksuppaphol &Rerksuppaphol, 2006; Scarmo et al., 2012).

The scoring ranges of the Resonance Ramen Spectroscopy/ BioPhotonic Scanner™ are based on the measurements of over 1,300 individuals who had a wide range or variety of diets (Pharmanex, 2003). The scoring range representing a high presence of carotenoids is the 50,000- 59,000 range, a very good presence is the 40,000-49,000 range, the 30,000-39,000 range represents a good presence of carotenoids, 20,000-29,000 is the moderate range of carotenoids detected in the skin, and the10,000-19,000 range is low amounts of carotenoid results. The measurement is known as the Carotenoid Score Index or Ramen score (Pharmanex, 2003).

| Ramen Scan Score Range | Relevance |
|---|---|
| 50,000- Above | High |
| 40,000-49,999 | Very Good |
| 30,000-39,999 | Good |
| 20,000-29,999 | Moderate |
| 10,000-19,999 | Low |

**Table 4.9: Ramen Scan Score Relevance**

The index scores may vary between individuals based on lifestyle factors such diet, physical activity, and toxins such as cigarette smoke (Pharmanex, 2003). Factors such as the amount of physical activity and smoking in the child's home have been shown in the literature to have an impact on carotenoid levels (Jahns et al., 2014). This study examines the difference or delta between a baseline and post-access or access and education score.  Therefore, the change in scores, rather than the actual value or score is what is of importance.  The delta or difference is the examined and useable/ useful outcome or variable in this study.

**Descriptive Statistics of Initial Scan Scores**

Through use of the BioPhotonic Scanner™ initial scan scores ranged from to a low score of 5645 Ramen units to a high score of 51115.  The range for initial scan scores was 45470.

The mean of the initial or pre scan score was 29957.56 with a Standard Deviation of 9013.836.  The mean is a measure of central tendency.  Standard deviation and variance are measures of variability.  Standard deviation, very similar to variance, was 81249245.88 for pre-scan scores.

The median, another measure of central tendency, was 30522 for the pre-scan scores.  Mode for this score was 21049.  The distribution of pre-scan scores has a .016 skewness indicating a longer right tail (towards higher value).  The standard error of skewedness is .168.

| | | |
|---|---|---|
| N | Valid | 209 |
| | Missing | 0 |
| Mean | | 29957.56 |
| Median | | 30522.00 |
| Mode | | 21049[a] |
| Std. Deviation | | 9013.836 |
| Variance | | 81249245.880 |
| Skewness | | .016 |
| Std. Error of Skewness | | .168 |
| Range | | 45470 |
| Minimum | | 5645 |
| Maximum | | 51115 |

a. Multiple modes exist. The smallest value is shown

**Table 4.10: Descriptive Statistics for All Pre-Scan Scores Combined**

Beginning descriptive statistics of scan scores for cluster A, B, and C follow. Cluster A had a range of 45,470 and a minimum of 5,645. The maximum of the scores was 51,115. The mean of the 66 pre-scan scores in cluster A was 29649.85 and the Standard Deviation was 9814.618. Variance of Cluster A's pre scan scores were 96326735.980 with a skewness of .124 and a standard error of skew of .295.

| | | |
|---|---|---|
| N | Valid | 66 |
| | Missing | 0 |
| Mean | | 29649.85 |
| Median | | 30154.50 |
| Mode | | 5645[a] |
| Std. Deviation | | 9814.618 |
| Variance | | 96326735.980 |
| Skewness | | .124 |
| Std. Error of Skewness | | .295 |
| Range | | 45470 |
| Minimum | | 5645 |
| Maximum | | 51115 |

a. Multiple modes exist. The smallest value is shown

**Table 4.11: Descriptive Statistics for Cluster A Pre-Scan**

Cluster B had a range of 43,432 with the minimum being 6,429 and the maximum 49,861. The mean of the 61 pre-scan scores in cluster B was 30202.28 and the Standard Deviation was 9827.724. Cluster B's variance is 96584154.100 and the skewness is -.127. The standard error of skew is -.306.

| | | |
|---|---|---|
| N | Valid | 61 |
| | Missing | 0 |
| Mean | | 30202.28 |
| Median | | 30817.00 |
| Mode | | 6429[a] |
| Std. Deviation | | 9827.724 |
| Variance | | 96584154.100 |
| Skewness | | -.127 |
| Std. Error of Skewness | | .306 |
| Range | | 43432 |
| Minimum | | 6429 |
| Maximum | | 49861 |

a. Multiple modes exist. The smallest value is shown

**Table 4.12: Descriptive Statistics for Cluster B Pre-Scan**

Cluster C had a range of 34, 744 with a 13,000 minimum to a maximum of 47, 477. The mean of the 82 pre-scan scores in cluster C was 30,023.20 and the Standard Deviation was 7,724.660. The variance of Cluster C is 59670375.100 and the skewness if .070. The standard error of skew is .266.

| | | |
|---|---|---|
| N | Valid | 82 |
| | Missing | 0 |
| Mean | | 30023.20 |
| Median | | 30498.00 |
| Mode | | 31896 |
| Std. Deviation | | 7724.660 |
| Variance | | 59670375.100 |
| Skewness | | .070 |
| Std. Error of Skewness | | .266 |
| Range | | 34744 |
| Minimum | | 13000 |
| Maximum | | 47744 |

a. Multiple modes exist. The smallest value is shown

**Table 4.13: Descriptive Statistics for Cluster C Pre-Scan**

**Descriptive Statistics for Post-Scan Scores**

There are also 209 post-scan scores used as a comparison to examine if the changes between the pre and post-scan scores show children's intakes of fruits and vegetables have increased throughout the intervention period.

Overall post-scan scores ranged from a low score of 5297 to a high value of 62657. The range of the post-scans was 57360. Variance of the post-scan scores was

98058213.480. Mean of the post-scan scores was 35285.23 and the Standard Deviation was 9902.435. The median was 34621.00 and the mode was 30163. The distribution has a skewness of .047 indicating a longer right tail (towards higher value). The standard error of skewedness is .168.

| | | |
|---|---|---|
| N | Valid | 209 |
| | Missing | 0 |
| Mean | | 35285.23 |
| Median | | 34621.00 |
| Mode | | 30163[a] |
| Std. Deviation | | 9902.435 |
| Variance | | 98058213.480 |
| Skewness | | .047 |
| Std. Error of Skewness | | .168 |
| Range | | 57360 |
| Minimum | | 5297 |
| Maximum | | 62657 |

a. Multiple modes exist. The smallest value is shown

**Table 4.14: Descriptive Statistics for Overall Post-Scan**

Each post-scan score descriptive statistical analysis is further broken down by cluster A, B, and C below. Cluster A (control) post-scan had a range of 40,039 and a minimum of 10,208. The maximum of the post scores was 50,247. The mean of the 66 post-scan scores in cluster A was 32273.76 and the Standard Deviation was 8869.677. Variance of Cluster A post-scan scores is 78671162.710 and the skewness is -.049 with the standard error of skew of .295.

| | | |
|---|---|---|
| N | Valid | 66 |
| | Missing | 0 |
| Mean | | 32273.76 |
| Median | | 32262.50 |
| Mode | | 10208[a] |
| Std. Deviation | | 8869.677 |
| Variance | | 78671162.710 |
| Skewness | | -.049 |
| Std. Error of Skewness | | .295 |
| Range | | 40039 |
| Minimum | | 10208 |
| Maximum | | 50247 |

a. Multiple modes exist. The smallest value is shown

**Table 4.15: Descriptive Statistics for Cluster A Post-Scan**

Cluster B (access) post-scan had a range of 57360 and a minimum of 5297. The maximum of the post-scores was 62657. The mean of the 61 post-scan scores in cluster B was 35088.93 and the Standard Deviation was 10568.852. Variance of Cluster B post-scan scores is 111700629.000 and the skewness is -.046 with the standard error of skew of .306.

| | | |
|---|---|---|
| N | Valid | 61 |
| | Missing | 0 |
| Mean | | 35088.93 |
| Median | | 34621.00 |
| Mode | | 5297[a] |
| Std. Deviation | | 10568.852 |
| Variance | | 111700629.000 |
| Skewness | | -.046 |
| Std. Error of Skewness | | .306 |
| Range | | 57360 |
| Minimum | | 5297 |
| Maximum | | 62657 |

a. Multiple modes exist. The smallest value is shown

**Table 4.16: Descriptive Statistics for Cluster B Post-Scan**

Cluster C (access plus education) post-scan had a range of 43683 and a minimum of 16476. The maximum of the post scores was 60159. The mean of the 82 post-scan scores in cluster C was 37855.12 and the Standard Deviation was 9582.640. Variance of Cluster C post-scan scores is 91826995.170 and the skewness is .113with the standard error of skew of 266.

| | | |
|---|---|---|
| N | Valid | 82 |
| | Missing | 0 |
| Mean | | 37855.12 |
| Median | | 38494.00 |
| Mode | | 16476[a] |
| Std. Deviation | | 9582.640 |
| Variance | | 91826995.170 |
| Skewness | | .113 |
| Std. Error of Skewness | | .266 |
| Range | | 43683 |
| Minimum | | 16476 |
| Maximum | | 60159 |

a. Multiple modes exist. The smallest value is shown

**Table 4.17: Descriptive Statistics for Cluster C Post-Scan**

## Descriptive Statistics for Scan Score Changes

The descriptive statistics for the changes, or delta, of the 209 pre and post-scan scores showed a range of 40,153 with a minimum of -10,163 to a maximum of 29,990. Variance of the differences from pre to post-scan scores was 43422758.710. The mean of the scan score changes was 4813.00 and the Standard Deviation was 6589.595. The median was 4813.00 and the mode was -10163. The distribution has skewness of .602 indicating a longer right tail (towards higher value). The standard error of skewedness is .168.

| | | |
|---|---|---|
| N | Valid | 209 |
| | Missing | 0 |
| Mean | | 5328.53 |
| Median | | 4813.00 |
| Mode | | -10163[a] |
| Std. Deviation | | 6589.595 |
| Variance | | 43422758.710 |
| Skewness | | .602 |
| Std. Error of Skewness | | .168 |
| Range | | 40153 |
| Minimum | | -10163 |
| Maximum | | 29990 |

a. Multiple modes exist. The smallest value is shown

**Table 4.18: Descriptive Statistics for Overall Scan Change**

The control cluster, or Cluster A, showed a range of scan score changes of 23,558 with a minimum of -9474 to a maximum of 14,085. Variance of the differences from pre to post-scan scores was 23814707.470. The mean of the scan score changes was 2623.91 and the Standard Deviation was 4880.032. The median was 1530.00 and the mode was -9474. The distribution has skewness of .308 indicating a longer right tail (towards higher value). The standard error of skewedness is .295.

| | | |
|---|---|---|
| N | Valid | 66 |
| | Missing | 0 |
| Mean | | 2623.91 |
| Median | | 1530.00 |
| Mode | | -9474[a] |
| Std. Deviation | | 4880.032 |
| Variance | | 23814707.470 |
| Skewness | | .308 |
| Std. Error of Skewness | | .295 |
| Range | | 23559 |
| Minimum | | -9474 |
| Maximum | | 14085 |

a. Multiple modes exist. The smallest value is shown

**Table 4.19: Descriptive Statistics for Cluster A Scan Change**

The scan change for the access cluster, or Cluster B, showed a range of 38,226 with a minimum of -10,163 to a maximum of 28,063. Variance of the differences from pre to post-scan scores was 49879994.500. The mean of the scan score changes was 4886.66 and the Standard Deviation was 7062.577. The median was 3538.00 and the mode was -10163. The distribution has skewness of .763 indicating a longer right tail (towards higher value). The standard error of skewedness is .306.

| | | |
|---|---|---|
| N | Valid | 61 |
| | Missing | 0 |
| Mean | | 4886.66 |
| Median | | 3538.00 |
| Mode | | -10163[a] |
| Std. Deviation | | 7062.577 |
| Variance | | 49879994.500 |
| Skewness | | .763 |
| Std. Error of Skewness | | .306 |
| Range | | 38226 |
| Minimum | | -10163 |
| Maximum | | 28063 |

a. Multiple modes exist. The smallest value is shown

**Table 4.20: Descriptive Statistics for Cluster B Scan Change**

The access with education cluster, or Cluster C, scan change showed a range of 39,172 with a minimum of -9,182 to a maximum of 29,990. Variance of the differences from pre to post-scan scores was 42983755.150. The mean of the scan score changes was 7834.12 and the Standard Deviation was 6556.200. The median was 7285.00 and the mode was -9182. The distribution has skewness of .358 indicating a longer right tail (towards higher value). The standard error of skewedness is .266.

| | | |
|---|---|---|
| N | Valid | 82 |
| | Missing | 0 |
| Mean | | 7834.12 |
| Median | | 7285.00 |
| Mode | | -9182[a] |
| Std. Deviation | | 6556.200 |
| Variance | | 42983755.150 |
| Skewness | | .358 |
| Std. Error of Skewness | | .266 |
| Range | | 39172 |
| Minimum | | -9182 |
| Maximum | | 29990 |

a. Multiple modes exist. The smallest value is shown

**Table 4.21: Descriptive Statistics for Cluster C Scan Change**

The skewedness of the scan change data distribution is great enough to cause the researcher some concern as a perfectly symmetrical distribution of the data would have a result of 0 skew. When a result is less than negative 1 or greater than positive 1 this is defined as a situation of great skewedness. In this particular data the value of the scan score changes has a positive skew of .602. The skewness of Cluster A, B, and C are .295,

.763, and .358 respectively. These values fall into the interpretation of skewedness, but not overly great. Given the large sample size (209) of this data set, the normal model will work well despite the skewedness. If n were small or the value for the skewness was larger, then re-expressing the variables may be beneficial.

It should be noted that despite the skewedness of this data, the graphs are read the same. With a larger variance comes a larger standard deviation although the data will still be read as a 68%, 95% and 99.7% distribution of the values. For most frequency distributions, approximately 68% of all observations are within one standard deviation on either side of the mean. This data is considered continuous data because pre and post-scan scores are values that can assume any value over a continuous range of possibilities.

**t-Tests**

This section begins with a description of the delta, or change in the pre and post-scan scores, and the intervention group in which the children were randomly placed for the study observation. Sections presenting the findings of the data and these variables follow.

**Study Respondents: Demographics (t-Test)**

The study population frame included 209 observations. The number includes the total number of observations or data points for variables, (66) children in the Control group or Cluster A, (61) children in the Access group or Cluster B, and (82) children in Access & Education group or Cluster C. The variables are quantitative data, as they are numbers representing an amount or count. The independent variable or the variable that is manipulated in this data is treatment which consists of access, access with education, or control. The dependent variable, the variable that is measured, counted, or recorded is the amount of fruits and vegetable intake of children as measured by the Ramen Scan Scores and the difference or change between the pre-scan and the post-scan values.

There are five assumptions that need to be met prior to the use of t-tests. The five assumptions include: comparison of means, the use of interval or ratio data, random sampling, assumption of normal distribution, and equal variances. These assumptions were examined and considered met. Therefore, the use of the Two Tailed Dependent Samples t-Tests provided valuable analysis which was helpful in determining the disposition of the hypothesis.

**Hypothesis 1- Findings**

Null Hypothesis 1: Weekly F&V access, accompanied by nutrition education,

does not change children's fruit and vegetable consumption.

The null hypothesis was: $H0: \mu1=\mu2$

Alternative Hypothesis 1: Weekly F& V access, accompanied by nutrition education,

does change children's fruit and vegetable consumption.

The alternative hypothesis was: $H1: \mu1 \neq \mu2$

The null hypothesis predicts no difference or relationship. This analysis seeks to find a relationship and to reject the null hypothesis.

The Paired Samples t-Test was used to determine if there is a statistically significant difference between the means of the variables. This test was chosen because each subject had a pre and post- scan result. A cluster's scan change (A, B, and C) as well as the overall group's scan change for the group's t value were calculated. Each t-value was then compared to the number of degrees of freedom (df) for the cluster sample being analyzed. The observations in one cluster (pre-scan) were compared to the same cluster (post-scan). Additionally, the overall pre-scan change was compared to the post-scan change. Scan scores were able to be paired on a one-to-one basis making the paired sample t-test a good fit for this data analysis.

The mean of the differences of scan scores of Cluster group A is -2623.909 (SD=4880.032). The t value of Cluster A is -4.368 which is significant at .000.

| | | Paired Differences | | | | | |
|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | t | df | Sig. (2-tailed) |
| Pair 1 | Pre-scan -Post-scan | -2623.909 | 4880.032 | 600.690 | -4.368 | 65 | .000 |

**Table 4.22: Paired Samples Test Cluster A**

The mean of the differences of scan scores of Cluster B is -4886.656 (SD=7062.577). The t value is -5.404 which is significant at .000.

| | | Paired Differences | | | | | |
|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | t | df | Sig. (2-tailed) |
| Pair 1 | Pre-scan - Post-scan | -4886.656 | 7062.577 | 904.270 | -5.404 | 60 | .000 |

**Table 4.23: Paired Samples Test Cluster B**

The mean of the differences of scan scores of Cluster C is -7831.927 (SD= 6555.580). T value is -10.818 also significant at .000.

| | | Paired Differences | | | | | |
|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | t | df | Sig. (2-tailed) |
| Pair 1 | Pre-scan -Post-scan | -7831.927 | 6555.580 | 723.943 | -10.818 | 81 | .000 |

**Table 4.24: Paired Samples Test Cluster C**

The mean of the differences of scan scores of All Clusters Combined is -5327.665 (SD=6589.026). The t value is -11.689 also significant at .000

| | | Paired Differences | | | | | |
|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | t | df | Sig. (2-tailed) |
| Pair 1 | Pre-scan - Post-scan | -5327.665 | 6589.026 | 455.772 | -11.689 | 208 | .000 |

**Table 4.25: Paired Samples Test All Clusters Combined**

This data is considered continuous data because carotenoid Raman Scan Scores are values that can assume any value over a continuous range of possibilities. The variables are quantitative data as they are numbers representing an amount or count. Since the variables are quantitative, the scale of measurement is interval in this case.

**Study Results: Analysis of Variance for Intervention and Control Groups (ANOVA)**

Null Hypothesis 1: Weekly F&V access, accompanied by nutrition education, does not change children's fruit and vegetable consumption.

The null hypothesis was: H0: $\mu 1=\mu 2$

Alternative Hypothesis 1: Weekly F& V access, accompanied by nutrition education does change children's fruit and vegetable consumption.

The alternative hypothesis was: H1: $\mu 1 \neq \mu 2$

The differences in scan scores are being examined per intervention or control groups accordingly. The null hypothesis predicts no difference or relationship. This study seeks to find a relationship and to reject the null hypothesis. An analysis of variance (ANOVA) is being conducted to determine whether or not the difference in Ramen Scan Scores differ based on intervention cluster or category.

**One-way Analysis of Variance**

Analysis is used to test the null hypothesis for the differences in Resonance Ramen Scan Scores and the cluster intervention groups of three intervention groups consisting of control, access, or access and education. Three one-way ANOVA's were conducted with Post Hoc tests including Tukey HSD comparisons using a significance value of 0.05.

ANOVA was run for pre-scan. The F value is .063 with a significance of .939.

| | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Between Groups | 10255675.750 | 2 | 5127837.876 | .063 | .939 |
| Within Groups | 16889587470.000 | 206 | 81988288.680 | | |
| Total | 16899843140.000 | 208 | | | |

**Table 4.26: ANOVA Pre-scan**

The F statistic for ANOVA was .063 which is the ratio of:

$$F = \frac{\text{(between group mean square) } 5127837.876}{\text{(within group mean square) } 81988288.680}$$

Because the group sizes are unequal, the F value, which is calculated using degrees of freedom (a value based on group size), is a high value. As a result of the unequal group sizes, with the access and education group being higher at 82 than the access (61) or control (66) cluster group sizes, a homogeneous subset of the data was developed using a harmonic mean sample size. The subset, because it was a random sampling, did not distort the means.

The ANOVA for post-scans shows an F value of 6.112, significant at .003.

| | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Between Groups | 1142458476.000 | 2 | 571229238.200 | 6.112 | .003 |
| Within Groups | 19253649930.000 | 206 | 93464320.030 | | |
| Total | 20396108400.000 | 208 | | | |

**Table 4.27: ANOVA Post-scan**

The F statistic for ANOVA was 6.112 which is the ratio of:

$$F = \frac{\text{(between group mean square) } 571229238.200}{\text{(within group mean square) } 93464320.030}$$

Because the group sizes are unequal, the F value, which is calculated using degrees of freedom (a value based on group size), is a high value. As a result of the unequal group sizes, with the access and education group being higher at 82 than the access (61) or control (66) cluster group sizes, a homogeneous subset of the data was developed using a harmonic mean sample size. The subset, because it was a random sampling, did not distort the means.

The ANOVA for scan change shows an F value of 12.961, significant at .000.

| | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Between Groups | 1009493990.000 | 2 | 504746995.000 | 12.961 | .000 |
| Within Groups | 8022439822.000 | 206 | 38943882.630 | | |
| Total | 9031933812.000 | 208 | | | |

**Table 4.28: ANOVA Scan Change**

The F statistic for ANOVA was 12. 961 which is the ratio of:

$$F = \frac{\text{(between group mean square) } 504746995.000}{\text{(within group mean square) } 38943882.630}$$

Because the group sizes are unequal, the F value, which is calculated using degrees of freedom (a value based on group size), is a high value. As a result of the unequal group sizes, with the access and education group being higher at 82 than the access (61) or control (66) cluster group sizes, a homogeneous subset of the data was developed using a harmonic mean sample size of 68.587. The subset, because it was a random sampling, did not distort the means.

Tukey HSD post hoc tests, for pre-scans, showed significance values of .937 between control and access and .966 between control and access plus education. A .992 significance level was shown between access and access plus education.

| (I) Cluster | (J) Cluster | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval Lower Bound | Upper Bound |
|---|---|---|---|---|---|---|
| Control | Access | -552.430 | 1608.203 | .937 | -4349.04 | 3244.18 |
| | Access Plus Education | -373.347 | 1497.366 | .966 | -3908.30 | 3161.60 |
| Access | Control | 552.430 | 1608.203 | .937 | -3244.18 | 4349.04 |
| | Access Plus Education | 179.084 | 1530.989 | .992 | -3435.24 | 3793.41 |
| Access Plus Education | Control | 373.347 | 1497.366 | .966 | -3161.60 | 3908.30 |
| | Access | -179.084 | 1530.989 | .992 | -3793.41 | 3435.24 |

**Table 4.29: Multiple Comparisons: Pre-scan Tukey HSD**

Tukey HSD Post Hoc ANOVA for post-scan resulted in a significance of .231 between control and access. Access plus education versus control has a significance of .002 and access versus access and education resulted in a .211 significance value.

| (I) Cluster | (J) Cluster | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval Lower Bound | 95% Confidence Interval Upper Bound |
|---|---|---|---|---|---|---|
| Control | Access | -2815.177 | 1717.070 | .231 | -6868.80 | 1238.45 |
| | Access Plus Education | -5581.364* | 1598.729 | .002 | -9355.61 | -1807.12 |
| Access | Control | 2815.177 | 1717.070 | .231 | -1238.45 | 6868.80 |
| | Access Plus Education | -2766.188 | 1634.629 | .211 | -6625.19 | 1092.81 |
| Access Plus Education | Control | 5581.364* | 1598.729 | .002 | 1807.12 | 9355.61 |
| | Access | 2766.188 | 1634.629 | .211 | -1092.81 | 6625.19 |

*. The mean difference is significant at the 0.05 level.

**Table 4.30: Multiple Comparisons: Post-scan Tukey HSD**

Tukey HSD Post Hoc ANOVA for the scan change resulted in a significance of .105 between control and access. Access plus education versus control has a significance of .000 and access versus access and education resulted in a .016 significance value.

| (I) Cluster | (J) Cluster | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| Control | Access | -2262.747 | 1108.370 | .105 | -4879.36 | 353.87 |
| | Access Plus Education | -5210.213* | 1031.981 | .000 | -7646.49 | -2773.93 |
| Access | Control | 2262.747 | 1108.370 | .105 | -353.87 | 4879.36 |
| | Access Plus Education | -2947.466* | 1055.154 | .016 | -5438.45 | -456.48 |
| Access Plus Education | Control | 5210.213* | 1031.981 | .000 | 2773.93 | 7646.49 |
| | Access | 2947.466* | 1055.154 | .016 | 456.48 | 5438.45 |

*. The mean difference is significant at the 0.05 level.

**Table 4.31: Multiple Comparisons: Scan Change Tukey HSD**

**Research Hypothesis 2**:

Null Hypothesis 2: Providing weekly F&V access does not change parent's provision of fruits and vegetables in the home and their consumption of F&V?

The null hypothesis was: H0: $\mu1=\mu2$

Alternative Hypothesis 2: Weekly provision of F&V access does change parent's provision of fruits and vegetable in the home and their consumption of F&V?

The alternative hypothesis was: H1: $\mu1\neq \mu2$

The null hypothesis predicts no difference or relationship. This analysis seeks to find a relationship and to reject the null hypothesis.

The Two Tailed Dependent Samples t-Test was used to determine if there is a statistically significant difference between the means of the variables. The observations in one cluster (pre-scan) will be compared to the same cluster (post-scan) as the samples are able to be paired on a one-to-one basis.

The self-reported Availability Survey-Fruit, Juice, &Vegetables At Home questionnaire was used to determine the disposition of Hypothesis 2. The response rate of the pre-survey was 198 completed surveys out of the initial 240 consented subjects for an 82.5% response rate. After considering those who withdrew from Head Start, 183 pre-surveys were counted for comparison or 92.4%. The number of post surveys completed for comparison purposes was 96 for a 52.4% attrition rate.

The first survey question examined for the support of Hypothesis 2 was the comparison of the number of fruits and vegetables available in the responding parent or guardian's home prior to the interventions or treatments, which included access to produce. The question stated, "Did you have any of the following fruits or vegetables in your home during the past week?" Twenty five fruits and vegetables were listed with checkbox columns Yes or No beside each fruit or vegetable. Additionally, six juices/smoothies were listed with the corresponding check boxes of Yes or No. The computation of this data was done by adding up all the Yes responses on the pre-survey and adding up all the Yes responses on the post-survey. The differences between the pre and the post survey were then calculated.

The next question used to support Hypothesis 2, included the number of provided foods which included sweet potatoes, squash, carrots, pumpkin, tomato products, and mangos. These foods are shown below along with the verbiage used on the survey. The calculation was done by adding up the number of these foods self-reported to have been consumed over the past week by the parent and for the child prior to the intervention and then after the intervention. The number of servings of those foods consumed that were supplied throughout the eight week provision/access were counted and compared pre and post-survey.

| **Did you have any of the following fruits or vegetables in your home during the past week? How many times in the last week did you eat any of the following fruits or vegetables? These could be consumed at home or away from home.**<br>Fruits and vegetables can be fresh, frozen, canned, or dried. | | | |
|---|---|---|---|
| Please check all that apply. ☑ | | | |
| | **Yes** | **Times eaten Adult** | **Times eaten Child** |
| Carrots | ☐ | | |
| Mango | ☐ | | |
| Squash | ☐ | | |
| Sweet Potatoes | ☐ | | |
| Tomatoes | ☐ | | |
| Other | ☐ | | |

**Table 4.32: Provided Foods in Survey**

**Descriptive Statistics for Question 1**

The descriptive statistics of the fruits and vegetables, available in the homes of the parents or the guardians of the Head Start children at the start of the study included: a mean of 12.32 fruits and vegetables in the home, a median of 12 and a mode of 8. The range for the availability was 26. The range was calculated from a minimum of 2 and a maximum of 28. Standard deviation was computed to be 5.520 with a variance of 30.474. Skewness was .431with a standard error of skewness of .246 was found.

| | | |
|---|---|---|
| N | Valid | 96 |
| | Missing | 113 |
| Mean | | 12.32 |
| Median | | 12.00 |
| Mode | | 8[a] |
| Std. Deviation | | 5.520 |
| Variance | | 30.474 |
| Skewness | | .431 |
| Std. Error of Skewness | | .246 |
| Range | | 26 |
| Minimum | | 2 |
| Maximum | | 28 |

a. Multiple modes exist. The smallest value is shown

**Table 4.33: Statistics for Pre- Available F/V**

The descriptive statistics of the fruits and vegetables, available in the homes after the intervention, of the parents or the guardians of the Head Start children included:  a mean of 14.38 fruits and vegetables in the home, a median of 14.50 and a mode of 13. The range for the post intervention availability was 21.  The range was calculated from a minimum of 3 and a maximum of 24.  Standard deviation was computed to be 5.188 with a variance of 26.911.  Skewness was -.123with a standard error of skewness of .246 was found.

| | | |
|---|---|---|
| N | Valid | 96 |
| | Missing | 113 |
| Mean | | 14.38 |
| Median | | 14.50 |
| Mode | | 13[a] |
| Std. Deviation | | 5.188 |
| Variance | | 26.911 |
| Skewness | | -.123 |
| Std. Error of Skewness | | .246 |
| Range | | 21 |
| Minimum | | 3 |
| Maximum | | 24 |

a. Multiple modes exist. The smallest value is shown

**Table 4.34: Statistics for Post- Available F/V**

Analysis of the paired samples t-test between pre-available fruit and vegetables reported and post-available fruit and vegetables reported show a t value of -3.611 with a significance level of .000.

| | | Paired Differences | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | Std. Error | | | |
| | | Mean | Std. Deviation | Mean | t | df | Sig. (2-tailed) |
| Pair 1 | Pre-avail - Post-avail | -2.052 | 5.568 | .568 | -3.611 | 95 | .000 |

**Table 4.35: Paired Samples Test for Pre-Available vs. Post Available F/V**

The descriptive statistics of the number of select (high carotenoid F/V provided to access and access and education families) fruits and vegetables consumed prior to the intervention included: a mean of 1.99 fruits and vegetables consumed per week, a median of 1.00 and a mode of 0. The range for the parent intake was 12. The range was calculated from a minimum of 0 and a maximum of 12. Standard deviation was computed to be 2.401with a variance of 5.765. Skewness was -1.830 with a standard error of skewness of .266 was found.

| | | |
|---|---|---|
| N | Valid | 82 |
| | Missing | 127 |
| Mean | | 1.99 |
| Median | | 1.00 |
| Mode | | 0 |
| Std. Deviation | | 2.401 |
| Variance | | 5.765 |
| Skewness | | 1.830 |
| Std. Error of Skewness | | .266 |
| Range | | 12 |
| Minimum | | 0 |
| Maximum | | 12 |

**Table 4.36: Parent Pre-Provided Statistics**

## Descriptive Statistics of Question 2

The descriptive statistics of the number of select (high carotenoid F/V provided to access and access and education families) fruits and vegetables consumed at the end of the intervention included: a mean of 3.22 fruits and vegetables in the home, a median of 2.00 and a mode of 0. The range for the parent intake was 13. The range was calculated from a minimum of 0 and a maximum of 13. Standard deviation was computed to be 1.011 with a variance of 8.889. Skewness was -1.011 with a standard error of skewness of .266 was found.

| | | |
|---|---|---|
| N | Valid | 82 |
| | Missing | 127 |
| Mean | | 3.22 |
| Median | | 2.00 |
| Mode | | 0 |
| Std. Deviation | | 2.982 |
| Variance | | 8.889 |
| Skewness | | 1.011 |
| Std. Error of Skewness | | .266 |
| Range | | 13 |
| Minimum | | 0 |
| Maximum | | 13 |

**Table 4.37: Parent Post Provided Statistics**

Analysis of the paired samples t-test between pre-provided and consumed fruit and vegetables reported and post-available provided fruit and vegetables reported show a t value of -3.579 with a significance level of .001.

| | | Paired Differences | | | | | |
|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | t | df | Sig. (2-tailed) |
| Pair 1 | Parent Pre-provided-Parent Post- provided | -1.232 | 3.116 | .344 | -3.579 | 81 | .001 |

**Table 4.38: Paired Samples Test for Parents Pre-Provided vs. Post Provided F/V**

**Research Hypothesis 3**:

Null hypothesis 3: Skin carotenoid levels are not correlated with self-reported intake of F&V?

The null hypothesis was; H0: $\mu 1=\mu 2$

Alternative hypothesis 3: Skin carotenoid levels are correlated with self-reported intake of F&V?

The alternative hypothesis was: H1: $\mu 1 \neq \mu 2$

The null hypothesis predicts no difference or relationship. This analysis seeks to find a relationship and to reject the null hypothesis.

The Two Tailed Dependent Samples t-Test was used to determine if there is a statistically significant difference between the means of the variables. The observations in one cluster (pre-scan) will be compared to the same cluster (post-scan) as the samples are able to be paired on a one-to-one basis.

The dichotomous question of whether or not families (Groups B and C) used the provided produce was useful in answering this question. Additionally, survey questions completed by the child's parent or guardian were utilized to answer this research question of skin carotenoid or Ramen Resonance Scan Score versus the child's self-reported intake of fruits and vegetables. The question used to examine carotenoid scores versus self-reported intake was that of fruits and vegetables provided versus the number the child consumed weekly pre and post-intervention.

The first question utilized to answer this question was:

Did you use the produce sent home each week? Yes No

The second question utilized in Hypothesis #3 was the child's intake of the fruits and vegetables provided in the intervention. These high carotenoid items included: sweet potatoes, carrots, pumpkin, mangoes, tomatoes, and butternut squash. The number of reported items consumed by the child before the intervention began and those that were consumed after the intervention was completed were then counted and compared. The difference between the pre and post- consumption were compared to help answer this hypothesis.

**Descriptive Statistics for Question 1**

The descriptive statistics of the usage of the fruits and vegetables provided at home for Cluster B and Cluster C are listed below. The control group was not included in this analysis as the children and families in the control group did not receive fruits and vegetables from this researcher team during this study. Descriptive statistics such as the analysis of mean, mode, median, and standard deviation were not calculated for this question as this was a dichotomous response (Yes or No). Cluster B's analysis showed of the 40 responses collected, a 92.5 % Yes response to using some to all of the fruits and vegetables provided. The No response from Cluster B was 7.5%, indicating that 7.5% of those responding to the survey did not use the fruits and vegetables sent home to the families.

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Yes | 37 | 60.7 | 92.5 | 92.5 |
| | No | 3 | 4.9 | 7.5 | 100.0 |
| | Total | 40 | 65.6 | 100.0 | |
| Missing | System | 21 | 34.4 | | |
| Total | | 61 | 100.0 | | |

**Table 4.39: Were the Fruits and Vegetables Used at Home? Cluster B**

Cluster C's analysis showed of the 38 responses collected a 100 % Yes response to using some to all of the fruits and vegetables provided.  The No response from Cluster C was zero, indicating that all of those responding to the survey did use at least some of the fruits and vegetables sent home to the families.

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | Yes | 38 | 46.3 | 100.0 | 100.0 |
| Missing | System | 44 | 53.7 | | |
| Total | | 82 | 100.0 | | |

**Table 4.40: Were the Fruits and Vegetables Used at Home? Cluster C**

**Descriptive Statistics for Question 2**

The second question useful for supporting Hypothesis 3 is the question about those select foods provided in the intervention and how many of those were consumed by the children.  This information was self-reported by the parent of guardian.  Of interest was looking at the information reported by the parent or guardian pre-intervention and comparing that to the number reported by the parent or guardian post –intervention. Descriptive analysis is documented below for pre-intervention consumption.

The mean of the number of fruits and vegetables consumed, from the list of provided items, prior to the intervention was 2.14 fruits and vegetables.  The median was 2 and the mode 0.  The range for the number of fruits and vegetables eaten was 12, with a minimum of 0 and a maximum of 12 fruits and vegetables.  Standard deviation was 2.557

and the variance was 6.540. Skewness was 1.817 and the Standard Error of skewness was .264.

| | | |
|---|---|---|
| N | Valid | 83 |
| | Missing | 126 |
| Mean | | 2.14 |
| Median | | 2.00 |
| Mode | | 0 |
| Std. Deviation | | 2.557 |
| Variance | | 6.540 |
| Skewness | | 1.817 |
| Std. Error of Skewness | | .264 |
| Range | | 12 |
| Minimum | | 0 |
| Maximum | | 12 |

**Table 4.41: Child Pre-Provided Statistics**

The mean of the number of fruits and vegetables consumed, from the list of provided items, after the intervention was 3.37 fruits and vegetables. The median was 3 and the mode 0. The range for the number of fruits and vegetables eaten was 22, with a minimum of 0 and a maximum of 22 fruits and vegetables. Standard deviation was 3.598 and the variance was 12.944. Skewness was 2.261 and the Standard Error of skewness was .264.

| | | |
|---|---|---|
| N | Valid | 83 |
| | Missing | 126 |
| Mean | | 3.37 |
| Median | | 3.00 |
| Mode | | 0 |
| Std. Deviation | | 3.598 |
| Variance | | 12.944 |
| Skewness | | 2.261 |
| Std. Error of Skewness | | .264 |
| Range | | 22 |
| Minimum | | 0 |
| Maximum | | 22 |

**Table 4.42: Child Post Provided Statistics**

Analysis of the paired samples t-test between pre-provided versus post-provided/ consumed fruit and vegetables reported by parents or guardians show a t value of -2.748 with a significance level of .007.

| | | Paired Differences | | | | | |
|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | t | df | Sig. (2-tailed) |
| Pair 1 | Child Pre-provided- Child Post- provided | -1.229 | 4.073 | .447 | -2.748 | 82 | .007 |

**Table 4.43: Paired Samples Test for Child Pre-Provided vs. Post Provided F/V**

Interpretation of the analysis and the disposition of the Hypothesis, reject or fail to reject, for each of the three questions is detailed in Chapter 5.

# Chapter 5: Discussion, Implications, Recommendations, and Conclusions

## Introduction

Chapter 5 begins with a summary of the research study, followed by a description of the food distribution/ access process used in this study. This is followed by a section describing scan scores values and their differences along with the usefulness of carotenoids in measuring fruits and vegetables. A brief description of the subjects' characteristics is in the next section. Following the subject's characteristics is a discussion on each of the research hypotheses. This is followed by implications of the conceptual model, recommendations for practice, and topics for future research. This chapter concludes with final remarks involving the research and lessons learned.

## Study Summary

Based on the Theory of Planned Behavior, this cluster randomized control study examined the idea of fruit and vegetable consumption and how, and if consumption can be influenced in Head Start Preschool children and their parent or guardian. The idea of ready access or access with education's influence on fruit and vegetable intake of Head Start children and their family was the focus of this study. Variables at the individual level included access and access with education. These variables were measured by the BioPhotonic Scanner™ and the Availability Survey- Fruit, Juice and Vegetables At

Home parental questionnaire to determine differences in consumption from pre to post-intervention.

After receiving human subjects review board approval, data was gathered from a final sample of 209 Head Start children. The study population was composed of 3 to 5 year old children and their parent or guardian. Parents or guardians voluntarily participated in the study by completing a pre and post intervention survey and allowing their child to be scanned with the BioPhotonic Scanner™ pre and post- intervention. The overall participation rate of children scanned was 83%. Questionnaire response for the pre-intervention survey was 198 returned questionnaires, with 183 total after those who were withdrawn from the Head Start locations were removed from the study. Post-intervention survey collection was 96 for a 52.5% response rate from pre to post-intervention survey collection. Descriptive statistics, t-tests, and analysis of variance (ANOVA) were the primary data analysis techniques used to interpret the data.

**Food Access and Education Information**

During each week of an eight week intervention, fruits and vegetables were distributed to parents and guardians of those children randomly placed in Clusters B and C. The following information outlines the products supplied each week in the food distribution and the items produced for classroom education. Food distribution was provided to a total of 142 families by the conclusion of the eight week timeframe. Initially, 165 families received produce. Twenty-two families who were receiving fruits and vegetables were withdrawn from the Head Start school locations over this time period, resulting in a 14% attrition rate from the start to the end of the food distribution time period.

The food was bagged weekly and delivered to the bus drivers who transported the fruits and vegetables to the families at pick up and drop off of the children participating in the study. Additionally, the children who were dropped off and picked up by a parent or guardian received their bags of fruit and vegetables from the classroom teacher.

Below are the weekly food distribution and tasting items provided each week.

- Week one the families received 2 large sweet potatoes, 2 apples, a large butternut squash, and 1 can of cooked carrots. The food tasting included fresh raw carrots, cooked carrots, and a Beta Carotene mini carrot muffin.
- Week two the families received 3 large sweet potatoes, 3 large carrots, and 1 can of pumpkin. Pumpkin bars were offered as the tasting in the education classes.
- Week three food distribution included 3 large sweet potatoes, 1 can of carrots, and 2 cans of tomato sauce. The classroom snack was a sweet potato applesauce cookie.
- The fourth week of the intervention included 3 large sweet potatoes, 3 large carrots, and 1 can of pumpkin. Education class tastings consisted of a pumpkin dip with mangoes, peaches, and watermelon.
- Week 5 provisions were 5 medium sweet potatoes, 2 cans of tomato sauce, and 1 can of cooked carrots. A vegetable soup and smoothie tasting were included in the educational sessions. The vegetable soup included sweet potatoes, carrots, tomato sauce, salsa, mixed vegetables, green beans, and potatoes. Smoothies

containing mangoes, peaches, and carrot juice were offered to the children to taste as well.

- The sixth week of the intervention included 5 sweet potatoes, a large mango, one can of carrots, and canned pumpkin. Education tasting this week was pumpkin pudding and fruit smoothies.
- During week seven, 5 sweet potatoes, a can of tomato sauce, one can of canned pumpkin, and one can of carrots were distributed. The tastings in the education sessions included mashed sweet potatoes and fruit smoothies. This week fell during the Thanksgiving holiday.
- The final week distribution included 5 sweet potatoes, a can of carrots, and a can of canned pumpkin. Pumpkin pudding and carrot muffins were offered as the final tastings. Portion size fruit and vegetable individual serving size containers were given as incentives to all the children in the education groups this week.

Details of the amounts of mixed carotenoid distributed each week are included in the table in Appendix F. The range of the amount of mixed carotenoids given to families each week was 110.8 to 269.4 mgs. (Higdon, Drake, and Delage, 2016). Mean amounts of carotenoid provided was 178.9 mg. per week to each child's family.

The Supplemental Nutrition Assistance Program Education (SNAP-Ed) was provided to Cluster C each week for the eight week treatment period. This education was delivered by a SNAP-Ed program staff member. Fidelity was increased through use of the same team member all eight weeks. The Harvest for Healthy Kids curriculum was used and each week the focus was on a high carotenoid fruit or vegetable. Story books, activities such as making pumpkin pudding in a bag, and tastings were the foundation of the class sessions. Classes were delivered for 30 minutes in each of the six Cluster C classrooms.

## Scan Score Differences

The scoring ranges of the Resonance Ramen Spectroscopy/ BioPhotonic Scanner™ are based on the measurements of over 1,300 individuals who had a wide range or variety of diets (Pharmanex, 2003). The scoring range representing a high presence of carotenoids is the 50,000- 59,000 range, a very good presence is the 40,000-49,000 range, the 30,000-39,000 range represents a good presence of carotenoids, 20,000-29,000 is the moderate range of carotenoids detected in the skin, and the10,000-19,000 range is low amounts of carotenoid results. This is known as the Carotenoid Score Index or Ramen score (Pharmanex, 2003). These index scores may vary between individuals based on lifestyle factors such diet, physical activity, and toxins such as cigarette smoke in the home (Pharmanex, 2003). Physical activity, multi-vitamin use, and smoking in the child's home may have an effect on the child's scan score although the value of importance was the change in the individual carotenoid level over time not the actual carotenoid score or value.

According to Jahns, Johnson, Mayne, Cartmel, Picklo, Ermakov, Gellerman, and Whigham (2014), skin carotenoids are useful for measuring changes in intakes of vegetables and fruits. Skin and blood carotenoids, which are highly correlated, are considered a status biomarker rather than a reference biomarker. Status biomarkers measure the body's skin or blood carotenoid levels, whereas reference biomarkers measure the actual carotenoid intake in a lab setting. A status biomarker is useful for detecting changes in intake of fruits and vegetables rather than measuring absolute intake of either carotenoids or fruits and vegetables (Jahns et al., 2014).

Previous research shows a wide distribution of skin carotenoid concentrations and high reproducibility has been documented in the literature when no intervention was implemented. In cases where no treatment was performed, carotenoid measures remained essentially the same over time (Jahns et. al., 2014). Validity has also been shown in multiple studies in the literature. Carotenoid scan scores have been measured against blood concentrations, skin biopsy, and self-reported fruit and vegetable intakes showing skin scores to be strongly correlated to these other methods (Jahns et. al., 2014).

## Carotenoids and Measurements of F/V intakes

Blood carotenoids are documented as being the superior biomarker in the consideration of fruit and vegetable intake. Carotenoids are attractive biomarkers due to the fact that humans cannot synthesize them. Carotenoids are also readily deposited into body tissues. Collecting blood carotenoids, for use in the measurement of intake changes of fruits and vegetables has multiple downsides. Blood carotenoids are invasive and relatively expensive to analyze. The use of the Resonance Ramen Spectroscopy (RRS)/ BioPhotonic Scanner™ is noninvasive, reliable, and valid. Additionally, skin carotenoid measures, which perform similarly to blood carotenoids, respond quickly to changes in fruit and vegetable intake as well as having a longer half-life than blood carotenoids.  This makes them an excellent, objective substitute for blood carotenoid measures (Jahns, et. al., 2014).

The use of carotenoids is particularly critical as a measure of assessing behavioral interventions attempting to increase fruit and vegetables.  History shows that it is difficult to determine changes in intake of fruits and vegetables due to the limitations of the available methods used to collect such data.  While it is common to use dietary recalls and food-frequency questionnaires due to their lower logistical barriers, cost, and burden on study subjects, bias and measurement errors are shown to be inherent (Jahns, et. al., 2014).  When researchers use both a valid biomarker, coupled with a self-reported fruit and vegetable questionnaire, they can then choose and utilize statistical methods that may reduce such magnitudes of error (Jahns, et. al., 2014).

It was determined that both the valid and non-invasive carotenoid biomarker and the self-report Availability Survey- Fruit, Juice, and Vegetable at Home Survey were useful in this research.  As shown in past studies, the collected self-report information appeared to contain both bias and measurement error.  Therefore, the primary outcome variable in this study was the change in the carotenoid skin score or the ramen scan score change.

## Carotenoid Dosage in the Literature

Two studies in the literature  in which food or carotenoid products were supplied to subjects and the RSS scanner was used to measure intake included Jahns et al., (2014) and Aguilar's et al., (2015) Breakfast Bite research.  Amounts of carotenoid given in these studies were 62 mg/day in the Jahns et al., (2014) study, which included four phases in its design. A depletion stage was followed by a prescribed diet phase (62mg average carotenoid /day), followed by another depletion phase, and a final phase consisting of the subjects' normal diet. This study was conducted with 29 adults with an average age of 32.4. Jahns et al., (2014) showed a 264% increase in scanner scores, which were performed at the end of the high carotenoid food phase of the study.

Aguilar, Reed, and Allen (2015) conducted research in which Breakfast Bites were produced, which contained 4.3 mg of mixed carotenoids per day or 30.1 mg/week. Forty-six children, ages 5-18, were asked to eat one serving of Breakfast Bites per day. Aguilar, Reed, and Allen (2015) showed a mean scanner score difference of 5801 in the group consuming the daily Breakfast Bites. In both Jahns et al., (2014) and Aguilar, Reed, and Allen's (2015) studies, significant differences in scan scores were shown in subjects consuming high doses of carotenoid. The amount of carotenoids in these studies was prescribed and a stable dose was utilized.

### Scanned Children's Characteristics: Demographics

The average child participant was 4 years old (116 out of 209), followed by 80 three year old children and 13 five year old children. The female to male ratio was 107 (51%) to 102 (49%) respectively.

Examining the Body Mass Index (BMI) of the children participating in the study, 39 children (18.6%) were overweight. Twenty five (12%) out of the 209 children were classified as obese. There were 21 (10%) of the 209 children scanned that were categorized as underweight. The remaining 59.4% were normal weight.

Using the Center for Disease Control's information, children with a BMI between the $85^{th}$ and the $95^{th}$ percentile were considered overweight. Children over the $95^{th}$ percentile were classified as obese, while those under the $5^{th}$ percentile were considered underweight. According to a study conducted by the USDA and the Supplemental Program for Women, Infants, and Children (WIC), obesity rates of low-income children have decreased from 15.9% in 2010 to 14.5% in 2014. Obesity prevalence is higher for the low-income children when compared to the 8.9% overall national obesity prevalence rate in 2-4 year old children. The obesity rate of the subjects in this study was lower than the prevalence found in the WIC study (14.5%) but higher than the national average of 8.9% at the 12% level.

Children are classified by the Community Action Commission Head Start centers into one of four ethnicities or races. These four classifications include Hispanic, white, black, and multi. Breaking the participants down into the four groups show 9 (4%) Hispanic children, 152 (73%) white children, 36 (17%) multi and 12 (6%) black children. The county in which this research took place has an overall population of 65,720 according to http://quickfacts.census.gov. Of those 65,720, the census data shows that the community is 91% white, 6.4 % black and 2.4% Hispanic, with 2% other rounding out the percentage breakdown of the county population. The Head Start population had a higher percentage of Hispanic and multi race/ethnicity than the overall county race/ethnicity.

## Explanation/ Interpretation of Hypothesis 1

Analysis and interpretation of four t-tests and 3 ANOVA and 3 ANOVA Post-Hoc tests were completed to answer the first hypothesis of:

Null Hypothesis 1: Weekly F&V access, accompanied by nutrition education, does not change children's fruit and vegetable consumption.

The null hypothesis was: H0: $\mu 1 = \mu 2$

Alternative Hypothesis 1: Weekly F& V access, accompanied by nutrition education, does change children's fruit and vegetable consumption.

The alternative hypothesis was: H1 $\mu 1 \neq \mu 2$

A paired sample t-test was chosen because each subject had a pre and post- scan result. Each cluster's scan change (A, B, and C) as well as the overall group's scan change for the group's t value were calculated. Each t-value was then compared to the number of degrees of freedom (df) for the cluster sample being analyzed. Below, each t-test will be described individually followed by the ANOVA testing also used to infer a difference between the groups' mean and to determine significance.

### t-test Cluster A

The calculated t value for the first paired samples test of Cluster A (control) is -4.368, which assumes equal variances using a 2-tailed t-test. A confidence interval of the difference of 95% was utilized and the alpha 5% value was used as the standard for comparison. Using the Critical Values of t Table C (Levin, Fox, & Forde, 2014) or Appendix D (DeVeaux, Vellman, & Bock, 2012) and the degrees of freedom of 65 (66 subjects minus 1) the values can then be compared to the value in Table C or Appendix D. At the .05 level of significance, which is the level below which the probability is considered so small that we decide to reject the null hypothesis, the value is ±2.00. Therefore, the calculated t-value, at -4.368 is greater than ±2.00, the value in Table C/ Appendix D, so we reject the null hypothesis and accept the alternative hypothesis in this case. The value is significant at .000.

**t-test Cluster B**

The calculated t value for the second paired samples test of Cluster B (access) is -5.404 which assumes equal variances using a 2-tailed t-test. A confidence interval of the difference of 95% was utilized and the alpha 5% value was used as the standard for comparison. Using the Critical Values of t Table C (Levin, Fox, & Forde, 2014) or Appendix D (DeVeaux, Vellman, & Bock, 2012) and the degrees of freedom of 60 (61 subjects minus 1) the values can then be compared to the value in Table C or Appendix D. At the .05 level of significance, which is the level below which the probability is considered so small that we decide to reject the null hypothesis, the value is ±2.00. Therefore, the calculated t-value, at -5.404 is greater than ±2.00, the value in Table C/ Appendix D, so we reject the null hypothesis and accept the alternative hypothesis in this case. The value is significant at .000.

**t-test Cluster C**

The calculated t value for the third paired samples test of Cluster C (access with education) is -10.818 which assumes equal variances using a 2-tailed t-test. A confidence interval of the difference of 95% was utilized and the alpha 5% value was used as the standard for comparison. Using the Critical Values of t Table C (Levin, Fox, & Forde, 2014) or Appendix D (DeVeaux, Vellman, & Bock, 2012) and the degrees of freedom of 81 (82 subjects minus 1) the values can then be compared to the value in Table C or Appendix D. At the .05 level of significance, which is the level below which the probability is considered so small that we decide to reject the null hypothesis, the value is ±1.992.

Therefore, the calculated t-value, at -10.818 is greater than ±1.992, the value in Table C/ Appendix D, so we reject the null hypothesis and accept the alternative hypothesis in this case. The value is significant at .000.

**t-test Overall Sample**

The calculated t value for the final paired samples test of the entire sample is -11.689 which assumes equal variances using a 2-tailed t-test. A confidence interval of the difference of 95% was utilized and the alpha 5% value was used as the standard for comparison. Using the Critical Values of t Table C (Levin, Fox, & Forde, 2014) or Appendix D (DeVeaux, Vellman, & Bock, 2012) and the degrees of freedom of 208 (209 subjects minus 1) the values can then be compared to the value in Table C or Appendix

D. At the .05 level of significance, which is the level below which the probability is considered so small that we decide to reject the null hypothesis, the value is ±1.973. Therefore, the calculated t-value, at -11.689 is greater than ±1.973, the value in Table C/ Appendix D, so we reject the null hypothesis and accept the alternative hypothesis in this case. The value is significant at .000.

When the value is greater than the alpha value the null hypothesis is rejected, which is the hope when setting up the research hypothesis. We can also conclude that there is statistically significant difference in all four performed t-tests because the Sig (2-tailed) value at .000 is less than .05 (the accepted level of significance). This indicates that the difference between the two means is likely not due to chance, but rather the independent variable manipulation.

Authors note that levels of significance do not give us an *absolute* statement as to the correctness of the null hypothesis (Levin, Fox, & Forde, 2014). When we reject the null hypothesis at the .05 level of significance, there is a 5 out of 100 chance that we should have retained the null, known as the Type I error. The more stringent the level of significance, the less likely we are to make a Type I error.

Therefore, based on the analysis of the four t-tests and calculated t values the null hypothesis should be rejected, and the alternative hypothesis accepted. There is sufficient evidence at the alpha level of significance (.05) to reject the claim that: weekly F&V access, accompanied by nutrition education, does not change children's fruit and vegetable consumption. Based on the findings of the t-test calculations, the alternative hypothesis, stating weekly fruit and vegetable access accompanied by nutrition education does change children's fruit and vegetable consumption, is accepted.

## ANOVA and ANOVA Post-Hoc tests

ANOVA and ANOVA Post Hoc tests were used to perform calculations to attempt to determine if the means of multiple groups, in this case three, are equal. Explanations of the various ANOVA tests that were run are summarized below with each test broken out for separate interpretation. When examining ANOVA statistical tests, F determines the significance, or P value. An ANOVA was run for pre-scans to determine the F value and significance.

## ANOVA Pre-Scan test

To reject the null hypothesis at the 0.05 level, examination of the significance level at .939 and degrees of freedom of 2 for between clusters and 206 for within clusters was used. The calculated F ratio must exceed 3.05 (table value). Because there is an F value of .63 which is lower than the value stated in the table we fail to reject the null hypothesis for pre-scan score differences, stating there is no difference in the pre-scan score differences between the groups. This was also shown in the significance level which, at .939 shows there was not significance in the pre-scan scores between groups. One can conclude from this test that pre-scan scores were not significantly different among the three clusters.

**ANOVA Post-Scan test**

Next, an ANOVA was run of the post-scan scores to determine the F value and significance. To reject the null hypothesis at the 0.05 value, examination of the significance level at .003 and degrees of freedom of 2 for between clusters and 206 for within clusters was used. The calculated F ratio must exceed 3.05 (table value). Because there is an F value of 6.112 which is greater than the value stated in the table, we can reject the null hypothesis for post-scan score differences. This was also shown in the significance level which, at .003 shows there is significance in the post -scan scores between groups. Therefore, one can conclude that significant difference did occur when post scan scores were compared via t-test.

**ANOVA Scan change**

Finally, an ANOVA was run for overall scan score changes to determine the F value and significance. To reject the null hypothesis at the 0.05 level examination of the significance level at .000 and degrees of freedom of 2 for between clusters and 206 for within clusters was used. The calculated F ratio must exceed 3.05 (table value). Because there is an F value of 12.961 which is greater than the value stated in the table, we can reject the null hypothesis for scan score changes between groups. This was also shown in the significance level which, at .000 shows there is significance in the scan score changes between groups.

### ANOVA Post-Hoc

Post-Hoc tests are useful if the independent variable includes more than two groups. Since this analysis is based on three clusters, the Tukey HSD test was done to determine where the scan score differences fall among the groups.

### ANOVA Post-Hoc Pre-scan Test

The pre-scan Post-Hoc test calculations showed all non-significant values (.937, .966, and .962) between the Cluster A (control), Cluster B (access), and Cluster C (education/access) groups. Specifically, the control to access only value was .937. The control to access with education value was calculated at .966 and the access to access with education value at .992. The post-hoc analysis points to no significant differences between the pre-scan values. The pre-scan scores are said to be comparable between the clusters.

### ANOVA Post-Hoc Post-scan Test

The post-scan Post-Hoc test calculations showed one significant value of .002 between the control and the access with education cluster. The control (Cluster A) to access (Cluster B) group was not significant at .231; the access (Cluster B) to access with education group (Cluster C) was not significant at .211. According to this Post-Hoc calculation, the only significant difference was seen between the access with education and the control group. Therefore, one can infer that the post-hoc scan score calculations obtained from the end of the study showed significance only between the control cluster and the access with education cluster.

**ANOVA Post-Hoc Scan Changes**

The final Post-Hoc test calculation was computed for the change in scan scores between the three groups. In these comparisons, between group means the control compared to access with education group resulted in a .000 level of significance. Additionally, the access versus access with education cluster showed significance at .016. The one comparison that was not considered significant was the control to access group with a significance level of .105.

The results of the ANOVA tests showed that for the pre-scan scores there were no significant differences between the three groups. The post-scan and overall groups scan change scores did show significance between the means of the clusters. The Post-Hoc tests showed a slightly different conclusion. The pre-scores remained without significance in the Post-Hoc scores, although significance was seen between the control and the access with education pairing for the post-scan scores. The scan score changes showed significance for both the access with education and control and the access and access with education cluster. These results continue to suggest that we reject the null hypothesis in favor of accepting the alternative hypothesis. Therefore, we can assume there is a difference between the scan scores in Cluster A, Cluster B, and Cluster C post intervention of access with education versus the control group.

## Explanation/ Interpretation of Hypothesis 2

Null Hypothesis 2: Providing weekly F&V access does not change parent's provision of fruits and vegetables in the home and their consumption of F&V?

The null hypothesis was: H0: $\mu1=\mu2$

Alternative Hypothesis 2: Weekly provision of F&V access does change parent's provision of fruits and vegetable in the home and their consumption of F&V?

The alternative hypothesis was: H1: $\mu1\neq \mu2$

The null hypothesis predicts no difference or relationship. This analysis seeks to find a relationship and to reject the null hypothesis.

The Paired Samples t-Test was used to determine if there is a statistically significant difference between the means of the variables. The observations in one cluster (pre-scan) will be compared to the same cluster (post-scan) as the samples are able to be paired on a one-to-one basis.

Interpreting hypothesis #2 involved the use of two questions from the Availability Survey- Fruit, Juice, and Vegetables at Home questionnaire. Using the question from the survey asking about access or availability of fruits and vegetables in one's home was one method of determining the status of this hypothesis. Twenty-five fruits and vegetables with a Yes or No checkbox allowed all yes responses to be counted and added to the yes responses for the six juices or smoothie options. A total of thirty-one fruit and vegetable products could have been checked with a yes response by the parent or guardian. The number of checked yes boxes prior to the intervention was compared to the number of checked yes boxes after the intervention.

The means of the number of fruit and vegetables in the parent's or guardian's home pre to post-intervention was significant at a level of .000 with a t value of -3.611. This indicates that distribution and education interventions may have contributed to an increase in the number of these products available in the homes of the Head Start families involved in this study. This is expected due to the number of products distributed. This may acknowledge that the subjects added these items to their pantries and used them rather than gave them to others or disposed of the items.

The second item from the questionnaire used to determine the disposition of hypothesis 2 is a paired t-test used to calculate the difference in the means of the amount of fruit and vegetables stated to be consumed by the parents from the list of distributed items before and after the intervention. Those fruits and vegetables given to the study subjects included: carrots, mangos, squash or pumpkin, sweet potatoes, and tomatoes or tomato products. Tomato juice and smoothies made from the items distributed would also be included in this list of fruits and vegetables distributed weekly to study subjects. In addition to the question about the number of times these items were eaten, an additional clarifying statement was included on the questionnaire. This item explained that the fruits or vegetables could be canned, frozen, or fresh and could be consumed both at home and away from home at restaurants or cafeterias, for example.

The process for calculating the data needed for this t-test to be run included counting all the items listed above and how many times the parent or guardian responded that they consumed the item per week. This was then compared and run versus the number of times the parent or guardian stated they consumed the above fruits and vegetables in the week following the intervention. Analysis of the paired samples t-test between those fruits and vegetables provided and consumed prior to the study intervention and those fruits and vegetables provided and stated by the parent or guardian to have been consumed in the week following the intervention were then run.

The t value computed in the paired sample t-test was -3.579 and the significance level was .001. This can be interpreted to mean that there was a significant change shown for parents regarding their consumption of those foods provided from the beginning of the eight week study until the completion of the eight week study. This is a positive finding as this may indicate that the foods provided to the subjects were consumed in a greater quantity in part due to the distribution of the fruits and vegetables than such consumption of these foods prior to the study.

Conclusions of these findings result in the ability to reject the null hypothesis that providing weekly fruits and vegetables did not change the parent's provision of fruits and vegetables in the home and the parent or guardian's consumption of the fruits and vegetables. Instead, the alternative hypothesis can be accepted and it can be stated that weekly fruits and vegetable provision will likely increase the weekly availability and access of these foods in the home and the consumption of these provided items in the diets of the parents or guardians.

## Explanation and Interpretation for Hypothesis 3

Null hypothesis 3: Skin carotenoid levels are not correlated with self-reported intake of F&V?

The null hypothesis was: H0: $\mu1=\mu2$

Alternative hypothesis 3: Skin carotenoid levels are correlated with self-reported intake of F&V?

The alternative hypothesis was: H1: $\mu1\neq \mu2$

The null hypothesis predicts no difference or relationship. This analysis seeks to find a relationship and to reject the null hypothesis.

The Paired Samples t-Test was used to determine if there is a statistically significant difference between the means of the variables. The observations in one cluster (pre-scan) will be compared to the same cluster (post-scan) as the samples are able to be paired on a one-to-one basis.

Interpreting hypothesis #3 involves the use of questions from the Availability Survey- Fruit, Juice, and Vegetables at Home questionnaire. Two questions were utilized for this hypothesis as well. The first of those questions was only examined for Clusters B and C as the question pertained to usage of those fruits and vegetables sent home to the families. This was a Yes or No response option asking "Did you use the fruits and vegetables that were provided?" Additionally, a qualitative/open answer response area asked about what if any of the foods provided were not used and comments about the usage were also welcomed at this point.

Results of this question showed that 92.5% and 100% of parent's responding from Cluster B and C respectively indicated that they used the fruits and vegetables sent home. It can be postulated from this response that those receiving the fruit and vegetable provisions used some or all of what they received from those foods distributed. This is encouraging and further supported by the scan score increases of the children in Cluster B and C.

The second question used to support Hypothesis #3 is the question asking about the child's intake of those foods supplied during the eight week provision period. Parents or guardians were asked to indicate the number of times during the week that their child in Head Start ate the provided fruits and vegetables. The number of these fruits and vegetables eaten prior to the intervention was counted and compared to the number of fruits and vegetables eaten the week after the intervention ended (post –intervention). Paired t-tests were run to compare the means between the pre-intervention reported intakes and the post-intervention reported intakes. The t-value of this comparison of means was -2.748 with a significance of .007.

Findings from the two questions described above lead one to conclude that the null hypothesis of skin carotenoid levels not being correlated with self-reported intake of F&V should be rejected in favor of accepting the alternative hypothesis. Therefore, the alternative hypothesis of a correlation between skin carotenoid level and self-reported intake of F&V being likely, although not definitive, can be made. Cause and effect is unable to be determined in all situations due to the chance of error (Cano & Agner, 2014). A conclusion of likely positive correlation between skin carotenoid levels and self-reported intake of fruits and vegetables can be made in this case.

## Implications of Conceptual Model

The Theory of Planned Behavior (TPB) has been shown to be useful for understanding a wide variety of health behaviors, including health related decision making behaviors in children (Fila & Smith, 2006). An extension of the Theory of Reasoned Action, the TPB incorporates a third construct known as perceived behavioral control (Fila & Smith, 2006). The TPB explores the relationship between behavior and beliefs, attitudes, and intentions. Behavior intention is the most important determinant of behavior. It is said that a person's attitude influences behavior intention and beliefs about whether individuals who are important to the person approve or disapprove of a behavior. This is known as subjective norm (Rimer & Glanz, 2005).

An additional construct, enhancing the original Theory of Reasoned Action, is known as perceived behavioral control. Perceived behavioral control involves people's beliefs that they control a particular behavior. It is believed that a person might try harder to perform a behavior if they feel they have a higher degree of control over that behavior. Many examples in the literature use the Theory of Planned Behavior as their theoretical foundation. The TPB postulates that attitude, subjective norms, and perceived behavioral control predict intention (Carter, 2011).

Intention, when coupled with perceived behavioral control, predicts actual behavior (Peters & Templin, 2010). Intention is directly driven by the three major constructs; beliefs and attitudes, subjective norms, and perceived behavioral control, with the idea that the stronger the intention, the more likely a person will be to perform the behavior (Fila & Smith, 2006). Identifying attitudes that promote healthful eating is grounded in the theoretical foundation of the Theory of Planned Behavior (Fila & Smith, 2006). Those attitudes include the consumption of fruits and vegetables, identifying who or what promotes healthful dietary behavior, and examining to what extent children perceive control over their dietary behavior.

According to Ajzen, who generated the idea of the TPB, human behavior is influenced by attitudes and self-efficacy in addition to the social norms that surround the behavior (Carter, 2011). Carter (2011) discussed how this is an important concept in program development. Targeting beliefs and the attitudes and perceptions associated with those beliefs, can affect intention to adopt a particular behavior. Behavior intention increases as the person develops a more positive attitude toward and more confidence in their ability to perform a behavior. In addition, as feedback from important people in their social sphere increases, the intention to perform a behavior of interest increases (Carter, 2011). Increased intention to change and control over a particular behavior leads to the increased likelihood of behavior adoption (Carter, 2011).

This study attempted to remove some of the major barriers said to confront the low socio-economic or low-resourced populations enabling a stronger behavioral control for fruits and vegetables provided for the population studied. As discovered in formative research and focus groups performed by Haynes-Maslow, Parsons, Wheeler, and Leone (2013), cost or price of the produce rose above other barriers four times more frequently than any other barrier. Food distribution in this study removed the cost barrier by providing fruits and vegetables at no cost to those in treatment groups B and C. Additionally, transportation was mentioned and again removed in this study as the fruits and vegetables were hand delivered to the parents of those children participating in the study which rode the bus. Fruits and vegetables were hand delivered at drop off or pick up times every Tuesday over the eight week treatment period. As mentioned in the comments by parents or guardians and by staff of the school, a desire for education on the use of some of the produce was noted. Parents and guardians commented that they “did not have recipes or know how to fix items”, such as squash.

This study addressed this barrier by providing education in Cluster C (access with education) through inclusion of such items as recipes, coloring pages and puzzles, and newsletters encompassing and focusing on the items provided. The focus of the educational sessions and the educational materials sent home was on the high carotenoid items including: pumpkin or squash, carrots, sweet potatoes, tomato based products, mangos, peaches, apricots, and watermelon. The Harvest for Healthy Kids curriculum (Izumi, Hoffman, Eckhardt, Johnson, Hallman, & Barberis, 2015) was used as the basis for the lessons.

Attitude and social norms may also have been impacted in this study. Head Start classrooms are structured in a unique manner. Meals and snacks in Head Start classrooms are eaten family style, with children allowed to select and portion the amount of items they would like to eat. All children are encouraged to try and taste all foods by taking at least 2 bites. Lead teachers and teacher aides eat with the students and encourage them by being a role model in tasting and eating all foods. During the SNAP-Ed education that was conducted in the six classrooms that received the education, all teachers did this type of role modeling. Education consisted of stories, discovery about different fruits and vegetables provided each week, and tasting. For example, during Week 1 raw fresh carrots were shown to the children and tasted, cooked carrots were shown to the children and tasted and mini carrot cake muffins containing carrots were tasted. The children were able to see different forms of carrots and the teachers encouraged the tasting of all three options. An attitude regarding an item that may have been perceived to be disliked, due to never having tasted it or tried it in a different form or recipe, may have played a role in the acceptance and consumption of some of the fruits and vegetables. Additionally, social norms or everyone else trying the fruit or vegetable and possibly liking the food may have played a role as well.

## Topics for Further Research

Research recommendations for future research are:

- Replicate this study with other preschool classes similar to Head Start to identify similarities and differences, with respect to scan scores and self-reported fruit and vegetable intake. Would the findings be similar in other areas of the state or country?
- Considering the attrition rate for parent and guardian surveys at post-intervention, replicate the study with a creative plan to gather additional surveys. This may include an incentive such as grocery store gift cards or Farmer's Market coupons for completion of the questionnaire. Would a greater return rate of post-intervention surveys have affected the results of the analysis?

- Exploring a way to scan parents or guardians in this type of research. Pairing the parent's or guardian's scan with their child's scan scores could greatly contribute to the body of knowledge in this area. Would the parents/guardians of the children who exhibited positive differences in their scan scores also have positive increases in their scan scores? Are parents tasting and eating with their children when they are out of school, at home and when eating away from home?
- Consider replication of this research in other school settings. Would other children, such as those not in a Head Start preschool setting, show an increase in scan scores and fruit and vegetable intake? Do other preschool settings encourage tasting and family style meals and snacks? What impact, if any, does this type of classroom structure have on intake, attitude towards fruits and vegetables, and trying unknown foods or items disliked in the past?
- Explore and describe a method with less error of measurement and bias to examine actual intakes of family's home consumption of fruits and vegetables. Would using pictures of meals and snacks provide a more accurate idea of what is consumed in the homes of the children? Would photos allow for more reliable ideas of home intake? What other validated instruments are available for such use?
- Explore and further refine the factors in the Theory of Planned Behavior that were acted upon in this research. Would manipulation of other factors have made an impact on scan results? What other factors might have impacted intention of the subjects beyond the access and education treatments offered?

- Consider how the Social Cognitive Theory may also play a role in this type of research. Role modeling and imitation appears to be a valuable factor in the success of this type of research. Teachers of the Head Start classes and the SNAP-Ed staff appear to make an impression on the children's willingness to taste and consume the foods being offered. Do these theories work in tandem to contribute to the foundation of this type of educational information dissemination?

## Recommendations for Practice

Based upon the study findings and associated literature review, the researcher suggests the following recommendations for practice.

- Further design and develop nutrition interventions that use quantitative evidence-based research to support impactful program dissemination. Legislators and program funders continue to request documentation of effective dissemination of nutrition programs. Through evidence and research based findings, those in the positions to make decisions about funding see the true need of these programs and the impact that they have the potential to create.
- Educate and motivate, through explanation of the study findings, about the need for high quality programming by those that deliver nutritional programming. Explain the importance that was discovered of the need for meaningful and high quality experiential based programming. The inclusion of tastings and hands on learning opportunities appeared to make a difference in the learning, attitude,

intention, and behavior changes that the subjects adopted post- nutrition education and intervention.

- Emphasize the components that constitute effective nutrition education for those delivering the nutrition materials. Six factors that Share Our Strength (S.O.S.) (2016), a federal non-profit agency, published are listed below. This list of items compiled from a consensus of nutrition experts who shared what, per their experiences, constituted effective nutrition education. S.O.S. defined effective nutrition education as education that moves one beyond knowledge into behavior that leads to change and is sustainable.

These include:

1) A focus on behaviors rather than knowledge or awareness.

Start by planning from the inception of the program, with the end goal of creating impactful programming that leads to the adoption of behavior change, is the suggested factor.

2) Active participation in the offered nutrition education.

Current literature shows that participants are more inclined to retain what is shown, practiced, and applied as opposed to solely discussed. Doing the proposed activity appears to have more impact than telling or showing.

3) Taking barriers, motivations, needs, perceptions, and desires of the targeted groups into consideration.

Delving into the participant's self-determinates to generate programming which aligns with the barriers and challenges of the group, allows for prescriptive and inclusive meaningful program delivery.

4) Self–assessment and feedback.

Through an understanding of program delivery and how participants are impacted, programming can continue to be strongly implemented or strengthened if need be, with an emphasis on quality program outcomes and objectives.

5) Application of appropriate theoretical framework.

Programming is more likely to make a sustained behavior change if conducted with a target population using specific objectives tied to a foundation of theoretical underpinnings.

6) Measurement and evaluation of programming.

Quantitative, valid, and accurate measurement of programming is critical to program improvement as well as sustaining programming for the future.

- Collaborate and connect with sustained food provision agencies, such as Food Banks and Food Pantries. Working in tandem with those who influence the foods utilized for distribution and the opportunities for accompanying education, examine the findings of this study to allow for changes and improvements.

Examining the importance of healthy food provisions coupled with engaging education and the success discovered through this research, positive and potential improvements to procedures and policies could be made. This would encompass what was learned about consumption, the importance of education, and other lessons learned.

## Conclusions

Experiences with food at a young age may affect lifelong food choices and overall health and wellbeing (Kim, 2014). Researchers have postulated that by offering appealing and accessible fruits and vegetables at every opportunity, in addition to using hands-on learning techniques, such as growing, tasting, and preparation of fruits and vegetables, preschool children will be well positioned to improve their fruit and vegetable intake (Williams et al., 2014). Establishing long term healthy eating patterns, utilizing access with education, beginning with young children has been shown via this research conducted in the Head Start setting, to have potential value.

The United States Department of Agriculture suggests that fruit and vegetable variety introduced through positive and engaging activities may increase the chance that children as young as preschool age will taste and consume a variety of health promoting fruits and vegetables (United States Department of Agriculture, 2016b).

The gaps in the current literature (Aguilar, Wengreen, Lefevre, Madden, & Gast, 2014) show that knowledge and intention have been measured sporadically in preschool children regarding fruit, vegetable, and healthy intakes, but behavior change and true application of the knowledge have rarely been investigated and are more difficult to measure. Children are difficult to gather reliable intake information from, and other than invasive serum measures, few valid and reliable quantitative methods have been available to show a relationship between interventions or treatments and impacts and behavior changes (Aguilar et al., 2014).

This study demonstrated a relationship between self-reported fruit and vegetable intake and quantitative BioPhotonic Scanner™ scores. Scanner scores were increased in both the access and the access with education clusters of children who received fruit and vegetable provisions. Additionally, the self-reported intakes of fruits and vegetables were reported to have increased in both the children as well as their parents. This was most notable between the access with education cluster versus the control cluster, although significance was also noted between the access cluster and the control cluster as shown in ANOVA testing.

This approach of providing fruits and vegetables to low resourced families helps to demonstrate the importance of education supplementing the provisions of fruits and vegetables. Subjects who were provided with information on how to prepare and use such provisions appeared more inclined to utilize the items, resulting in an increased carotenoid level as evidenced by said scan score results. Results of this study will be useful to demonstrate to legislators and program funders the importance of education along with produce provisions for those in need. Taste testing, hands-on experiential learning, recipe and newsletter type educational information is shown to change the behavior and consumption in persons receiving such interventions.

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# Appendix A: Survey Instrument

This survey was collected from all consenting parents at baseline and at the conclusion of the study, eight weeks. Parents completed this survey when they picked up or dropped off their children, at orientation meetings conducted by the Head Start staff or at other progress meetings that Head Start offers. This survey was chosen from the Compendium of Surveys for Fruit and Vegetable Consumption and Physical Activity. These instruments were a compilation generated by The Network for a Healthy California's Research and Evaluation Unit, housed in the California Department of Public Health. Questions were believed to align with the study purpose and theoretical framework. The research team will guide the participants by reading the questions and clarifying and answering any questions the participants may ask.

**End of Study- Time Critical Data**
**Availability Survey- Fruit, Juice & Vegetables At Home**
**Please complete and return as soon as possible**

1. Gender: Child M F

2. Age of Child? ______

3. Does anyone in the home smoke? Y N

4. Does your child take a multivitamin? Y N

   What brand? ______________________________

5. Number of people living in the home? ____________

**Did you have any of the following fruits or vegetables in your home during the past week? <u>How many times in the last week</u> did you eat any of the following fruits or vegetables? These could be consumed at home or away from home.**
Fruits and vegetables can be fresh, frozen, canned, or dried.

Please check all that apply. ☑

| | **Yes** | **No** | **# Times eaten Adult** | **# Times eaten Child** |
|---|---|---|---|---|
| Apples | ☐ | ☐ | | |
| Asparagus | ☐ | ☐ | | |
| Bananas | ☐ | ☐ | | |
| Broccoli | ☐ | ☐ | | |

| | | | | |
|---|---|---|---|---|
| Cabbage | ☐ | ☐ | | |
| Carrots | ☐ | ☐ | | |
| Corn | ☐ | ☐ | | |
| Grapes | ☐ | ☐ | | |
| Greens | ☐ | ☐ | | |
| Green beans | ☐ | ☐ | | |
| Mango | ☐ | ☐ | | |
| Melon | ☐ | ☐ | | |
| Oranges | ☐ | ☐ | | |
| Peaches | ☐ | ☐ | | |
| Peas | ☐ | ☐ | | |
| Pears | ☐ | ☐ | | |
| Peppers | ☐ | ☐ | | |
| Pineapple | ☐ | ☐ | | |
| Plums | ☐ | ☐ | | |
| Potatoes (not French fries) | ☐ | ☐ | | |
| Raisins | ☐ | ☐ | | |
| Squash | ☐ | ☐ | | |
| Sweet Potatoes | ☐ | ☐ | | |
| Tomatoes | ☐ | ☐ | | |
| Other | ☐ | ☐ | | |

**Did you have any 100% fruit or vegetable juices in your home during the past week? How many times in the last week did you drink any of the following fruit or vegetable juices? These may have been consumed at home or away from home.**

It may have been fresh, frozen, or canned.

Please check all that apply. ☑

| | Yes | No | Glasses drank Adult | Glasses drank Child |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 100% Apple | ☐ | ☐ | | |
| 100% Grape | ☐ | ☐ | | |
| 100% Grapefruit | ☐ | ☐ | | |
| 100% Orange | ☐ | ☐ | | |
| 100% Tomato | ☐ | ☐ | | |
| Other including smoothies made from fruits or vegetables | ☐ | ☐ | | |

## Do you ever receive free produce from any of these locations?

☐ St. Paul's Episcopal Church-Produce Market

☐ The Salvation Army-Produce Market

☐ St. Paul's Lutheran Church-Produce Market

☐ Kirkpatrick Food Pantry-Produce

Did you use the produce sent home each week? Yes No

Which, if any, produce did you **NOT** use:

- Sweet Potatoes
- Carrots (fresh)
- Carrots (canned)
- Pumpkin
- Tomato Sauce
- Squash
- Mango

If you did not use a certain produce, give a brief explanation of why you did not use that produce.

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

_______________________________________________________________________________

**Appendix B: Letter of Device Training**

UtahStateUniversity

DEPARTMENT OF NUTRITION, DIETETICS & FOOD SCIENCES

**August 17, 2016 Graduate Committee**

**Dear Committee Members,**

**I had the pleasure of working with Liz Smith on June 16 at Utah State University Center for Human Nutrition Studies in the Department of Nutrition, Dietetics, and Food Sciences. I trained her on using the Pharmanex BioPhotonic Scanner, Everest 2 and 3. She was able to accurately use the devices and was able to verbalize the protocol that we use when using the devices.**

**Please feel free to contact me with any further questions.**

**Sincerely,**

Sheryl Aguilar

**Sheryl Aguilar, MS, RD, COE**
**Professional Practice Assistant Professor, NDFS Senior Research Dietitian, CHNS**
**Utah State University Sheryl.aguilar@usu.edu**

Appendix C: Weekly Head Start Menu

| Type | Component | Minimum Serving | Monday | Tuesday | Wednesday | Thursday |
|---|---|---|---|---|---|---|
| Breakfast | Milk fluid | ¾ cup | 6 oz 1% milk | 6 oz 1% milk | 6 oz 1% milk | 6 oz 1% milk |
| | Juice, Fruit Or Vegetable | ½ cup | 4 oz applejuice | Peaches | 4 oz strawberry banana juice | 4 oz pineapple juice |
| | Grains, Breads Dry cereal | ½ slice 1/3 cup or ½ oz | 1/3 C Kix Cereal | Breakfast Burritio | 1/3 C Life cereal | Whole grain mini bagel w/jam or cream cheese |
| Lunch | Meat or meat alternate | 1 ½ oz | Meatloaf | Chicken patty sandwich | Salisbury steak w/gravy | Spaghetti w/meatballs |
| | Grains, Breads,Pasta, Noodles | ½ slice ¼ cup | Whole grain roll Butter | Whole grain bun Ketchup | Slice wheat bread Butter | Whole grain garlic cheese toast |
| | Fruit and/or vegetable and/or juice (2 servings total) | ½ cup total | ¼ C corn<br><br>¼ C applesauce | ¼ C green beans<br><br>¼ C diced pears | ¼ C canned sweet potatoes<br>¼ C tropical fruit | ¼ C mixed salad w/ ranch dressing<br>¼ C pineapple |
| | Milk fluid | ¾ cup | 6 oz 1% milk | 6 oz 1% milk | 6 oz 1% milk | 6 oz 1% milk |
| Snack | Milk fluid | ½ cup | 4 oz 1% milk | 4 oz apple juice | 4 oz grape juice | 4 oz 1% milk |
| | Juice, fruit or vegetable | ½ cup | | | | |
| | Grains/ Breads, Dry Cereal | ½ slice 1/3 cup | Whole grain animal crackers | Cucumbers w/ hummus or ranch | Whole grain giant goldfish graham crackers | Apples in the bag |
| | Meat or meat alternate | ½ oz | | | | |

# Appendix D: Pumpkin Pudding recipe

OHIO STATE UNIVERSITY EXTENSION

# Recipe

| | |
|---|---|
| Prep Time: | |
| Cook Time: | |
| Serving Size: | 6 |

**Nutrients Per Serving:** Calories 120 , Protein 3 **g**, Carbohydrate 25 **g**, Dietary Fiber 2 **g**, Total Fat 1 **g**, Saturated Fat 1 **g**, Sodium 320 **mg**

County information

This recipe provided by the Ohio SNAP-Ed Nutrition Education Program

SNAP

Putting Healthy Food Within Reach

## Pumpkin Pudding

### INGREDIENTS

1 can pumpkin (15 oz, or 2 cups cooked mashed squash such as Hubbard)

2 teaspoons pumpkin pie spice (or 1 teaspoon cinnamon, 1/2 teaspoon ginger, 1/4 teaspoon nutmeg, and 1/4 teaspoon cloves)

1/8 teaspoon salt

1 1/2 cups milk (low-fat)

1 package vanilla pudding (instant, 3.5 oz (small box))

### DIRECTIONS

1. Remember to start by washing your hands. In a large bowl mix pumpkin, salt and pumpkin spice together.

2. Slowly stir in milk and mix well. Add instant pudding mix and stir for 2 minutes until it thickens. Refrigerate until serving time.

Oregon State University Cooperative Extension Service, Healthy Recipes

**Source:**

What's Cooking? USDA Mixing Bowl

For other healthy, low-cost recipes, visit *www.whatscooking.fns.usda.gov*

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# Appendix E: SNAP-Ed Newsletter

OHIO STATE UNIVERSITY EXTENSION

Brought to You by Ohio SNAP-Ed and the Ohio Expanded Food and Nutrition Education Program (EFNEP) Volume 4 Issue 3

# NUTRITION AND YOU...SWEET POTATOES

## FOOD FOR THOUGHT

Sweet potatoes are one of the most nutritious foods from the vegetable group. The dark orange potatoes are sweeter than the yellow variety. Store sweet potatoes in a cool, dark place, not the refrigerator. They can be baked, broiled, fried, grilled, microwaved, roasted or steamed.
Sweet potatoes keep most of their nutrients when cooked in their skin.

*Note: 1 large sweet potato provides 1 cup of your daily vegetable requirement*

## SHOP SMART

In Ohio, locally grown sweet potatoes are available from September to December and in April and May. Sweet potatoes can be purchased year round.

## EAT HEALTHY

**Sweet Potatoes are:**

- Low in calories
- High in Vitamins A and C
- Fat free
- High in dietary fiber with skin
- Cholesterol free
- Low in sodium
- A good source of potassium

## KEEP IT SAFE

These food safety tips will help protect you and your family:

- Wash hands for 20 seconds with hot water (as hot at you can stand) and soap before and after preparing food.
- Wash sweet potatoes under cold running water before peeling or cutting them.
- Cut away damaged or bruised areas. Discard sweet potatoes that look spoiled.

Your Local Story here:

**18 pt Arial Bold Headline**

Text in 11 pt. Arial Regular

THE OHIO STATE UNIVERSITY

COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

COLLEGE OF EDUCATION AND HUMAN ECOLOGY

FAMILY AND CONSUMER SCIENCES

## RECIPE

**Sweet Potato Patties**

**Ingredients:**

- 3 sweet potatoes
- 1 cup crushed dry bread crumbs
- 1 Tablespoon vegetable oil

**Instructions:**

1. Wash the sweet potatoes.
2. Cook the sweet potatoes in a microwave until they are soft.
3. Remove the peels from the sweet potatoes.
4. Put the sweet potatoes in a medium bowl. Mash them with a fork.
5. Crush the bread crumbs on a cutting board with a rolling pin or jar.
6. Put the crushed bread crumbs in a small bowl.
7. Shape sweet potato into 6 small patties.
8. Roll each patty in the crushed crumbs.

**Nutrition Facts: Sweet Potato Patties**

Cost Per Recipe: $ 1.60 — Per Serving: $ 0.26
Serving Size: 1 patty — (1/6 of recipe)
Calories: 150 — Calories from Fat: 30

| Per Serving | % Daily Value |
|---|---|
| Total Fat – 3.5 g | 5% |
| Saturated Fat – 0 g | 0% |
| Dietary Fiber – 3 g | 12% |
| Sodium – 170 mg | 7% |
| Sugars – 4 g | |
| Protein – 3 g | |

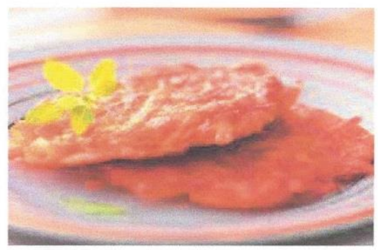
*Percent daily value Based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your caloric needs.

Note: For variety, add some finely chopped apple to the mashed sweet potatoes before shaping them into patties.

9. Heat the oil in a frying pan on medium heat.
10. Brown each patty on both sides in the oil.

## FOCUS ON FITNESS

Fun activities can be anything you and your family enjoy. They may range from team sports, individual sports, or recreational activities such as walking, running, skating, bicycling, swimming, playground activities, and free-time play.
Have you heard the phrase "Go take a hike?" Why not make it a family activity? Any time of the year is great for a hike in the woods. Many state parks have walking trails to enjoy. State parks may have planned nature hikes on weekends.
For more information about activities in Ohio go to: www.dnr.state.oh.us/parks



## REMEMBER:

Use MyPlate to select a variety of foods for the family.

## REFERENCES


- The Recipe Finder. SNAP-Ed Connection recipefinder.nal.usda.gov/
- United States Department of Agriculture, ChooseMyPlate choosemyplate.gov
- The Wellness Encyclopedia of Food and Nutrition, The University of California at Berkeley, 1992



Revised 12-2015.
This material funded by USDA-Food & Nutrition Service's Supplemental Nutrition Assistance Program (SNAP), Ohio Food Assistance Program Grant/Contract ODJFS Grant Agreement G-1213-17-0612, October 1, 2012-June 30, 2013

# Appendix F: List of Amount of Alpha and Beta Carotene and Lycopene in Food Provisions

## (Groups B & C)

Week 1

| | |
|---|---|
| 2 large sweet potatoes | 52.4 mg. B-carotene |
| 2 apples | |
| butternut squash | 2.8 mgs. Alpha carotene<br>11.4 mg. Beta carotene<br>5.8mg lutein & zeaxanthin |
| 1 can carrots | 11.8 mg Alpha carotene<br>26 mg B-carotene<br>.6 mg B-cryptoxanthin |
| Total | 110.8 mg mixed carotenoids |

Week 2

| | |
|---|---|
| 2 large sweet potatoes | 52.4 mg. B-carotene |
| 3 large fresh carrots | 12.6 mg. Alpha carotene<br>30.6 mg B-carotene |
| 1 can of pumpkin | 23.4 mg Alpha<br>34 mg B-carotene<br>7.2 mg. B- Cryptoxanthin<br>5.0 mg lutein & zeaxanthin |
| Total | 165.2 mg. mixed carotenoids |

Week 3

| | |
|---|---|
| 2 large sweet potatoes | 52.4 mg. B-carotene |
| 1 can carrots | 11.8 mg Alpha carotene<br>26 mg B-carotene<br>.6mg B-cryptoxanthin |
| 2 cans tomato sauce | 109 mg. lycopene |
| Total | 199.8 mg mixed carotenoids |

Week 4

| | |
|---|---|
| 5 small sweet potatoes | 52.4 mg. B-carotene |
| 3 large fresh carrots | 12.6 mg alpha carotene<br>30.6 mg B-carotenoid |
| 1 can of pumpkin | 23.4 mg Alpha<br>34 mg B-carotene<br>7.2 mg. B- Cryptoxanthin<br>5.0 mg lutein & zeaxanthin |
| Total | 165.2 mg. mixed carotenoids |

Week 5

| | |
|---|---|
| 5 small sweet potatoes | 52.4 mg B-carotene |
| 1 can of carrots | 11.8 mg Alpha carotene<br>26 mg B-carotene<br>.6mg B-cryptoxanthin |
| 2 small cans of tomato sauce | 109 mg. lycopene |
| Total | 199.8 mg mixed carotenoids |

Week 6

| | |
|---|---|
| 1 can of pumpkin | 23.4 mg Alpha<br>34 mg B-carotene<br>7.2 mg. B- Cryptoxanthin<br>5.0 mg lutein & zeaxanthin |
| 5 small sweet potatoes | 52.4 mg B-carotene |
| 1 can of carrots | 11.8 mg Alpha carotene<br>26 mg B-carotene<br>.6mg B-cryptoxanthin |
| mango | |
| Total | 160.4 mg mixed carotenoids |

Week 7

| | |
|---|---|
| 5 small sweet potatoes | 52.4 mg B-carotene |
| 1 can of carrots | 11.8 mg Alpha carotene<br>26 mg B-carotene<br>.6mg B-cryptoxanthin |
| 2 small cans of tomato sauce | 109 mg. lycopene |
| 1 can of pumpkin | 23.4 mg Alpha<br>34 mg B-carotene<br>7.2 mg. B- Cryptoxanthin<br>5.0 mg lutein & zeaxanthin |
| Total | 269.4 mg. mixed carotenoids |

Week 8

| | |
|---|---|
| 5 small sweet potatoes | 52.4 mg B-carotene |
| 1 can of carrots | 11.8 mg Alpha carotene<br>26 mg B-carotene<br>.6mg B-cryptoxanthin |
| 1 can of pumpkin | 23.4 mg Alpha<br>34 mg B-carotene<br>7.2 mg. B- Cryptoxanthin<br>5.0 mg lutein & zeaxanthin |
| Total | 160.4 mg. mixed carotenoids |

# Appendix G: Foods made for Classroom Education

Week 1- comparison of raw carrots, cooked carrots, and a Beta Carotene carrot muffin

Week 2- pumpkin bars

Week 3- made sweet potato applesauce cookies

Week 4- mangos, watermelon, peaches and pumpkin dip

Week 5- had vegetable soup and smoothies

vegetable soup had sweet potatoes, carrots, salsa, and tomato sauce as well as mixed vegetables

smoothies contained peaches and mangos with V-8 carrot mango juice

Week 6- made pumpkin pudding and smoothies

Week 7- made mashed sweet potatoes and smoothies

Week 8- made pumpkin pudding and smoothies

incentive was a small fruit or vegetable serving size box with a carrot muffin as a snack