THE INFLUENCE OF CHILD AND PARENT HEALTH LITERACY STATUS ON HEALTH OUTCOMES FROM A CHILDHOOD OBESITY TREATMENT PROGRAM

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Thesis submitted to the faculty of the Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of

Masters of Science

In

Human Nutrition, Foods and Exercise

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April 22nd, 2016
Blacksburg, VA

Keywords: Health Literacy, Health Numeracy, Health Outcomes, Dietary Quality, Obesity Treatment

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ABSTRACT

While limited health literacy has been associated with poorer health decisions and poorer health outcomes, there remains a gap in the literature related to the influence of health literacy on weight and weight-related behaviors. The primary aim of this study is to examine the influence of child and parent health literacy status on child's body mass index (BMI) and health behaviors, within an adapted evidence-based family-based childhood obesity intervention, iChoose, implemented in the medically underserved Dan River Region (DRR). Previously developed measures were used to assess health literacy and health behaviors. iChoose consisted of 101-parent-child dyads. Using the New Vital Sign (NVS), 46% of children and 13% of parents had low to limited health literacy levels at baseline. Younger children and parents who were African American, had no high school diploma, and earned <$25,000/year were significantly more likely to have low health literacy when compared to their counterparts. Health literacy levels for these individuals ranged between 0 to 3, which is considered low to limited health literacy. Health literacy levels were further examined between health outcomes. However, BMI, fruit and vegetable intake, sugar-sweetened beverages (SSB), minutes of moderate to vigorous physical activity, and screen time did not differ by health literacy levels at baseline. Among children, improvements in the NVS was significantly correlated with decreases in SSB consumption (r = -.275, p < .05), but with no other outcomes. There were no significant correlations among changes in parent NVS score and changes in child health behaviors. Results from this study fill a gap in understanding the associations in health literacy and weight and weight-related behavioral outcomes in children. It also provides insights into the opportunities and challenges in measuring health literacy among children. Future research is

needed to explore further health literacy measurement issues among children and the influence of both child and parent health literacy in family-based childhood obesity treatment efforts. Additional efforts are also needed to assist community and health care providers in finding more effective strategies to guide children with low health literacy to better health outcomes.

Acknowledgements

First, I would like to thank my Lord and Savior Jesus Christ for presenting me with the opportunity to be a graduate student in the Department of Human Nutrition, Foods and Exercise at Virginia Tech. I would especially like to thank Dr. Randy Grayson for granting me the George Washington Carver Assistantship and Dr. Jamie Zoellner for mentoring me for the past two years in the Behavioral Lab. In addition to your mentorship, I want to thank you for believing in me more than I believe in myself. Your guidance and confidence in me throughout my tenure is something that will resonate with me for a lifetime.

I would also like to thank my committee, Dr. Paul Estabrooks, Dr. Jennie Hill and Dr. Wen You, for your unwavering support, encouragement, and valuable advice. Each of you provided an essential component to this project. Through your guidance and support, you helped me obtain a better insight to what it takes to become a better researcher, and I thank you. Additionally, I would like to thank Donna Brock, for your help as well. You were always available for my many and last minute questions. You didn't have a problem with talking me through points that I just couldn't get a grasp on. Your many cheers and motivational, "You got this!!" continuously pushed me to get through, and for that, I want to thank you. Also, I would like to thank my iChoose family. I know I came on the project a little later, but you all accepted me with open arms and great times.

Finally, I would like to thank my family and friends for their unconditional love and support throughout my graduate tenure. I would like to thank especially my mama and papa bear, Linda and Willie, my brothers, Yusuf, and Jermaine, and cousin, Taylor, I love you all more than words could ever explain and without you none of this would have been possible.

Thank you,

Aurielle Lowery

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Chapter 1: Literature Review

Introduction to Health Literacy and Health Numeracy

Health literacy has been recognized as a major leading health concern that has silently affected both adults and young children (Driessnack, Chung, Perkhounkova, & Hein, 2014). To date, it has been observed that approximately 80 million American adults are affected by low health literacy (Berkman, Sheridan, Donahue, Halpern, & Crotty, 2011). Health literacy has been defined as "the capacity to which individuals can obtain, process, and understand basic health information needed to make appropriate health decisions" (Chari, Warsh, Ketterer, Hossain, & Sharif, 2014).This definition assumes that individuals with adequate health literacy can make appropriate decisions for improving their health and well-being (R. Parker, 2000). Health literacy encompasses factors that include cognitive capacities, communication skills, decision-making capacity, cultural, social and policy influences (Chari et al., 2014). Individuals with low health literacy have been associated with poorer health outcomes leading to increased hospitalizations; greater use of emergency care; increased health care cost; decreased ability to demonstrate taking medications appropriately; and decreased ability to interpret labels and health care messages (Chew et al., 2008). Rates for inadequate health literacy are higher among the elderly (Osborn, Cavanaugh, Wallston, White, & Rothman, 2009) poor persons with less than a high school diploma (Berkman et al., 2011), publicly insured or uninsured individuals (Osborn et al., 2009), and/or members of a racial or ethnic minority group (Osborn et al., 2009; Paasche-Orlow, Parker, Gazmararian, Nielsen-Bohlman, & Rudd, 2005). (Osborn et al., 2009; Paasche-Orlow & Wolf, 2010). Recent studies have shown that poorer health literacy may explain some of the persistent socioeconomic inequality and racial disparities in health. It is imperative that individuals with limited health literacy are identified, so they can obtain literacy sensitive instructions needed to manage their medication(s) and chronic disease(s) (Baker, Williams, Parker, Gazmararian, & Nurss, 1999).

While researchers are now beginning to investigate the relationship between health literacy between the adult population, very little research has been done directly with the child population, leading to a significant gap in literature (DeWalt & Hink, 2009; Driessnack et al., 2014). It has been identified by the state national reading test that one in three children are reading below grade level (Sanders, Federico, Klass, Abrams, & Dreyer, 2009; Sanders, Shaw, Guez, Baur, & Rudd, 2009). This suggests that these children do not have the ability to comprehend information found in their textbooks and are at risk for falling behind (Davis et al., 2006; Sanders, Federico, et al., 2009). Additionally, children with inadequate health literacy are more likely to exhibit characteristics such as antisocial or aggressive behavior (Davis et al., 2006). Obtaining child health literacy research is critical due to the development of foundational behaviors, attitudes, and knowledge during childhood stages. It is the most detrimental point of care for assessment and intervention for improving health literacy before problematic health behaviors and attitudes develop (Sanders, Shaw, et al., 2009). Identifying low literacy could assist health professionals with screening for academic problems, markers for health risk behaviors, and identifying when to tailor health information is needed (Davis et al., 2006).

Another critical component needed to understand health information is health numeracy. Unfortunately, to date, health numeracy has no precise definition. However, health numeracy is commonly be defined as "the degree to which individuals have the capacity to access, process, interpret, communicate, and act on numerical, quantitative, graphical, biostatistical, and probabilistic health information needed to make effective health decisions" (Golbeck, Ahlers-Schmidt, Paschal, & Dismuke, 2005; Rothman, Montori, Cherrington, & Pignone, 2008).This definition recognizes the significance of health numeracy skills needed to interpret information effectively and communicate numeric concepts in terms of the individual's health (Golbeck et al., 2005). While research suggest that approximately 80 million Americans have poor health literacy, even more struggle with the ability to have adequate health numeracy skills. To date, The National Assessment of Adult Literacy found that more than 110 million Americans have

inadequate health numeracy skills, which means they did not have the ability to effectively solve a single operational math problem (Fagerlin et al., 2007; Mary M Huizinga et al., 2008).

Adequate health numeracy is a detrimental component to the understanding of quantitative information. Quantitative information plays a critical role in the informed decision-making making process, assisting individuals with the risk of their disease and the benefits of different treatment choices (Lipkus, Samsa, & Rimer, 2001; Schwartz, Woloshin, Black, & Welch, 1997). In recent research, researchers found a high correlation between health literacy and health numeracy (Cavanaugh et al., 2008; Rothman et al., 2008). While others have found that individuals can have adequate health literacy but still have inadequate health numeracy. (Cavanaugh et al., 2008; Rothman et al., 2008). For everyday life, adequate health numeracy skills are used for proper drug dosage (Mary M Huizinga et al., 2008), proper mixing of infant formula (Moon, Cheng, Patel, Baumhaft, & Scheidt, 1998), comprehension of food labels (Rothman et al., 2006; White, Wolff, Cavanaugh, & Rothman, 2010), diabetes self-management care (Al Sayah, Williams, & Johnson, 2012; Berkman et al., 2011; Nutbeam, 2008; White et al., 2010), weight management (Huizinga, Beech, Cavanaugh, Elasy, & Rothman, 2008), and understanding calorie intake and calorie expenditure (Mary Margaret Huizinga et al., 2008; Rothman et al., 2006).

For an individual to completely understand quantitative information, and function within the healthcare system they must have a range of abilities, which include basic, computational, analytical and statistical skills. These core competencies imply that the individual will be able to identify numbers and understand quantitative data (Golbeck et al., 2005). Computational health numeracy suggests that the individual should have the capacity to count, quantify, compute and use simple manipulation of numbers to function within the everyday lifestyle. Analytical skills implies that the individual's has the ability to understand basic graphs and statistical health numeracy, which focuses on the individual's ability to compare, and critically analyze information that consist of probability, proportions and percentages (Golbeck et al., 2005).

Understanding these core components could help individuals make better treatment decisions that are compatible with their health.

While health numeracy does play a vital role in understanding health-related information, there is little research that has examined parent or child health numeracy. Therefore, the remaining review of literature will focus on the understanding of child and parent health literacy on health behaviors and outcomes. Future research is needed to understand the role of health numeracy on child and parent health outcomes.

Health Literacy and the Role of Parental Health Literacy

Low health literacy is a significant problem that affects over half of caregivers (parents). Research has shown that parents with inadequate health literacy are 1.5 to 3 times likely to encounter in poorer health decisions, underutilize health resources, make unhealthy decisions, and have increased chronic diseases chances (Shin, Braun, & Inglehart, 2014). Low health literacy has been associated with poorer health behaviors such as increased household emergencies (Sanders, Shaw, et al., 2009), lower medical adherence, and lower awareness of the child's medical condition (Liechty, 2011). Also, longer hospital stays and greater use of the emergency department has been associated with parents with lower health literacy status' (Liechty, 2011). For a parent with inadequate health literacy skills, this can produce problems when applying health information or services to their children. Research suggest this is why parents with low health literacy are unlikely to have insurance and primary care providers for their children (Morrison, Myrvik, Brousseau, Hoffmann, & Stanley, 2013), and why they are unlikely to adhere to medical recommendations due to the inability to understand written information. For a parent to effectively care for a child, the parent must understand typical medication labels and health education materials given (Kumar et al., 2010).

The average English-speaking US adult reads at an 8th grade level (Shah, West, Bremmeyr, & Savoy-Moore, 2010). Unfortunately, a large portion of the healthcare material produced by the American Academy of Pediatrics (AAP) and the Center for Disease Control and Prevention (CDC), such as patient brochures, health questionnaires, pamphlets, health education material and consent forms are all written on a level at or above a tenth-grade level. This indicates that written materials exceed most parents reading levels (Kumar et al., 2010; Murphy, Davis, Long, Jackson, & Decker, 1993). Parents with low health literacy are often able to hide their deficiencies; therefore, problems with understanding instructions are often unrecognized by health care providers (Murphy et al., 1993). One possible way to identify if parents have low health literacy is to examine the extent to which they seek medical care for their child at the emergency department. This can happen due to the poor understanding of their child's illness, which could lead to seeking emergency care for non-urgent conditions (Morrison, Brousseau, Brazauskas, & Levas, 2015).

For a parent to provide optimal care for a child, adequate health literacy is strongly suggested (Emmerton et al., 2013). An excellent example of providing optimal care for a child is when the parent can interpret the child's symptoms and make a responsible decision on how to properly manage those symptoms. This will require the parent to know how to administer medication, select or calculate the appropriate dosage, and properly measure the dosage (Emmerton et al., 2013). Then the parent needs to figure out if the medicine requires repeated dosage at certain intervals, and if additional medical attention is needed (Emmerton et al., 2013). Parents who lack adequate health literacy will have difficulty carrying out this process, leading to the possibility of worsening health outcomes. There have been several articles in the literature that have recognized that parents who lack adequate health literacy have difficulty carry out this process, leading to the possibility of worsening child health outcomes. Examples include lower parental health literacy related to more severe child asthma symptoms (DeWalt, Dilling, Rosenthal, & Pignone, 2007); poorer dental disease status (Miller, Lee, DeWalt, & Vann,

2010); and increased depressive symptoms (Zaslow, Hair, Dion, Ahluwalia, & Sargent, 2001). Adequate health literacy is needed to understand the health care process and to make an effective health-related decision.

As stated before, in the health care setting, parents with inadequate health literacy have trouble with providing adequate health history. This can also affect the parent's ability to ask questions or engage in the medical decision-making process (Morrison, Chanmugathas, et al., 2014). Parents can mask their lack of understanding by displaying perceived parental efficacy. Perceived parental efficacy is the belief or judgment a parent holds of their capacity to organize adequately and execute the task related to parenting a child (Pulgarón et al., 2014). Later, this could lead to additional problems such as the parent's inability to understand how to follow suggested prevention methods or instructions at home. If the parent is unable to understand health information or instructions, they are less likely to follow suggested recommendations related to prevention (Heerman et al., 2014). Given that parents play a critical role in the child's health care, it is important to provide appropriate literacy sensitive health information needed to guide medical decision making, inform the decision process, and promote follow-up procedures for their child's medical status (Morrison et al., 2013). Adequate health literacy can improve health behaviors and outcomes for both the parent and the child.

Measurements of Health Literacy in Adults

The relationship between health literacy skills and one's health status is becoming more apparent within the health care system (Nutbeam, 2008). In previous years, most attempts to measure the individual's health literacy was directly captured by testing the individuals "functional literacy". Functional literacy is described as the ability to use reading, writing and computational skills at a level that can meet the needs of everyday life (Baker et al., 1999; R. Parker, 2000). It was later recognized that this approach was not an effective way to measure

the individual's ability to interpret health information. Therefore, the need to develop proper

screening instruments to identify inadequate health literacy individuals has emerged. Over the

course of 20 years, 51 instruments have been developed to measure health literacy. These 51

health measures include 26 general health literacy tools, 15 diseases or content-specific tools

(e.g., asthma, cancer, dentistry, genetics, vascular surgery, food label, Chinese health, Chinese

diabetes, diabetes, nutrition, HIV), and 10 instruments for specific populations (Haun, Valerio,

McCormack, Sørensen, & Paasche-Orlow, 2014). Although there are no gold standards for

measuring general health literacy, the most commonly used measurements include: the Test of

Functional Health Literacy in Adults (TOFHLA), the Short Test of Functional Health Literacy in

Adults (S-TOFHLA), and the Rapid Estimate of Adult Literacy in Medicine (REALM) (Berkman et

al., 2011) (R. Parker, 2000).

The TOFHLA is one of most frequently used instrument during health care research for

health literacy. The purpose of the TOFHLA is to test the individual's capacity to read passages

or phrases that contain material commonly used in the healthcare setting (R. M. Parker, Baker,

Williams, & Nurss, 1995). It is a 50-item reading comprehension and 17-item numerical ability

test, which takes about 18 to 22 minutes to administer (R. M. Parker et al., 1995). For the

reading comprehension assessment portion, individuals are provided with medical scenarios,

which include medical instructions on prescription labels, registration forms, and preparation for

a diagnostic procedure (R. M. Parker et al., 1995). Individuals are encouraged to read and

answer each medical scenario to the best of their ability.

The S-TOFHLA is a modified version of the TOFHLA health literacy assessment. S-

TOFHLA measures reading comprehension and numeracy and takes about 12 minutes or less

to administer (Baker et al., 1999). It contains a 36-item reading comprehension and 4-item

numeracy portion along with two prose passages (Baker et al., 1999). Results are distributed

into three categories based on a score ranging from 0 to 100 (Baker et al., 1999). A score of 0

to 53 indicates inadequate health literacy, 54 to 66 marginal health literacy and a score above 67 indicates adequate health literacy (Baker et al., 1999).

The REALM is a 66-item health related word recognition test that takes about two to three minutes to administer and score. The word list is arranged in order of increasing difficulty and measures a person's ability to read and correctly pronounce each word (Baker et al., 1999). The individual reads aloud each word while the examiner records the response on an individual test form (Murphy et al., 1993). Individuals are allowed five seconds for the pronunciation of each word before the examiner ask them to move to the next word (Murphy et al., 1993). Once reaching a point where no additional words can be read, individuals are allowed to go over remaining words on the list to determine whether they recognize any additional words (Murphy et al., 1993). If they are unable to recognize and pronounce, any of the additional words, the testing will then stop (Murphy et al., 1993). Scoring for REALM answers is based on placing a plus by each correct response, a check by an incorrect answer, and a minus by words not attempted (Murphy et al., 1993). REALM scoring ranges from 0 to 66. A score of 0 to 18 indicates a health literacy level at or below a 3rd grade reading level, 19 to 44 is a 4th to 6th grade reading level, 45 to 60 is a marginal health literacy that is equivalent to a 7th to 8th grade reading level, and 61 to 66 indicates an adequate health literacy and a 9th grade or above reading level (Murphy et al., 1993).

A newer measurement instrument, that has gained more use across America, is the Newest Vital Sign (NVS) developed by Weiss and colleagues (2005). The NVS is a clinical or research tool used for identifying adequate health literacy in adults (Driessnack et al., 2014). The NVS health literacy tool is developed from multiple scenarios and compounded into one. It takes about three to six minutes to complete and includes six questions based on a nutrition label on the back of a container of one pint of ice cream (Weiss et al., 2005). This six-item assessment requires individuals to have the fundamental ability to read and apply information from a nutritional label (Weiss et al., 2005). This includes performing simple mathematical

equations, such as addition and subtraction (Weiss et al., 2005). Of the six questions, four are numeracy related. The NVS results are categorized to identify individuals with low literacy and individuals unlikely to have low literacy (Weiss et al., 2005). Individuals with low to limited health literacy scores range from 0 to 1, possibility of limited health literacy range from 2 to 3, and individuals that are unlikely to have low literacy scores range from 4 to 6 (Weiss et al., 2005). While the REALM only assess health literacy, the TOFHLA, S-TOFHLA and NVS include both health and numeracy questions.

Measurements of Health Literacy in Children

To date, there is no instrument in literature designed to screen children for adequate or inadequate health literacy in the health care setting younger than 12 years of age (Sanders, Federico, et al., 2009). Nonetheless, there are a few studies that have assessed health literacy and numeracy in children younger than 12 years of age in the health care setting, using instruments such as the Slosson Oral Reading Test-Revised (SORT-R), The Rapid Estimate of Adult Literacy in Medicine-Teen (REALM-Teen), the Wide Range Achievement Test-Revised, 3rd Edition (WRAT-3) (Davis et al., 2006), and the NVS (Weiss et al., 2005) .

The SORT-R is a standardized reading recognition assessment that examines the individual's ability to correctly pronounce words at numerous levels of difficulty, pre-primer through ninth-grade level (Davis et al., 1991). The assessment has two hundred words that are then broken up into ten columns. The assessment takes approximately three minutes to give and score (Davis et al., 1991). Raw scores are then converted into reading grade levels. This can determine if the child is reading on grade level or below (Davis et al., 1991).

The Rapid Estimate of Adult Literacy in Medicine-Teen (REALM-Teen) is a reading recognition instrument modeled after the REALM. It is a health literacy tool that has been validated in young adult's ages 10 to 19 years old (Davis et al., 2006). REALM-TEEN consist of

66 medical terms organized in three columns, along with 22 words in each column. The words are placed in order of difficulty, with the words that are least difficult to pronounce placed at the top of the list (Davis et al., 2006). Individuals are asked to read words aloud and if they are unable to read the word, pronounced it incorrectly, or skipped the word, no credit is given. To receive credit, individuals would need to pronounce the word correctly according to Webster's Third New International Dictionary of English Language. The number of correctly pronounced words are then correlated to a reading grade level represents the total score. Scores can ranged from 0 to 66, which was then converted to four grade level ranges groups (Davis et al., 2006). Less than 3rd grade, 4th to 6th grade, 7th to 8th grade, and greater than 9th grade (Davis et al., 2006). Grade ranges are used to determine the degree to which the adolescent's health literacy was at, below, or above the self-reported grade level. REALM-Teen has highly correlated scores with the WRAT-3 and SORT-R (Davis et al., 2006).

As previously stated, WRAT-3 is a nationally validated reading recognition, spelling, and arithmetic computation screening instrument (Al Sayah et al., 2012). The reading recognition section comprise of 15 letters and 42 individual words (Al Sayah et al., 2012). The spelling test consist of 13 letters and 40 words (Al Sayah et al., 2012). The arithmetic component is broken up into two parts. Part one evaluates the individual's ability to count, read number symbols, and solve simple arithmetic equations. Part two consist of 40 arithmetic problems. The individual obtains three separate scores, which can range from 0 to 100.

The NVS is an evidence-based health literacy screening tool that includes a standardized Nutrition Facts label and six accompanying questions, that requires fundamental comprehension and numeracy skills (Weiss et al., 2005). The capacity of a person to read and analyze a nutrition label has been noted to parallel the conceptual and analytical skills needed to understand health-related content (Weiss et al., 2005). A major appeal of the NVS is that it can be completed in less than three minutes (Driessnack et al., 2014). The NVS has previously been used in as a clinical or research tool for identifying adequate health literacy in adults

(Driessnack et al., 2014). As previously noted, there are no instruments validated for screening adequate health literacy or numeracy in children less than the 12 years of age (Sanders, Federico, et al., 2009). However, research shows that the NVS has been used in children as young as seven (Chari et al., 2014; Driessnack et al., 2014). The simplicity of the NVS and its relevance in child health decision-making realm makes the NVS an appropriate tool to test reading and math computation in the pediatric population (Chari et al., 2014).

Limitations of Health Literacy Instruments

To date, there have been several standardized instruments used to test comprehensive health literacy; however, none define the fundamental principles of health literacy. Most instruments assess the individual's reading ability or word recognition of terminology used in the health care setting, but exclude the other components of health literacy, such as health numeracy skills, oral skills, and navigational skills. Of all the instruments developed, not one single tool fully captures an individual's ability to obtain, process and understand basic health information. For example, the Test of Functional Health in Adults (TOFHLA), the Short Test of Functional Health in Adults (S-TOFHLA), and Rapid Estimate of Adult Literacy in Medicine (REALM) are the most commonly used measurements for health literacy in the healthcare. However, TOFHLA and S-TOFHLA only focus on the individual's ability to interpret printed literacy. The TOFHLA and S-TOFHLA do not test the individual's ability to apply complex mathematical skills such as multi-step mathematical problems, probability, and problem-solving. These skills are needed to assist the individual in the risk of their disease and decision-making process (Lipkus et al., 2001; Rothman et al., 2008; Schwartz et al., 1997). It is very hard to determine if the individual can perform a complex numerical calculation or understand probability, and problem-solving equations needed to contrast different treatment outcomes when both TOFHLA and S-TOFHLA only test for simple mathematical calculations. Neither TOFHLA nor S-TOFHLA was intended to accurately measure the individual's ability to apply

complex numeracy skills, but were developed to examine the individual's ability to read fundamental numeracy language used in a medical setting. For example, examining if the individual had the capacity to read medicine instructions and understand how to properly take the medication based on the instructions given.

The REALM, REALM-Teen, and the Wide Range Achievement Test, 3RD Edition (WRAT-3) have similar gaps as the TOFHLA and S-TOFHLA. They are all word recognition test that examines the individual's ability to recognize, read, or pronounce individually isolated words. Word recognition assessments are unable to examine an individual's ability to comprehend the application of commonly used medical terms. Furthermore, these instruments do not examine the individual's quantitative literacy, which is very effective during the decision-making process.

For the remaining health literacy measurement tools, additional limitations include lengthy time to administer in busy settings, lack of research to support validity of the instrument, and lack of validation studies in representative samples. Also, there has been a limited number of studies conducted in the pediatric population meaning that there is no validated test tool that measures both reading comprehension and numeracy. The Newest Vital Sign (NVS) only tools that has been used to measure both literacy and numeracy in the pediatric population. The NVS uses a six question assessment and comprehension assessment based on a nutrition label on the back of a container of one-pint ice cream (Weiss et al., 2005). This will determine if the individual is health literate (Weiss et al., 2005). The six-item assessment requires the individual to read and apply information from a nutrition label. This includes performing simple mathematical equations, such as addition, subtraction, and percentages. Research has shown that children as young as seven years of age were able to complete the NVS. However, researchers have questioned NVS ability to assess children as young as seven when The National Curriculum Math Standards and Benchmarks revealed that calculating percentages are

bench markers for 5th-graders (typically 9 to 10 years of age) (Driessnack et al., 2014). This would make it very difficult for a seven-year-old to understand at least one of the questions.

Additional limitation includes different classified levels of health literacy. Some measures collapse individuals into three categories such as, inadequate, marginal and adequate while some assign individuals a particular grade or grade range equivalent to reading level. Diversity between health literacy tools has led to inconsistencies in measurements, which can complicate the researcher's ability to interpret the findings. In the future, there is a stronger need to develop a comprehensive assessment instrument to measure both health literacy and health numeracy. This could provide a better understanding of the individual's health status.

Health Literacy Related to Health Disparities

Understanding the cause of health disparities is a critical component for improving health and reducing social inequalities (Gordon-Larsen, Nelson, Page, & Popkin, 2006). There are a number of definitions in the literature to describe health disparities. Healthy People 2010 describe health disparities as "the differences that occur by gender, race or ethnicity, education or income, disability, living in rural localities or sexual orientation" (Cheng, Dreyer, & Jenkins, 2009). While others defined health disparities as "inequitable differences in health, health care and developmental outcomes that are potentially systematic and avoidable" (Cheng et al., 2009). Health disparities are higher among the elderly (Osborn et al., 2009), poor persons with less than a high school diploma (Berkman et al., 2011), publicly insured or uninsured (Osborn et al., 2009), low socioeconomic status (Morrison et al., 2015; Morrison et al., 2013), and/or members of a racial or ethnic minority group (Osborn et al., 2009; Paasche-Orlow & Wolf, 2010). Evidence suggests that neighborhood socioeconomic characteristics and proximity/access to recreational facilities also disproportionately affected individuals with low health literacy as well.

Over the past decades, an overarching goal of Healthy People 2010 and 2020 has been to reduce and eliminate health disparities (People, 2011; People & Services, 2000). Efforts to reduce and eliminate disparities have focused primarily on disease, illnesses and health care services. These efforts have shown to improve the health of adults and children. For adults, the efforts have focused on low educational attainment individuals, which in turn has been associated with health disparities. Research suggest that adults that have low educational attainment have difficulty understanding health-related information, especially if they have children (Kumar et al., 2010). Adults with low educational attainment may have trouble apply health information or services to their child. A large portion of child health information reads above an eighth-grade level, which may be too difficult for parents to understand (Kumar et al., 2010). For parents who may not understand their child illness, this can lead to seeking care for a non-urgent condition, inability to give complete medical history and are disengaged from the medical decision process (Morrison et al., 2015). Additionally, they'll likely have poorer access to preventive care services (Sanders, Shaw, et al., 2009). For children among parents with decreased health literacy, they are more susceptible to increased sugar-sweetened beverages consumption, screen time and physical inactivity that can lead to childhood obesity versus children of parents with adequate health literacy (Cluss et al., 2013). Recently studies have shown that parents' that have adequate health literacy skills are likely to have better health outcomes in their children (Sanders, Shaw, et al., 2009). Furthermore, of those studies, effective prevention strategies showed the ability to decrease health disparities (Sanders, Shaw, et al., 2009). Additional research is needed that addresses health promotion and literacy strategies that meet the health needs of children to bridge this gap. One way to increase the health literacy and reduce health disparities is through community health interventions that target communities of minority populations (Mullins, Blatt, Gbarayor, Yang, & Baquet, 2005). Health interventions have been shown to improve the quality of care, reduce health care cost, and eliminate health disparities (Mullins et al., 2005).

Trends in Health Behaviors and Health Outcomes

Increased Sugar-Sweetened Beverages Intake

The increased consumption of sugar-sweetened beverages (SSBs) may be a key factor in the rising epidemic of overweight and obesity. Over the past years, the high prevalence of SSBs has increased dramatically between the 1960's and early 2000's among all races/ethnicities, ages, and economic levels in America (Duffey & Popkin, 2007). Levels increased from 236 calories per day in 1965 to 458 calories per day in 2002 (Duffey & Popkin, 2007). Americans are consuming 150 to 300 more calories per day than they did 30 years prior, which significantly exceeds the daily recommended value (Chen et al., 2009). It is estimated that almost 50% of the increased daily caloric intake is coming from high consumptions of calorically sweetened beverages (Chen et al., 2009).

Additionally, energy intakes from those beverages represent 21% of total energy consumption (Chen et al., 2009). As a result of these astonishing statistics, the World Health Organization suggested that liquid sugars should not exceed more than 10% of dietary energy (Malik, Schulze, & Hu, 2006). For individuals who are unable to identify liquid sugars that could contribute to dietary energy, the 2010 Dietary Guidelines for Americans developed a clear definition for the better understanding. SSBs were defined as "beverages that are sweetened with sugars that can add calories, including but not limited to sucrose, high-fructose corn syrup, and glucose" (Kit, Fakhouri, Park, Nielsen, & Ogden, 2013). Examples of these beverages include but are not restricted to soft drinks, fruit drinks, sports drinks, sweetened coffee and teas, energy drinks, alcohol, and flavored milk (Kit et al., 2013). By 2001, soft drinks alone accounted for 9.2% of daily energy for a person older than two years of age (Drewnowski & Bellisle, 2007). Another 7.3% of energy was supplied from fruit juices and flavored milk (Drewnowski & Bellisle, 2007). Soft drinks are one of the leading sources of sugary liquids. Alone, an average 12-oz serving of soda provides 150 calories and 40 to 50 grams of sugar in

the form of high-fructose corn syrup (Malik et al., 2006). This is equivalent to 10 teaspoons of table sugar. Ingesting high levels of such dietary sugars have been linked to increased risk of dental caries and obesity, which can cause additional health concerns such as coronary heart disease (Fung et al., 2009), cardiovascular disease (CVD), diabetes (Schulze et al., 2004), metabolic syndrome (Malik et al., 2010), and non-alcoholic fatty liver disease (Lowndes et al., 2012).

Adults with lower health literacy and education level are more frequent SSB consumers (Zoellner et al., 2011). Additionally, adults among rural, low-socioeconomic status population consume higher SSB intake. Rates are increasingly higher among males compared to females (Zoellner et al., 2011). An average male consumes 178 calories per day from sugary drinks while a female consumes an average of 103 calories per day (Duffey & Popkin, 2007). For children, Non-Hispanic black children consume more SSB in relation to their other counterparts (Duffey & Popkin, 2007). Additionally, children who live in low-income regions consume more sugar drinks compared to children of higher income (Duffey & Popkin, 2007). In efforts to reduce health risk associated with increased SSBs, it is encouraged that both, adults and children reduce their consumption.

Health Literacy related to Sugar-Sweetened Beverages

Unfortunately, few studies have investigated the relationship between health literacy and SSB consumption in adults and none in children. Of the studies examined, most explore the relationship between health literacy and comprehension of food labeling (Rothman et al., 2006; White et al., 2010), and diabetes self-management care (Al Sayah et al., 2012; Berkman et al., 2011; Nutbeam, 2008; White et al., 2010), leaving a large gap that doesn't address the role of health literacy and beverage quality (SSBs). However, in one recent study conducted by Zoellner and colleagues, researchers finally began to investigate the role of adult health literacy skills related to SSB consumption (Zoellner et al., 2011). Using a cross-sectional survey design,

researchers collected data from a community-based proportional sample of adults residing in the rural lower Mississippi Delta region (Zoellner et al., 2011). Health literacy was assessed using the Newest Vital Sign and a dietary intake was assessed using a validated 158-item regional food-frequency questionnaire (FFQ) (Zoellner et al., 2011). Researchers collected data from 376 participants, whom the majority were African American (67.6%) (Zoellner et al., 2011). Researchers found that a vast majority of the participants (73.9%) scored in the lowest levels of the health literacy category (high likelihood of limited literacy skills and possibility of limited health literacy skills) (Zoellner et al., 2011). These scores were significantly predicted to SSB consumption (R^2=0.15; F=6.3; P<0.01) (Zoellner et al., 2011). A multivariate linear model indicated for every 1.21 points in a health literacy score, was directly connected to 34 or fewer kilocalories of SSBs per day (Zoellner et al., 2011).

Decreased Fruit and Vegetable Consumption

Fruit and vegetable consumption contribute essential nutrients needed to assist proper human development. Previous research has shown that fruit and vegetable consumption contribute to the lower risk of developing many chronic diseases such as cardiovascular disease and certain cancers (Pérez, 2002). Also, eating more fruits and vegetables helps manage body weight when consumed in place of more energy-dense foods (Moore et al., 2008). Low consumption of fruits and vegetables has been associated with increased physical inactivity, smoking, obesity, and alcohol-dependence (Pérez, 2002). In the United States, the average adult only consumes fruit about 1.1 times per day and vegetables about 1.6 times per day (Prevention-CDC, 2011). It is recommended that approximately 1.5 to 2.0 cups of fruit and 2 to 3 cups of vegetables daily are consumed (Prevention-CDC, 2011). In 2007-2010, more than half of the US population consumed less than one cup of fruit and 1.5 cups of vegetables daily (Moore et al., 2008). Approximately 76% and 87% did not meet the recommended fruit and vegetable intake (Moore et al., 2008). While fruit and vegetable consumption has significantly

impacted the adult population, research has suggested that the child population has been greatly affected as well (Prevention-CDC, 2011). It is recommended that on average that children obtain one to two cups of fruit and one to three cups of vegetables (Prevention-CDC, 2011). However, most children eat less than the recommended amount. According to the CDC in 2003 to 2004, children only ate about a quarter of a cup (0.24 cups) of whole fruit for every 1000 calories. By 2009 to 2010 they ate just under a half of a cup (0.40 cups) of whole fruit for every 1000 calories (Moore et al., 2008). Despite the fact children are beginning to consume more fruits, they are still eating less than the recommended intake.

Health Literacy related to Fruit and Vegetable consumption

To date, very little research that has examined the relationship between health literacy and fruit and vegetable consumption outcomes. Furthermore, there has been no research conducted on the child population. In a study conducted by von Wagner and colleagues, researchers measure the prevalence of functional health literacy in the associations with health behaviors (fruit and vegetable consumption, physical exercise and smoking) and self-rated health among adults. Health literacy was assessed using TOFHLA (Von Wagner, Knight, Steptoe, & Wardle, 2007). Researchers found that 11.4% (5.7% marginal and 5.7% inadequate) of participants had either marginal or inadequate health literacy (Von Wagner, Knight, Steptoe, & Wardle, 2007). These findings were also highly correlated with low fruit and vegetable consumption. Researchers found for every point higher on the health literacy scale increased the likelihood of the individual consuming at least five portions of fruits and vegetables a day (Von Wagner et al., 2007). For example, 29.3% of individuals with inadequate health literacy consumed more than five portions of fruits and vegetables a day. While 39% of marginal and 47.4% of adequate individuals received more than five portions of fruits and vegetables per day. This research showed that individuals that have higher health literacy obtain increased portions of fruits and vegetables per day (Von Wagner et al., 2007).

In a study conducted by Neuhouser and colleagues, researchers conducted a random-digit- dial telephone survey of 1,450 adults residing in Washington State. Researchers examine the association between demographic characteristics with nutrition label use, diet-related psychosocial factors, and health behaviors with nutrition label use (Neuhouser, Kristal, & Patterson, 1999). Researchers found that individuals who reported low-fat diets were able to understand food labels versus their counterparts (Neuhouser et al., 1999).

In another study conducted by Satia and colleagues, researchers explored the relationship of reading nutrition labels on food packages on improved food choices and healthful dietary practices. Researchers used an 11-page questionnaire to analyze demographic characteristics, lifestyle and behavior factors, diet-related psychosocial factors, dietary intake, and nutrition label use (Satia, Galanko, & Neuhouser, 2005). All data used were self-reported. Researchers found that individuals who read and understood food labels had higher fruit and vegetable consumption than individuals who did not understand food labels (Satia et al., 2005). Although these studies do not use a valid measure of health literacy, they suggest that individuals who were able to read and understand food labels made better choices which is related to increased intake of fruit and vegetable consumption.

Increased Screen Time

Increased sedentary behaviors have shown to be one of the contributing factors to the increased childhood obesity epidemic. Engaging in substantial amounts of screen time is a major activity that has influences sedentary behaviors of individuals of all ages, especially adolescents and children. Sedentary behaviors involve activities that do not take physical effort, this includes excessive television and computer usage (Wahi, Parkin, Beyene, Uleryk, & Birken, 2011). Research has indicated that the most prevalent form of sedentary behavior is time spent in front of a screen (screen time), which includes television, video games, videos (tapes or DVD), and computer usage (Wahi et al., 2011). Time spent engaging in screen time activities

distracts from important activities, such as physical activity and social development. In 2011, research suggested that approximately 1 in 4 children living in the United States watched an average of four hours per day (Prevention-CDC, 2011). Today, research shows that children eight years and over engage in an average of seven hours and eleven minutes of screen time per day, which will likely increase rapidly with age (Lanningham-Foster et al., 2006). According to the American Academy of Pediatrics (AAP), it is recommended that children should have no more than one to two hours of screen time per day (Prevention-CDC, 2011). Results show that children who spend two or more hours of screen time per day are most likely to experience delayed language development, aggressive behavior, and cigarette smoking (Prevention-CDC, 2011). Additional psychological difficulties include hyperactivity, emotional problems and engagement with peers has also been found (Lanningham-Foster et al., 2006). Academic challenges include lower grades and fewer books read. Studies have found that children who engage in reduced screen time can prevent obesity, behavioral problems, and improve overall school performance (Gortmaker et al., 1999).

Health Literacy related to increased screen time

To date, no known studies have focused on health literacy and screen time. Therefore, future research is needed in this area for both the adult and child populations.

Increased Physical Inactivity

Physical inactivity is a problem highly associated with the increasing rates of overweight and obesity. Engaging in regular physical activity has shown to improve your overall health while reducing your chances of chronic diseases. Decrease physical inactivity has been linked to the increased risk of cardiovascular disease, Type 2 Diabetes and metabolic syndrome, early death, and some cancers (Prevention-CDC, 2011). Advantages of engaging in physical activity

include weight management, muscle and bone strengthening, and emotional improvement (Prevention-CDC, 2011). However, despite the well-known benefits of physical activity, only one in five adults (21%) meet the 2008 Physical Activity Guidelines (Control & Prevention, 2001). It is recommended that adults engage in at least 150 minutes of moderate-intensity aerobic activity (Control & Prevention, 2001). Examples of moderate-intensity aerobic activity can include a brisk walk, water aerobics, bicycling, and general gardening. While physical inactivity has significantly impacted the adult population, research has suggested that the child population has been greatly affected as well. It is recommended that any persons less than 18 years of age obtain 420 minutes per week or 60 minutes per day (7 days a week) of moderate-intensity physical activity (Control & Prevention, 2001). Less than a third of students in grades 9 through 12 (high school) meet the physical activity guidelines. It is suggested that, even less in middle and elementary school are meeting the recommended guidelines.

Health Literacy related to Physical Activity

There has been a major gap in the literature that has examined the relationship between health literacy and physical activity in adults. Furthermore, to date, there has been no recent studies that have explored the relationship between health literacy and physical activity within the child population. Of the few studies conducted, recent literature suggests that individuals with limited health literacy are linked to poorer physical activity outcomes. However, the relationship of how health literacy and physical activity is related remains unclear. In one study conducted by Wolf and colleagues, researchers collected information from 2,923 adults on health literacy and behaviors. Health literacy was measured using the S-TOFHLA (Wolf, Gazmararian, & Baker, 2007). The health behaviors focused on self-reports of current and past cigarette smoking status, alcohol, physical activity and seat belt usage (Wolf et al., 2007). Researchers found that individuals with limited health literacy (38.2%) were more prone to

engaging in physical inactivity, which consist of more than one 20-minutes physical activity session per week compared to individuals with adequate health literacy (21.6%).

In a randomized controlled trial (RCT) conducted by Bickmore and colleagues, researchers obtained information from 263 participants within the Boston Medical Center on health literacy and physical activity. Health literacy was assessed using TOFHLA (Bickmore et al., 2013). Physical activity was assessed using a digital pedometer (HJ-720ITC, Omron Healthcare, Inc., Bannockburn, IL) (Bickmore et al., 2013). Researchers found that participants with adequate health literacy that participated in the physical activity intervention group did significantly better than individuals with inadequate health literacy (Bickmore et al., 2013).

Based on the literature, studies still have not indicated how the relationship between health literacy and physical activity causal pathways are related. Outcomes for each study are significantly similar. However, further research is necessary to determine their relationship. Previous studies indicated that research in the child population is severely needed due to developmental behaviors. Future advanced research is needed to understand the relationship between child's health literacy, and physical health activity behaviors and outcomes.

Increased Body Mass Index

The increased prevalence of overweight and obesity has gradually become a leading public health concern since the early 1960's. Overweight has previously been defined as having a body mass index (BMI) greater than or equal to 25.0 to 29.9. Obesity has been defined as having a BMI greater than or equal to 30. Class I obesity (BMI 30.0-34.9) Class II obesity (BMI 34.9-39.9) and Class III obesity (BMI ≥ 40.0) describe significant classes of obesity. BMI is calculated as weight (kg) divided by height (m) squared (Flegal, Carroll, Kuczmarski, & Johnson, 1998). As your BMI increases, so does your risk for cardiovascular disease (CVD), hypertension, diabetes, stroke, and certain cancers (Buttar, Li, & Ravi, 2005). While this these

obesity-related health risks have severely impacted individuals of all ethnicities, some individuals have been increasingly more affected than others. Research has shown that, Non-Hispanic blacks have the highest rates of obesity (47.8%), Hispanics (42.5%), non-Hispanic whites (32.6%), and non-Hispanic Asians (10.8%) (Flegal et al., 1998). Additionally, obesity has increasingly affected middle-aged adults, aged 40 to 59 years old (39.5%) following older adults above 60 years old (35.4%), and younger adults age 20 to 39 years old (30.3%) (Flegal et al., 1998).The significant increase in obesity over the past decades has increased medical cost. It was estimated in 2008 that almost 147 billion dollars was contributed to the obesity-related medical cost (Flegal et al., 1998). That is $1,429 higher than individuals of normal weight (BMI 18.5-25) (Flegal et al., 1998). While the increase in overweight and obesity and has significantly affected the adult population research suggest that the child population has been affected as well. To date, the high prevalence of childhood obesity has estimated approximately one-third of US children to be overweight (>85th percentile) or obese (> 95th percentile) (Ogden, Carroll, Kit, & Flegal, 2014). In 2012, researcher found that 34.2% of boys and girls between the ages of 6 to 12 were classified as overweight or obese (Ogden et al., 2014). Increased weight gain in children increases chances for weight gain during adolescences and adulthood, which could lead to increased risk for other health complications (Bellg et al., 2004).

Currently, there is no single or simple solution to decrease this ongoing obesity epidemic. However, efforts to reduce the obesity risk have focused on decreasing SSB consumption, screen time, and physical inactivity (Cluss et al., 2013).

Health Literacy related to Body Mass Index

Unfortunately, to date, there has been very little studies that have investigated the relationship between health literacy and BMI in the adult and especially in the child population. Of the studies conducted within the adult population, a vast majority of research focuses on the elder population. The research in the child population focuses on the parental health literacy to

determine the child health outcomes (BMI) versus the child individual health literacy. Among the studies conducted, the relationship between health literacy and BMI relationship remains very unclear. In one cross-sectional study conducted by Rothman and colleagues, investigators examine the effects of the patient's comprehension of food labels, along with the relationship of their underlying literacy and numeracy skills (Rothman et al., 2006). Literacy was assessed using REALM and numeracy was assessed using WRAT-3. 200 primary care patients was assessed, and researchers found that 75% of patients had less than a high school education, 77% had 9th-grade literacy skills, and 37% had 9th-grade math skills (Rothman et al., 2006). While the majority of the patients had health literacy skill above a 9th-grade reading level, which is relatively high, on average 69% of the food-label questions were answered incorrectly. Poor health outcomes were highly correlated to low health literacy and health numeracy. This study also demonstrated that patients with high health literacy can still have difficulty with their health numeracy skills.

In one recent study conducted in the child population by Sharif and Blank (2010), researchers explored the relationship between child health literacy and BMI Z-scores in overweight children using a cross-sectional survey. Health literacy was assessed using the Short Test of Functional Health Literacy (S-TOFHLA) and a linear regression tested for predictors of childhood BMI Z-score, adjusting for confounders (Sharif & Blank, 2010). Researchers found that child health literacy was negatively correlated with BMI Z-scores ($r =$ -0.37, $p = 0.0009$) in overweight children, suggesting that the reason why is because health literacy is the intersection between self-efficacy and behavior change when designing interventions that aim to improve BMI.

Both studies examine the relationship between health literacy and BMI. However, both studies receive different outcomes. In the future, further research is needed to determine the relationship between health literacy and BMI within the adult and child population.

Application of a Health Literacy Framework in the Treatment of Childhood Obesity

There has been only one known study that has applied a health literacy framework into the treatment of childhood obesity. In this study, Sanders and colleagues explored the effectiveness of low literacy, primary care intervention on the reduction of early childhood obesity (Sanders, Perrin, Yin, Bronaugh, & Rothman, 2014). Using a cluster randomized controlled trial design, researcher's collected data from an academic-medical-centered-based pediatric primary care clinic within the diverse areas of the eastern United States, with two sites (New York University/Bellevue Hospital and University of Miami/Jackson Memorial Hospital), serving higher population-density communities, and two sites from a less dense communities (Vanderbilt and University of Chapel Hill) (Sanders et al., 2014). Health literacy was assessed at baseline with the S-TOFHLA, and the pediatric-specific health literacy skills with the pediatric health literacy assessment test (Sanders et al., 2014). The study was primarily used to inform evidenced-based principles for early child obesity prevention using a health literacy approach and the findings have not been released.

Clearly, there remains a large gap in the literature that investigates the relationship between health literacy in the treatment of childhood obesity and other health-related outcomes. While there are few trials that address effective treatment strategies that using a health literacy sensitive approach, additional research is needed to explore the relationship between health literacy and future treatment strategies (Sanders et al., 2014).

Aims and Hypotheses

In order to understand the relationship between health literacy research in children, the aims of this research are:

1. To describe the baseline health literacy levels of *i*Choose children (by age) and parents using the Newest Vital Sign.

- We anticipate that children and parents will have a higher prevalence of limited health literacy as compared to other studies

2. To test the baseline relationship between *i*Choose children and parents' health literacy status.

- We hypothesize that children and parents' health literacy levels will be positively correlated.

3a. To examine how child and parent *baseline* health literacy status influences child's *baseline* BMI and self-reported behaviors including fruit and vegetable intake, sugar-sweetened beverages, minutes of moderate to vigorous physical activity, and screen time.

- ▪ We hypothesize that children with low health literacy will have higher BMI and less healthy self-reported behaviors including fruit and vegetable intake, sugar-sweetened beverages, minutes of moderate to vigorous physical activity, and screen time.

- ▪ We hypothesize that parents with low health literacy will have children with higher BMI and less healthy self-reported behaviors including fruit and vegetable intake, sugar-sweetened beverages, minutes of moderate to vigorous physical activity, and screen time.

3b. To explore how child and parents' *baseline* health literacy status *influences 0-3 month* changes in child's BMI and self-reported behaviors including fruit and vegetable intake, sugar-sweetened beverages, minutes of moderate to vigorous physical activity, and screen time.

- ▪ We hypothesize that children and parents' with adequate health literacy skills at *baseline* will experience greater 0-3 improvements in BMI and self-reported behaviors including fruit and vegetable intake, sugar-sweetened beverages, minutes of moderate to vigorous physical activity, and screen time (as compared to child and parents with limited health literacy at baseline).

4a. To describe the 0-3 month changes in the health literacy levels of *i*Choose children and parents.

- ▪ We hypothesize that child and parent health literacy status will improve from baseline to follow up.

4b. To explore how *0-3 month changes* in children and parents' health literacy status correlates with *0-3 month changes* in child's BMI and self-reported behaviors including fruit and vegetable

intake, sugar-sweetened beverages, minutes of moderate to vigorous physical activity, and

screen time.

- We hypothesize a positive correlation between improvements in child

    and parents' health literacy and improvements in child's BMI and self-

    reported behaviors including fruit and vegetable intake, sugar-

    sweetened beverages, minutes of moderate to vigorous physical

    activity, and screen time.

Chapter 2: The Influence of Child and Parent Health Literacy Status on Health Outcomes from a Childhood Obesity Treatment Program

Introduction

Rates for inadequate health literacy are steadily increasing causing major problems within the United States for both adult and young children. Individuals with inadequate health literacy are at increased risk for poorer health outcomes (Chew et al., 2008). Risk factors are increasingly higher for children and parents with inadequate health literacy. For parent's, problems can occur when applying health information for their child or themselves. If the parent is unable to understand common medical language, medical labels, and health education materials, it is likely they will not be able to effectively care for a child (Kumar et al., 2010). Furthermore, their child will be more susceptible to increased health concerns such as increased sugar-sweetened beverage consumption, increased screen time viewing, and decreased physical activity, which can lead to childhood obesity (Cluss et al., 2013).

While research has shown a strong link between health literacy related to health behaviors, researchers are now beginning to investigate the role of health numeracy as it relates to health behaviors and outcomes. Having fundamental health numeracy skills is pivotal to understand quantitative information, such as during the informed decision-making process. Both, health literacy, and health numeracy are often overlooked pertaining to the prevention, healthcare, and treatment process within the health care field. It is important to gain a better understanding of the relationship that health literacy and health numeracy have on the individual's health behaviors because it may play a vital role in the influence of their health decisions and health outcomes.

While most health literacy research focuses on the adult population, there remains a large gap in the literature that explores the relationship between health literacy and health behaviors and outcomes among the child population. It is suggested that one in three children are reading below grade level (Sanders, Federico, et al., 2009). This implies that these children

not only lack the fundamental ability to comprehend information found in their textbooks, but are most likely having trouble understanding the fundamental health-related material as well (Sanders, Federico, et al., 2009). Providing assessment and intervention during early childhood stages are important due to the development of foundational behaviors and attitudes (Driessnack et al., 2014). Children as young as four years old are making unsupervised decisions that can influence their individual health outcome (Chari et al., 2014). Children spend a substantial amount of their day at school and after school programs where they regularly have the opportunity to make independent decisions about their food and drink consumption (Chari et al., 2014). It is imperative to identify children who have inadequate health literacy and health numeracy to gain a better understanding and assist with current and future health behaviors and health outcomes.

Health disparities have been increasingly higher among; racial/ethnic minorities groups (Berkman et al., 2011); poorer persons with less than a high school diploma (Berkman et al., 2011); publicly insured or uninsured individuals (Osborn et al., 2009); and individuals with low socioeconomic status' (Morrison et al., 2015; Morrison et al., 2013). These same rates are disproportionately higher among individuals with inadequate health literacy and numeracy as well. Individuals among health-disparate regions are more susceptible to increased sugar-sweetened beverage consumption, increased screen time viewing, and decreased physical activity, which can ultimately lead to poorer health behaviors and outcomes. Research suggest one way to reduce health disparities is through evidence-based community health interventions (Mullins et al., 2005). Health interventions have been shown to improve the quality of care and reduce health care cost for families (Mullins et al., 2005).

In efforts to increase health literacy, health numeracy and decrease health disparities *i*Choose is a childhood obesity reduction and treatment program developed by the Virginia Polytechnic Institute and State University (Virginia Tech) Human Nutrition, Foods and Exercise Department (HNFE) and Partnering for Obesity Planning and Sustainability Community

Advisory Board (POPS-CAB) and implemented in the medically underserved Dan River Region. *i*Choose was an adapted from a previous evidence-based childhood obesity program, "Bright Bodies" (Jacobs, Jones, Gabella, Spring, & Brownson, 2012). The adapted 3-month family-based program was implemented using a participatory research approach. *i*Choose focuses on teaching families' alternatives ways to eat healthier while encouraging participants to incorporate physical activity into their daily lifestyle to attain a healthier weight.

Using 0-3 month data from the iChoose program, the primary aims of this research are to (1) describe the baseline health literacy and health numeracy levels of *i*Choose children (by age) and parents using the Newest Vital Sign (NVS); (2) describe the baseline relationship between *i*Choose children and parents health literacy status; (3) examine how child and parent baseline health literacy status influences child's baseline body mass index (BMI) and self-reported behaviors including fruit and vegetable intake, sugar-sweetened beverages, minutes of moderate to vigorous physical activity, and screen time; (4) explore children and parents' baseline health literacy status influences 0-3 month changes in child's BMI and self-reported behaviors including fruit and vegetable intake, sugar-sweetened beverages, minutes of moderate to vigorous physical activity and screen time; (5) describe the 0-3 month changes in the health literacy levels of *i*Choose children and parents; and (6) explore how 0-3 month changes in child and parent health literacy status correlate with 0-3 month changes in BMI and self-reported behaviors including fruit and vegetable intake, sugar-sweetened beverages, minutes of moderate to vigorous physical activity, and screen time.

Target Population

The *i*Choose evidence-based family-based obesity prevention program targets the Dan River Region, which is a federally designated medically underserved area. The Dan River Region is located in South Central Virginia and North-Central North Carolina. The Dan River

Region counties include Pittsylvania County, Henry County and Caswell County, which is positioned in North Carolina. Among the three counties, the total population is approximately 140,000 persons. The Dan River Region is known to suffer from health and economic disparities. According to Virginia foundation for healthy youth annual report, approximately one-third of the population does not have medical insurance. The Dan River Region is one of the most health disparate regions in the Commonwealth with increased rates of unemployment, low rates of educational attainment and increased levels of poverty (Statistics, 2008). Only nine percent of the population received a bachelor's degree or higher, which is below the national level (Statistics, 2008). In addition, 17% of the population lives on an income below 25,000, which is less than the Federal Poverty Level.

Recruitment and Eligibility

A number of recruitment strategies were used to gain participants of the *i*Choose program. First, physicians from the local Children's Healthcare Center (CHC) and Pittsylvania Danville Public Health District (PDHD) scanned their medical records to identify children that met the program eligibility criteria. CHC and PDHD then mailed an *i*Choose invitation letter and program brochure that informed the potential participants about the program. Approximately one week later, trained staff members contacted and screened the families who showed interest in participating. These telephone calls determined if families met the qualifications to be included in the program. Additional recruitment strategies included, approximately 2,000 letters were sent to Danville Elementary Schools, Westover Christian Academy, and Sacred Heart. Also, about 50 Flyers were sent to various health care providers in the region, and flyers were posted in several Parks and Recreation facilities. Advertisements were published in the Register and Bee, Star Tribune, and the Piedmont Shopper.

The inclusion criteria for *i*Choose included persons that live in the Dan River Region, English-speaking, 8-12 years of age, and a BMI percentile ranking in the 85% or higher. Exclusion criteria included children with major cognitive impairment, and parents or children with contraindications for physical activity. Also, concurrent participation in a childhood obesity treatment program were omitted from this program.

Study Design

iChoose was selected and adapted by using the National Cancer Institute's "Using What Works" adoption guide (Jacobs et al., 2012). This guide was used to determine an appropriate evidence base intervention process. After three programs had been reviewed including theTraffic Light Diet (Epstein, Valoski, Wing, & McCurley, 1994), the Home Environmental Change Model (Golan, Kaufman, & Shahar, 2006), and Bright Bodies (Savoye et al., 2005), the POPS-CAB members found Bright Bodies (BB) to be most appealing. BB is an evidence-based family-based obesity intervention program. It incorporates healthy eating and physical activity, using physical activity sessions, and educational material that focus on both the caregiver and child. Components, such as program objectives from BB was used to guide the iChoose learning objectives. iChoose, also incorporates health literacy concepts, such as [Aurielle to fill in]. During the program, all participants were invited to attend six classes that emphasis on nutrition education, goal setting, and exercise. Group physical activity classes were offered Tuesday, Thursday, and every other Saturday. iChoose newsletters were sent out to encourage progress towards attaining a healthier lifestyle using fun activities and to reinforce content, and parents received bi-weekly telephone support using the teach-back and teach-to-goal strategies.

Program eligibility includes youth 8 to 12 years old with a body mass index (BMI) ≥ 85th percentile. Effectiveness data were evaluated at baseline and 3-month follow-up. Participants

received incentives for the assessments. At baseline, each participant (parent and child) received a $25 Walmart gift card, and at 3-month follow-up each participant received a $50 Walmart gift card.

Data Collection and Outcome Measurements

Data collection took place at City of Danville Parks & Recreation by trained staff members. The protocol was followed from the manual of procedures, which was developed under the planning grant. Trained researchers and staff members administered surveys and questionnaires orally. Self-reported physical activity behaviors were evaluated using the Godin Leisure-Time Exercise Questionnaire (Godin & Shephard, 1985). Godin Leisure-time total physical activity was collected and determine based on minutes active. Physical activity minutes active had to be greater than 15 minutes to be considered physically active. Fruit and vegetable consumption was assessed using the behavioral risk factor surveillance system (BRFSS), which is the six-item brief screening assessment tool (System, 2016). Fruit and vegetable total consumption was based on servings per day. SSB consumption was determined using a validated Beverage Questionnaire (Hedrick, Comber, Estabrooks, Savla, & Davy, 2010; Hedrick et al., 2012). Screen time was categorized for both television and video games were into 4 categories which included; zero identified as no screen time, one as 1 hour or less of screen time, two equaling 2-3 hours of screen time; and three equal to 4 or more hours of screen (System, 2016). Health literacy was evaluated using the NVS (Fagerlin et al., 2007; Weiss et al., 2005; Zikmund-Fisher, Smith, Ubel, & Fagerlin, 2007). NVS levels was scored based on NVS standards. A score of 0-1 suggest high likelihood of limited health literacy; 2-3 indicates the possibility of limited health literacy; and 4-6 almost always indicates adequate health literacy.

Data Analysis

All data was collect and coded according to valid standardized coding procedures. All analyses were conducted using SPSS the 22.0 version. Student researchers and staff member's quality assured to ensure the quality and integrity of the data collected. Descriptive statistics, including means, standard deviations, frequencies, correlations, ANOVA, independent paired t-test, and partial correlations. These descriptive statistics were used to explore the relationship between baseline health literacy levels of iChoose children and parents using the NVS. Additionally, it was used to explore the relationship between baseline iChoose children and parents' health literacy status. Bivariate analysis was used to investigate the relationship between how child and parent baseline and 0 to 3-month health literacy status may influence the child's baseline and 0 to 3 month BMI, and self-reported behaviors, which includes; (1) fruit and vegetable intake, (2) sugar-sweetened beverages, (3) minutes of moderate to vigorous physical activity; and (4) screen time.

Results

Demographics

Child and parent demographics of enrolled participants are reported in **Table A**. Of the 101 child participants enrolled, the majority were African-American (61.0%) males (51.0%) with a mean age of 9.78 (SD = 1.29). For the 94 enrolled parents, the majority were African American (59.0%) female (94.0%) with a mean age of 39.66 (SD = 8.84). Self-reports of parent educational status indicated that 12.0% had no high school diploma and 29.0% completed obtained high school diploma as their highest level of education, while 21.7% completed some college, and 36.9% completed college and/or graduate school. Reports of annual household income indicated that one half of participating parents made less than $25,000 per year, 28.0% made between $26,000 and $55,000 per year, and 22.0% made more than $55,000 per year.

Differences in Health Literacy Levels by Demographic Characteristics

The NVS levels range from 1 (low) to 6 (high), and the overall mean health literacy score found across among all children was 1.63 (SD = 1.25), which indicates that most children had low health literacy (**Table A**). Differences in health literacy scores were examined by demographic characteristics that include gender, race and age for children and gender, race, educational level and income for parents. For children, NVS scores were significantly different by age with a trend of 12-year-olds scores significantly higher (M = 2.33 SD =1.41) versus their counterparts which include; 8-year-olds (M = 1.06, SD = .97); 9-year-olds (M = 1.29, SD = .90); 10-year-olds (M = 2.06, SD = 1.66); and 11-year-olds (M = 1.85, SD = 1.20) (**Table A**) (p = 0.077). For children, health literacy was not significantly different by gender or race.

For parents, health literacy levels were not significantly different by gender, but were significantly different by race, educational level and income (p<0.001) (**Table A**). By race, baseline health literacy status for Caucasians (M = 4.89, SD = 1.37) were higher versus their African American (M = 3.49, SD = 1.86) and other counterparts (M = 1.00, SD = 1.00). By educational status, baseline health literacy levels for individuals with less than a high school degree (M = 1.91, SD = 1.45) and individuals with a high school degree (M = 3.41, SD = 1.89) scored significantly lower than individuals that obtain some form of college (M = 4.65, SD = 1.51). Similar to race and education, there was a significant difference among income levels. Individuals who made less than $25,000 per year (M = 1.59, SD = 1.09) scored moderately less than individuals who made between $26,000 and $55,000 (M = 1.79, SD = 1.50) and over $55,000 (M = 1.75, SD = 1.31) per year.

Differences in Health Literacy Levels by Age

Health literacy levels were categorized into three groups which include, low to limited health literacy (NVS = 0 to 1), the possibility of limited health literacy (NVS = 2 to 3), and

adequate health literacy (NVS = 4 to 6). By age, results indicated that 8-year-olds had higher levels of low to limited health literacy levels (66.0%), followed by 9-year-olds (57.0%), 10-year-olds (39.0%); 11-year-olds (33.0%), and 12-year-olds (22.0%) (**Table B**). Children between the ages of 10 to 12 (10-year-olds 17%, 11-year-olds 7%, and 12-year-olds 11%) had higher levels of adequate health literacy versus children under ten. Overall, 46.0% were classified as having low to limited health literacy, 48.0% as having the possibility of limited health literacy, and 6.0% as having adequate health literacy.

For the 94 participating parent's, over half were classified as having adequate to high health literacy levels (66.0%), following a 21.0% classified as having the possibility of limited health literacy, and 13.0% as having low to limited health literacy (**Table B**).

In the item-by-item analysis for the NVS (questions 1-6), it was observed that across all age groups, all children (ages 8 thru 12) struggled with items 1 thru 4, with only a small proportion of children (3-13%) answering those items correctly (**Table C**). This may be due to Items 1 thru 4 being considered as numeracy items (due to calculations) versus the reading comprehension items (Questions 5 and 6), which did not require calculations. Children scored better on questions 5 (78% correct) and 6 (52% correct) (**Table C**).

Parents also performed better on the reading comprehension (82-87% correct on questions 5-6), as compared to the numeracy items (38-69% correct on questions 1-4). The one question of the NVS that posed the most difficulty for the parents was item 4 that required calculating percentages, with only 38% answering this question correctly (**Table C**).

Correlation between children's baseline NVS and Child Age

A significant moderate positive correlation was found between children's baseline NVS scores and their age (r = .311, p = .002).

Correlation between Child Baseline Health Literacy and Parent Baseline Health Literacy

A parent-child dyads correlation test indicated a significant moderate positive relationship between baseline child and parent health literacy levels (r = .322, p = .001).

Differences in Health Literacy Status by Health Behaviors

As indicated in the **Table D-D.2**, BMI and health behaviors (i.e., fruit and vegetable intake, sugar-sweetened beverages, minutes of moderate to vigorous physical activity, and screen time) at baseline and follow-up were not significantly influenced by health literacy for children or parents. A further analysis of screen time (television and video games) indicated that child and parent baseline health literacy and screen time were not significantly related.

Health Literacy Levels of iChoose Children and Parents from Baseline to Follow-up

Differences in health literacy levels for children from baseline to follow up (3-months) indicated that majority maintained their health literacy scores (52.0%). The proportion of children who increased (26.0%) their health literacy status was nearly identical to those who decreased (22%) (**Table E - E.1**).

For parents, the majority maintained their health literacy scores (46.2%), followed by 39.0% who scores increased, and a small number who health literacy levels decreased (15.4%) (**Table F - F.1**).

Correlations of Health Literacy and Child BMI and Health Behaviors

Correlations among changes in health literacy (among children and parents) and changes in child BMI and child behaviors are illustrated in **Table G**. Among children, changes in

the NVS was significantly correlated with changes in SSB consumption (r = -.275, p < .05). This negative correlation supports Aim 4 hypothesis; health literacy status increases were significantly related to decreases in SSB consumption (r = -.275, p < .05). Aside from SSB, there were no significant correlations in change in child NVS and other health behaviors. Likewise, there were no significant correlations among changes in parent NVS score and changes in child health behaviors.

Discussion

Health literacy has primarily been researched and assessed in the adult population. There has been relatively little research assessing health literacy among the child population. To date, this is one of the first studies to investigate the health literacy of children between the ages of 8 to 12 and determine associations with weight and health-related outcomes such as SSB, fruit and vegetable, screen time, physical inactivity, and body mass index in a health disparate region.

For this study, health literacy levels were examined by demographic variables that included gender, race, and age for children. For parents, demographic variables included gender, race, educational attainment, and income. For children, health literacy levels differed by age, indicating 8-year-olds were more likely to have low to limited health literacy versus a 12-year-old child. This trend support the small body of health literacy literature conducted in similar studies with children between the ages of 7 to 12 (Chari, Warsh, Ketterer, Hossain, & Sharif, 2014; Driessnack, Chung, Perkhounkova, & Hein, 2014; Morrison, Schapira, Hoffmann, & Brousseau, 2014). For parents, health literacy levels significantly differed by race, educational attainment, and annual household income status. Results found that parents who were African American, had no high school diploma, and earned <$25,000/year were significantly more likely to have low health literacy when compared to their counterparts. These results support a body

of literature, which indicate race, educational attainment, and income level can influence health literacy level (Berkman et al., 2011; Kumar et al., 2010; Wolf et al., 2007).

As described in Aim one, we wanted to describe the baseline health literacy levels of iChoose children (by age) and parents using the newest vital sign (NVS). We anticipated that both child and parent would have a higher prevalence of limited health literacy versus other studies. Our findings indicated that of the enrolled iChoose participants, 94% of children and 34% of parents had low to limited health literacy (NVS <4). Our findings reveal that the prevalence of limited health literacy levels among children was higher when compared to other studies (Chari et al., 2014; Driessnack et al., 2014). However, for parents, our anticipated findings contradicted current literature. In previous studies conducted, researchers explored health literacy levels in parents using the NVS and found that health literacy levels range between 19% to 65% (Chari et al., 2014; Driessnack et al., 2014). Sociodemographic for these studies varied, however, results indicated across all studies reviewed the majority of participates only had a high school diploma or GED. Previous literature suggests that persons with less than a high school diploma or less are more likely to having adequate health literacy (Berkman, Sheridan, Donahue, Halpern, & Crotty, 2011). We can only assume that because over half (59%) of iChoose parents had some form of college education the prevalence of health literacy status was not as high when compared to other studies conducted (Chari et al., 2014; Driessnack et al., 2014; Morrison, Schapira, et al., 2014).

An item-by-item analysis revealed what questions were answered correctly on the NVS. The item-by-item analysis of child (by age) and parent health literacy indicated that of the parents and children that completed the NVS, the most incorrectly answered item was item four. Only 3% (n = 100) of children and 38% (n = 94) of parents correctly answered item four. This question required the individual to calculate percentages using information from a nutrition label on the back of a container of ice cream. In a study conducted by Hoffman and colleagues, researchers found that on a scale of negative 1 (extremely easy) to positive 6 (difficult) children

between the ages of 10 to 16 rated question 4 as one of the most difficult questions (3.25)

(Hoffman, Marsiglia, Lambert, & Porta, 2015). In another study conducted by Driessnack and

colleagues, researchers found that question four posed the most difficulty for parents and

children, with only 57% (n = 27) and 70% (n = 33) of children (ages 7 to 12) and parents

answering it correctly (Driessnack et al., 2014). For children under the age of ten, this item may

pose a problem. According to the National Curriculum Math Standards and Benchmarks

calculating percentages is a learning benchmark for 5th-graders who are typical between the

ages of 9 to 10 (Driessnack et al., 2014). For parents, it is unclear why most answered question

four incorrectly (Driessnack et al., 2014). In the same study conducted by Hoffman and

colleagues, researchers found that on a scale of negative 6 (extremely easy) to positive 6

(difficult), children between the ages of 10 to 16 rated question five (-4.23) and six (-1.96) easy,

which could be classified as comprehension questions because they do not require calculations

(Hoffman et al., 2015). Results also indicated that both child and parent in our study scored

better on the question 5 and 6. However, for some of our study participants, they were unable to

identify why the food was unsafe to eat resulting in question 6 being incorrect.

Further findings reveal a significant correlation between child's baseline NVS and child

age (r = .311, p = .002), and a significant correlation between child's baseline health literacy and

parents baseline health literacy r = .322, p = .001). These results indicate that the relationship

between child baseline health NVS and parents baseline health literacy were significantly

related, which is supported by several other research studies (Chari, Warsh, Ketterer, Hossain,

& Sharif, 2014; Driessnack et al., 2014).

Differences in child health literacy status related to child's BMI and self-reported health

behaviors indicated that there was no significant relationship, which contradicted our

hypothesis. While the relationship between child health literacy status and self-reported

behaviors such as sugar-sweetened beverages, fruit and vegetable consumption, screen time,

and physical inactivity, has not been thoroughly examined within the child population. However,

there has been a very few study that has begun to investigate the relationship between child health literacy status and BMI. In a study conducted by Sharif and Blank, researchers tested the relationship between child health literacy and BMI Z-scores in overweight children. Using a cross-sectional survey design, researchers collected data from 107 children ages 6 to 19 living near the inner-city academic health center in the Bronx, New York (Sharif & Blank, 2010). The study site was a community health center that predominately served a poor African American and Latino population (Sharif & Blank, 2010). Health literacy was assessed using the short test of functional health literacy (STOFHLA), and researchers found that child STOFHLA was negatively correlated with BMI Z-scores ($r = -0.37$, $p = 0.0009$) (Sharif & Blank, 2010). In a study conducted by Chari and colleagues, researchers tested the associated between child and adolescent obesity and parental health literacy (Chari et al., 2014). Using a cross-sectional survey, researchers surveyed 239 child-parent dyads living in the Philadelphia, PA, and Wilmington, DE, area (Chari et al., 2014). Children surveyed were between the ages of 7 to 11. Health literacy was assessed using the NVS, and researchers found that child obesity was significantly associated with parent obesity (Chari et al., 2014). For adolescent aged 12-19, researchers found that the odds of obesity were higher for adolescents with the lowest category NVS score and lower parental education (Chari et al., 2014). While this is the only known literature that has investigated the relationship between health literacy and BMI in the child population; future research is needed.

In our study, differences in parent health literacy status related to child's BMI and self-reported health behaviors indicated that there was no significant relationship, which also contradicted our hypothesis. There has been numerous studies that indicates parents with health literacy status can influence child health behaviors and outcomes (DeWalt, Dilling, Rosenthal, & Pignone, 2007; Zaslow, Hair, Dion, Ahluwalia, & Sargent, 2001). However, there are no studies that examine the relationship between parent health literacy status and child health behaviors such as sugar-sweetened beverages, fruit and vegetable consumption, screen

time, and physical inactivity. However, there have been one known study that have assessed the relationship between parent health literacy and child BMI. In one study conducted by Chari and colleagues, researchers tested the association between child and parental health literacy and odds of child obesity in children between the ages of 7 to 11 (Chari et al., 2014). Health literacy was assessed using the NVS, and researchers found that odds of childhood obesity decreased with higher parent NVS status. There remains a large gap in the literature that investigates the role of parental health literacy and child outcomes, results from this study can be used to add to that body of literature.

Results indicated that there was no statistically significant relationship between parent or child baseline health literacy status on BMI and self-reported health behaviors at follow-up (3-month), which was contradictory to our hypothesis. There remains a gap in the literature that examines the relationship between child and parent baseline health literacy and in child health outcomes. In a study conducted by Chari and colleges, her future implications direct researchers to evaluate the change in health literacy over time and related to health outcomes to see if health literacy or health outcomes can improve over time (Chari et al., 2014).

Analysis of enrolled parents and children health literacy levels from baseline to the 3-month follow-up indicated that the majority of children maintained their health literacy score (52%). The number of children who decreased (22%) was almost identical to those that increased (26%). For parents, the majority maintained (46%) their health literacy score as well, following 39% who increased, and 15% who decreased health literacy levels. It is unknown why some individual's health literacy levels regressed from baseline to follow-up. One possible assumption is that some health literacy scores were artificially inflated by correct guesses (yes or no) for question 5. If one was to consider rescoring question 5 by requiring both 5 and 6 to be correct, then in most cases, less than a third of individuals would get this question correct.

Findings for enrolled parents and child from baseline to follow-up in BMI and self-reported behaviors indicated that there was a statistically significant correlation between SSBs.

The negative correlation between health literacy status and SSB consumption showed that as health literacy status increases SSB consumption decreases, which supports our hypothesis. To date, there has only been one study that analyzes the relationship between health literacy and SSB consumption. In a study conducted by Zoellner and colleagues, researchers used a cross-sectional survey to examine health literacy skills in relation to SSB consumption in the adult population (Zoellner et al., 2011). Health literacy was assessed using the NVS, and researchers found that for every one point in health literacy scores was associated with 34 fewer kilocalories per day from SSBs (Zoellner et al., 2011). Researchers can use the results from this study to understand the effects of limited health literacy on dietary consumption.

There are a few limitations to the study. The first limitation is the unbalanced sample size. The sample size for the child health literacy group included 94 low to limited health literacy and 6 within the adequate health literacy group. Uneven groups could influence our inferences. Another limitation of this study is that it may not be generalizable. Study participants were primarily African-American, low-income, low health literate, and within a disadvantaged region. Findings of this study may only be applicable to individuals with similar characteristics. Another limitation to consider is the use of the NVS instrument in the child population. Even though the NVS is an evidence-based instrument that has been used in both the adult and child population, there has been uncertainty that the original "cut-off" would work well in the pediatric population (Morrison, Chanmugathas, et al., 2014; Morrison, Schapira, et al., 2014). The National Curriculum Math Standards and Benchmarks revealed that calculating percentages are bench markers for children aged 9 to 10-years old. This would make it very difficult for a child under ten to understand at least one of the questions. For this reason, we suggest, for our study to re-analyze NVS scores only looking at children aged 10 thru 12 to see if we examine increased health literacy scores. Another alternative strategy could include the re-categorization of limited and adequate health literacy for the population being studied (Morrison, Schapira, et al., 2014; Wolf, Feinglass, Thompson, & Baker, 2010) or a supplemental question for item four, for

children less than the age of ten. The implementation of these strategies could foster a better insight on health literacy and numeracy for children under the age of ten.

Practice Implications

Previous instruments used to determine adequate health literacy have primarily been investigated in the adult population (Haun et al., 2014). There have only been a few instruments used in the child population to determine adequate health literacy, and of the instruments used, most examine the child's ability to recognize words, spelling, or pronunciation (Haun et al., 2014). While these concepts are critical, they neglect to determine the child's ability to obtain, process and understand health-related information. The NVS is an evidence-based screening instrument for identifying inadequate health literacy. It contains a standardized nutrition facts label and six accompanying questions that require basic reading and numeracy skills. The ability to analyze a nutrition label has been noted to parallel conceptual and analytic skills needed to understand fundamental health-related instructions. While the NVS has been noted to be an effective instrument to use in the adult population, additional research or altered strategies will be needed for the proper implementation with in the child population. Altered strategies can include, but not limited to, re-categorizing health literacy categories or a supplemental question for item four, for children less than the age of ten (Morrison, Schapira, Hoffmann, & Brousseau, 2014; Wolf, Feinglass, Thompson, & Baker, 2010). These strategies can enhance the insight on health literacy and numeracy skills in children under the age of ten. If these alternative strategies are not considered, future research is needed to develop a health literacy instrument that is appropriate for children of different ages or under the age of ten. Developing an age appropriate instrument will provide future researchers with the ability to evaluate child health literacy independently of their parents.

Additionally, previous intervention strategies to decrease childhood obesity has focused

on the implementation of patient-centered communication, motivational interviewing and the patients' readiness for behavior change, specifically, shared-decision making, parenting skills training, food monitoring and follow-up (Chari et al., 2014). While these strategies are essential to prevention and treatment of childhood obesity during an intervention, these strategies neglect to consider individuals with inadequate health literacy. Inadequate health literacy has been associated with poorer health decisions and poorer outcomes, which may be a result of the individual's inability to engage in shared decision making and follow through on treatment recommendations. A common mistake that researchers and health care providers can make in communication is assuming the patient already is familiar with the information given, using jargon, and technical terminology while failing to evaluate their understanding. Based on this study it is recommended that future research integrates effective communication techniques such as plain language and clear communication to enhance the child and/or parent's ability to participant in shared-decision making (Chari et al., 2014). As one example, medical terminology should be replaced with words that people use every day in their conversation. Also, what is consider plain language to one cultural group may not be clear to another. Therefore, developing communication strategies that are culturally sensitive should be considered. As one example, use a health literacy tool that is provided in the individual's naïve language. Recommended intervention strategies should also include the teach-back method, which confirms understanding method (Chari et al., 2014). This will require for the individual to repeat back information to the provider they believe they have just heard. This will allow the health care provider to understand what the individual heard in their own words. Teach-to-goal strategies (reinforcement) are also suggested. This method allows for to confirm the understanding by improvement of health outcomes.

Conclusion

      This research suggested that child and parent health literacy status does not influence health behaviors such as BMI and self-reported behaviors including fruit and vegetable intake, sugar-sweetened beverages, minutes of moderate to vigorous physical activity, and screen time. There were only a few statistically significant demographic relationships found in this study. However, these results help fill a significant gap in the literature in regards to the increase prevalence of inadequate health literacy and weight-related clinical and behavior outcomes in the Dan River Region through an evidence-based treatment program. Additionally, this study provided results that evaluated child health literacy independently of their parents. Future research for iChoose should determine if program participation or attendance influences health literacy and self-reported behaviors. Also, if the program is extended to a 6-month or more if health literacy and self-reported behaviors would be influenced.

Table A: Differences in Child and Parent Health Literacy Scores by Child (n = 100) and Parent (n = 80 – 94) Demographics

		n (%)	Mean HL (SD) [c]	p value
Child (n = 100)[a]				
Gender	Male	51 (51%)	1.69 (1.45)	.649
	Female	49 (49%)	1.57 (1.02)	
Race	Black	61 (61%)	1.48 (1.89)	.294
	White	36 (36%)	1.89 (1.47)	
	Other	3 (3%)	1.67 (1.52)	
Age	8	18 (18%)	1.06 (.94)	.017 [d]
	9	28 (28%)	1.29 (.90)	
	10	18 (18%)	2.06 (1.66)	
	11	27 (27%)	1.85 (1.20)	
	12	9 (9%)	2.33 (1.41)	
Overall Age	8 - 12	100 (100%)	1.63 (1.25)	
Parent (n = 80 - 94)[b]				
Gender	Male	6 (6%)	3.67 (2.42)	.695
	Female	86 (93%)	3.98 (1.83)	
Race	Black	53 (58%)	3.49 (1.86)	.001[e]
	White	35 (39%)	4.89 (1.37)	
	Other	3 (3%)	1.00 (1.00)	
Educational Level	No High School Diploma	11 (12%)	1.91 (1.45)	.001[f]
	High School Diploma	27 (29%)	3.41 (1.89)	
	College	54 (59%)	4.65 (1.51)	
Income	Less than $25,000	39 (50%)	3.18 (1.89)	.001[g]
	$26K – $55,000	22 (28%)	4.18 (1.76)	
	More than $55K	17 (22%)	5.35 (.86)	

a. Due to missing data, n = 100 for children data instead of 101
b. Due to missing data, n = 80 – 94 for parent data
c. Mean Health Literacy (HL) range 1- 6 (1-2 High likelihood of limited HL; 3-4 Possibility of limited HL; 5-6 Adequate HL)
d. 8 years old < 12 years olds trending (p = 0.077)
e. Post Hoc Tukey test indicates significant difference between groups: Black vs. White (p = .001); Black vs. Other (p = .031); White vs. Other (p = .001)

Table B: Baseline Health Literacy Category among Children (by age) and Parents

	Low to Limited Health Literacy	Possibility of Limited Health Literacy	Adequate to High Health Literacy	Total n (%)
Child				
8	12 (66%)	6 (33%)	0 (0%)	18
9	16 (57%)	12 (43%)	0 (0%)	28
10	7 (39%)	8 (44%)	3 (17%)	18
11	9 (33%)	16 (59%)	2 (7%)	27
12	2 (22%)	6 (67%)	1 (11%)	9
Child Overall	**46 (46%)**	**48 (48%)**	**6 (6%)**	**100[a]**
Parent Overall	**12 (13%)**	**20 (21%)**	**62 (66%)**	**94**
a. Due to missing data, n = 100 for children data instead of 101				

Table C: Item by Item Analysis of the Newest Vital Sign (items 1-6) Questions Answered Correctly for Child (by age) and Parent

NVS items	8 n = 18	9 n = 28	10 n = 18	11 n = 27	12 n = 9	Child Overall n = 100[a]	Parent n = 94
1. If you eat the entire container, how many calories will you eat?	1 (6%)	2 (7%)	5 (28%)	3 (11%)	2 (22%)	13 (13%)	63 (67%)
2. If you are allowed to eat 60 grams of carbohydrate as a snack, how ice cream can you have?	1 (6%)	0 (0%)	4 (22%)	4 (15%)	1 (11%)	10 (10%)	65 (69%)
3. The doctor advises you to reduce the amount of saturated fat in your diet. You usually have a total of 42 grams of saturated fat each day, which includes one serving of ice cream. If you stop eating one serving of ice cream, how many grams of saturated fat would you be eating each day?	0 (0%)	0 (0%)	2 (11%)	2 (7%)	9 (33%)	7 (7%)	50 (53%)
4. If you usually eat 2500 calories in a day, what percentage of your daily value of calories will you be eating if you eat one serving?	0 (0%)	0 (0%)	1 (6%)	1 (4%)	1 (11%)	3 (3%)	36 (38%)
5. Pretend that you are allergic to the following substances: Penicillin, peanuts, latex gloves, and bee stings. Is it safe for you to eat this ice cream?	12 (67%)	22 (79%)	14 (78%)	23 (85%)	7 (78%)	78 (78%)	82 (87%)
6. If the respondent says no to 5, why not?	5 (28%)	12 (43%)	11 (61%)	17 (63%)	7 (78%)	52 (52%)	77 (82%)

a. Due to missing data, n = 100 for children data instead of 101

Table D: Differences in Child BMI and Health Behaviors by Child and Parent Health Literacy Status at Baseline

		Overall Mean (SD)[a]	Low to Limited Health Literacy [b]	Adequate to High Health Literacy [b]	p value
Child			**n = 94**	**n = 6**	
BMI, Z-Score	n = 100	1.91 (.46)	1.90 (.47)	2.06 (.30)	.395
F & V, Servings	n = 100	3.07 (2.45)	3.12 (2.50)	2.13 (1.41)	.337
SSB, Calories	n = 100	254.50 (255.03)	248.63 (253.63)	346.47 (283.76)	.365
MVPA, Minutes	n = 91	264.65 (1096.14)	273.71 (1126.80)	107.00 (59.12)	.743
Screen Time, Categories [c]					
Television	n = 100	1.74 (.84)	1.76 (.85)	1.50 (.55)	.471
Video Games	n = 100	1.30 (.84)	1.30 (.85)	1.17 (.75)	.714
Parent			**n = 32**	**n = 62**	
BMI, Score	n = 94	1.90 (.48)	1.85 (.55)	1.91 (.44)	.512
F & V, Servings	n = 93	3.07 (2.45)	3.57 (2.94)	2.81 (2.14)	.143
SSB, Calories	n = 93	258.67 (261.05)	261.36 (213.96)	257.26 (284.31)	.943
MVPA, Minutes	n = 86	151.52 (155.59)	124.29 (157.13)	165.58 (154.22)	.232
Screen Time, Categories [c]					
Television	n = 93	1.74 (.86)	1.84 (.92)	1.69 (.83)	.410
Video Games	n = 93	1.32 (.85)	1.56 (.98)	1.20 (.75)	.048

a. Mean Health Literacy (HL) range 1- 6
b. 1-4 Low to limited HL; 5-6 Adequate HL
c. Screen Time Categories; Television and Video Games: 0 = no screen time; 1 = < 1hr; 2 = 2-3hrs; 3 = > 4

Table D.1: Differences in Child BMI and Health Behaviors (Screen-Time) by Child and Parent Health Literacy Status at Baseline (Chi-Square)

	Low to Limited Health Literacy [a]	Adequate to High Health Literacy [a]	Chi Square
Child	**n = 94**	**n = 6**	
Television			
None	6	0	.522
< 1 Hour	30	3	
2-3 Hours	39	3	
> More than 4 Hours	19	0	
Video Games			
None	13	1	.749
< 1 Hour	51	3	
2-3 Hours	19	2	
> More than 4 Hours	11	0	
Parents	**n = 34**	**n = 66**	
Television			
None	2	4	
< 1 Hour	12	21	.434
2-3 Hours	11	31	
> More than 4 Hours	9	10	
Video Games			
None	5	9	.109
< 1 Hour	14	40	
2-3 Hours	8	12	
> More than 4 Hours	7	4	
a. 1-4 Low to limited HL; 5-6 Adequate HL			

Table D.2: Differences in Child BMI and Health Behaviors by Child and Parent Health Literacy Status at Follow-up (3-months)

		Overall Mean (SD)[a]	Low to Limited Health Literacy [b]	Adequate to High Health Literacy [b]	p value
Child			n = 60	n = 9	
BMI Z-Score, Change*	n = 75	- 0.05 (.13)	- 0.04 (0.19)	- 0.05 (0.08)	.866
F & V Change, Servings*	n = 69	- 0.08 (2.38)	- 0.02 (3.10)	0.02 (1.66)	.879
SSB Change, Calories*	n = 64	- 28.40 (39.84)	- 21.75 (50.08)	- 35.05 (29.59)	.562
MVPA Change, Minutes*	n = 59	78.80 (178.34)	47.59 (231.59)	110.00 (125.10)	.557
Screen Time, Categories [c]					
Television Change*	n = 69	- 0.20 (0.85)	- 0.22 (0.95)	- 0.17 (0.75)	.858
Video Games Change	n = 69	0.13 (0.93)	- 0.06 (0.97)	0.33 (0.52)	.326
Parent			n = 17	n = 52	
BMI Z-Score, Change*	n = 71	- 0.05 (.20)	- 0.06 (.24)	- 0.04 (0.16)	.824
F & V Change, Servings*	n = 69	- 0.16 (3.13)	- 0.18 (3.51)	- 0.15 (2.74)	.973
SSB Change, Calories*	n = 64	- 22.57 (48.78)	- 21.95 (47.78)	- 23.20 (49.79)	.925
MVPA Change, Minutes*	n = 59	50.46 (224.32)	40.95 (217.33)	59.97 (231.31)	.756
Screen Time, Categories [c]					
Television, Change*	n = 69	- 0.25 (0.93)	- 0.30 (0.93)	- 0.20 (0.93)	.649
Video Games, Change*	n = 69	- 0.05 (0.10)	- 0.13 (1.22)	0.02 (0.77)	.530

a. *Mean Health Literacy (HL) range 1- 6*
b. *1-4 Low to limited HL; 5-6 Adequate HL*
c. *Screen Time Categories; Television and Video Games: 0 = no screen time; 1 = < 1hr; 2 = 2-3hrs; 3 = > 4*
*. *Follow up Score (3-month) minus Baseline Score equal Change*

Table E: Proportion and Direction of Change in the Newest Vital Sign Score from Baseline to Follow-up among Children (3-months)

NVS Score (Child)	Change at 3-month (Follow-up)
Increased Score	18 (26%)
Maintained Score	36 (52%)
Decreased Score	15 (22%)

Table E.1: Child Change in Newest Vital Sign Score from Baseline to Follow-up (3-months)

		Child Baseline Health Literacy							Total
		.00	1.00	2.00	3.00	4.00	5.00	6.00	
Child Time 2 Health Literacy Score from NVS	.00	5	2	1	0	0	0	0	8
	1.00	2	12	7	0	0	0	0	21
	2.00	4	1	13	3	0	0	0	21
	3.00	2	1	3	2	1	1	0	10
	4.00	0	0	3	0	1	0	0	4
	5.00	0	1	0	1	0	2	0	4
	6.00	0	0	0	0	0	0	1	1
Total		13	17	27	6	2	3	1	69

Table F: Proportion and Direction of Change in the Newest Vital Sign Score from Baseline to Follow-up among Parents (3-months)

NVS Score (Parents)	Change at 3-month (Follow-up)
Increased Score	25 (39%)
Maintained Score	30 (46.2%)
Decreased Score	10 (15.4%)

Table F.1: Parent Change in Newest Vital Sign Score from Baseline to Follow-up (3-months)

Parent Baseline Health Literacy Score from NVS								
		Parent Baseline Health Literacy Score from NVS						Total
		.00	1.00	2.00	3.00	4.00	5.00	6.00	
Parent Time 2 Health Literacy Score from NVS	.00	2	0	1	0	0	0	0	3
	1.00	0	3	0	0	0	0	0	3
	2.00	0	3	0	0	0	0	0	3
	3.00	0	1	2	3	1	1	0	8
	4.00	0	0	1	1	4	1	3	10
	5.00	0	1	0	3	4	9	3	20
	6.00	0	0	1	1	2	7	11	22
Total		2	8	5	8	11	18	17	69

Table G: Change in Health Literacy over time (Baseline & Follow up; 3-months) in relation to Change in Child BMI and Health Behaviors

		Change Over Time BMI Z-Scores[#]	Change Over Time Fruit and Vegetables[#]	Change Over Time Sugar Sweetened Beverages[#]	Change Over Time Moderate to Vigorous Physical Activity[#]	Change Over Time Television[#]	Change Over Time Video Games[#]
Child Change Over Time NVS[#]	Pearson Correlation	-.076	-.112	**-.275[*]**	.170	.054	-.181
	N	69	69	64	59	69	69
Parent Change Over Time NVS[#]	Pearson Correlation	-.006	.134	.203	.092	-.064	.031
	N	69	68	63	58	68	68

[#]. Follow up Score (3-month) minus Baseline Score equal Change
[*]. Correlation is significant at the 0.05 level (2-tailed).

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