ABSTRACT

HOW FOOD INSECURITY IMPACTS THE HEALTH LITERACY
AND NUTRITION BEHAVIORS OF ADOLESCENT TEENS

By Arianna Nicole Mack

The purpose of this study was to investigate the relationship of nutrition behaviors and health literacy among adolescent teens who may be food insecure. The study explored adolescent teens' experiences with food insecurity and sought to describe the possible relationship between nutrition behaviors and the following two types of health literacies: functional health literacy and interactive health literacy. The participants for this study were adolescent teens that participated in a youth development initiative in Cleveland, OH. Teens that volunteered for the survey were given access to an online survey which was composed of four research instruments. These instruments measured food security status, asked for self-reported nutrition behaviors and demographic information, and asked questions related to reading ability, literacy environments, functional health literacy, and interactive health literacy. Data collected from the survey was assessed using independent t-tests and Chi-square tests to provide information on the magnitude of the association between food insecurity, nutritional behaviors, and health literacy. The findings indicated a strong relationship between food insecurity, reading ability, functional health literacy, and interactive health literacy.

HOW FOOD INSECURITY IMPACTS THE HEALTH LITERACY AND NUTRITION BEHAVIORS OF ADOLESCENT TEENS

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Chapter 1

Introduction

The problem to be investigated is the experience of food insecurity among adolescent teens in the midwestern United States. A potential need is to elaborate on the relationship of food insecurity, nutrition behaviors, and health literacy in the context of health equity. Therefore, the purpose of this study is to investigate the relationship of nutrition behaviors and health literacy among adolescent teens who may experience food insecurity.

This investigation examines the nutrition behaviors and health literacy of adolescents who are between the ages of 14 to 18 and whether they experience food insecurity. Food insecurity and low health literacy are associated with poor health outcomes which influence the ability of individuals to apply proper health practices in their everyday life behaviors (Dilley, Rettiganti, Christie, O'Brien, Patterson, Weeks, Aronson, Scurlock, Perry, Pesek, Bell, Kennedy, Chandler, Magee, Simmons, Chervinskiy, Casey, & Jones, 2019). The adolescent teen age group is critical to reach because teens from low-income families that experience inadequate access to healthy foods are more likely to engage in unhealthy behaviors that could determine the trajectories of their health (Simpson, Pedigo, & Hamdan, 2020). When teens do not have adequate access to food, they become less concerned about the future and focus on satisfying their immediate basic needs (Smith, Ward, Vancampfort, López-Sánchez, Yang, Grabovac, Jacob, Pizzol, Veronese, Shin, Lee, McDermott, & Koyanagi, 2021).

Social determinants of health are important to understanding health outcomes (Nutbeam & Lloyd, 2021) and why different populations may vary in levels of both food insecurity and health literacy. Food insecurity is a critical social determinant of health that is often affected by an individual's uncertain or limited physical, social, and economic access to nutritional foods (Dilley et al., 2019). This social determinant (food insecurity) is directly linked to health inequity where inequitable differences in the population are correlated to systemic conditions of economic and social inequality (Lee & Navarro, 2018). For this reason, food insecure persons tend to live in obesogenic environments that they are systematically placed in, and their food options tend to lead to poor health outcomes such as obesity and cardiovascular diseases (Myers, Martin, Newton, Apolzan, Arnold, Davis, Price-Haywood, & Katzmarzyk, 2019; Lee & Navarro, 2018). This systemic issue calls on interventionists and decision-makers to go beyond just providing food options, but ensuring that the options are healthy foods (Lee & Navarro, 2018). Healthier

eating consumption is related to higher levels of knowledge about nutrition and self-efficacy for healthier eating (McNamara, Mena, Neptune, & Parsons 2021).

A lack of nutritious food options in some geographical locations, combined with a low socioeconomic status, often contribute to the selection of cheaper, energy-dense foods instead of the selection of healthier foods such as fruits and vegetables (Simpson et al., 2020). Additionally, food insecurity can affect health through malnourishment, undernutrition, or overnutrition, which research has found to occur globally (Banerjee, Radak, Khubchandani, & Dunn, 2021; Smith et al., 2021). These poor health outcomes emphasize a need to understand health better among youth and the role that functional health literacy and interactive health literacy may play in nutrition behavior.

Health literacy is defined as "the degree to which an individual has the capacity to obtain, communicate, process, and understand health information and services in order to make appropriate health decisions" (Patient and Affordable Care Act of 2010, Title V). Poor health literacy is linked to increased hospitalizations and poor self-reported health status (Dilley et al., 2019). Health literacy has been studied from three different perspectives, e.g., functional, interactive, and critical (Nutbeam, 2000; Ubbes & Ausherman, 2018) and has been studied as a social determinant of health (Nutbeam & Lloyd, 2021). Adequate health literacy can lead to the maintenance of health literacy in different contexts (Truman, Bischoff, & Elliott, 2019).

Health educators need to place health equity at the center of their work and address how individual health outcomes are a result of inequitable processes (Lee & Navaro, 2018). To date, economic and social exclusion need to be addressed and incorporated into interventions that target food insecurity and poor health literacy. Low health literacy and food insecurity are critical health indicators in which poor health outcomes are likely to follow.

Culturally sensitive approaches for targeting food insecurity in schools and in community programming for youth are needed. Being knowledgeable of these relationships could create an opportunity for food insecure populations to be targeted with more expansive health education among food insecure populations.

The proposed study will explore how food insecurity negatively affects health literacy in later life. Ultimately, the hypothesis that food insecurity will be negatively related to health literacy in adolescent teens will help to improve the health literacy of food insecure populations and a need to improve access to healthy foods and ultimately better nutrition behaviors.

Definitions

Major concepts in the research are defined below:

Food insecurity is often affected by an individual's uncertain or limited physical, social, and economic access to nutritional foods (Begley, Paynter, Butcher, & Dhaliwal, 2019).

Functional health literacy is defined as one's ability to read, write, and speak about health (Ubbes & Ausherman, 2018).

Health literacy is defined as the degree to which an individual has the capacity to obtain, communicate, process, and understand health information and services in order to make appropriate health decisions (Patient and Affordable Care Act of 2010, Title V).

Interactive Health Literacy is defined as a more advanced cognitive and literacy skills which, together with social skills, can be used to actively participate in everyday activities, to extract information and derive meaning from different forms of communication, and to apply new information to changing circumstances (Nutbeam, 2000)

MyCom Youth Development Initiative is a youth development initiative supported by the Cleveland Foundation focused on out-of-school time programming and youth employment (Flannery et al., 2020).

Nutrition behaviors can include nutrition-related tasks, such as following dietary recommendations from health practitioners, reading food labels, and making informed decisions when faced with choices in the grocery store (Speirs, 2012).

Social Determinants of Health (SDOH) are the conditions in the environments where people are born, live, learn, work, play, worship, and age that affect a wide range of health, functioning, and quality-of-life outcomes and risks (Office of Disease Prevention and Health Promotion [ODPHP], n.d.).

Social as it relates to human society is defined as the interaction of the individual and the group, or the welfare of human beings as members of society (Merriam-Webster Dictionary, 2021). Maintaining healthy relationships, enjoying being with others, developing friendships and intimate relations, caring about others, and letting others care about you (Stoewen, 2017).

Variables

The independent variable will include food insecurity. The dependent variables include health literacy and reading ability. Health literacy will be investigated at two levels: functional health literacy and interactive health literacy.

Covariate variables investigated include nutrition behaviors, age, gender, grade level, location, grade point average (GPA), mother education level, father education level, and family income. Gender will have the following levels: male and female. Grade level will include levels: 9th grade, 10th grade, 11th grade, and 12th grade. Geographical location was queried at four levels: Urban city, Suburban town, Rural-farm, or Rural-non farm.

Research Question

The main research question is "What are the relationships between food insecurity, nutrition behavior, and health literacy among adolescent teens?"

Hypotheses

The main hypothesis of the study is that adolescent teens who are food insecure will have lower health literacy than their food secure peers. Two null hypotheses will be tested:

Null hypothesis: $H0_1$: There will be no significant difference on health literacy (functional health literacy and interactive health literacy) between youth who have low food insecurity and high food insecurity.

Null hypothesis: $H0_2$: There will be no significant difference on health literacy between youth who have low food insecurity and high food insecurity.

Summary

In summary, this chapter focuses on the relationship between food insecurity, nutrition behavior, and health literacy in adolescent teens who are participants in a youth development initiative in Cleveland, Ohio. The chapter also included definition of terms, the research question, and the null hypotheses for the investigation. The chapter demonstrates how this study will explore adolescents' experiences with food insecurity and sought to describe the possible relationship between nutrition behaviors and two types of health literacy (i.e., functional health literacy and interactive health literacy). This study will incorporate the relationship with certain health literacy components and the adolescent teen population that previously have left a gap in research.

Chapter 2
Review of the Literature

Introduction

The relationship between food insecurity, nutrition behavior, and health literacy is critical to understanding the context in which poor health outcomes are developed. The purpose of this study is to investigate the relationship of nutrition behaviors and health literacy among adolescent teens who may be food insecure. The literature review that follows will focus on research related to food insecurity and nutrition behaviors, health literacy and food insecurity, and the social determinants of health and food insecurity among adolescent teens. Information on health literacy in the context of adolescent health will conclude this chapter.

Food Insecurity and Nutrition Behaviors

Food insecurity is defined as the limited or uncertain availability of nutritionally adequate or foods or uncertainty to acquire food (Dilley, Rettiganti, Christie, O'Brien, Patterson, Weeks, Aronson, Scurlock, Perry, Pesek, Bell, Kennedy, Chandler, Magee, Simmons, Chervinskiy, Casey, & Jones, 2019). Food insecurity is a social determinant of health because research suggests a strong relationship between food insecurity and poor health outcomes (Dilley et al., 2019). Food insecurity is often affected by an individual's uncertain or limited physical, social, and economic access to nutritional foods (Begley, Paynter, Butcher, & Dhaliwal, 2019). Food insecurity in adolescent populations typically depends on the financial status of the household and can be dependent on social environmental factors that exist (Banerjee, Radak, Khubchandani, & Dunn, 2021).

Food security and nutrition security are two explicitly different terms used in research (Mozaffarian, Fleischhacker, & Andrés, 2021). In contrast to the main focus of "food security" on access to food, "nutrition security" is arguably harder to implement with its emphasis on access to balanced nutritious foods and diet quality (Mozaffarian et al. 2021). One step toward nutrition security would be efforts to improve nutrition behaviors such as nutrition-related tasks, including reading food labels, following dietary recommendations from health practitioners, and making informed decisions when faced with choices in the grocery store (Speirs, Messina, Munger, & Grutzmacher, 2012). Individuals who are food insecure tend to live in obesogenic environments where calorie-dense foods are easily available and physical activity is not

prevalent (Myers et al., 2019). These food options tend to lead to health outcomes such as obesity and cardiovascular diseases and contribute to the likelihood that low-income families will select cheaper more energy-dense foods over healthy foods such as fruits and vegetables compared to more affluent families (Simpson et al., 2020). Younger populations' dietary habits are particularly important to examine because often when they are established during childhood, such habits will extend into adulthood and determine health trajectories throughout the lifespan (Simpson et al., 2020).

Functional Literacy, Functional Health Literacy, and Interactive Health Literacy

Functional literacy has proven to be an important predictor of self-reported health (Ubbes & Zullig, 2010) and is significantly related to health promoting behaviors (Fleary, Joseph, & Pappagianopoulos, 2018; Zullig, Ubbes, & Mann, 2013). Functional literacy is a bridge to functional health literacy (Ubbes, Coyle, & Tzoc, 2018) and though in its infancy, has been defined and investigated in a variety of ways with children (Broder, Okan, Bauer, Bruland, Schlupp, Bollweg, Saboga-Nunes, Bond, Sørensen, Bitzer, Jordan, & Pinheiro, 2017; Okan, Lopes, Bollweg, et al. 2018).

Health literacy is defined as the degree to which individuals have "the capacity to obtain, communicate, process, and understand health information and services in order to make appropriate health decisions" (Patient and Affordable Care Act of 2010, Title V). There are many subdivisions of health literacy (Nutbeam, 2000), but when targeting food insecurity, functional health literacy and interactive health literacy should also be examined for optimal health outcomes. Functional health literacy is "one's ability to read, write, and speak about health" (Ubbes & Ausherman, 2018; Ubbes, Coyle, & Tzoc, 2018). Functional health literacy is often used as an application of literacy and numeracy skills to health-related materials, such as the practical use of reading food labels (Fleary et al., 2018). When considering food insecurity and its relation to social factors, it is important to incorporate interactive health literacy, defined as more advanced cognitive and literacy skills which, together with social skills, can be used to actively participate in everyday activities, to extract information and derive meaning from different forms of communication, and to apply new information to changing circumstances (Nutbeam, 2000). Interactive health literacy facilitates one's ability to extract information and derive meaning to apply that new information to changing circumstances (Parnell, 2014).

Interactive health literacy is critical for individuals to extract health information and derive meaning from different forms of communication (Nutbeam & Lloyd, 2021) and includes "interpersonal communication between people, including their interactive use of print and electronic materials for health enhancement" (Ubbes & Ausherman, 2018). Figure 1 summarizes some of the key definitions for health literacy.

Updated Definition by Ubbes & Ausherman (2019)	Updated Definition by Ubbes & Ausherman (2019)	Updated Definition by Ubbes & Ausherman (2019)
Functional Health Literacy is the ability to read, write, and speak about health.	**Interactive Health Literacy** is interpersonal communication between people, including their interactive use of print and electronic materials for health enhancement.	**Critical Health Literacy** addresses issues of "access and equity" for health information and services. This process includes critical problem posing with creative solutions to empower people who have a variety of backgrounds, health needs, and interests.
Nutbeam's Definition for Health Literacy	Nutbeam's Definition for Health Literacy	Nutbeam's Definition for Health Literacy
Functional Health Literacy: communication of information	**Interactive Health Literacy:** development of personal skills	**Critical Health Literacy:** personal and community empowerment
Nutbeam's Definition for Literacy (2000)	Nutbeam's Definition for Literacy (2000)	Nutbeam's Definition for Literacy (2000)
Basic or Functional Literacy—sufficient basic skills in reading and writing to be able to function effectively in everyday situations.	**Communicative or Interactive Literacy**—more advanced cognitive and literacy skills which, together with social skills, can be used to actively participate in everyday activities, to extract information and derive meaning from different forms of communication, and to apply new information to changing circumstances.	**Critical Literacy**—more advanced cognitive skills which, together with social skills, can be applied to critically analyze information, and to use this information to exert greater control over life events and situations.

Figure 1: Functional Health Literacy, Interactive Health Literacy, and Critical Health Literacy Definitions (Nutbeam, 2000; Ubbes & Ausherman, 2018)

Health Literacy and Food Insecurity

Critical health literacy, although not investigated in the current study, can be applied to health literacy research in order to examine complex information and gain greater control over life events and circumstances (Parnell, 2014). Critical health literacy addresses issues of access and equity for health information and services (Ubbes & Ausherman, 2018), all of which are critical components to one's food security (Begley et al., 2019).

Recent research has called for the need for different measurement tools for various age groups and stages of life, particularly adolescents and children, for which there is no comprehensive measurement tool currently available (Ormshaw, Paakkari, & Kannas, 2013).

Most of the literature that exists on health literacy in adolescents is descriptive research that discusses the current state of health literacy in a specific adolescent population (Perry, 2014).

Social Determinants of Health and Food Insecurity

Social determinants of health are "the conditions in the environments where people are born, live, learn, work, play, worship, and age that affect a wide range of health, functioning, and quality-of-life outcomes and risks" (Office of Disease Prevention and Health Promotion [ODPHP], n.d.). Both food insecurity and poverty are social determinants of health (Figure 2), and more recent research indicates that health literacy is often associated with established social determinants of health (Nutbeam & Lloyd, 2021). Poverty is the state of [an individual] who lacks a usual or socially acceptable amount of money or material possessions (Merriam-Webster Dictionary, 2021). Poverty is one of the risk factors for food insecurity in that food-insecure individuals tend to have lower quantities and quality of food intake (Banerjee et al., 2021). Poverty in younger populations is critical to examine because the childhood poverty rate is a vital indicator of children's well-being (Chaudry & Wimer, 2016).

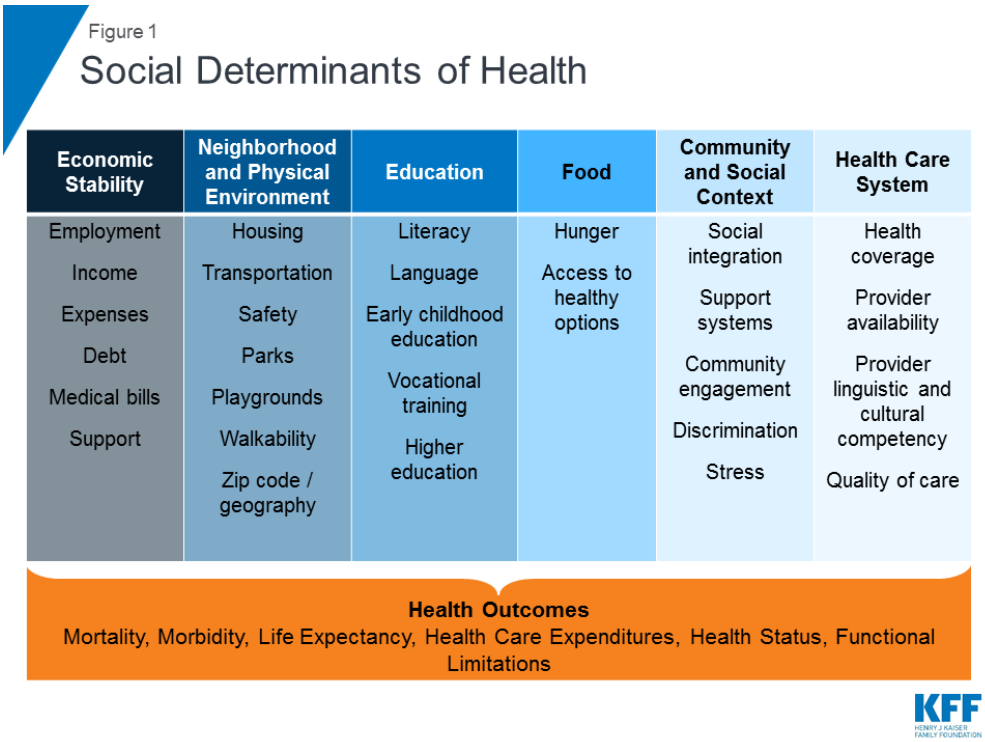

Figure 2: Social Determinants of Health (Artiga & Hinton, 2018)

Research has indicated that health literacy mediates the association between socioeconomic status, a social determinant of health, as well as specific health outcomes, health-related behaviors, and access to and use of health services (Nutbeam & Lloyd, 2021). Social determinants can be seen through the discriminatory practices of larger institutional forces, such as sociopolitical injustice based on race, class, gender, age, and disability. Racialized policies and systems shape the economic and social institutions known as structural racism (Lee & Navarro, 2018). Health equity specifically focuses on social determinants, including structural racism, that create a systematic inequality in health (Lee & Navarro, 2018). Everyone is entitled to fairness and justice which is a pursuit for equity, known as just and fair inclusion (Lee & Navarro, 2018). Advocating for health equity is a tool to help influence the impact that social determinants of health have on individuals.

Access to adequate food is a critical factor in healthy eating and is often influenced by societal factors. Inadequate access to healthy foods is particularly troublesome for teens from low-income families who are more likely to engage in unhealthy behaviors (Simpson et al., 2020). In 2019, the United States Department of Agriculture (USDA) reported that 13.6% of households with children were affected by food insecurity in the United States, which is roughly 5.3 million children. Since food insecurity acts as a social determinant of health, it is often influenced by other determinants of health as well. These social determinants include race and socioeconomic status. When examining minority populations, an estimated 19.1% of Black, non-Hispanic households were food insecure in the United States (Coleman-Jensen, Rabbitt, & Gregory, 2020). Close behind were Hispanic households with an estimated 15.6% (Coleman-Jensen, Rabbitt, & Gregory, 2020). When examining households with incomes below 185% of the Federal poverty threshold, 27.6% experienced food insecurity in 2019 (Coleman-Jensen, Rabbitt, & Gregory, 2020). In Ohio, the amount of those who were food insecure was above the United State's average of 4.1% (Coleman-Jensen, Rabbitt, & Gregory, 2020). Furthermore, households located in principle cities have experienced what the USDA referred to as “very low” food insecurity, demonstrating a need for interventions in urban areas.

Relationship between Food Insecurity, Health Literacy, and Obesity

Research studies have implied that food insecure participants have lower health literacy than those who are food secure (Dilley et al., 2019). Due to this, research that examines the

relationship between food insecurity and food literacy now intends to equip participants with the skills and knowledge to contribute to better health, especially in adolescent populations (Manganello, DeVellis, Davis, & Schottler-Thal, 2015). Moreover, many studies have adapted the construct of self-efficacy to better understand if the food literacy being received through intervention efforts is related to food security outcomes. But these studies have been limited due to the inability to change the environmental factors of the adolescent participant's personal lives. Most of the current research has incorporated interventions that teach better cooking and shopping skills (Rodriguez et al., 2013). Many research studies have pointed out how teaching participants to know and prepare healthier food options does not improve their socioeconomic status to allow them greater access to healthier food options (Rodriguez, Applebaum, Stephenson-Hunter, Tinio, & Shapiro, 2013). Therefore, most of the interventions targeted toward food insecurity should increase access to health foods in some way. Researchers need to go beyond just 'having' food and ensuring that it is healthy food.

One study in particular had three objectives that included the increase of knowledge of nutritional recommendations, the understanding of the effect of nutrition and physical activity on health, and the awareness of and self-efficacy in making healthier choices (Rodriguez et al., 2013). The overall findings represented a change in children's knowledge and attitudes, but due to the environmental factors, the children's behaviors barely changed, showing a significant relationship between the engagement of curriculum items and the importance of environmental factors on behavior change (Rodriguez et al., 2013).

Another study used dietary intake, nutrition knowledge, and perceived self-efficacy of various nutrition behaviors and physical activity to promote a healthier lifestyle for teens as an effort to prevent obesity and Type II diabetes (Yazel-Smith, El-Mikati, Adjei, Haberlin-Pittz, Agnew, & Hannon, 2020). The study found that the participants demonstrated an increased knowledge about healthy behaviors, but there was no difference in dietary intake after the completion of the program (Yazel-Smith et al., 2020). This suggests that the interventions being done in adolescent populations should focus on prevention efforts for a longer-lasting effect in health behaviors, namely eating healthy food.

The impact of food insecurity and health literacy and their relationship to obesity have also been researched. In particular, one study examined the social determinants of obesity on economic stability, education, health, and healthcare (Scott, Dardas, Sloane, Wigington, Noonan,

& Simmons, 2019). This study then assessed health literacy, cardiometabolic, and obesity risk in a rural, food insecure population (Scott et al., 2019). This study suggested that individuals with insufficient health literacy were twice as likely to be in the highest cardiometabolic risk category (Scott et al., 2019). Similarly, another study examined the associations between food insecurity and cardiovascular health and measures of obesity by sex, race, and health literacy status and found that being being food insecure was significantly linked to a decreased likelihood of "good" cardiovascular health (Myers et al., 2019).

Overall research has emphasized that, "health literacy can improve aspects of food insecurity as improved knowledge and skills may assist to maximize income, but only to a certain point as education cannot change the cost of food or resolve other food insecurity causes that are economic in nature," (Begley et al., 2019). This quote addresses elements of food insecurity that have been overlooked in other studies and calls for food insecure populations to be equipped with proper resources beyond practical knowledge and skills that many studies have suggested.

In summary, this chapter was a review of the literature on food insecurity, nutrition behaviors, food insecurity, and health literacy. This chapter then went on to discuss the implications of functional literacy, functional health literacy, and interactive health literacy and how research in these areas relate to the impact of food insecurity. Food insecurity as a social determinant of health was then discussed as well as other social determinants of health which influence the food insecurity status and health literacy levels that individuals possess. The chapter ended with a discussion about the relationship between food insecurity, health literacy, and obesity while reflecting on what achieving improved food security would call for in current food insecure populations, namely adolescent youth.

Chapter 3

Methodology

The purpose of this study is to investigate the relationship of nutrition behaviors and health literacy among adolescent teens who may be food insecure. This chapter will describe and explain the participants, research instruments, and procedures to be used in the study. Measures, inclusion criteria, and data analysis are also described.

Participants

The participants (n=66) for this study were adolescents who engaged in the youth development initiative called MyCom, located in community centers and faith-based organizations in Cleveland, Ohio. MyCom is a youth development initiative supported by the Cleveland Foundation with a focus on out-of-school time programming and youth employment (Flannery et al., 2020). This population was chosen because several high-risk behaviors begin in adolescence and persist into adulthood (Centers for Disease Control and Prevention, 2019). Understanding high-risk behaviors such as food insecurity and nutrition behaviors are important to ensure adolescent health (Underwood, Brener, & Halpern-Felsher, 2020).

The selected sample consisted of 17 participants who were males (25.8%) and 49 participants who were females (74.2%). The sample consisted of 5 participants who were 13-year olds (7.6%), 4 participants who were 14-year olds (6.1%), 8 participants who were 15-year olds (12.1%), 12 participants who were 16-year olds (18.2%), 17 participants who were 17-year olds (25.8%), and 20 participants who were 18-years or older (30.3%). The sample consisted of 9 participants in the 9th grade (13.6%), 12 participants in the 10th grade (18.2%), 8 participants in the 11th grade (12.1%), 31 participants in the 12th grade (47.0%), and 6 participants Ungraded or other grade (9.1%). The sample consisted of 2 Asian participants (3.0%), 36 Black participants (54.5%), 22 White participants (33.3%), 1 American Indian or Alaskan Native participant (1.5%), 1 Hispanic participant (1.5%), 1 Hispanic and Black participant (1.5%), 1 Hispanic and White participant (1.5%), 1 Black and White participant (1.5%), and 1 Hispanic, Black, and White participant (1.5%). The sample consisted of 19 participants from a Town or City (28.8%), 1 participant from a Rural-Farm (1.5%), 4 participants from a Rural-Non Farm (6.1%), 29 participants from Suburban (43.9%), 12 participants from Urban (18.2%), and 1

participant from Other (1.5%). The average grade point average (GPA) was a 3.45 with a standard deviation of 0.07.

In this sample regarding the participants' mothers' education level, 1 participant's mother was "Home schooled/Did not attend local school" (1.5%), 10 participant's mothers "Completed some high school" (15.2%); 10 participants' mothers "Obtained high school diploma (or GED - Graduate Equivalency Diploma)" (15.2%); 11 participants' mothers "Completed some college" (16.7%); 18 participants' mothers "Obtained college degree or vocational degree" (27.3%); 9 participants' mothers "Obtained advanced degree (Masters, Specialist, Doctorate)" (13.6%); and 6 participants answered "I do not know the answer to this question." (9.1%). Regarding the participants' fathers' education level, 2 participants' fathers' were "Home schooled/Did not attend local school" (3.0%); 6 participant's fathers "Completed some high school" (9.1%); 16 participants' fathers "Obtained high school diploma (or GED - Graduate Equivalency Diploma)" (24.2%); 11 participants' fathers "Completed some college" (16.7%); 11 participants' fathers "Obtained college degree or vocational degree" (16.7%); 12 participants' fathers "Obtained advanced degree (Masters, Specialist, Doctorate)" (18.2%); and 7 participants answered "I do not know the answer to this question." (10.6%).

Regarding the participants' family income level, 1 participant's family income was "Below $25,000" (1.5%); 6 participants' family income level was "$25,001-$50,000" (9.1%); 9 participants' family income level was "$50,001-$65,000" (13.6%); 1 participant's family income level was "$65,001-$80,000"; 6 participants' family income level was $80,001-$100,000" (9.1%); 4 participants' family income level was "$100,001-$150,000" (6.1%); 3 participants' family income level was "$150,001-$200,000" (4.5%); 9 participants' family income level was "Above $200,000" (13.6%); and 27 participants reported "I don't know my family's income per year" (40.9%).

Instruments

Four research instruments were used to test the relationship between food security, nutrition behaviors, reading ability, and two types of health literacy (i.e., functional health literacy and interactive health literacy). The four instruments included: 1) the USDA Six-Item Food Security Short Form, 2) Demographics and Nutrition Behavior Questions from the Youth Risk Behavior Survey, 3) Reading Ability and Literacy-Rich Environments Survey (Zullig &

Ubbes, 2010), and 4) two components of the Health Literacy Assessment Scale for Adolescents (HAS-A) (Manganello, DeVellis, Davis, & Schottler-Thal, 2015). Each of these instruments are described below.

USDA Food Security Six-Item Module

A questionnaire was given to the participants that incorporated the United States Department of Agriculture (USDA) Food Security's Six-Item Module to measure food security. The Cronbach alpha of this instrument for internal consistency has been reported as 0.87 (Gulliford, Mahabir, & Rocke, 2004). Food security status was determined for each question as: high food security (0-1 points); moderate food security (2 points); and low food security (3 points).

Students were asked: 1) "The food that (I/we) bought just didn't last, and (I/we) didn't have money to get more. Was that often, sometimes, or never true for (you/your household) in the last 12 months?" Responses are: Often True, Sometimes True, Never True, and Don't know or Refuse to answer; 2) "(I/we) couldn't afford to eat balanced meals. Was that often, sometimes, or never true for (you/your household) in the last 12 months?" Responses are: Often True, Sometimes True, Never True, and Don't know or Refuse to answer; 3) "In the last 12 months, since last (name of current month), did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?" Responses are: Yes, No, I Don't Know; 4) "How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?" Responses are: Almost every month, Some months but not every month, Only 1 or 2 months, Don't Know; 5) "In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?" Responses are: Yes, No, I Don't Know; and 6) "In the last 12 months, were you ever hungry but didn't eat because there wasn't enough money for food?" Responses are: Yes, No, I Don't Know.

Demographics and Nutrition Behavior Questions from the Youth Risk Behavior Survey

The Youth Risk Behavior Survey monitors health-related behaviors during the middle and senior high school years, including college (Center for Disease Control and Prevention, 2020). For the purposes of this study, two parts of the high school YRBS were used to assess self-reported nutrition behaviors and demographic information.

Related to nutrition behavior, students were asked: 1) "During the past 7 days, how many times did you drink **100% fruit juices** such as orange juice, apple juice, or grape juice? (Do **not** count punch, Kool-Aid, sports drinks, or other fruit-flavored drinks.); 2) "During the past 7 days, how many times did you eat **fruit**? (Do **not** count fruit juice.)"; 3) "During the past 7 days, how many times did you eat **green salad**?"; 4) "During the past 7 days, how many times did you eat **potatoes**? (Do **not** count french fries, fried potatoes, or potato chips.)"; 5) "During the past 7 days, how many times did you eat **carrots**?"; 6) "During the past 7 days, how many times did you eat **other vegetables**? (Do **not** count green salad, potatoes, or carrots.)"; 7) "During the past 7 days, how many times did you drink a **can, bottle, or glass of soda or pop**, such as Coke, Pepsi, or Sprite? (Do **not** count diet soda or diet pop.)"; 8) "During the past 7 days, how many times did you drink **a can, bottle, or glass of a sports drink** such as Gatorade or Powerade? (Do **not** count low-calorie sports drinks such as Propel or G2.)"; 9) "During the past 7 days, how many times did you drink **a bottle or glass of plain water**? (Count tap, bottled, and unflavored sparkling water.)"; 10) "During the past 7 days, how many **glasses of milk** did you drink? (Count the milk you drank in a glass or cup, from a carton, or with cereal. Count the half pint of milk served at school as equal to one glass.)"; and 11) "During the past 7 days, on how many days did you eat **breakfast**?".

Related to demographic information, students were asked: 1) "How old are you?"; 2) "What is your sex?"; 3) "In what grade are you?"; 4) "Are you Hispanic or Latino?"; 5) "What is your race?"; 6) "Which setting best describes where you live?"; 7) "What is the highest level of education that your mother has obtained?"; 8) "What is the highest level of education that your father has obtained?"; 9) "What is your family's income per year?"; and 10) "What is your current overall grade point average (GPA)? Please use three numbers when you write the answer. For example: 2.89."

The internal consistency, or reliability (i.e., Cronbach alpha), of the 9th through 12th grade level instrument has been reported as 0.770 for the overall scale (Lima, Maia, Brito, Pinho, & Silveira, 2020).

Reading Ability and Literacy-Rich Environments Survey

Students were asked six items related to reading ability and literacy-rich environments (Zullig & Ubbes, 2010). Those items were: 1) "How would you rate your ability to read this

health survey?"; 2) "How often do you find yourself reading books, newspapers, magazines, and other reading materials outside of school (do not include school work.)?"; 3) "How do you feel about your ability to read?"; 4) "How often did you see your parents or caregiver reading something in the past two days?"; 5) "Have you been to the public library in the last year?"; and 6) "Have you been to a online bookstore in the last year?".

Cohen's kappa coefficient of this instrument has been reported for inter-rater reliability as 61.8 for the overall scale (Zullig & Ubbes, 2010). Modifications to two questions were made for the purposes of this study.

Health Literacy Assessment Scale for Adolescents (HAS-A)

Eleven items were adapted from the Health Literacy Assessment Scale for Adolescents (HAS-A) (Manganello, DeVellis, Davis, & Schottler-Thal, 2015) related to functional health literacy and interactive (communication) health literacy. There were six questions that focused on functional health literacy and five questions that focused on interactive health literacy. Students were asked six questions about functional health literacy (including reading ability and numeracy): 1) "How often do you get confused when reading instructions for medicine?"; 2) "How often do you have problems learning about an illness or health topic because of difficulty understanding the written information you get?" 3) "How often do you think the forms you complete at your doctor's office are confusing?"; 4) "How often are you confused by health information that has a lot of numbers and statistics?"; 5) "When you talk to people other than your doctor about health issues, how often are you confused by what they tell you?"; and 6) "When reading brochures or hand-outs about health issues, how often do you need someone to help you read them?". All questions are scored using the following responses: Always, Usually, Sometimes, Rarely, and Never.

Students were asked five questions about interactive health literacy which is called communication health literacy in the Manganello, DeVellis, Davis, & Schottler-Thal (2015) study. The interactive health literacy (communication) questions included: 1) "How often is it easy for you to ask your doctor questions about your health?"; 2) "How often does your doctor understand what you mean when you ask him or her a question about your health?"; 3) "How often can you easily describe a health problem you have to your doctor?"; 4) "How often does your doctor seem to understand you when you answer a question he or she asks?"; and 5) "How

often do you understand the answers your doctor gives to your questions?". All questions were scored using the following responses: Always, Usually, Sometimes, Rarely, and Never.

The Cronbach alphas of this instrument have been reported for internal consistency as 0.76 for the functional health literacy scale and 0.77 for the communication scale (Manganello, DeVellis, Davis, & Schottler-Thal, 2015).

Measures

The independent variables for this study included health literacy and reading ability. The dependent variables for this study were food insecurity status. Other covariate variables investigated were nutrition behaviors, age, gender, grade level, geographical location, grade point average (GPA), mother education level, father education level, and family income. Health literacy was investigated at two levels: functional health literacy and interactive health literacy. Gender was queried at the following levels: male, female, or non-binary. Grade level was queried at four levels: 9th grade, 10th grade, 11th grade, or 12th grade. Geographical location was queried at four levels: Urban city, Suburban town, Rural-farm, or Rural-non farm.

Inclusion Criteria

The participants in this study met the following inclusion criteria: 1) student in grades 9 through 12th grade, 2) a participant of a youth development initiative in Cleveland, Ohio, and 3) an English language speaker. Exclusion criteria included youth who were aged 19 years or older and youth who were younger than 13 years old.

Procedures

After obtaining Institutional Review Board (IRB) approval from Miami University, active parental consent was obtained for every participant under the age of 18 years. The Principal Investigator (PI) contacted the MyCom Network Manager who put the PI in contact with a few Regional Coordinators that worked directly with the youth. After IRB approval, the PI worked with the Network Manager and the Regional Coordinators to set up initial visits to distribute the parent consent forms to the youth and to give a very brief purpose of the study. The PI also explained the reason for the parent consent form and encouraged the youth to talk to a parent or guardian at home so they can fill out the form and return it to the MyCom center with a

signature. Participants (youth) in the study accessed a survey available on Qualtrics, which is an online secure platform. Only youth who received the link were able to take the survey as directed by the PI. Other procedures for the data collection included the following:

1) The PI described the research study to the prospective participants with a MyCom representative present in their school or community MyCom gathering space or online during their MyCom gathering time. The PI or MyCom instructor handed out the parent consent form to each participant. The form detailed the purpose of the study and provided parents with University contact names if they had any questions. Youth were encouraged to give the consent form to a parent or guardian at home and returned the form within one week.
2) When the forms were returned, the Regional Coordinator of MyCom put them in a folder and handed them to the PI.
3) The PI created a list of youth who had been given consent to participate by their parents or guardian. Only youth with active parental consent were allowed to participate in the survey.
4) The PI then gave approved participants a paper with the website address so they could go to the internet to complete the survey on the Qualtrics platform. Participants needed to assent to participate in the survey; the assent question was on page 1 of the survey.

Because of the contemporary context of the COVID-19 pandemic during this study, safeguards were put into place for social distancing of students taking the survey in a common space. The PI consulted with the MyCom Regional Coordinators (n=7) to obtain a classroom with seating so the youth would maintain social distancing and have perceived comfort from moments that could seem embarrassing or uncomfortable. These steps were repeated at five different MyCom region locations. Modifications were then requested from the Institutional Review Board of Miami University to increase participation rates during the coronavirus pandemic. The specific modification request included: use of Zoom for a virtual meeting to recruit participants. Approval for recruitment modifications were granted by the IRB in January 2022.

Data Analyses

Participant responses from the four surveys using a Qualtrics platform were downloaded, cleaned, and analyzed using the Statistical Package for the Social Sciences (SPSS) version 26.0 (IBM Corporation, Armonk, NY, USA).

Descriptive statistics such as percentages and averages were calculated for demographic characteristics. Descriptive statistics were used for food insecurity patterns, nutrition behaviors, and health literacy patterns.

Inferential statistics (i.e., Independent T-tests and Chi-square) were calculated for gender, race, grade level, and age. The Independent Samples T-test compares the means of two independent groups in order to determine whether there is statistical evidence that the associated population means are significantly different (SPSS, 2022). The Independent T-tests were conducted to understand the relationships between two independent groups (i.e., high food insecure group and low food insecure group) and four dependent variables (i.e., reading ability, reading environment, functional health literacy, and interactive health literacy).

The Chi-square test of independence checked whether two variables were likely to be related or not. Since age, gender, grade level, geographical location, grade point average (GPA), mother education level, father education level, and family income were identified as contributors to food insecurity in the general population (Wazlowski, 2020), these variables were intended to be included as covariates in the analyses. However, although the PI recruited from four MyCom locations, there was an inconsistent sample size between the MyCom locations. This resulted in a low sample size. Therefore, s$\texttt{tatistical significance was set at } p \leq 0.10$ to manage any type II errors. Type II errors occur when there is an assumed relationship that does not exist when in fact the evidence supports that the relationship does exist. Additionally, there was an effort to try to account for the variability that may have been decreased due to a lower sample size. Banerjee, Chitnis, Jadhav, Bhawalkar, and Chaudhury (2009, p. 129) state that "although type I and type II errors can never be avoided entirely, the investigator can reduce their likelihood by increasing the sample size (the larger the sample, the lesser is the likelihood that it will differ substantially from the population)". Since the sample size could not be adjusted in this study, the PI reduced the confidence level to 90%.

Chapter 4

Results

Introduction

This chapter will be organized by first reporting the results from the four instruments used in this survey: 1) the USDA Six Item Food Security Short Form, 2) Demographics and Nutrition Behavior Questions from the Youth Risk Behavior Survey, 3) Reading Ability and Literacy-Rich Environments Survey (Zullig & Ubbes, 2010), and 4) two components of the Health Literacy Assessment Scale for Adolescents (HAS-A) (Manganello, DeVellis, Davis, & Schottler-Thal, 2015). The chapter will then go on to describe the independent t-tests that were conducted to investigate the relationships between some of the food insecurity questions (n=5), reading ability, functional health literacy, and interactive health literacy. Lastly, this chapter will describe the Chi-square analyses that were conducted to investigate some questions for food insecurity (n=3), reading ability, functional health literacy, and interactive health literacy.

Description of the Sample

A total of 74 students were surveyed from five different MyCom locations in Cleveland, Ohio. After cleaning the data set, the responses of 66 participants were eligible for data analysis. The selected sample consisted of 17 participants who were males (25.8%) and 49 participants who were females (74.2%). The sample consisted of 5 participants who were 13-year olds (7.6%), 4 participants who were 14-year olds (6.1%), 8 participants who were 15-year olds (12.1%), 12 participants who were 16-year olds (18.2%), 17 participants who were 17-year olds (25.8%), and 20 participants who were 18-years or older (30.3%).

USDA Food Security Six-Item Module

Six items from the United States Department of Agriculture Six-Item Food Security Module Short Form were answered by 66 participants. Table 1 shows the results from the USDA Food Security Six-Item Module. When asked the question, “The food that (I/we) bought just didn’t last, and (I/we) didn’t have money to get more. Was that often, sometimes, or never true for (you/your household) in the last 12 months?”, 2 participants responded “Often True” (3.0%), 15 participants responded “Sometimes True” (22.7%), 48 participants responded “Never True” (72.7%), and 1 participant responded “Don’t Know or Refuse to Answer” (1.5%).

When asked the question, “(I/we) couldn’t afford to eat balanced meals. Was that often, sometimes, or never true for (you/your household) in the last 12 months?”, 2 participants responded “Often True” (3.0%), 11 participants responded “Sometimes True” (16.7%), and 53 participants responded “Never True” (80.3%).

When asked the question, “In the last 12 months, since last (name of current month), did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?”, 4 participants responded “Yes” (6.1%), 61 participants responded “No” (92.4%), and 1 participant responded “Don’t Know” (1.5%). When asked the question, “How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?” (3.0%), 2 participants responded “Almost every month” (3.0%), and 2 participants responded “Some months but not every month” (6.1%).

When asked the question, “In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?”, 12 participants responded “Yes” (18.2%) and 52 participants responded “No” (78.8%).

When asked the question, “In the last 12 months, were you ever hungry but didn't eat because there wasn't enough money for food?”, 8 participants responded “Yes” (12.1%), 56 participants responded “No” (84.8%), and 2 participants responded “Don’t know” (3.0%).

Table 1. USDA Six Item Food Security Module

Survey Items: USDA Six Item Food Security Module	Sample Response n (%)
1. "The food that (I/we) bought just didn't last, and (I/we) didn't have money to get more." Was that often, sometimes, or never true for (you/your household) in the last 12 months?	
Often True	2 (3.0%)
Sometimes True	15 (22.7%)
Never True	48 (72.7%)
Don't Know or Refuse to Answer	1 (1.5%)
2. "(I/we) couldn't afford to eat balanced meals." Was that often, sometimes, or never true for (you/your household) in the last 12 months?	
Often True	2 (3.0%)
Sometimes True	11 (16.7%)
Never True	53 (80.3%)
3. In the last 12 months, since the last (name of current month), did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?	
Yes	4 (6.1%)
No	61 (92.4%)
4. How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?	
Almost every month	2 (3.0%)
Some months but not every month	2 (3.0%)
5. In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?	
Yes	12 (18.2%)
No	52 (78.8%)
6. In the last 12 months, were you ever hungry but didn't eat because there wasn't enough money for food?	
Yes	8 (12.1%)
No	56 (84.8%)
Don't Know	2 (3.0%)

Nutrition Behavior Questions from the Youth Risk Behavior Survey

Table 2 shows the 11 questions from the Nutrition Behavior Questions from the Youth Risk Behavior Survey. When asked the question, “During the past 7 days, how many times did you drink **100% fruit juices** such as orange juice, apple juice, or grape juice? (Do **not** count punch, Kool-Aid, sports drinks, or other fruit-flavored drinks.)”, 24 participants responded “I did not drink 100% fruit juice during the past 7 days” (36.4%), 25 participants responded “1 to 3 times during the past 7 days” (37.9%), 5 participants responded “4 to 6 times during the past 7 days” (7.6%), 4 participants responded “1 time per day” (6.1%), 2 participants responded “2 times per day” (3.0%), 2 participants responded 3 times per day (3.0%), and 4 participants responded “4 or more times per day” (6.1%).

When asked the question, “During the past 7 days, how many times did you eat **fruit**? (Do **not** count fruit juice.)”, 8 participants responded “I did not eat fruit during the past 7 days” (12.1%), 30 participants responded “1 to 3 times during the past 7 days” (45.5%), 16 participants responded “4 to 6 times during the past 7 days” (24.2%), 4 participants responded “1 time per day” (6.1%), 5 participants responded “2 times per day” (7.6%), and 4 participants responded “2 or more times per day” (3.0%).

When asked the question, “During the past 7 days, how many times did you eat **green salad**?”, 28 participants responded “I did not drink eat green salad during the past 7 days” (42.4%), 24 participants responded “1 to 3 times during the past 7 days” (36.4%), 5 participants responded “4 to 6 times during the past 7 days” (7.6%), 4 participants responded “1 time per day” (6.1%), 2 participants responded “2 times per day” (3.0%), 2 participants responded 3 times per day (3.0%), and 4 participants responded “4 or more times per day” (6.1%).

When asked the question, “During the past 7 days, how many times did you eat **potatoes**? (Do **not** count french fries, fried potatoes, or potato chips.)”, 20 participants responded “I did not eat potatoes during the past 7 days” (30.3%), 29 participants responded “1 to 3 times during the past 7 days” (43.9%), 7 participants responded “4 to 6 times during the past 7 days” (10.6%), 4 participants responded “1 time per day” (6.1%), 1 participant responded “2 times per day” (1.5%), 1 participant responded 3 times per day (1.5%), and 1 participant responded “4 or more times per day” (1.5%).

When asked the question, “During the past 7 days, how many times did you eat **carrots**?” 45 participants responded “I did not eat carrots during the past 7 days” (68.2%), 12 participants responded “1 to 3 times during the past 7 days” (18.2%), 3 participants responded “4 to 6 times

during the past 7 days" (4.5%), 3 participants responded "1 time per day" (4.5%), 1 participant responded "2 times per day" (1.5%), and 1 participant responded 3 times per day (1.5%).

When asked the question, "During the past 7 days, how many times did you eat **other vegetables**? (Do **not** count green salad, potatoes, or carrots.)", 8 participants responded "I did not eat other vegetables during the past 7 days" (12.1%), 20 participants responded "1 to 3 times during the past 7 days" (30.3%), 20 participants responded "4 to 6 times during the past 7 days" (30.3%), 10 participants responded "1 time per day" (15.2%), 3 participants responded "2 times per day" (4.5%), 1 participant responded 3 times per day (1.5%), and 3 participants responded "4 or more times per day" (4.5%).

When asked the question, "During the past 7 days, how many times did you drink a **can, bottle, or glass of soda or pop**, such as Coke, Pepsi, or Sprite? (Do **not** count diet soda or diet pop.)", 18 participants responded "I did not drink a can, bottle, or glass of soda or pop during the past 7 days" (27.3%), 26 participants responded "1 to 3 times during the past 7 days" (39.4%), 10 participants responded "4 to 6 times during the past 7 days" (15.2%), 1 participant responded "1 time per day" (1.5%), 4 participants responded "2 times per day" (6.1%), 4 participants responded "3 times per day" (6.1%), and 3 participants responded "4 or more times per day" (4.5%).

When asked the question, "During the past 7 days, how many times did you drink **a can, bottle, or glass of a sports drink** such as Gatorade or Powerade? (Do **not** count low-calorie sports drinks such as Propel or G2.)", 37 participants responded "I did not drink a can, bottle, or glass of a sports drink during the past 7 days" (56.1%), 17 participants responded "1 to 3 times during the past 7 days" (25.8%), 3 participants responded "4 to 6 times during the past 7 days" (4.5%), 2 participants responded "1 time per day" (3.0%), 4 participants responded "2 times per day" (6.1%), and 2 participants responded "4 or more times per day" (3.0%).

When asked the question, "During the past 7 days, how many times did you drink **a bottle or glass of plain water**? (Count tap, bottled, and unflavored sparkling water.)", 1 participant responded "I did not drink a bottle or glass of plain water during the past 7 days" (1.5%), 7 participants responded "1 to 3 times during the past 7 days" (10.6%), 7 participants responded "4 to 6 times during the past 7 days" (7.6%), 4 participants responded "1 time per day" (6.1%), 6 participants responded "2 times per day" (9.1%), 13 participants responded "3 times per day" (19.7%), and 28 participants responded "4 or more times per day" (42.4%).

When asked the question, “During the past 7 days, how many **glasses of milk** did you drink? (Count the milk you drank in a glass or cup, from a carton, or with cereal. Count the half pint of milk served at school as equal to one glass.)”, 45 participants responded “I did not drink glasses of milk during the past 7 days” (68.2%), 12 participants responded “1 to 3 times during the past 7 days” (18.2%), 3 participants responded “1 time per day” (4.5%), 3 participants responded “2 times per day” (4.5%), and 1 participant responded “4 or more times per day” (1.5%).

When asked the question, “During the past 7 days, on how many days did you eat **breakfast**?”, 14 participants responded “0 days” (21.2%), 9 participants responded “1 day” (13.6%), 6 participants responded “2 days” (9.1%), 16 participants responded “3 days” (24.2%), 6 participants responded “4 days” (9.1%), 6 participants responded “5 days” (9.1%), 2 participants responded “6 days” (3.0%), and 7 participants responded “7 days” (10.6%).

Further statistics on this survey could not be calculated due to a low overall sample size. As a result of the multiple responses that students could select for each of the Youth Risk Behavior Survey questions, there were not enough data (student responses) for each cell. Thus, there was not enough variability to study the covariates of Age, Location, Race, GPA, and Grade Level.

Table 2. Nutrition Behavior Questions from the Youth Risk Behavior Survey

Survey Items: **Nutrition Behavior Questions from the Youth Risk Behavior Survey**	**Sample Response n (%)**
"During the past 7 days, how many times did you drink **100% fruit juices** such as orange juice, apple juice, or grape juice? (Do **not** count punch, Kool-Aid, sports drinks, or other fruit-flavored drinks.)	
I did not drink 100% fruit juice during the past 7 days	24 (36.4%)
1 to 3 times during the past 7 days	25 (37.9%)
4 to 6 times during the past 7 days	5 (7.6%)
1 time per day	4 (6.1%)
2 times per day	2 (3.0%)
3 times per day	2 (3.0%)
4 or more times per day	4 (6.1%)
"During the past 7 days, how many times did you eat **fruit**? (Do **not** count fruit juice.)"	
I did not eat fruit juice during the past 7 days	8 (12.1%)
1 to 3 times during the past 7 days	30 (45.5%)
4 to 6 times during the past 7 days	16 (24.2%)
1 time per day	4 (6.1%)
2 times per day	5 (7.6%)
3 times per day	4 (3.0%)
4 or more times per day	
"During the past 7 days, how many times did you eat **green salad**?"	
I did not eat green salad during the past 7 days	28 (42.4%)
1 to 3 times during the past 7 days	24 (36.4%)
4 to 6 times during the past 7 days	5 (7.6%)
1 time per day	4 (6.1%)
2 times per day	2 (3.0%)
3 times per day	2 (3.0%)
4 or more times per day	4 (6.1%)
"During the past 7 days, how many times did you eat **potatoes**? (Do **not** count french fries, fried potatoes, or potato chips.)"	
I did not eat potatoes during the past 7 days	20 (30.3%)
1 to 3 times during the past 7 days	29 (43.9%)
4 to 6 times during the past 7 days	7 (10.6%)
1 time per day	4 (6.1%)
2 times per day	1 (1.5%)

3 times per day	1 (1.5%)
4 or more times per day	1 (1.5%)
"During the past 7 days, how many times did you eat **carrots**?"	
I did not eat carrots during the past 7 days	45 (68.2%)
1 to 3 times during the past 7 days	12 (18.2%)
4 to 6 times during the past 7 days	3 (4.5%)
1 time per day	3 (4.5%)
2 times per day	1 (1.5%)
3 times per day	1 (1.5%)
"During the past 7 days, how many times did you eat **other vegetables**? (Do **not** count green salad, potatoes, or carrots.)"	
I did not eat other vegetables during the past 7 days	
1 to 3 times during the past 7 days	8 (12.1%)
4 to 6 times during the past 7 days	20 (30.3%)
1 time per day	20 (30.3%)
2 times per day	10 (15.2%)
3 times per day	3 (4.5%)
4 or more times per day	1 (1.5%)
"During the past 7 days, how many times did you drink a **can, bottle, or glass of soda or pop**, such as Coke, Pepsi, or Sprite? (Do **not** count diet soda or diet pop.)"	3(4.5%)
I did not drink soda or pop during the past 7 days	
1 to 3 times during the past 7 days	18 (27.3%)
4 to 6 times during the past 7 days	26 (39.4%)
1 time per day	10 (15.2%)
2 times per day	1 (1.5%)
3 times per day	4 (6.1%)
4 or more times per day	4 (6.1%)
"During the past 7 days, how many times did you drink **a can, bottle, or glass of a sports drink** such as Gatorade or Powerade? (Do **not** count low-calorie sports drinks such as Propel or G2.)"	3 (4.5%)
I did not drink sport drinks during the past 7 days	
1 to 3 times during the past 7 days	37 (56.1%)
4 to 6 times during the past 7 days	17 (25.8%)
1 time per day	3 (4.5%)
2 times per day	2 (3.0%)
4 or more times per day	4 (6.1%)
	2 (3.0%)

"During the past 7 days, how many times did you drink **a bottle or glass of plain water**? (Count tap, bottled, and unflavored sparkling water.)"	
I did not drink water during the past 7 days	1 (1.5%)
1 to 3 times during the past 7 days	7 (10.6%)
4 to 6 times during the past 7 days	7 (7.6%)
1 time per day	4 (6.1%)
2 times per day	6 (9.1%)
3 times per day	13 (19.7%)
4 or more times per day	28 (42.4%)
"During the past 7 days, how many **glasses of milk** did you drink? (Count the milk you drank in a glass or cup, from a carton, or with cereal. Count the half pint of milk served at school as equal to one glass.)"	
I did not drink milk during the past 7 days	45 (68.2%)
1 to 3 times during the past 7 days	12 (18.2%)
1 time per day	3 (4.5%)
2 times per day	3 (4.5%)
4 or more times per day	1 (1.5%)
"During the past 7 days, on how many days did you eat **breakfast**?".	
0 days	14 (21.2%)
1 day	9 (13.6%)
2 days	6 (9.1%)
3 days	16 (24.2%)
4 days	6 (9.1%)
5 days	6 (9.1%)
6 days	2 (3.0%)
7 days	7 (10.6%)

Reading Ability and Literacy-Rich Environments

Table 3 shows the 6 questions from the The Reading Ability and Literacy-Rich Environments Survey (Zullig & Ubbes, 2010). When asked the question, "How would you rate your ability to read this health survey?", 62 participants responded "It was easy for me to read this survey" (93.9%) and 3 participants responded "I had some difficulty reading this survey" (4.5%).

When asked the question, “How often do you find yourself reading books, newspapers, magazines, and other reading materials outside of school (do not include school work.)?”, 7 participants responded “Never” (10.6%), 45 participants responded “Sometimes” (68.2%), and 13 participants responded “Most of the time” (19.7%). When asked the question, “How do you feel about your ability to read?”, 34 participants responded “I love or like to read” (51.5%), 24 participants responded “I will read if I am asked” (36.4%), and 8 participants responded “Most of the time” (12.1%).

When asked the question, “How often did you see your parents or caregiver reading something in the past two days?”, 28 participants responded “Every day” (42.4%), 12 participants responded “1 day” (18.2%), 9 participants responded “0 days” (19.7%), and 17 participants responded “Not sure” (25.8%). When asked the question, “Have you been to the public library in the last year?”, 37 participants responded “Yes” (56.1%), 23 participants responded “No” (34.8%), and 5 participants responded “Not sure” (7.6%). When asked the question, “Have you been to an online bookstore in the last year?”, 33 participants responded “Yes” (50.0%), 30 participants responded “No” (45.5%), and 3 participants responded “Not sure” (4.5%).

Table 3. Reading Ability and Literacy-Rich Environments Survey

Survey Items: **Reading Ability and Literacy-Rich Environments Survey**	**Sample Response n (%)**
1) "How would you rate your ability to read this health survey?"	
It was easy for me to read this survey.	62 (93.9%)
I had some difficulty reading this survey.	3 (4.5%)
2) "How often do you find yourself reading books, newspapers, magazines, and other reading materials outside of school (do not include school work.)?"	
Never	7 (10.6%)
Sometimes	45 (68.2%)
Most of the time	13 (19.7%)
3) "How do you feel about your ability to read?"	
I love or like to read.	34 (51.5%)
I will read if I am asked.	24 (36.4%)
Most of the time.	8 (12.1%)
4) "How often did you see your parents or caregiver reading something in the past two days?"	
Every day	28 (42.4%)
1 day	12 (18.2%)
0 days	9 19.7%)
Not sure	17 (25.8%)
5) "Have you been to the public library in the last year?"	
Yes	37 (56.1%)
No	23 (34.8%)
Not sure	5 (7.6%)
6) "Have you been to an online bookstore in the last year?"	
Yes	3 (50.0%)
No	30 (45.5%)
Not sure	3 (4.5%)

Health Literacy Assessment Scale for Adolescents (HAS-A)

Table 4 shows the 11 questions taken from the Health Literacy Assessment Scale for Adolescents (Manganello, DeVellis, Davis, & Schottler-Thal, 2015). Students were asked six questions about functional health literacy (including reading ability and numeracy). When asked question 1, "How often do you get confused when reading instructions for medicine?", 2

participants responded “Usually” (3.0%), 20 participants responded “Sometimes” (30.3%), 26 participants responded “Rarely” (39.4%), and 18 participants responded “Never” (27.3%). When asked question 2, “How often do you have problems learning about an illness or health topic because of difficulty understanding the written information you get?”, 2 participants responded “Always” (3.0%), 2 participants responded “Usually” (3.0%), 12 participants responded “Sometimes” (18.2%), 29 participants responded “Rarely” (43.9%), and 20 participants responded “Never” (30.3%).

When asked question 3 pertaining to functional health literacy, “How often do you think the forms you complete at your doctor’s office are confusing?”, 2 participants responded “Always” (3.0%), 3 participants responded “Usually” (4.5%), 10 participants responded “Sometimes” (15.2%), 25 participants responded “Rarely” (37.9%), and 25 participants responded “Never” (37.9%).

When asked question 4 pertaining to functional health literacy, “How often are you confused by health information that has a lot of numbers and statistics?”, 3 participants responded “Always” (4.5%), 5 participants responded “Usually” (7.6%), 20 participants responded “Sometimes” (30.3%), 23 participants responded “Rarely” (34.8%), and 15 participants responded “Never” (22.7%).

When asked question 5 pertaining to functional health literacy, “When you talk to people other than your doctor about health issues, how often are you confused by what they tell you?” 1 participant responded “Usually” (1.5%), 19 participants responded “Sometimes” 28.8%), 23 participants responded “Rarely” (34.8%), and 22 participants responded “Never” (33.3%).

When asked question 6 pertaining to functional health literacy, “When reading brochures or hand-outs about health issues, how often do you need someone to help you read them?”, 1 participant responded “Always” (1.5%), 2 participants responded “Usually” (3.0%), 5 participants responded “Sometimes” (7.6%), 20 participants responded “Rarely” (30.3%), and 37 participants responded “Never” (56.1%).

Students were asked five questions about interactive health literacy which is called communication health literacy in the Manganello, DeVellis, Davis, & Schottler-Thal (2015) study. When asked the first question about interactive health literacy, “How often is it easy for you to ask your doctor questions about your health?”, 19 participants responded “Always” (28.8%), 20 participants responded “Usually” (30.3%), 14 participants responded “Sometimes”

(21.2%), 9 participants responded “Rarely” (13.6%), and 3 participants responded “Never” (4.5%).

When asked the second interactive health literacy question, “How often does your doctor understand what you mean when you ask him or her a question about your health?”, 19 participants responded “Always” (28.8%), 30 participants responded “Usually” (45.5%), 12 participants responded “Sometimes” (18.2%), and 4 participants responded “Rarely” (6.1%).

When asked the third interactive health literacy question, “How often can you easily describe a health problem you have to your doctor?”, 18 participants responded “Always” (27.3%), 21 participants responded “Usually” (31.8%), 17 participants responded “Sometimes” (25.8%), 8 participants responded “Rarely” (12.1%), and 1 participant responded “Never” (1.5%).

When asked the fourth interactive health literacy question, “How often does your doctor seem to understand you when you answer a question he or she asks?”, 19 participants responded “Always” (28.8%), 30 participants responded “Usually” (45.5%), 12 participants responded “Sometimes” (18.2%), and 4 participants responded “Rarely” (6.1%).

When asked the fifth interactive health literacy question, “How often do you understand the answers your doctor gives to your questions?”, 17 participants responded “Always” (25.8%), 28 participants responded “Usually” (42.4%), 15 participants responded “Sometimes” (22.7%), and 5 participants responded “Rarely” (7.6%).

Table 4. Health Literacy Assessment Scale for Adolescents (HAS-A)

Survey Items: **Health Literacy Assessment Scale for Adolescents (HAS-A)**	**Sample Response n (%)**
Functional Health Literacy Questions:	
1) "How often do you get confused when reading instructions for medicine?"	
Usually	2 (3.0%)
Sometimes	20 (30.3%)
Rarely	26 (39.4%)
Never	18 (27.3%).
2) "How often do you have problems learning about an illness or health topic because of difficulty understanding the written information you get?"	
Always	2 (3.0%)
Usually	2 (3.0%)
Sometimes	12 (18.2%)
Rarely	29 (43.9%)
Never	20 (30.3%)
3) "How often do you think the forms you complete at your doctor's office are confusing?"	
Always	2 (3.0%)
Usually	3 (4.5%)
Sometimes	10 (15.2%)
Rarely	25 (37.9%)
Never	25 (37.9%)
4) "How often are you confused by health information that has a lot of numbers and statistics?"	
Always	3 (4.5%)
Usually	5 (7.6%)
Sometimes	20 (30.3%)
Rarely	23 (34.8%)
Never	15 (22.7%)
5) "When you talk to people other than your doctor about health issues, how often are you confused by what they tell you?"	
Usually	1 (1.5%)
Sometimes	19 (28.8%)
Rarely	23 (34.8%)
Never	22 (33.3%)
6) "When reading brochures or hand-outs about health issues, how often do you need someone to help you	

read them?"	
Always	1 (1.5%)
Usually	2 (3.0%)
Sometimes	5 (7.6%)
Rarely	20 (30.3%)
Never	37 (56.1%)
Interactive Health Literacy Questions:	
1) "How often is it easy for you to ask your doctor questions about your health?"	
Always	19 (28.8%)
Usually	20 (30.3%)
Sometimes	14 (21.2%)
Rarely	9 (13.6%)
Never	3 (4.5%)
2) "How often does your doctor understand what you mean when you ask him or her a question about your health?"	
Always	19 (28.8%)
Usually	30 (45.5%)
Sometimes	12 (18.2%)
Rarely	4 (6.1%)
3) "How often can you easily describe a health problem you have to your doctor?"	
Always	18 (27.3%)
Usually	21 (31.8%)
Sometimes	17 (25.8%)
Rarely	8 (12.1%)
Never	1 (1.5%)
4) "How often does your doctor seem to understand you when you answer a question he or she asks?"	
Always	19 (28.8%)
Usually	30 (45.5%)
Sometimes	12 (18.2%)
Rarely	4 (6.1%)
5) "How often do you understand the answers your doctor gives to your questions?"	
Always	17 (25.8%)
Usually	28 (42.4%)
Sometimes	15 (22.7%)
Rarely	5 (7.6%)

Inferential Statistics

To understand the relationship between food insecurity, reading ability, and health literacy, independent t-tests and Chi-square tests were conducted. The first hypothesis reads: There will be no significant difference on health literacy (i.e., functional health literacy and interactive health literacy) between youth who have low food insecurity and high food insecurity. A probability level of < 0.10 was considered significant. The hypothesis was predicated upon the assumption that there is a difference in health literacy (functional health literacy and interactive health literacy) between youth who have low food insecurity and high food insecurity.

Independent Variables

Food insecurity questions (n=5) from the USDA Food Security Six-Item Module were used as independent variables. Two of the food insecurity questions (i.e., FoodLast and NotAffordMeal) that had the options Often True, Sometimes True, and Never True were split into two categories: True (i.e., Often True and Sometimes True) and False (i.e., Never True). Three of the questions (i.e., SkipMeal, EatLess, and Hungry) required a "Yes" or "No" response. The sixth food insecurity question was not measured due to only four participants answering this question.

To compare the means between two groups, the groups were categorized by "high food insecurity" and "low food insecurity". For the two questions (i.e., FoodLast and NotAffordMeal) that were split into "True" and "False", the "True" respondents were categorized as high food insecure and the "False" respondents were categorized as low food insecure. For the three questions (i.e., SkipMeal, EatLess, and Hungry) that had the responses "Yes" and "No", the "Yes" respondents were categorized as high food insecure and the "No" respondents were categorized as low food insecure.

Factor Scores

In order to conduct independent t-tests, factor scores were calculated. Factors scores were calculated for the Reading Ability and Literacy-Rich Environments Survey (Zullig & Ubbes, 2010) and for the selected questions from the Health Literacy Assessment Scale for Adolescents (HAS-A) (Manganello, DeVellis, Davis, & Schottler-Thal, 2015). Factor scores are phenomena with several indicators (Strauss, 2021) and consist of items that cannot directly be measured. For

example, an objective reading score was not calculated in the current study, but participants reported perceptions of their reading ability which needed to become factor scores for the statistical analyses. Another example of factor scores in the HAS-A were the two provided by Manganello, DeVellis, Davis, & Schottler-Thal (2015) for their functional health literacy scale and interactive (communication) health literacy scale (Functional Health Literacy Factor Score equals (FHL1 +FHL2 + FHL3 + FHL4 + FHL5 + FHL6); Interactive Health Literacy Factor Score equals (IHL1 + IHL2 + IHL3 + IHL4 + IHL5).

Dependent Variables

Reading ability questions (n=3) were used as dependent variables. These questions included RA1ReadSurvey which reads: "How would you rate your ability to read this health survey?", RA2ReadOutsideSchool which reads "How often do you find yourself reading books, newspapers, magazines, and other reading materials outside of school (do not include school work.)?", and RA3FeelReading which reads "How do you feel about your ability to read?". Reading ability questions were calculated into a factor score with the equation: Reading Ability Factor Score equals (RA1ReadSurvey + RA2ReadOutsideSchool + RA3FeelReading) divided by 3.

Reading environment questions (n=3) were used as dependent variables. These questions included RA4ParentsReading which reads: "How often did you see your parents or caregiver reading something in the past two days?", RA5PublicLibrary which reads "Have you been to the public library in the last year?", and RA6OnlineBookstore which reads "Have you been to a online bookstore in the last year?". Reading environment questions were calculated into a factor score with the equation: Reading Environment Factor Score equals (RA4ParentsReading + RA5PublicLibrary + RA6OnlineLibrary) divided by 3.

Functional health literacy questions (n=6) and interactive health literacy questions (n=5) were used as dependent variables. Scale item response choices were: Never (0), Rarely (1), Sometimes (2), Usually (3), and Always (4) (Manganello, DeVellis, Davis, & Schottler-Thal, 2015). Scale scores were created by summing the responses for scale items (Manganello, DeVellis, Davis, & Schottler-Thal, 2015). For example, the six functional health literacy questions were calculated into a factor score with the equation: Functional Health Literacy Factor Score equals (FHL1 +FHL2 + FHL3 + FHL4 + FHL5 + FHL6). The factor score for the

functional health literacy scale was reported by Manganello, DeVellis, Davis, & Schottler-Thal (2015) as a possible score of 0-20, but we assumed the possible score to be 0-24 based on the six questions asked. The higher score equals a lower ability to read health information and understand numbers. The factor score for the interactive (communication) health literacy scale with five questions was reported as a possible score of 0-20 with the higher score meaning better interpersonal communication.

Independent T-Tests

A series of independent t-tests were conducted to understand the relationship between food insecurity, reading ability, reading environments, and health literacy.

Table 5 shows the results of the independent t-test conducted. An independent t-test was calculated for the question, "The food that (I/we) bought just didn't last, and (I/we) didn't have money to get more." Was that often, sometimes, or never true for (you/your household) in the last 12 months?" (FoodLast). Results do not show any statistically significant relationships between food insecurity level, reading ability, reading environment, functional health literacy, and interactive health literacy.

Table 5. Independent T-Test Analyses

*Equal Variances assumed	SkipMeal					
	Sig	t	df	N	Mean	SD
Reading Ability Factor Score	0.086	1.40	62	4	1.75	0.17
				60	1.49	0.36
Reading Environment Factor Score	0.068	0.311	62	4	1.83	0.19
				60	1.74	0.60

*Key for Terms in Table Above: SkipMeal = "In the last 12 months, since last (name of current month), did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?", Reading Ability Factor Score = (RA1ReadSurvey + RA2ReadOutsideSchool + RA3FeelReading)/3, Reading Environment Factor Score = (RA4ParentsReading + RA5PublicLibrary + RA6OnlineLibrary)/3.

An independent t-test was used for the question, “(I/we) couldn’t afford to eat balanced meals. Was that often, sometimes, or never true for (you/your household) in the last 12 months?” (NotAffordMeal) and the results do not show any statistically significant relationships between food insecurity level, reading ability, reading environment, functional health literacy, or interactive health literacy variables.

An independent t-test was used for the question, “In the last 12 months, since last (name of current month), did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?” (SkipMeal). Results show that the 4 participants that identified as high food insecure ($M = 1.75$, $SD = 0.17$) compared to the 60 participants that identified as low food insecure ($M = 1.49$, $SD = 0.36$) demonstrated significantly better reading ability scores, $t(62) = 1.40$, $p = .086$.

An independent t-test was used for the question, “In the last 12 months, since last (name of current month), did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?” (SkipMeal). Results show that the 4 participants that identified as high food insecure ($M = 1.83$, $SD = 0.19$) compared to the 60 participants that identified as low food insecure ($M = 1.74$, $SD = 0.60$) demonstrated significantly better reading environments scores, $t(62) = 0.31$, $p = .068$.

An independent t-test was used for the question, “In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?” (EatLess). The results did not show any statistically significant relationships between food insecurity level, reading ability, reading environment, functional health literacy, and interactive health literacy.

An independent t-test was used for the question, “In the last 12 months, were you ever hungry but didn't eat because there wasn't enough money for food?” (Hungry). The results did not show any statistically significant relationships between food insecurity level, reading ability, reading environment, functional health literacy, and interactive health literacy.

Chi-Square Tests

Due to the “Yes” or “No” nature of three food insecurity questions, Chi-square tests were conducted to understand the relationship of SkipMeal, EatLess, and Hungry with reading ability, reading environments, functional health literacy, and interactive health literacy. Chi-square analyses test the difference in proportions in two or more nominal groups (Cottrell & McKenzie,

2011). Values of Chi-square were calculated to determine the statistical significance using a cross tabulation procedure to compare age, sex, intelligence, and socioeconomic status. A probability level of < 0.10 was considered significant.

Table 6 shows the results of the Chi-square tests conducted. A chi-square test of independence was performed to examine the relation between "In the last 12 months, since last (name of current month), did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?" (SkipMeal) and "How often do you find yourself reading books, newspapers, magazines, and other reading materials outside of school (do not include school work.)?" (RA2ReadOutsideSchool). The relation between these variables was significant, X^2 (4, N = 65) = 10.187, p = 0.037. Students who read outside of school were more likely than students who did not read outside of school to cut the size of their meals or skip a meal.

A Chi-square test of independence was performed to examine the relation between "In the last 12 months, since last (name of current month), did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?" (SkipMeal) and "How do you feel about your ability to read?" (RA3FeelReading). The relation between these variables was significant, X^2 (4, N = 66) = 12.037, p = 0.017. Students who felt better about their ability to read were more likely than students who did not feel well about their ability to read to cut the size of their meals or skip a meal.

A Chi-square test of independence was performed to examine the relation between "In the last 12 months, since last (name of current month), did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?" (SkipMeal) and "How often do you think the forms you complete at your doctor's office are confusing?" (FHL3FormsDocOffice). The relation between these variables was significant, X^2 (8, N = 65) = 32.825, p < 0.001. Students who thought forms at the doctor's office are confusing were more likely than students who did not find these forms confusing to cut the size of their meals or skip a meal.

A Chi-square test of independence was performed to examine the relation between "In the last 12 months, since last (name of current month), did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?" (SkipMeal) and "How often are you confused by health information that has a lot of

numbers and statistics?" (FHL4HealthNumbersConfusion). The relation between these variables was significant, X^2 (8, N = 66) = 22.404, p = 0.004. Students who were confused by health information with a lot of numbers and statistics were more likely than students who were not confused by this health information to cut the size of their meals or skip a meal.

A Chi-square test of independence was performed to examine the relation between "In the last 12 months, since last (name of current month), did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?" (SkipMeal) and "When reading brochures or hand-outs about health issues, how often do you need someone to help you read them?" (FHL6ReadingBrochures). The relation between these variables was significant, X^2 (8, N = 65) = 15.295, p = 0.054. Students who were confused by health information with a lot of numbers and statistics were more likely than students who are not confused by this health information to cut the size of their meals or skip a meal.

A Chi-square test of independence was performed to examine the relation between "In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?" (EatLess) and "How often did you see your parents or caregiver reading something in the past two days?" (RA4ParentsReading). The relation between these variables was significant, X^2 (3, N = 64) = 8.947, p = 0.030. Students who did not see their parents read something were more likely than students who did see their parents read something to eat less than they felt they should.

A Chi-square test of independence was performed to examine the relation between "In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?" (EatLess) and "How often do you think the forms you complete at your doctor's office are confusing?" (FHL3FormsDocOffice). The relation between these variables was significant, X^2 (4, N = 63) = 10.450, p = 0.033. Students who thought the forms at the doctor's office were confusing were more likely than students who did find the forms confusing to eat less than they felt they should.

A Chi-square test of independence was performed to examine the relation between "In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?" (EatLess) and "How often are you confused by health information that has a lot of numbers and statistics?" (FHL4HealthNumbersConfusion). The relation between these variables was significant, X^2 (4, N = 64) = 8.104, p = 0.088. Students who were confused by

health information with a lot of numbers and statistics were more likely than students who were not confused by the health information to eat less than they felt they should.

A Chi-square test of independence was performed to examine the relation between “In the last 12 months, were you ever hungry but didn't eat because there wasn't enough money for food?” (Hungry) and “How would you rate your ability to read this health survey?” (RA1ReadSurvey). The relation between these variables was significant, X^2 (2, N = 65) = 21.192, $p < 0.001$. Students who did not have the ability to read this health survey well were more likely than students who could read this survey to be hungry.

A Chi-square test of independence was performed to examine the relation between “In the last 12 months, were you ever hungry but didn't eat because there wasn't enough money for food?” (Hungry) and “Have you been to the public library in the last year?” (RA5PublicLibrary). The relation between these variables was significant, X^2 (4, N = 65) = 8.279, $p = 0.082$. Students who had not been to a public library in the last year were more likely than students who had been to a public library in the last year to be hungry.

A Chi-square test of independence was performed to examine the relation between “In the last 12 months, were you ever hungry but didn't eat because there wasn't enough money for food?” (Hungry) and “Have you been to an online bookstore in the last year?” (RA6OnlineBookstore). The relation between these variables was significant, X^2 (4, N = 66) = 10.954, $p = 0.027$. Students who had not been to an online library in the last year were more likely than students who had been to an online library in the last year to be hungry.

A Chi-square test of independence was performed to examine the relation between “In the last 12 months, were you ever hungry but didn't eat because there wasn't enough money for food?” (Hungry) and “How often do you have problems learning about an illness or health topic because of difficulty understanding the written information you get?” (FHL2HealthLearningDifficult). The relation between these variables was significant, X^2 (8, N = 65) = 32.709, $p < 0.001$. Students who had difficulty understanding written information about health topics were more likely than students who did not have difficulty understanding to be hungry.

A Chi-square test of independence was performed to examine the relation between “In the last 12 months, were you ever hungry but didn't eat because there wasn't enough money for food?” (Hungry) and “When reading brochures or hand-outs about health issues, how often do

you need someone to help you read them?" (FHL6ReadingBrochures). The relation between these variables was significant, X^2 (8, N = 65) = 36.456, p = 0.027. Students who needed help reading brochures or handouts were more likely than students who did not need help reading brochures or handouts to be hungry.

A Chi-square test of independence was performed to examine the relation between "In the last 12 months, were you ever hungry but didn't eat because there wasn't enough money for food?" (Hungry) and "How often do you understand the answers your doctor gives to your questions?" (IHL5AnswersDoc). The relation between these variables was significant, X^2 (6, N = 65) = 13.627, p = 0.034. Students who did not understand their doctor's questions were more likely than students who did understand their doctor's answers to be hungry.

Table 6. Chi-Square Analyses

	SkipMeal		EatLess		Hungry	
	$\chi 2$	P-Value	$\chi 2$	P-Value	$\chi 2$	P-Value
RA1ReadSurvey	-	-	-	-	21.192	<0.001
RA2ReadOutsideSchool	10.187	0.037	-	-	-	-
RA3FeelReading	12.037	0.017	-	-	-	-
RA4ParentsReading	32.825	<0.001	8.947	0.03	-	-
RA5PublicLibrary	-	-	-	-	8.279	0.082
RA6OnlineLibrary	-	-	-	-	10.954	0.027
FHL2HealthLearningDifficult	-	-	-	-	32.709	<0.001
FHL3FormsDocOffice	-	-	10.45	0.033	-	-
FHL4HealthNumbersConfusion	22.404	0.004	8.104	0.088	-	-
FHL5OtherTalkHealth	-	-	-	-	-	-
FHL6ReadingBrochures	15.295	0.054	-	-	36.456	0.027

IHL5AnswersDoc	-	-	-	-	13.627	0.034

*p-value < 0.10.

*Key for Terms in Table Above: SkipMeal = "In the last 12 months, since last (name of current month), did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?", EatLess = "In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?", Hungry = "In the last 12 months, were you ever hungry but didn't eat because there wasn't enough money for food?", RA1ReadSurvey = “How would you rate your ability to read this health survey?”, RA2ReadOutsideSchool = “How often do you find yourself reading books, newspapers, magazines, and other reading materials outside of school (do not include school work.)?”, RA3FeelReading = “How do you feel about your ability to read?”, RA4ParentsReading = “How often did you see your parents or caregiver reading 48 something in the past two days?”, RA5PublicLibrary = “Have you been to the public library in the last year?”, RA6OnlineLibrary = “Have you been to a online bookstore in the last year?”, FHL2HealthLearningDifficult = “How often do you have problems learning about an illness or health topic because of difficulty understanding the written information you get?”, FHL3FormsDocOffice = “How often do you think the forms you complete at your doctor’s office are confusing?”, FHL4HealthNumbersConfusion = “How often are you confused by health information that has a lot of numbers and statistics?”, FHL5OtherTalkHealth = “When you talk to people other than your doctor about health issues, how often are you confused by what they tell you?”, FHL6ReadingBrochures = “When reading brochures or hand-outs about health issues, how often do you need someone to help you read them?”, IHL5AnswersDoc = "How often do you understand the answers your doctor gives to your questions?"

Summary

This chapter summarized the main results collected from four surveys using a Qualtrics platform. This chapter provided results for two hypotheses and one research question. Independent t-tests were conducted to investigate the relationships between the independent variables, (i.e., FoodLast, NotAffordMeal, SkipMeal, EatLess, and Hungry), and the dependent variables (i.e., reading ability, reading environment, functional health literacy, and interactive health literacy). Factor scores were calculated in order to conduct independent t-tests with

variables containing multiple indicators. Chi-square analyses were conducted to investigate the relationships between the independent variables (i.e., SkipMeal, EatLess, and Hungry), and the dependent variables (i.e., reading ability, reading environment, functional health literacy, and interactive health literacy).

Chapter 5

Discussion

This chapter will describe major findings in the relationship between food insecurity, reading ability, and health literacy. This chapter will then discuss conclusions that can be drawn from the reported findings and suggest future research based on the current available literature on food insecurity and health literacy. The chapter will conclude with a summary of this research project.

The purpose of this study was to investigate the relationship between food insecurity and health literacy. The relationship between food insecurity and health literacy is critical to understanding the context in which poor health outcomes follow. Poor health outcomes can be a result of decision-making and happenstance (Lee & Navarro, 2018). Previous research has indicated that food insecurity and low health literacy influence the ability of individuals to engage in proper health practices in their everyday life (Dilley et al., 2019). The dietary habits of younger populations' are particularly important to examine because they are established during childhood, extend into adulthood, and determine health trajectories throughout the lifespan (Simpson et al., 2020). In this population specifically, there was a gap of knowledge on the relationship between food insecurity and health literacy skills among adolescents. After collecting data from adolescent teens in Cleveland, Ohio who were involved in a youth development initiative called MyCom, independent t-tests and Chi-square tests were conducted to examine this relationship. The data regarding self-reported nutrition behavior were not determined due to an inadequate sample size and many response options on the Youth Risk Behavior Survey. Thus, there was not enough variability for the covariates Age, Location, Race, GPA, and Grade Level.

This study investigated two hypotheses. The first hypothesis was, "There will be no significant difference on health literacy (functional health literacy and interactive health literacy) between youth who have low food insecurity and high food insecurity". The second hypothesis was, "There will be no significant difference on health literacy between youth who have low food insecurity and high food insecurity". The research question was, "What are the relationships between food insecurity, nutrition behavior, and health literacy among adolescent teens?".

Hypothesis 1: There will be no significant difference on health literacy (functional health literacy and interactive health literacy) between youth who have low food insecurity and high food insecurity.

Independent t-tests indicated that there were statistically significant relationships identified between the independent variables for food insecurity, reading ability, reading environments, and health literacy. After conducting independent t-tests, the independent variable named FoodLast (which read: "The food that (I/we) bought just didn't last, and (I/we) didn't have money to get more") was not statistically significant with reading ability, reading environment, functional health literacy, or interactive health literacy. This relationship supports the first research hypothesis stating there will be no significant difference on health literacy (functional health literacy and interactive health literacy) between youth who have low food insecurity and high food insecurity.

The independent variable, named NotAffordMeal (which read: "(I/we) couldn't afford to eat balanced meals. Was that often, sometimes, or never true for (you/your household) in the last 12 months?") was not statistically significant with reading ability, reading environment, interactive health literacy, or functional health literacy. This relationship supports the first research hypothesis stating there will be no significant difference on health literacy (functional health literacy and interactive health literacy) between youth who have low food insecurity and high food insecurity.

The independent variable, named SkipMeal (which read: "In the last 12 months, since last (name of current month), did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?") was statistically significant with reading ability and reading environment. This finding suggests that participants who did not need to skip meals (because they have adequate food) had the affordance to read outside of school and liked reading for leisure. This may be due to the cognitive functions of the brain, where getting enough nutrition may allow the brain to comprehend health information in a more coherent way. Research suggests that food insecurity may impose a burden on cognitive health (Royer, Guerithault, Braden, Laska, & Bruening, 2021). Fortunately, this study showed that food secure adolescents had higher perceived reading ability skills and were in literacy-rich reading environments, thus providing support for the first hypothesis, that there will be no significant difference on health literacy (functional health literacy and interactive health literacy)

between youth who have low food insecurity and high food insecurity. These variables also speak to positive reading behavior and the ability to experience literacy-rich environments in which reading is modeled by their parents. This relationship suggests that adolescents who had enough food had higher health literacy skills, thus providing support for the first research hypothesis, that there will be no significant difference on health literacy (functional health literacy and interactive health literacy) between youth who have low food insecurity and high food insecurity.

The independent variable, named EatLess which read: "In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?" was not statistically significant with reading ability, reading environment, functional health literacy, or interactive health literacy. This relationship does not provide support for the first research hypothesis, that low food insecurity is associated with higher health literacy.

The independent variable, named Hungry, (which read: "In the last 12 months, were you ever hungry but didn't eat because there wasn't enough money for food?") was not statistically significant with reading ability, reading environment, functional health literacy, or interactive health literacy. This relationship does not provide support for the first research hypothesis, that there will be no significant difference on health literacy (functional health literacy and interactive health literacy) between youth who have low food insecurity and high food insecurity.

Hypothesis 2: "There will be no significant difference on health literacy between youth who have low food insecurity and high food insecurity".

The data regarding self-reported nutrition behavior were not determined due to an inadequate sample size and many response options on the Youth Risk Behavior Survey. Thus, there was not enough variability for the covariates Age, Location, Race, GPA, and Grade Level.

Research Question: "What are the relationships between food insecurity, nutrition behavior, and health literacy among adolescent teens?".

The independent variable, named Hungry, (which read: "In the last 12 months, were you ever hungry but didn't eat because there wasn't enough money for food?") was statistically significant with six dependent variables named RA1ReadSurvey (which read: "How would you rate your ability to read this health survey?"), RA5PublicLibrary (which read: "Have you been to

the public library in the last year?"), RA6OnlineBookstore (which read: "Have you been to an online bookstore in the last year?"), FHL2HealthLearningDifficult (which read: "How often do you have problems learning about an illness or health topic because of difficulty understanding the written information you get?"), FHL6OtherTalkHealth (which read: "When reading brochures or hand-outs about health issues, how often do you need someone to help you read them?"), and IHL5AnswersDoc (which read: "How often do you understand the answers your doctor gives to your questions?").

These findings indicate that the majority of participants were not hungry and were able to read the survey easily, go to the public library, and go to an online bookstore. Findings also indicated that it was easier for the participants to learn health information, talk to others about health concerns, and understand answers from their doctors. These relationships suggest that adolescents who were not hungry also had higher functional health literacy skills, thus providing support for the research question, that there is a relationship between food insecurity and health literacy among adolescent teens.

The original research question did not include reading ability as a variable to investigate. The findings of this study, however, resulted in many statistically significant relationships between reading ability, reading environments, food insecurity, and health literacy. The reading ability questions (Zullig & Ubbes, 2010) were beneficial and were investigated through Chi-square tests to understand the relationship with the functional health literacy and interactive health literacy questions (Manganello, DeVellis, Davis, & Schottler-Thal, 2015). Most of the current literature that explored the relationships between reading ability and health literacy defined reading ability as "reading skills and comprehension" (Schonlau, Martin, Haas, Derose, and Rudd, 2011). Reading skills are defined as "a cognitive ability which a person is able to use when interacting with texts" (Liu, 2010). When practicing reading skills, research has suggested that "encouraging children's increased perceptions of their reading ability may be more likely to provide (a) reading tasks and/or reading opportunities that afford feelings of accomplishment, (b) normative information and/or evaluative feedback when their child is performing above-average, and (c) an environment that reduces stress while their child in engaged in academic tasks" (Zullig, Ubbes, & Mann, 2013). Research has also suggested that when value is placed on literacy-related behaviors by parents, such as going to a library or bookstore, and are observed

reading by their children, positive health influences and preventative behaviors may result for youth (Zullig, Ubbes, & Mann, 2013; Zullig & Ubbes, 2010).

The relationships identified by the independent t-tests reflected that the ability to read this survey was related to functional health literacy skills, as indicated by questions if youth could read instructions for medicine, learn about health topics, and read health brochures. Other results showed that reading outside of school made it easier for students to talk to their doctors about personal health concerns. For reading environments, RA5PublicLibrary and RA6OnlineBookstore could be explained as literacy-rich environments where young people obtain educational and entertainment resources. Results showed that participants in this study frequented public libraries and online bookstores, which are environments where reading abilities are accessible and supported (Zullig & Ubbes, 2010). Youth from more vulnerable populations often have fewer resources and affordances to facilitate the development of life skills, including health literacy (Manganello & Sojka, 2016), so it is important to identify reading skills that can address different types of health literacy. Specifically, identifying reading skills that address functional health literacy can be beneficial as functional health literacy is defined as one's ability to read, write, and speak about health (Ubbes & Ausherman, 2018).

Overall, there seems to be a prominent relationship between reading ability, reading environments, and health literacy skills. The data indicated that the more adolescents like to read and the more their environments support reading behaviors, the higher their literacy skills. This distinction allows for a relationship to better identify how reading ability can impact adolescent health literacy.

Summary

There was a significant relationship ($p<0.10$) between reading ability and each food insecurity variable, indicating that reading ability was related to food insecurity. The more conducive the environment was to reading, the more likely the participants were food secure and have functional and interactive health literacy skills. Functional health literacy skills had a significant relationship ($p<0.10$) to every food insecurity variable except for FoodLast. Contrary to this, only Hungry and NotAffordMeal were statistically significant ($p<0.10$) with interactive literacy skills. This suggests that functional health literacy skills are foundational skills that are acquired from having a food secure status. Interactive health literacy skills may require more

attention and experiences through interactive communication (Manganello, DeVellis, Davis, & Schottler-Thal, 2015). This study also suggests that there is a distinct difference in different types of health literacies, and brings into question what other types of health literacy would present possible relationships with food insecurity. A possible type of health literacy to consider in future research would be critical health literacy, as we know it addresses issues of access and equity for health information and services through an empowerment model (Ubbes & Ausherman, 2018) and a social determinants of health framework (Nutbeam & Lloyd, 2021). As such, food insecurity is a matter of concern for issues of accessibility, equity, and social justice as well.

Recommendations for future research should consider the idea that "health literacy can improve aspects of food insecurity, as improved knowledge and skills may assist to maximize income, but only to a certain point as education cannot change the cost of food or resolve other food insecurity causes that are economic in nature" (Begley et al., 2019). New solutions should also take into consideration how individuals with lower reading skills are less likely to engage in screening programs and find other ways to target food insecure and low health literacy communities (Schonlau et al., 2011). Health solutions should also incorporate health coursework that help with skill building to improve health literacy, as it may be an important way to help reduce health disparities for this population (Manganello & Sojka, 2016). Additionally, solutions to addressing food insecure and low literacy populations should base their solutions on equity, putting justice and fair inclusion at the center (Lee & Navarro, 2018).

The current study did not specifically incorporate survey instruments that focused on food literacy, which research has referred to as the most common subdivision of health literacy used in nutrition research (Dilley et al., 2019). Future research should include more on the relationship between food insecurity and inadequate food literacy that may coexist (Morgan et al., 2021). Additionally, future research should go beyond food insecurity and attempt to achieve nutrition security which prioritizes access to balanced nutritious foods and improved diet quality (Mozaffarian et al. 2021)

Several limitations of the present study must be acknowledged. The purpose of this study was to identify both food secure and food insecure populations to understand both groups' relationships with health literacy. However, the present study had an overwhelming majority of adolescents who did not identify as food insecure. Though the primary objective was met, more

research needs to be conducted with different populations as these results may not be representative of youth aged 13 to 18. Second, there was an unexpected low response rate due to the COVID-19 pandemic which limited the statistical power of the research. Third, increasing the p-value to 0.10 puts the current data at risk for type II error, which means there is an assumed relationship that does not exist when in fact the evidence supports that it does exist. The results may indicate a relationship between food insecurity and one of the dependent variables, when a relationship does not really exist. Lastly, this study did not explicitly investigate reading ability as a contributor to health literacy. Future research should do so. Since functional health literacy has been defined as the "ability to read, write, and speak about health" (Ubbes & Ausherman, 2019), future studies should continue to elaborate on the importance of reading ability in health equity research. Reading ability is only one form of functional health literacy, so other expressive forms of literacy (e.g., speaking and writing) need further investigations in health-related contexts.

In summary, this chapter discussed some of the findings of the results indicating a strong relationship between food insecurity, health literacy, and reading ability. The chapter sought to explore adolescents' experiences with food insecurity and to describe significant relationships between reading ability and two types of health literacy (i.e., functional health literacy and interactive health literacy). This study adds to the gap in the literature concerning youth, food insecurity, and health literacy. This chapter concluded with recommendations for future research and limitations to this study.

References

Artiga, S., & Hinton, E. (2018). Beyond health care: The role of social determinants in promoting health and health equity. Kaiser Family Foundation. https://www.kff.org/racial-equity-and-health-policy/issue-brief/beyond-health-care-the-role-of-social-determinants-in-promoting-health-and-health-equity/

Artiga, S., & Hinton, E. (2019). Beyond health care: The role of social determinants in promoting health and health equity. *Health*, *20*(10), 1-13.

Banerjee, A., Chitnis, U. B., Jadhav, S. L., Bhawalkar, J. S., & Chaudhury, S. (2009). Hypothesis testing, type I and type II errors. *Industrial Psychiatry Journal*, *18*(2), 127.

Banerjee, S., Radak, T., Khubchandani, J., & Dunn, P. (2021). Food insecurity and mortality in American adults: Results from the NHANES-linked mortality study. *Health Promotion Practice*, *22(2)*, 204-214.

Begley, A., Paynter, E., Butcher, L. M., & Dhaliwal, S. S. (2019). Examining the association between food literacy and food insecurity. *Nutrients*, *11*(2), 445. https://doi.org/10.3390/nu11020445.

Bröder, J., Okan, O., Bauer, U., Bruland, D., Schlupp, S., Bollweg, T.M., Saboga-Nunes, L., Bond, E., Sørensen, K., Bitzer, E.M. and Jordan, S. & Pinheiro, P. (2017). Health literacy in childhood and youth: A systematic review of definitions and models. *BMC Public Health, 17(1)*, 1-25.

Centers for Disease Control and Prevention. 2019 Youth Risk Behavior Survey Data. Available at: www.cdc.gov/yrbs. Accessed on February 19, 2021.

Centers for Disease Control and Prevention. 2021 Youth Risk Behavior Survey Questionnaire. Available at: www.cdc.gov/yrbs. Accessed on March 3, 2021.

Chaudry, A., & Wimer, C. (2016). Poverty is not just an indicator: The relationship between income, poverty, and child well-being. *Academic Pediatrics*, *16(3)*, S23-S29.

Coleman-Jensen, A., Rabbitt, M. P., & Gregory, C. A. (2020, September 09). Key Statistics; Graphics. Retrieved December 02, 2020, from https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/key-statistics-graphics.aspx

Cottrell, R. R., & McKenzie, J. F. (2011). *Health promotion and education research methods: Using the five-chapter thesis/dissertation model* (2nd ed). Jones and Bartlett Publishers.

Dilley, M. A., Rettiganti, M., Christie, L., O'Brien, E., Patterson, M., Weeks, C., Aronson, J., Scurlock, A. M., Perry, T. T., Pesek, R. D., Bell, M. C., Kennedy, J. L., Chandler, P., Magee, J., Simmons, L., Chervinskiy, S. K., Casey, P., & Jones, S. M. (2019). Impact of food allergy on food insecurity and health literacy in a tertiary care pediatric allergy population. *Pediatric Allergy and Immunology: Official Publication of the European Society of Pediatric Allergy and Immunology*, *30(3)*, 363–369. https://doi.org/10.1111/pai.13019.

Flannery D.J., Yang L., Singer M.I., & Walker M. (2020) Cleveland, Ohio: A community law enforcement partnership for sustainable neighborhood change. In: Stokes R., Gill C. (eds) *Innovations in Community-Based Crime Prevention*. Springer, Cham. https://doi.org/10.1007/978-3-030-43635-3_6.

Fleary, S. A., Joseph, P., & Pappagianopoulos, J. E. (2018). Adolescent health literacy and health behaviors: A systematic review. *Journal of Adolescence, 62,* 116-127.

Gulliford, M. C., Mahabir, D., & Rocke, B. (2004). Reliability and validity of a short form household food security scale in a Caribbean community. *BMC Public Health*, *4(1)*, 1-9.

Lee, M. M., & Navarro, A. (2018). Prioritizing racial equity: How efforts to advance racial equity helped shape the WK Kellogg Food & Fitness Initiative. *Health Promotion Practice*, *19(1_suppl)*, 24S-33S.

Lima, C. A. G., Maia, M. D. F. M., Brito, M. F. S. F., Pinho, L. D., & Silveira, M. F. (2020). Psychometric properties of the Youth Risk Behavior Survey (YRBS) Instrument in Brazilian college students. *Paidéia (Ribeirão Preto)*, *30,* 1-12.

Liu, F. (2010). Reading abilities and strategies: A short introduction. *International Education Studies*, *3*(3), 153-157.

Manganello, J. A., DeVellis, R. F., Davis, T. C., & Schottler-Thal, C. (2015). Development of the Health Literacy Assessment Scale for Adolescents (HAS-A). *Journal of Communication in Healthcare*, *8(3)*, 172-184.

Manganello, J. A., & Sojka, C. J. (2016). An exploratory study of health literacy and African American adolescents. *Comprehensive Child and Adolescent Nursing*, *39*(3), 221-239.

McNamara, J., Mena, N. Z., Neptune, L., & Parsons, K. (2021). College students'

views on functional, interactive and critical nutrition literacy: A qualitative study. *International Journal of Environmental Research and Public Health, 18(3)*, 1124. https://doi.org/10.3390/ijerph18031124.

Mozaffarian, D., Fleischhacker, S., & Andrés, J. R. (2021). Prioritizing nutrition security in the US. *JAMA*. https://doi.org/10.1001/jama.2021.1915.

Myers, C. A., Martin, C. K., Newton, R. L., Jr, Apolzan, J. W., Arnold, C. L., Davis, T. C., Price-Haywood, E. G., & Katzmarzyk, P. T. (2019). Cardiovascular health, adiposity, and food insecurity in an underserved population. *Nutrients*, *11*(6), 1376. https://doi.org/10.3390/nu11061376.

Nutbeam, D., & Lloyd, J. E. (2021). Understanding and responding to health literacy as a social determinant of health. *Annual Review of Public Health*, *42*.

Office of Disease Prevention and Health Promotion. (n.d.). Diabetes. *Healthy People 2030*. U.S. Department of Health and Human Services. https://health.gov/healthypeople/objectives-and-data/browse-objectives/diabetes

Okan, O., Lopes, E., Bollweg, T.M., et al. (2018). Generic health literacy measurement instruments for children and adolescents: A systematic review of the literature. *BMC Public Health, 18,* 166. https://doi.org/10.1186/s12889-018-5054-0.

Ormshaw, M. J., Paakkari, L. T., & Kannas, L. K. (2013). Measuring child and adolescent health literacy: A systematic review of literature. *Health Education, 113(5),* 433-455.

Osborn, C. Y., Paasche-Orlow, M. K., Davis, T. C., & Wolf, M. S. (2007). Health literacy: An overlooked factor in understanding HIV health disparities. *American Journal of Preventive Medicine*, *33*(5), 374-378.

Parnell, T. A. (2014). *Health literacy in nursing: Providing person-centered care.* New York, NY: Springer Publishing Company.

The Patient Protection and Affordable Care Act (PPACA), Pub. L. No. 111-148, 124 Stat. 518 (March 23, 2010).

Perry, E. L. (2014). Health literacy in adolescents: An integrative review. *Journal for Specialists in Pediatric Nursing*, *19(3)*, 210-218.

Rodriguez, J., Applebaum, J., Stephenson-Hunter, C., Tinio, A., & Shapiro, A. (2013).

Cooking, Healthy Eating, Fitness and Fun (CHEFFs): Qualitative evaluation of a nutrition education program for children living at urban family homeless shelters. *American Journal of Public Health*, *103(S2)*, S361–S367. https://doi.org/10.2105/AJPH.2013.301558.

Royer, M. F., Guerithault, N., Braden, B. B., Laska, M. N., & Bruening, M. (2021). Food insecurity is associated with cognitive function: A systematic review of findings across the life course. *International Journal of Translational Medicine*, *1*(3), 205-222.

Scott, J., Dardas, L., Sloane, R., Wigington, T., Noonan, D., & Simmons, L. A. (2020). Understanding social determinants of cardiometabolic disease risk in rural women. *Journal of Community Health*, *45(1)*, 1-9.

Schonlau, M., Martin, L., Haas, A., Derose, K., & Rudd, R. (2011). Patients' literacy skills: More than just reading ability. *Journal of Health Communication*, *16*(10), 1046–1054. https://doi-org.proxy.lib.miamioh.edu/10.1080/10810730.2011.571345.

Simpson, V., Pedigo, L., & Hamdan Rodriguez, M. (2020). Healthy food access and low-income teens: A photovoice approach. *Western Journal of Nursing Research*, *00*(0), I-9. https://doi.org/10.1177/0193945920963800.

Smith, L., Ward, P. B., Vancampfort, D., López-Sánchez, G. F., Yang, L., Grabovac, I., Jacob, L., Pizzol, D., Veronese, N., Shin, J.I., Lee, J., McDermott, D.T., & Koyanagi, A. (2021). Food insecurity with hunger and sexual behavior among adolescents from 53 countries. *International Journal of Sexual Health*, 1-21.

Speirs, K. E., Messina, L. A., Munger, A. L., & Grutzmacher, S. K. (2012). Health literacy and nutrition behaviors among low-income adults. *Journal of Health Care for the Poor and Underserved*, *23(3)*, 1082-1091.

Strauss, C. L. (2021). *Evaluating the use of factor scores in latent mediation models* (Doctoral dissertation, The University of North Carolina at Chapel Hill).

Stoewen, D. L. (2017). Dimensions of wellness: Change your habits, change your life. *The Canadian Veterinary Journal*, *58(8)*, 861.

Truman, E., Bischoff, M., & Elliott, C. (2019). Which literacy for health promotion: Health, food, nutrition or media? *Health Promotion International, 35(2)*, 432-444. https://doi.org/10.1093/heapro/daz007.

Ubbes, V.A., & Ausherman, J.A. (2018). A historical interpretation of how 19th and

20th century books contributed an early language and vocabulary for health literacy. *The Health Educator*, *50(2)*, 26-40.

Ubbes, V.A., Coyle, J., & Tzoc, E. (2018). Evaluation of an oral health curriculum: Design feedback from three audiences. *The International Journal of Health, Wellness, and Society, 8(4),* 1-10. http://doi.org/10.18848/2156-8960/CGP/v08i04/1-10.

Underwood, J. M., N. Brener, and B. Halpern-Felsher. (2020). *Tracking adolescent health behaviors and outcomes: Strengths and weaknesses of the Youth Risk Behavior Surveillance System.* NAM Perspectives. Commentary, National Academy of Medicine, Washington, DC. https://doi.org/10.31478/202010.

Wazlowski, S. (2015). Understanding food insecurity in Navajo Nation through the community lens. *Food Insecurity and Public Health*, 178–197. https://doi.org/10.1201/b18451-13

Yazel-Smith, L., El-Mikati, H. K., Adjei, M., Haberlin-Pittz, K. M., Agnew, M., & Hannon, T. S. (2020). Integrating diabetes prevention education among teenagers involved in summer employment: Encouraging environments for health in adolescence (ENHANCE). *Journal of Community Health*, *45*, 856–861.

Zullig, K.J., Ubbes, V.A., & Mann, M. (2013). Early adolescent literacy influences, reading ability, and preventative health behaviors. *American Journal of Health Studies, 28(3)*, 134-141.

Zullig, K.J. & Ubbes, V.A. (2010). Impact of literacy influences and perceived reading ability on self-rated health of public middle school students. *Research in Middle Level Education, 33(8):* 1-9.

Appendix A

Updated Definition by Ubbes & Ausherman (2019)	Updated Definition by Ubbes & Ausherman (2019)	Updated Definition by Ubbes & Ausherman (2019)
Functional Health Literacy is the ability to read, write, and speak about health.	**Interactive Health Literacy** is interpersonal communication between people, including their interactive use of print and electronic materials for health enhancement.	**Critical Health Literacy** addresses issues of "access and equity" for health information and services. This process includes critical problem posing with creative solutions to empower people who have a variety of backgrounds, health needs, and interests.
Nutbeam's Definition for Health Literacy	Nutbeam's Definition for Health Literacy	Nutbeam's Definition for Health Literacy
Functional Health Literacy: communication of information	**Interactive Health Literacy:** development of personal skills	**Critical Health Literacy:** personal and community empowerment
Nutbeam's Definition for Literacy (2000)	Nutbeam's Definition for Literacy (2000)	Nutbeam's Definition for Literacy (2000)
Basic or Functional Literacy—sufficient basic skills in reading and writing to be able to function effectively in everyday situations.	**Communicative or Interactive Literacy**—more advanced cognitive and literacy skills which, together with social skills, can be used to actively participate in everyday activities, to extract information and derive meaning from different forms of communication, and to apply new information to changing circumstances.	**Critical Literacy**—more advanced cognitive skills which, together with social skills, can be applied to critically analyze information, and to use this information to exert greater control over life events and situations.

Figure 1: Functional Health Literacy, Interactive Health Literacy, and Critical Health Literacy Definitions (Nutbeam, 2000; Ubbes & Ausherman, 2018)

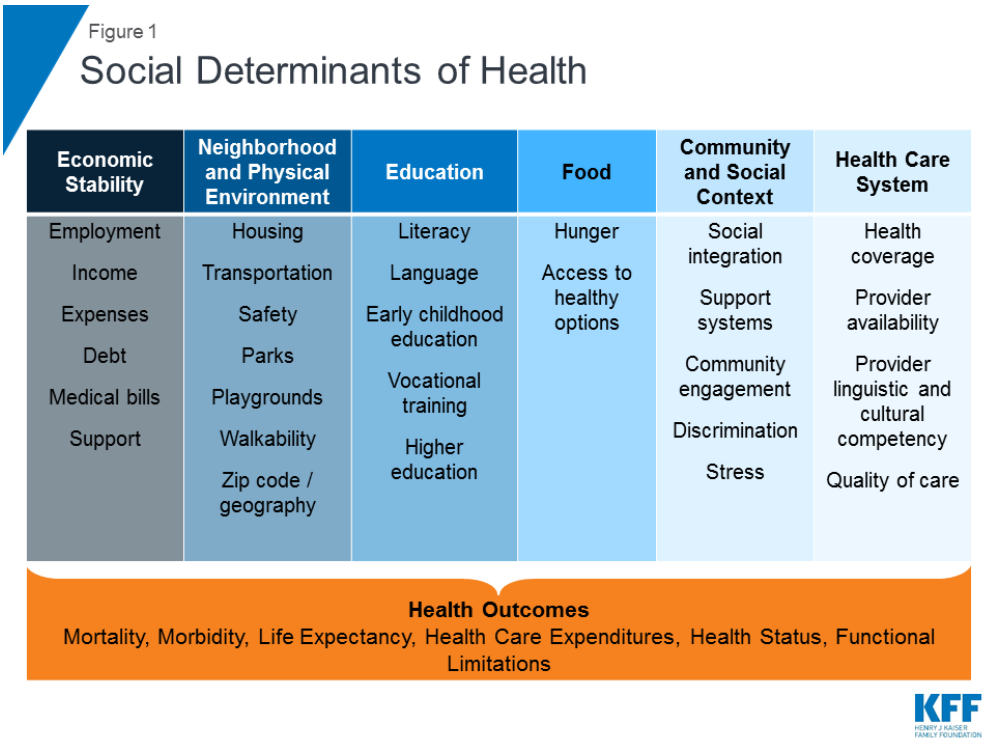

Figure 2: Social Determinants of Health (Artiga & Hinton, 2018)

Appendix B

Table of Contents for Instruments

Instruments

Title 1: Six Item Food Security Short Form (USDA, 2012)

Start of Block: Six Item Food Security Short Form (USDA, 2012)

Q1 The food that (I/we) bought just didn't last, and (I/we) didn't have money to get more." Was that often, sometimes, or never true for (you/your household) in the last 12 months?

- ○ Often true
- ○ Sometimes true
- ○ Never true
- ○ Don't know or Refuse to answer

Q2 "(I/we) couldn't afford to eat balanced meals." Was that often, sometimes, or never true for (you/your household) in the last 12 months?

- ○ Often true
- ○ Sometimes true
- ○ Never true
- ○ Don't know or Refuse to answer

Q3 In the last 12 months, since the last (name of current month), did (you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?

- ○ Yes
- ○ No
- ○ Don't know

Skip To: Q5 If In the last 12 months, since last (name of current month), did (you or other adults in your house... = No
Skip To: Q5 If In the last 12 months, since last (name of current month), did (you or other adults in your house... = Don't know

Q4 How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?

- ○ Almost every month
- ○ Some months but not every month
- ○ Only 1 or 2 months
- ○ Don't know

Q5 In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?

- ○ Yes
- ○ No
- ○ Don't know

Q6 In the last 12 months, were you ever hungry but didn't eat because there wasn't enough money for food?

- ○ Yes
- ○ No
- ○ Don't know

End of Block: Six Item Food Security Short Form (USDA, 2012)

Title 2: Nutrition Behavior and Demographic Questions from the Youth Risk Behavior Survey (YRBS, 2021)

Start of Block: Nutrition Behavior Questions from the Youth Risk Behavior Survey (YRBS, 2021)

Q1 During the past 7 days, how many times did you drink 100% fruit juices such as orange juice, apple juice, or grape juice? (Do not count punch, Kool-Aid, sports drinks, or other fruit-flavored drinks.)

- ○ I did not drink 100% fruit juice during the past 7 days
- ○ 1 to 3 times during the past 7 days
- ○ 4 to 6 times during the past 7 days
- ○ 1 time per day
- ○ 2 times per day
- ○ 3 times per day
- ○ 4 or more times per day

Q2 During the past 7 days, how many times did you eat fruit? (Do not count fruit juice.)

- ○ I did not eat fruit during the past 7 days
- ○ 1 to 3 times during the past 7 days
- ○ 4 to 6 times during the past 7 days
- ○ 1 time per day
- ○ 2 times per day
- ○ 3 times per day
- ○ 4 or more times per day

Q3 During the past 7 days, how many times did you eat green salad?

- ○ I did not eat green salad during the past 7 days
- ○ 1 to 3 times during the past 7 days
- ○ 4 to 6 times during the past 7 days
- ○ 1 time per day
- ○ 2 times per day
- ○ 3 times per day
- ○ 4 or more times per day

Q4 During the past 7 days, how many times did you eat potatoes? (Do not count french fries, fried potatoes, or potato chips.)

- ○ I did not eat potatoes during the past 7 days
- ○ 1 to 3 times during the past 7 days
- ○ 4 to 6 times during the past 7 days
- ○ 1 time per day
- ○ 2 times per day
- ○ 3 times per day
- ○ 4 or more times per day

Q5 During the past 7 days, how many times did you eat carrots?

- ○ I did not eat carrots during the past 7 days
- ○ 1 to 3 times during the past 7 days
- ○ 4 to 6 times during the past 7 days
- ○ 1 time per day
- ○ 2 times per day
- ○ 3 times per day
- ○ 4 or more times per day

Q6 During the past 7 days, how many times did you eat other vegetables? (Do not count green salad, potatoes, or carrots.)

- ○ I did not eat other vegetables during the past 7 days
- ○ 1 to 3 times during the past 7 days
- ○ 4 to 6 times during the past 7 days
- ○ 1 time per day
- ○ 2 times per day
- ○ 3 times per day
- ○ 4 or more times per day

Q7 During the past 7 days, how many times did you drink a can, bottle, or glass of soda or pop, such as Coke, Pepsi, or Sprite? (Do not count diet soda or diet pop.)

- ○ I did not drink soda or pop during the past 7 days
- ○ 1 to 3 times during the past 7 days
- ○ 4 to 6 times during the past 7 days
- ○ 1 time per day
- ○ 2 times per day
- ○ 3 times per day
- ○ 4 or more times per day

Q8 During the past 7 days, how many times did you drink a can, bottle, or glass of a sports drink such as Gatorade or Powerade? (Do not count low-calorie sports drinks such as Propel or G2.)

- ○ I did not drink sports drinks during the past 7 days
- ○ 1 to 3 times during the past 7 days
- ○ 4 to 6 times during the past 7 days
- ○ 1 time per day
- ○ 2 times per day
- ○ 3 times per day
- ○ 4 or more times per day

Q9 During the past 7 days, how many times did you drink a bottle or glass of plain water? (Count tap, bottled, and unflavored sparkling water.)

- ○ I did not drink water during the past 7 days
- ○ 1 to 3 times during the past 7 days
- ○ 4 to 6 times during the past 7 days
- ○ 1 time per day
- ○ 2 times per day
- ○ 3 times per day
- ○ 4 or more times per day

Q10 During the past 7 days, how many glasses of milk did you drink? (Count the milk you drank in a glass or cup, from a carton, or with cereal. Count the half pint of milk served at school as equal to one glass.)

- ○ I did not drink milk during the past 7 days
- ○ 1 to 3 times during the past 7 days
- ○ 4 to 6 times during the past 7 days
- ○ 1 time per day
- ○ 2 times per day
- ○ 3 times per day
- ○ 4 or more times per day

Q11 During the past 7 days, on how many days did you eat breakfast?

- ○ 0 days
- ○ 1 day
- ○ 2 days
- ○ 3 days
- ○ 4 days
- ○ 5 days
- ○ 6 days
- ○ 7 days

End of Block: Nutrition Behavior Questions from the Youth Risk Behavior Survey (YRBS, 2021)

Start of Block: Demographic Questions from the Youth Risk Behavior Survey (YRBS, 2021)

Q13 How old are you?

- ○ 12 years old or younger
- ○ 13 years old
- ○ 14 years old
- ○ 15 years old
- ○ 16 years old
- ○ 17 years old
- ○ 18 years old or older

Q14 What is your sex?

- ○ Male
- ○ Female

Q15 In what grade are you?

- ○ 9th grade
- ○ 10th grade
- ○ 11th grade
- ○ 12th grade
- ○ Ungraded or other grade

Q16 Are you Hispanic or Latino?

- ○ Yes
- ○ No

Q17 What is your race? (Select one or more responses.)

- ☐ American Indian or Alaska Native
- ☐ Asian
- ☐ Black or African American
- ☐ Native Hawaiian or Other Pacific Islander
- ☐ White

Q18 Which setting best describes where you live?

- ○ Urban city
- ○ Suburban town
- ○ Rural-farm
- ○ Rural-non farm
- ○ Other _____

Q19 What is the highest level of education that your mother has obtained?

- ○ Home schooled so did not attend local school
- ○ Completed some high school
- ○ Obtained high school diploma (or GED - Graduate Equivalency Diploma)
- ○ Completed some college
- ○ Obtained college degree or vocational degree
- ○ Obtained advanced degree (Masters, Specialist, Doctorate)
- ○ I do not know the answer to this question.

Q20 What is the highest level of education that your father has obtained?

- ○ Home schooled so did not attend local school
- ○ Completed some high school
- ○ Obtained high school diploma (or GED - Graduate Equivalency Diploma)
- ○ Completed some college
- ○ Obtained college degree or vocational degree
- ○ Obtained advanced degree (Masters, Specialist, Doctorate)
- ○ I do not know the answer to this question.

Q21 What is your family's income per year?

- ○ Below $25,000
- ○ $25,001-$50,000
- ○ $50,001-$65,000
- ○ $65,001-$80,000
- ○ $80,001-$100,000
- ○ $100,001-$150,000
- ○ $150,001-$200,000
- ○ Above $200,000
- ○ I don't know my family's income per year.

Q23 What is your current overall grade point average (GPA)? Please use three numbers when you write the answer. For example: 2.89.

End of Block: Demographic Questions from the Youth Risk Behavior Survey (YRBS, 2021)

Title 3: Reading Ability and Literacy-Rich Environments Survey (Zullig & Ubbes, 2010)
Start of Block: Reading Ability and Literacy-Rich Environments (Zullig & Ubbes, 2010)

Q1 How would you rate your ability to read this health survey?

- ○ It was easy for me to read this survey.
- ○ I had some difficulty reading this survey.
- ○ It was hard for me to read this survey.

Q2 How often do you find yourself reading books, newspapers, magazines, and other reading materials outside of school?

- ○ Most of the time
- ○ Sometimes
- ○ Never

Q3 How do you feel about your ability to read?

- ○ I love or like to read.
- ○ I will read if I am asked.
- ○ I do not like to read.
- ○ I have trouble reading most things.

Q4 How often did you see your parents or caregiver reading something in the past two days?

- ○ Every day
- ○ 1 day
- ○ 0 days
- ○ Not sure

Q5 Have you been to the public library in the last year?

- ○ Yes
- ○ No
- ○ Not sure

Q6 Have you been to an online bookstore in the last year?

- ○ Yes
- ○ No
- ○ Not sure

End of Block: Reading Ability and Literacy-Rich Environments Survey (Zullig & Ubbes, 2010)

Title 4: Two Components of the Health Literacy Assessment Scale for Adolescents (HAS-A) **(Manganello et al., 2015)**

Start of Block: Functional Health Literacy (Manganello et al., 2015)

Q1 How often do you get confused when reading instructions for medicine?

- Never
- Rarely
- Sometimes
- Usually
- Always

Q2 How often do you have problems learning about an illness or health topic because of difficulty understanding the written information you get?

- Never
- Rarely
- Sometimes
- Usually
- Always

Q3 How often do you think the forms you complete at your doctor's office are confusing?

- ○ Never
- ○ Rarely
- ○ Sometimes
- ○ Usually
- ○ Always

Q4 How often are you confused by health information that has a lot of numbers and statistics?

- ○ Never
- ○ Rarely
- ○ Sometimes
- ○ Usually
- ○ Always

Q5 When you talk to people other than your doctor about health issues, how often are you confused by what they tell you?

- ○ Never
- ○ Rarely
- ○ Sometimes
- ○ Usually
- ○ Always

Q6 When reading brochures or hand-outs about health issues, how often do you need someone to help you read them?

- ○ Never
- ○ Rarely
- ○ Sometimes
- ○ Usually
- ○ Always

End of Block: Functional Health Literacy (Manganello et al., 2015)

Start of Block: Interactive Health Literacy (Communication) (Manganello et al., 2015)

Q1 How often is it easy for you to ask your doctor questions about your health?

- Never
- Rarely
- Sometimes
- Usually
- Always

Q2 How often can you easily describe a health problem you have to your doctor?

- Never
- Rarely
- Sometimes
- Usually
- Always

Q3 How often can you easily describe a health problem you have to your doctor?

- Never
- Rarely
- Sometimes
- Usually
- Always

Q4 How often does your doctor seem to understand you when you answer a question he or she asks?

- ○ Never
- ○ Rarely
- ○ Sometimes
- ○ Usually
- ○ Always

Q5 How often do you understand the answers your doctor gives to your questions?

- ○ Never
- ○ Rarely
- ○ Sometimes
- ○ Usually
- ○ Always

End of Block: Interactive Health Literacy (Communication) (Manganello et al., 2015)