Child Nutrition and Cognitive Development: A Content Analysis

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Abstract

Nationally, approximately 6 million children are suffering from food insecurity. Children living in a food-insecure environment are at greater risk of nutritional deficiencies, which can decrease the ability to learn and lessen cognitive development in K–12 students. Data from the study addressed the gap of limited understanding of the potential thematic relationships across different situational environments and factors that influence success at school. The purpose of the qualitative content analysis (QCA) study was to analyze peer-reviewed medical journals to reveal the influence food has on a student's cognitive ability to learn. The significance of the study was to combat the effects of food on learning by incorporating knowledge into teaching and societal practices. Understanding potential thematic relationships can add overall knowledge to the connection between nutrition and academic performance and close the gap in knowledge via concise coding of peer-reviewed medical journals. The QCA study research goals focused on the conceptualization of data to create coding schemes that analyze the issues through a data reduction system, the abstraction of categories, and the thematic analysis between undernutrition and academic achievement. Selecting the appropriate peer-reviewed literature required the use of Walker and Avant's method, which was used to identify, refine, evaluate, and define the attributes of concepts used to answer the research questions. The major themes of the literature review that emerged were food deserts, food insecurity, nutrition and cognitive performance, nutrition and physical activity, stress, working memory, and attendance and absenteeism. The study had three limitations: sample size, time constraints, and lack of collecting representative data.

Keywords: undernutrition, academic performance, food desert, food insecurity, cognitive functioning, academic achievement

Dedication

I dedicate my dissertation work to my family. To my parents, Big Lonnie and Tia, thank you for installing the importance of education and the power to push through tough times. To my Parent-in-Laws, Maria and Alfonso, thank you for being there for my family and me whenever we needed your support. To my wife Andrea, you were there to help me however I can through this journey, especially with the birth of our two daughters during program completion and taking care of them for extended amounts of time. You always push me to take on anything, not settle for less and become the best version of myself. To my daughters, Natalia and Alicia, thank you for entering my life and being my motivation to persevere and never give up. Although you are only 3 and 1 years old, I hope I can share my dissertation story with both of you when you embark on your journeys to greatness. Please continue to be the inspiration for each other as you were to me.

I also would like to dedicate my work to my siblings. I watched your examples and needed your encouragement to push me forward during this process. Thank you all for always being in my corner.

Last, I would like to dedicate my work to my Peres Elementary Family, especially Ms. Adams, Ms. Harris and Dr. Scott for seeing something special in an inner-city Black kid from the Iron Triangle of Richmond, CA. You all modeled “Black Excellence” daily. You all sparked a fire and pushed me to be the leader you knew I could become.

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Chapter 1: Introduction

Across the United States, children are faced with nutritional deficiencies daily, which may pose a threat to nutritional quality and ability to learn (Abebe et al., 2017). A balanced diet is a critical component of a child's human and brain development throughout the life span (Asmare et al., 2018). When lacking proper nutrition, the academic performance and achievement of children may be negatively affected, which can be concerning to the goal of creating positive interactions with learning, school participation, and cognitive development of K–12 students (Seyoum et al., 2019).

While nutritional deficiencies can negatively affect student learning, the lack of food security and food access can lead to health disparities for children of lower socioeconomic status (SES; Bowers et al., 2018). Socioeconomic status has been universally recognized as a determinant of health status, which can perpetuate cycles of poverty and poor academic achievement across subsequent generations (Faught et al., 2017). The United States Department of Agriculture (USDA, 2018) stated about six million American children live in food-insecure households, and 540,000 children live in households in which one or more children experience low food security. Children living with food insecurity are at the greatest risk of exposure to chronic stressors, such as poverty, which can negatively affect a child's ability to read and write, lifetime earnings, health outcomes, and graduation rates (Robinson et al., 2017).

The overall well-being and nutritional development of children are established during the first 8 years of life (Robinson et al., 2017). Compared to their higher socioeconomic counterparts, children of low socioeconomic status (SES) can disproportionately face the burden of malnutrition from the increased consumption of energy-dense foods and the decline in development across the physical, cognitive, and behavioral domains (Robinson et al., 2017). The

sustained interruptions of a child's nutrition can lead to deficits in physical and cognitive growth, impairments to academic performance and linguistic development, and potential psychosocial disorders before K–12 graduation (Shankar et al., 2017). To understand better the issues of child nutrition on learning, the study explored the factors pertaining to the relationship between food and learning for K–12 students.

The sections discussed in this chapter are the background of the problem, problem statement, purpose of the study, significance of the study, research questions, definitions of terms, assumptions, scope and delimitations, limitations, and chapter summary. The introduction and background of the problem advance knowledge acquisition between nutrition and learning. The problem statement and purpose of the study were established to analyze peer-reviewed literature to identify themes and patterns to help understand the relationship between nutrition and academic performance output. The research questions guided the study. The definitions of terms were created to ease confusion and define important terms relevant to understanding the study. The assumptions and scope and delimitations are outlined to explore the relevant literature and theories pertaining to nutrition and learning. The limitations of the study are outlined to address the constraints of the study. The chapter summary amasses each section to articulate the objectives of the study.

Background of the Problem

This section provides the background information related to the problem of how nutritional deficiencies can influence the academic performance and achievement of K–12 students in the classroom. A concise overview of nutritional deficiencies is supplied. The influence of inadequate nutrition on the ability to learn is discussed. The effect of undernutrition across multiple environments and the associations between learning are addressed. Connections

are made between nutrition, stress, working memory, and absenteeism to conclude the background of the study.

The beginning of nutritional deficiencies can be traced back to the start of food deserts. The USDA (2019) defined a *food desert* as any part of the country that lacks affordability and accessibility to fresh fruit, vegetables, and healthy food choices. The origins of food deserts can be traced to the 1930s when societal infrastructures shifted to urban development, suburbanization, and highway development (Deener, 2017). Urban, suburban, and highway development led to fierce competition between small and large corporations (Deener, 2017). While urbanization provided infrastructure necessary for population growth and market formation, infrastructural exclusion became a by-product that led to unequal access to food distribution channels across SES levels (Deener, 2017). Unequal food access was recognized and linked to low food security in low-income communities (Block & Subramanian, 2015). Rossen and Kobernik (2016) concluded households that are likely to face food insecurity fall below the federal poverty threshold, have caregivers with less than a high school education, live in high-crime communities, and are more likely to be non-Hispanic Black or Mexican American.

Inadequate nutrition has been linked to poor neural and cognitive development in children facing poverty and low SES (Dolean et al., 2019). Delays in neural and cognitive development can lead to significant differences in both the child's nutrition and exposure to early language environments. Neurological networks, which assist in language acquisition before birth, set the foundation for language acquisition during the first 3 years of life (Zauche et al., 2017). Zauche et al. (2017) indicated SES is a key determinant for inequalities of language and cognitive development in children as early as 9 months old, a 30-million-word gap between low- and high-SES children by the age of 3, and disparities in the ability to read proficiently by the

third grade.

The home and school environments play a vital role in the nutritional development of K–12 students. Haddad et al. (2018) stated the home and school environments have a positive effect on primary school children's health behaviors. Health behaviors may be more difficult to manage due to economic instability (Gassman-Pines & Bellows, 2018). Households that faced economic instability were unfavorably associated with lower levels of school readiness and poorer kindergarten outcomes across all levels of development (Johnson & Markowitz, 2018a). Within the school environment, students who had increased consumption of discretionary foods were linked to poorer academic grades and in-class behaviors (Chan et al., 2017). School systems have the opportunity to close the nutrition gap with the adoption of healthy-eating programs, practices, and elements of organizational change (Frerichs et al., 2015).

The exposure to early adversities and lifestyle factors of a child can affect the child's ability to perform academically (Quach et al., 2017). Exposure to stressful life events, such as poor nutrition and financial hardship can lead to poorer mental health and academic problems, which increase with a higher number of disparities (Quach et al., 2017). An increase in academic problems may lead to a decrease in working memory, which can harm the learning processes of language, math, and reading (Cowan, 2017). Early adversities may lead to increased absenteeism, which can harm the education outcomes of children, dietary patterns, ability to make healthy choices, and future economic development in adulthood (Centeio et al., 2018; Tamiru et al., 2016).

Statement of the Problem

The problem of the qualitative content analysis (QCA) study was the lack of deep understanding of how nutrition deficiencies influence students' academic performance and

achievement in the classroom. The extent of the problem was evident when analyzing the significant barriers that prevent adequate nutrition and the disruptions nutritional deficiencies can cause in a student's self-regulatory functioning ability in the classroom (Johnson & Markowitz, 2018b). In 2017, about 11% of U.S. households faced food insecurity, where at least 6.5 million households had at least one child who was food insecure (Au et al., 2019). In children aged 6–12, food insufficiency has been associated with negative academic outcomes, such as lowered math scores and grade repetition (Baxter et al., 2017). Children with lower academic achievement and SES reported higher levels of food insecurity compared to children of higher academic achievement, and 13% are at risk of chronic absenteeism, which can increase the risk for poor long-term health outcomes (Baxter et al., 2017).

The relationship between nutrition and academic performance had to be further investigated to better understand how inadequate nutrition could affect student learning. A large amount of research details the relationship between adequate nutrition and academic development, but there is limited understanding of the potential thematic relationships across the multiple environments K–12 students exist within daily. The research conducted can add to the overall knowledge of adequate nutrition and academic performance via theme development by connecting existing evidence to identify meaningful clusters of information and reveal how frequently each theme relates to the others (Armborst, 2017).

Purpose of the Study

The purpose of the QCA study was to analyze peer-reviewed medical journals to reveal the effect food has on a student's cognitive ability to learn. Exploring the effect of nutrition across multiple environments can provide applicable solutions to reverse the barriers to successful learning caused by the factors of inadequate nutrition, such as food insecurity, low

SES, health behaviors and norms, and lack of social support in the home (Anderson et al., 2016; Haddad et al., 2018; Rossen & Kobernik, 2016). The data from this QCA study may provide a model that can investigate the issues comprising undernutrition and its influence on K–12 student success. If the issues investigated can be connected, then a multitude of factors can be explored to find solutions to maximize K–12 student learning. This section is a discussion of the research rationale, methodology and design, strategy, goals and objectives, and how the study filled the gap in scholarly literature.

Evidence supported children facing deficits in nutrition are linked to both negative dietary behaviors and decreased academic achievement (Brener et al., 2017). Without adequate nutrition, students may miss out on the opportunity to partake in healthy eating and physical activity, which have been associated with higher self-reported letter grades, decreased substance use and decreased engagement in health-risk behaviors (Rasberry et al., 2017). The goal of the QCA study was to explore underlying relationships between nutrition and K–12 student learning. The goal of the study aided in the classification of data to relationally analyze academic performance and cognitive functioning by the agency of undernutrition. The research design allowed for the exploration of the relationship between undernutrition and student learning by exploring the manifest and latent meanings within the literature, which can fill the gap in the literature by increasing the standard of intersubjectivity to find data hidden among existing literature (Maier, 2017; Neuendorf, 2017).

Significance of the Study

The significance of the QCA study is the valuable information provided pertaining to the influence between what a student eats and the ability to adequately perform well in the classroom. This QCA study served as a tool to engage in the efforts to help families suffering

from undernutrition across multiple generations and focus on the welfare of the entire family to break possible negative patterns leading to factors, such as food insecurity. Socioeconomically, children living in food-insecure environments may be more at risk of greater economic uncertainty, which can have a trickle-down effect on the children and the stressors faced in a household, such as a decrease in mental health (Hanson et al., 2016). To combat undernutrition and food-insecure environments, the study results might lead to changes in teaching practices, nutritional assistance programs, and national lunch programs at schools by exploring key themes that can contribute to the exploration of applicable solutions across future generations.

Research Questions

The QCA study focused on identifying key themes and patterns between food and learning in K–12 education. The goal was to conceptualize and condense meaning from relevant literature to understand the relationship between nutrition and the necessary characteristics of K–12 student success. The conceptualization of the data aided the development of key thematic relationships that analyzed the barriers preventing adequate nutrition and cognitive skill development guided by the research questions. The following research questions guided the study:

Research Question 1: According to research studies conducted between 2014 and 2019, how does undernutrition affect K–12 students' cognitive functioning in classrooms?

Research Question 2: According to research studies conducted between 2014 and 2019, how does undernutrition influence K–12 students' academic achievement?

Theoretical Framework

This section is a preview of the theoretical framework of the study. Chapter 2 provides a more comprehensive description of the theoretical framework. Grant and Osanloo (2016)

suggested the theoretical framework of the study is one of the most important aspects because the framework serves as the foundation on which knowledge is constructed and becomes the blueprint for the entire dissertation. Each theory aligned with the research questions and literature inquiry of the study. The three theories that laid the foundation of the theoretical framework were the structuration theory, social cognitive theory (SCT), and social-ecological theory.

The structuration theory developed by Anthony Giddens elucidates the complex relationship between human agency and social institutions (Canary & Tarin, 2017). The dualistic relationship between human agency and social institutions focuses on the meaningful patterns of activity between the structures, rules and resources that guide activities, and structuration, the production and reproduction of structures within the social system (McPhee et al., 2013). Across society, the wealthiest people have the power to affect the most change, while vulnerable populations become victims of health disparities, which plays a part in shaping healthy behaviors of individuals (Cleave et al., 2016).

The SCT is multifaceted when dealing with human behavior. Hall et al. (2015) stated the SCT can serve as a behavioral change engine via the reciprocal interactions across multiple environmental factors. Each factor influencing human behavior can be traced to the first moments of human development, which can ascertain to the outcome expectations, self-efficacy levels, and competence needed to navigate behavioral patterns for self-regulation (Muturi et al., 2016; Torkan et al., 2018). The SCT was designed to connect to the QCA approach of the study by seeking an understanding of nutritional self-regulation and its influence on academic performance. Alongside the SCT, the four systematic levels of health behaviors shaping each individual is described in the social-ecological theory. The social-ecological theory has insight

into the growth opportunities for nutritional knowledge acquisition and intervention (Venkataramani et al., 2016).

Definitions of Terms

The following definitions of terms are defined for the purpose of the study. Each definition is provided to enhance understanding of the content of the dissertation. The definitions offer explanations for clarity to aid the reader in understanding the context of how each definition was used in the study.

Absenteeism. Absenteeism is when a student misses 10% or more of school during a school year (Center for Research in Education and Social Policy [CRESP], 2018).

Academic Achievement. Academic achievement is the mastery of content skills and knowledge as measured by state academic standards and academic achievement testing (McCoy et al., 2005).

Academic Performance. Academic performance is the measurement of the learning process and capacity to acquire knowledge and skill mastery in the classroom setting, which is affected by direct and indirect contextual factors across multiple environments (Liem, 2019).

Energy-Dense Food. Energy-dense food is food that is high in fat and calories but has little to no nutritional value (Kral, 2018).

Food Desert. A food desert is any part of the country that lacks fresh fruit, vegetables, and healthy food affordability and accessibility (USDA, 2019).

Food Environment. A food environment is a location where children are exposed to different types foods, such as the home, school, and neighborhood (Kral, 2018).

Food Insecurity. Food insecurity is the economic and social conditions that limit access to food in a household (Gundersen & Ziliak, 2016).

Household-Level Food Insecurity. Household-level food insecurity is the perception of a household's ability to obtain enough food to meet everyday needs (Bonanno & Li, 2015).

Malnutrition. Malnutrition is a chronic state of nutrition that leads to diminished function and body composition change (Soeters et al., 2017).

Nutrition. Nutrition is a proper diet of essential nutrients that meets the dietary guidelines and maintains positive bodily function without the overconsumption or underconsumption of caloric intake (USDA, 2015).

Socioeconomic Status (SES). Socioeconomic status is a measure of a person's combined economic and social status in correlation (positive or negative) to health, which is commonly measured by education, income, and occupation (Baker, 2014).

Stress. Stress is the feeling of mental pressure and tension that can lead to harm of an individual and result in biological, psychological, and social problems (Shahsavarani et al., 2015).

Undernutrition. Undernutrition is a lack of proper nutrition that does not meet nutritional dietary guidelines, stems from the overconsumption of energy-dense foods, and include development deficits, such as stunting and neurocognitive delays (Blanton et al., 2016).

Working Memory. Working memory is the amount of information that can be retained and maintained temporarily to use in cognitive tasks (Adams et al., 2018).

Assumptions

This research was based on the following four key assumptions. The first assumption is those who share a similar sociocultural background would agree with the interpretation of the data collected and analyzed to describe the relationship between nutrition and academic development (Schreier, 2012). The second assumption is the conceptualization of thematic data

established meaningful and rich information connections that are context-specific by nature and understood at a higher level of abstraction. The third assumption, pertaining to data analysis, is the coder should be consistent with the method of coding via intercoder reliability, data processing, and relatability of data classification (Schreier, 2012). The fourth key assumption is the coder should be able to supplement the study's unique perspective alongside the intended meaning of the author of the literature chosen (Schreier, 2012).

Scope and Delimitations

The scope of the study was limited to peer-reviewed literature selected from reputable medical databases for finding evidence regarding the thematic relationship between nutrition and K–12 academic data. The QCA study consisted of data collection via the original work of experts to establish a relational analysis link between child nutrition realities and learning in the K–12 classroom. As no participants were involved in the study, all original work used was collected without misinterpreting or misusing the work's original intent and meaning. To ensure no misinterpretation or misuse of original work, the data collection process followed a systematic category creation method using Walker and Avant's concept analysis method (Squires et al., 2015). Walker and Avant's method was most suitable because the method allows the conceptualization of data while identifying and defining key attributes necessary to perform a proper investigation while analyzing comparable studies relating to the phenomenon (Yazdani & Shokooh, 2018). Each category constructed should demonstrate unidimensionality with the ability to collect and categorize similar data together, which can aid in adequate comparison across categories for theme creation (Graneheim et al., 2017).

Limitations

The limitations section includes the three limitations related to the dependability of the

results of the QCA study. Limiting the sample size to peer-reviewed literature can increase the probability of finding results that do not show a significant relationship between nutrition and learning. While the elimination of human participants removes recall bias, the sample of the literature analyzed can be misinterpreted, and a new meaning of the message can be inferred as real-time data can be missed in the data exchange (Maier, 2017).

The second limitation of the study is time constraints. Analyzing over 100 articles and displaying relational analysis via conceptualization can be a time-extensive process, which can cause a deficit in the time available to properly investigate the research problem and inaccuracies in analyzing the data (Maier, 2017). The third limitation of the study is the lack of collecting representative data. A key advantage of QCA is the ability to bypass human subjects and collect data from existing literature, which can become a disadvantage if not properly coded or messages of the data are misinterpreted (Maier, 2017). The lack of collecting representative data can alter the scope of the study, which increases the chance to not find significant trends and meaningful relationships in the data (Maier, 2017).

Chapter Summary

Chapter 1 contains an introduction and background information that explained the scope and rationale of the study. To determine the influence nutritional deficiencies have on K–12 learning, a QCA was conducted to make thematic connections between nutrition, stress, working memory, and absenteeism across multiple environments. K–12 students may face nutritional disruptions that can affect student learning. The goal of the QCA study was to analyze peer-reviewed medical journals to determine the influence food can have on a student's ability to learn, which was significant because the QCA study can provide information to help families facing undernutrition across multiple generations.

To accomplish the research goal, the study acknowledged the delimitations to not misinterpret or misuse the author's original work. For future research, the three limitations were sample size, time constraints, and lack of representative data. The following literature review is a description of the literature search strategy, theoretical framework, research literature review, and gap in the literature to give an analysis of current scholarly literature related to nutrition, nutrition deficits, and cognitive development in the K–12 classroom.

Chapter 2: Literature Review

The lack of adequate nutrition in school-age children can have devastating effects on each child's physical health, behavior, and cognitive development (Mmari et al., 2019). Students from families with low SES were linked with inadequate nutrition and high school dropout, which can lead to increased negative outcomes, such as drug use and being arrested at an earlier age (Lansford et al., 2016). The purpose of the QCA study was to analyze peer-reviewed medical journals to reveal the influence food has on a student's cognitive ability to learn. With 15% of Americans admitting to sometimes not being able to afford food, undernourishment can affect school-age children when unexpected expenses or income shortfalls cause hardship and temporary experiences with hunger (Bublitz et al., 2019).

The problem of the QCA study was the lack of deep understanding of how nutrition deficiencies influence students' academic performance and achievement. Undernutrition may be affecting the students' ability to maximize academic performance and cognitive development (Wolde & Belachew, 2019). The problem was evident in American households experiencing a lack of stable access to food (Allen et al., 2018). One in eight households reported a lack of stable access to food and hunger that resulted in diminished health and well-being for household members (Bublitz et al., 2019). K–12 students in households experiencing hunger or undernutrition may be more susceptible to development interruptions in physical size, cognitive growth, and motor skills, which may harm long-term ability to learn (Shankar et al., 2017).

The literature review includes current scholarly literature relating to undernutrition and how undernutrition affects K–12 student learning. The research literature review section provides a general overview of the two key themes and corresponding subthemes surrounding undernutrition and learning, along with the theoretical framework. The first theme centers on

undernutrition. The subthemes of undernutrition focus on food deserts and food insecurity. The second theme centers on academic performance, with two subthemes of cognitive functioning and academic achievement. The determination of each key theme was associated with the thematic relationship between undernutrition and academic development. The literature review helps readers to understand the relationship of key themes by drawing realistic conclusions through the conceptualized interpretations identified in the literature examined (Bengtsson, 2016).

The literature review chapter is an explanation of the issues through its organizational structure. Alongside the key themes explained in the literature review section, this chapter comprises the literature review strategy, theoretical framework, thorough review of past studies, and chapter summary. The literature review strategy section covers the strategies used to detail relevant literature sources conducive to the understanding of key themes in this chapter. The theoretical framework section is an explanation of theories that helped understand the issues of the study. The review of past studies led to the compilation of key information pertaining to each section of the literature review.

Literature Search Strategy

The research reviewed came from peer-reviewed journals, books, and documents published by government agencies, such as the USDA. The research met the three criteria to establish a successful search strategy within the QCA research design: (a) theory and rationale, (b) conceptualization, and (c) research question variables. To conduct a quality literature review, the first criterion, theory and rationale, should be identifiable when choosing data (Maggio et al., 2016). Theory and rationale assisted the process by determining which content would be examined and indicated which theories or perspectives were important to the content of the study

(Neuendorf, 2017). The second criterion, conceptualization, ensured the research reviewed was focused on the variables of the study that helped understand the relationships between undernourishment and academic performance and achievement in K–12 students (Neuendorf, 2017). The third criterion, research question variables, determined the confidence of the variables as described in the research literature reviewed (Neuendorf, 2017).

With the established criteria, the literature review search strategy began with searching the academic databases accessible through the American College of Education (ACE) library. Each search focused on keywords related to the concepts of the research design, variables of the research questions, and journals pertaining to child nutrition. Once each keyword search was completed, the subjects' topic headers and reference listings were investigated to find potential research articles not found using keyword searches and discover peer-reviewed literature that connects to nutrition and student learning. In the event enough research literature was not found in the ACE library, additional database options were explored, such as Google Scholar, and free database options, such as AGRICOLA and *The Journal of Child Nutrition & Management*. Keyword searches were done in the Google search engine to find relevant articles, resources, and possible experts on undernourishment and academic achievement.

The reasons for choosing additional databases are threefold. Each additional database was chosen to help answer the research questions of the study by gathering appropriate evidence pertaining to the study's focus (Bethel & Rogers, 2019). A comprehensive sampling strategy was used to find additional studies relevant to the issues of interest, draw together available knowledge to enhance the overall literature review, and gather gray literature not controlled by commercial publishers (Heyvaert et al., 2017). The comprehensive sampling process was essential to compile available knowledge to identify index terms and bibliographic data and limit

the risk of bias by completing exhaustive searches in the most cost-efficient manner possible (Heyvaert et al., 2017).

Theoretical Framework

The study was grounded on the concepts of structuration theory, SCT, and social-ecological theory to reveal the influence food has on a K–12 student's cognitive ability to learn (Bandura, 2011; Bronfenbrenner, 1979; Giddens, 1984). The section details the theoretical framework that provided an understanding of the relationship between nutrition and cognitive development in K–12 students. The theories selected were used to develop a preliminary understanding of the issues investigated (Ngulube et al., 2015). Each theory examined in the framework served as a linkage to the perspective of the research by connecting scholarly discourse to the body of literature, interpreting findings, and establishing a framework for the problem of the study to be properly investigated (Ngulube et al., 2015). Theories used to gather an understanding of the research are Giddens's structuration theory and food consumption behavior, Piaget's SCT, and the social-ecological theory.

Giddens's Structuration Theory and Food Consumption Behavior

Giddens's (1984) structuration theory defined the recursive and dualistic relationship between structures (rules and resources) and systems (reproduced relations between actions and collectives) within the nature of society via macro–micro perspectives, social practices, human behavior, and the reproduction of social systems. Giddens's structuration theory emphasized the duality of society based on societal behavior (Sadler et al., 2015). Determining the actions of individuals in society is imperative to explain society's ability to intervene and shape the social reality, behaviors, and norms of people (Cleave et al., 2016). The structuration theory is an explanation of the connections between situated interactions and the social structures of

meaning, norms, and power in society (Canary & Tarin, 2017).

A duality of the social structure acts as the creator by the suggested behavior(s) and structure(s) in society, especially food consumption behavior (Cleave et al., 2016). Individual food consumption behavior and the food system are linked to the structure of society and the healthy behaviors are chosen based on socioeconomic factors (Cleave et al., 2016). Recursive social practices occur between a combination of the macro processes, such as institutional power and the microprocesses, such as situation interactions, like the capability to make nutritious food choices (Canary & Tarin, 2017). In society, the wealthiest have the power to affect the most change, and vulnerable populations are unable to affect change (Sadler et al., 2016). Structurally, vulnerable populations become victims of health disparities because of the external, social, and political forces that lead to inequalities within a built environment (Sadler et al., 2015).

Social Cognitive Theory

The SCT deals with human behavior that can affect an individual on many levels. Social cognitive theory serves as a model for behavior change by emphasizing the reciprocal interaction of personal, behavioral, and environmental factors (Hall, Chai, & Albrecht, 2015). The human behavior each individual exhibits is a by-product of personal behavioral capabilities, or the specified actions needed to act on a given behavior (Bagherniya et al., 2017). Each human behavior is tied to an individual's thoughts and feelings (personal factors), health-related knowledge, and skills needed to regulate and act on one's health outcomes (behavioral factors), and the physical and social external factors that can affect health behaviors (environmental factors; Bagherniya et al., 2017). When combined, each factor plays a role in successfully reaching any outcome expectations.

From the first moments of human development, the affiliation between the factors

pertaining to nutritional choices influences the outcome expectations of nutrition (National Academies of Sciences, Engineering, and Medicine, 2016). A lack of nutrition of an expecting mother leads to low birth weight, lack of sufficient fetal growth development, and heavy birth weight, which may lead to childhood obesity and decreased academic performance (Torkan et al., 2018). Alongside birth weight, factors, such as food choice, eating behaviors, and behavior profiling, change based on an individual's eating competence (Hardcastle et al., 2015). An individual with a greater eating competence is more likely to be associated with higher fruit and vegetable intake, more healthy eating patterns among family members, paying more attention to labels to make healthier food purchases, and more willing to eat healthy outside of the home environment (Hardcastle et al., 2015).

Each behavioral factor linked to SCT works like a spider web network; the combination of each factor forms a structure in which self-efficacy, determination of goals, and outcome expectations spin together to create a web of positive or negative self-regulation (Torkan et al., 2018). To maintain positive self-regulation, the awareness of self-efficacy is needed to begin the transformation of negative nutrition behaviors (Caldwell et al., 2018). At the heart of SCT, awareness of self-efficacy is the key skill needed to change one's approach to dietary behavioral patterns (Muturi et al., 2016). When self-efficacy is considered, an individual's belief to produce the desired outcome affects the ability to execute the behaviors necessary to conquer perceived barriers related to nutrition (Hall, Chai, Koszewski, & Albrecht, 2015).

On the other hand, environmental factors, such as SES, are externally linked to self-efficacy (Müller & Seufert, 2018). Individuals who are faced with lesser levels of education, income, and employment are at higher risk of negative self-regulation behaviors and decreased self-efficacy within families and the school environment (Alves et al., 2017). Decreased self-

efficacy increases the challenge to overcome the barriers to a healthy lifestyle, such as nutrition knowledge and dietary intake (Zarnowiecki et al., 2020). Among individuals with low SES, the challenge to overcome barriers influences the response to cognitive behaviors, such as nutrition knowledge, attitude, and belief (Stephens et al., 2015). Research indicated youth with lower SES were prone to consume fewer fruits and vegetables and consume more foods high in fats, which negatively influenced the academic performance of children in school (Alves et al., 2017).

To counteract the effects of lower SES, schools have the opportunity to reverse the trends of undernourishment in the household by boosting nutritional self-efficacy (Zarnowiecki et al., 2020). Alves et al. (2017) stated the "school effect" (p. 50) promotes success in disadvantaged students by increasing nutritional self-efficacy at school. An increased self-efficacy improves the cognitive development of students by preventing the reproduction of societal difficulties and inequalities in schools for disadvantaged students (Alves et al., 2017). Social cognitive theory reveals, when a family or school contributes to the positive influence of children's health, the cognitive development of children improves via increased self-efficacy, nutrition intervention with breakfast and lunch programs, and enhanced target behavior (Hall, Chai, & Albrecht, 2015).

Social-Ecological Theory

The social-ecological theory describes the natural factors influencing the health behaviors of individuals (Venkataramani et al., 2016). An individual's health behaviors are influenced and organized into four systematic levels: individual, social environment, physical environment, and macrolevel environment (Safan et al., 2018). McCormack et al. (2017) stated individuals are influenced by the amalgamation of the systematic levels of influence, which are formed from the external factors within an individual's physical and social environments. Interventions to counteract the negative influences of the four systematic levels are a possibility in the social-

ecological theory perspective. By exploring the links of multilevel knowledge acquisition, interventions can boost knowledge via self-investment, environmental modification, and self-motivation (Schölmerich & Kawachi, 2016). In essence, change is a by-product of a person's ability to improve personal health environments and the assistance of a modified environment, such as school breakfast and lunch programs (Oostindjer et al., 2017).

Research Literature Review

The research literature review section is a description of research literature relevant to the purpose of the study. The goal of the literature review section is to focus attention on current literature related to the study. A review of the literature resulted in eight major topics emerging: (a) food deserts, (b) food insecurity, (c) nutrition and cognitive performance, (d) nutrition and physical activity, (e) obesity, (f) stress, (g) working memory, and (h) absenteeism and attendance. Each topic in the literature review covers how undernutrition can be linked to the academic achievement outcomes of K–12 students across multiple environments.

Food Deserts

The infrastructure of the food desert is embodied by its definition. The USDA (2019) defined a *food desert* as any part of the country that lacks fresh fruit, vegetables, and healthy food choices due to poverty, lack of grocery stores, or lack of accessibility to healthy food providers. The lack of accessibility to healthy resources in food desert environments can be characterized historically, geographically, and socioeconomically.

Historically, society's relationship with food can be traced through the influence of policies and SES on the food system in place (Padoongpatt, 2016). The existence of food deserts produced urban inequality through infrastructural exclusion (Deener, 2017). Infrastructural exclusion played a vital role in the relationships of organizations and infrastructures, which aided

in the facilitation or dislocation of urban interdependence (Deener, 2017). In the case of food desert communities, the characteristics of food deserts became invisible and were not seen as a public problem until people began experiencing breakdowns, such as limited access to clean water and loss of grocery stores (Deener, 2017). The invisible nature of food was acknowledged because the unseen complexities granted historical privilege to White middle-class consumers and overlooked the opportunity to consider societal solutions to food inequity (Padoongpatt, 2016).

The massive reorganization of society from decade to decade across communities of lower SES had an infrastructural effect on food deserts (Deener, 2017). The reorganization of society via suburbanization, deindustrialization, housing redlining, White flight, and middle-class outmigration led to urban disinvestment (Deener, 2017). The reorganization of society shifted public and private infrastructures to follow the money trail to the outskirts of suburban areas, avoided poor communities through retail redlining, and created a period of consumer vulnerability with higher-priced convenience stores (Deener, 2017). Present-day technology plays a large role in tracking the spread of disease activities and public concerns through Census data (Huang & Vaughn, 2016). Through social media outlets, such as Twitter, Census tract data were investigated and revealed the number of tweets with geotagged food were used to characterize a neighborhood's food and social environment (Huang & Vaughn, 2016). The higher the number of fast-food mentions in a specific neighborhood, the higher the prevalence of obesity, higher calorie-dense food, and health problems, such as diabetes and cardiovascular disease in a region (Huang & Vaughn, 2016).

Geographically, food deserts support scarcity of food resources for neighborhoods that are underserved and less desirable for retail stores (Howerton & Trauger, 2017). When an area is

undesirable and experiences an infrastructural breakdown, consumers begin paying more money for lower quality food options, which leads to urban isolation (Howerton & Trauger, 2017). Legally, the efforts of state planning and public policy continue to play a part in the political economic element of urban isolation. By developing urban isolation within more prominent communities, the communities with little economic power suffer from infrastructure deprivation at the hands of large corporations that participate in retail redlining and avoid poor communities and communities of color (Deener, 2017).

Socioeconomically, the poorer the community, the greater the accessibility to food that lacks adequate nutrition (J. D. Wright et al., 2016). Poorer communities are serviced with unhealthy food options that lack adequate nutrition (J. D. Wright et al., 2016). The same communities are faced with overpriced healthy food options when available and an abundance of health issues that follow, such as diabetes (J. D. Wright et al., 2016). High-calorie energy-dense foods are disproportionately targeted in low-income communities, specifically across Black and Hispanic communities (Kumanyika, 2019). When targeted, income levels can make communities a target for exclusion from equitable societal opportunities, such as employment, home ownership, jobs with health insurance or family leave, social inclusion, and behavior change knowledge (Kumanyika, 2019).

Food Environment

The current food desert environments provide easier access to unhealthy dietary intake for youth (Vedovato et al., 2016). With access to inexpensive, energy-dense, ready-to-eat foods, children become more exposed to a market heavily targeting the overconsumption of calories, excess weight gain, and the discernment of appropriate calorie consumption (Kral, 2018). The cyclical pattern of food insecurity establishes unhealthy eating behaviors linked to overeating,

decreased fruit and vegetable intake, and increased energy-dense food intake (Rasmusson et al., 2019). By lacking the appropriate knowledge and awareness to maintain a proper diet, children are at risk of undernourishment within each environment every day (Kral, 2018).

Energy density, or the amount of energy provided in a particular weight of food, is linked to a child's energy intake (Kral, 2018). Foods with a low energy density have high water content, such as fruits and vegetables, while foods with high energy density have high fat content and low water content (Kral, 2018). From analyzing food studies, Kral (2018) verified foods consumed by youth were energy-dense and nutritionally poor, with dietary changes based on weekdays and weekends (Brazendale et al., 2017). Weekdays provide a structured environment, which may prevent obesogenic behaviors, while the weekend may allow more independence to participate in compulsory activities, especially increased snacking (Brazendale et al., 2017). The authors concluded children who were considered obese consumed more energy-dense food than children of normal weight, which led to a higher energy intake being absorbed from added sugars and fats and lower energy intake from fruits and vegetables (Kral, 2018).

The three environments that make up the obesogenic food environment of children are home, school, and neighborhood (Kral, 2018). At home, parents and caregivers are instrumental in establishing the physical and social food environment because the heads of households are responsible for shopping, preparing meals, setting feeding practices, and modeling food choices and behaviors for children (Kral, 2018). While consumption of fresh fruits and vegetables is crucial to a healthy diet, those who are unable to meet dietary guidelines are most likely people of color and people living in poverty (O'Dare Wilson & Radey, 2016). *Sprawl*, or the interconnectivity of food access, resources, safety, and community services, was determined to be a contributor to fruit and vegetable intake (O'Dare Wilson & Radey, 2016). When compared

to counterparts in areas with less sprawl, individuals in areas with higher levels of sprawling characteristics were more likely to consume significantly fewer fruits and vegetables due to lack of nutritious food selection, lower income, and cultural food practices (O'Dare Wilson & Radey, 2016). Food environments with low levels of obesogenic characteristics consumed significantly more fruits and vegetables and fewer energy-dense foods (Kral, 2018).

Once children are old enough to attend school, the food behaviors learned in the home environment extend to the school environment (Kral, 2018). Temptations still lurk on campus in the form of food from home, easily accessible snacks from vendors or vending machines, and access to stores in the neighborhood before and after school (Kral, 2018). School food environment studies show about 80% of children attend school at least 9 months a year, 90% eat lunch at school, 23% eat breakfast at school, and 23% eat at least one snack a day (Kral, 2018). Among children, high energy-dense foods are usually consumed as a snack on average 3.3 times throughout the day (Shriver et al., 2018). Snacks consumed by children lead to increased sugar intake and a decrease in both healthy dietary habits and daily nutritional value (Shriver et al., 2018). While the structure of the school environment has proven to increase fruit and vegetable consumption during lunch by regulating obesogenic environments, energy-dense food consumption remains a risk when students consume foods perceived to be healthy (Brazendale et al., 2017).

Schools provide the diet-dynamics environment for students who lack adequate nutrition (Safan et al., 2018). Studies have shown approximately 90% of children do not get the recommended servings of fruits and vegetables set by the USDA (Safan et al., 2018). Students who do not receive adequate nutrition have the opportunity to consume nutrient-rich foods by participating in the school breakfast and lunch programs (Safan et al., 2018). With at least 50%

of student dietary intake coming from schools, school nutrition programs have ample opportunities to address healthy eating for students (Frerichs et al., 2015).

Schools play the centralized community role in the social development and intervention of K–12 students (McMahon, 2018). School personnel are responsible for delivering education when children may be most receptive to receiving attitudinal and behavioral changes (Haddad et al., 2018). Outside of the home environment, the school environment provides a legitimate window to encourage positive health behaviors because children spend at least 25% of the day on campus (Haddad et al., 2018). The time spent on campus offers the opportunity to expand the ecological focus via behavioral norms, classroom best practices, behavioral climate, and student support systems designed to address learning barriers (Darling-Hammond et al., 2019). By encouraging positive nutritional behaviors, some school environments can implement and evaluate the effectiveness of nutrition programs (Safan et al., 2018), but each school nutrition program does not experience success due to disparities of resources and accessibility to energy-dense foods (Kral, 2018).

Accessibility to food outlets in close proximity to schools extends the nutrition behavior of each child based on income level and race or ethnicity (Elbel et al., 2019). The nutrition environments of the youth are linked to the child's place of residence, school of attendance, income level, and possible disparities that define access (Elbel et al., 2019). There is a significant difference in food outlet availability between children who attend public schools and private schools (Elbel et al., 2019). When there are more fast-food and retail outlets than supermarkets on the travel path between school and home, there is an association between the food environment and weight (Green et al., 2018). Researchers have found that Black, Hispanic, and Asian students live closer to food outlets but have more access to foods with higher energy

density, such as fast-food restaurants (Elbel et al., 2019). To consider the influence of nutritional behavior and accessibility to food outlets, policy implementation should consider how environmental features and sociodemographic measures correlate to weight gain and obesity during adolescence (Green et al., 2018).

Neighborhood food environments contribute to a child's health via access and availability (Kral, 2018). The desirability, availability, and affordability of energy-dense foods create convenience that can make adolescent weight gain more susceptible in residential neighborhoods (Jia et al., 2019). Students who live in food desert neighborhoods are more prone to consume lower quality diets, become obese, and eat more nutrition-poor foods (Kral, 2018). The neighborhood food environments in food deserts are more prone to become obesogenic by nature due to value-size pricing (Kral, 2018).

Energy-dense nutrition increases due to exposure and being affordable to school-age children (Jia et al., 2019). In a market with value-size pricing, food retailers are able to use pricing strategies to provide greater access to energy-dense foods (Kral, 2018). Pricing strategies, such as making larger portion sizes cost less per unit, provide ample opportunity for children to purchase energy-dense foods (Kral, 2018). A 9-year longitudinal study found an increased body mass index (BMI) and weight gain were associated with the increase of convenience stores, fast-food restaurants, and dairy-product stores in school neighborhoods (Jia et al., 2019). When accounting for the 800-meter buffer zone between a school and the neighborhood environment, store classification matters (Jia et al., 2019). A school neighborhood environment could increase or decrease access to healthier food options when both a grocery store, which contains a variety of healthy and unhealthy options but is classified as a healthy venue, and specialty stores, such as candy stores exist in close proximity to the school (Jia et al., 2019).

To confirm the effect of a food environment, Katare and Beatty (2018) conducted a study involving the environments of international students. After studying international students across 40 public universities, the researchers found individuals made choices based on what was available in the nutrition environment, lifestyles of individuals adapted based on the environment, and weight gain was greater in counties with higher obesity rates (Katare & Beatty, 2018). Studies indicate when convenience stores are located closer to schools in low-income communities, purchases of energy-dense foods before and after school increase (Kral, 2018). The purchasing of energy-dense foods leads to the decreased consumption of fruits and vegetables, overconsumption of calories, and excess weight gain, and is a reflection of the offerings of a community to its members (Kral, 2018).

Independence becomes a crucial factor in the decision-making process for food consumption as children approach adolescence (McKeown & Nelson, 2018). Prior to adolescence, early childhood is a crucial time to prepare children to make independent food choices because the environment may establish food preferences, autonomous eating behaviors, and dietary habits (Mura Paroche et al., 2017). Outside of genetic disposition, individuals in a family system can teach separate food behaviors that can instill specific food values across a child's lifetime (Scaglioni et al., 2018). Each behavior learned via the family system may be influenced by other factors, such as nutritional knowledge, level of educational attainment, SES, level of food insecurity, neighborhood characteristics, and place of employment (Scaglioni et al., 2018). To increase the probability of proper dietary choices, a child's family may promote healthy self-regulation behaviors via regulated eating patterns, experimenting with a variety of taste experiences, and exposure to different foods during infancy (Scaglioni et al., 2018).

Poverty

Socioeconomic status plays a vital role in the ability to adhere to dietary recommendations (O'Dare Wilson & Radey, 2016). The lower the SES, the greater the decline in accessibility to and affordability of a healthy diet (O'Dare Wilson & Radey, 2016). The quality of an individual's diet was associated with the three income levels—low income (<131% poverty), medium income (131%–305% poverty), and high income (>350% poverty)—and educational attainment (R. S. Wright et al., 2017). The lower income level had the lowest educational attainment and literacy, consumption of fruits and vegetables, and nutrient-based quality (R. S. Wright et al., 2017). In the United States, the populations who suffer from low SES and are constrained by food desert environments are usually people of color, those who are less educated, and those who live at or below the poverty line (O'Dare Wilson & Radey, 2016). Living in food desert conditions brings forth barriers, such as having no or few grocery stores within at least a mile, transportation obstacles, and an overwhelming abundance of fast-food outlets and convenience stores (Deener, 2017).

Individuals of low SES may experience low levels of nutritional awareness and financial barriers to healthy food options (O'Dare Wilson & Radey, 2016). When experiencing low levels of nutritional awareness, proximity can influence one's willingness to travel the extra distance to alternative grocery stores or spend extra money on fresh food options (O'Dare Wilson & Radey, 2016). If a person of low SES is not able to travel the extra distance to alternative grocery stores, the closest alternatives are convenience stores that offer produce items of lower quality (O'Dare Wilson & Radey, 2016).

Financial barriers to fresh food options of lower SES demographics are twofold (Van Der Velde et al., 2019). The individual perception that fresh food options are too expensive can

prevent socioeconomically disadvantaged individuals from purchasing healthier food, which leads to fewer daily servings of food with nutritional value and decreased knowledge of actual affordability (Van Der Velde et al., 2019). Based on the USDA fruit and vegetable guidelines, families of poverty would have to spend 43% to 70% of the household food budget to buy produce alone (O'Dare Wilson & Radey, 2016). A limited budget is strongly linked to eating behaviors due to the weight of social and environmental factors, perceived barriers to eat healthier, and financial stress of a family (Van Der Velde et al., 2019).

Poverty disproportionately affects individuals based on income level, race, and living conditions (Hager et al., 2017). Key differences in child nutrition environments are connected to where children live and go to school, income level, and possible disparities that define access (Hager et al., 2017). Thomson et al. (2019) concluded there is an inverse relationship between child age and dietary quality across the poverty threshold classes in America. In lower income environments, African American girls are 3–4 times more likely to become obese than White girls are. Supermarket availability is about half that of White neighborhoods, and more grocery stores sell energy-dense foods (Hager et al., 2017). In terms of dietary quality, non-Hispanic Blacks have a lower total vegetable, protein, and whole-grain consumption than any other racial or ethnic group (Thomson et al., 2019).

Food Insecurity

Food insecurity is limited access to food due to socioeconomic factors within a household (Gundersen & Ziliak, 2016). With the Great Recession ending in 2013, approximately 15.7 million children in the United States are still living in food-insecure households (Gundersen & Ziliak, 2016). Living in a food-insecure household could lead to an overconsumption of energy-dense foods and a decline in neurocognitive development, which may be associated with child

behavioral issues (King, 2017). Food insecurity can have devastating negative effects on the health and educational outcomes of children from infancy to adolescence (Gundersen & Ziliak, 2016). King (2017) concluded food insecurity may be linked to unhealthy behaviors in children that can lead to increased sleep deprivation, sugary drink consumption, and nutrient deficiencies from a young age.

Children in food-insecure households face many daily challenges that may not occur in food-secure households (Hartline-Grafton & Dean, 2017). One of the key daily challenges of living in a food-insecure household is an inadequate diet (Loibl et al., 2017). Food-secure households are aligned with household resources and ability to recover from shocking events, such as loss of income, unemployment, and unpredictable earnings (Hanson et al., 2016). In food-insecure households, families who are unable to afford balanced meals may cut the size of meals or simply go hungry (Loibl et al., 2017). When faced with an inadequate diet, children's health has been associated with iron deficiency, dental problems, asthma, and an increase in hospital stays (Loibl et al., 2017). Over the course of time, the decline in a child's general health can lead to poorer physical and mental health, behavioral problems, and lower academic achievement (Au et al., 2019).

Lower income environments are faced with food insecurity because of uncertainty (Nettle et al., 2017). The uncertainty of having enough food due to lack of money or resources to purchase food can lead to a health crisis across households (Barnidge et al., 2017). Households of lower income face challenges to food security due to neighborhood context (Rossen & Kobernik, 2016). Neighborhood context, such as socioeconomic factors and urbanization, makes access to affordable healthy food options more difficult, which is linked to the different dietary intake behaviors and patterns across neighborhoods (Rossen & Kobernik, 2016). When parents

have to decide whether to have heat, a nutritious meal, or medicine, unpredictable dietary patterns may arise and inadequate nutrition can become a daily struggle (Miller et al., 2019).

The behaviors and patterns attached to food-insecure households are linked to the inability to manage finances and budgets for food expenses (Loibl et al., 2017). A food-insecure household does not have much flexibility in the budget, which may cause lower income families to place food security as a lower priority (Loibl et al., 2017). Food becomes a lower priority when a family is not able to meet society's basic needs first (Miller et al., 2019). In the budget, the basic needs, such as transportation and childcare may be inflexible compared to food, which may be more flexible, and reduces a family's spending on food (Loibl et al., 2017). Because food quality declines as a priority, a decrease in spending on food can lead to low-cost food options that lack nutrition and cause the disruption of eating patterns (Burke et al., 2016).

Eating patterns, diet quality, and SES have a positive association in the United States (Gressier et al., 2017). The lower a family's SES, the greater the effect poverty has on eating patterns and diet quality (Gressier et al., 2017). Poverty plays a vital role in a family's ability to have food security. Families facing poverty are linked to a lack of quality employment opportunities (Brucker & Nord, 2016), higher rates of anxiety and depression, lower education attainment, and adverse academic and social outcomes of children (Huang & Vaughn, 2016). The inadequate access to food security could amplify the effects of poverty and lower a family's ability to maintain daily health, which could lead to a decline in children's physical and mental well-being and the increased risk for cardiovascular disease (Kamimura et al., 2017).

The economic patterns associated with nutrition can be a determining factor in food-insecure environments (Balistreri, 2016). Families with inadequate income are usually residents of disadvantaged areas that are less desirable for grocery store retailers, lack economic growth

opportunities, and have less long-term demand (Bonanno & Li, 2015). Economically, the budget shortfalls combined with a lack of investment from grocery store retailers and public policy increase the episodic and chronic nature of food insecurity by establishing reduced accessibility to healthy food options (Camp, 2015). Food-insecure families may still be struggling to recover economically after the Great Recession due to inflation, increased food prices, and loss of access to government assistance programs (Balistreri, 2016).

Within a society, food insecurity costs add up in the form of preventable and avoidable costs (Balistreri, 2016). Costs related to food insecurity reduce economic viability for families, which can lead to lost productivity, health-care costs, and mental health issues (Pollard & Booth, 2019a). When society seeks to alleviate food insecurity through economic and public policy reforms, social disadvantages, such as poverty, could be mitigated (Pollard & Booth, 2019b). If economic reform and policy are not effective, the lack of access to healthy food options can lead to a reduced desirability for healthy foods, increased feelings of inferiority, and an inadequate selection of healthy food options (Camp, 2015; Pollard & Booth, 2019b).

Apart from income, factors, such as education, household characteristics, and program participation patterns add to the propensity of food insecurity (Vedovato et al., 2016). Higher education grants substantial protection from food insecurity for college graduates due to increased human capital attainment and income (Ziliak & Gundersen, 2016). In households with characteristics, such as large family composition, multiple children 13–18 years old, single parents, children born to unwed mothers, and multigenerational households, food insecurity can become a pressing crisis (Ziliak & Gundersen, 2016). Over the course of a year, multigenerational households are twice as likely to face food insecurity than families without resident grandchildren (Ziliak & Gundersen, 2016). The sociodemographic associations with

food insecurity can become an issue when families deal with hunger due to unemployment, negative learned food behaviors, unhealthy dietary options, and lack of quality health education (Vedovato et al., 2016).

Another controversial link to food insecurity is incarceration (Cox & Wallace, 2016). Dependent children of incarcerated parents face strained relationships that can make coping with societal challenges difficult and affect food insecurity directly and indirectly (Martin et al., 2017). Directly, incarceration financially cripples income-earning potential, upward income mobility, and job skill attainment (Cox & Wallace, 2016). Indirectly, the statutory restrictions on offenders can place prohibitions on voting, parenting, employment, and federal benefit programs, such as the Supplemental Nutrition Assistance Program (SNAP) and Women, Infants, and Children (WIC; Cox & Wallace, 2016). When participating in programs like WIC, the prevalence of food insecurity rates decreased by 49% for infants and 31% for children (Kreider et al., 2016). Without the ability to provide adequately for families, incarcerated parents face the possibility of intergenerational transmission of inequality to the children and future generations (Davison et al., 2019). Intergenerational transmission of inequality has collateral consequences leading to destabilized family relationships, impaired parenting behaviors, health-care access challenges, and barriers to reintegration (Davison et al., 2019).

Household-Level Food Security

Household-level food security, or the perception of a household's ability to obtain enough food to meet household needs (Bonanno & Li, 2015), can become a health concern for children in at-risk populations. At-risk characteristics can vary from household to household. There is a possibility each characteristic stems from socioeconomic factors, such as income and irregularity of eating healthy meals (Au et al., 2019). Living in a food-insecure household has

been linked to adiposity-related outcomes (Au et al., 2019). An observational study with schoolchildren age 4–15 determined children in food-insecure environments were 1.17 times more likely to be obese, ate dinner together less often with family, and had a higher BMI than food-secure counterparts (Au et al., 2019).

Adverse situations, such as household food insecurity can lead to a multitude of difficulties (Huang & Vaughn, 2016). Difficulties linked to food-insecure households include mental disorders (Burke et al., 2016) and behavioral problems (Huang & Vaughn, 2016). In a study analyzing the relationship between mental disorders and household food security among approximately 30,000 children, researchers concluded as the severity of the household food insecurity grew, the odds of obtaining a mental disorder increased (Burke et al., 2016). Among the children in the study, about 15% suffered from mental disability impairment, and an additional 5% suffered from mental disorder severe impairment (Burke et al., 2016). Transient episodes of food insecurity across development stages, such as adolescence could be associated with increased behavior problems, which last for short periods of time (Huang & Vaughn, 2016). Gaining knowledge of transient food insecurity episodes could identify children at risk of food insecurity, prevent or intervene with food security support when applicable, and help pay attention to key indicators of food insecurity, such as families signing up for free or reduced lunch in the middle of the school year (Huang & Vaughn, 2016). By determining the potential trajectories of behaviors across stages of development in childhood, behavior trends and patterns can be monitored to support academic achievement success and future life outcomes (Huang & Vaughn, 2016).

Roles and responsibilities may morph to prioritize survival in households suffering from food insecurity (Aurino et al., 2018). Food-insecure households may prioritize buying the basic

food items over nonfood items, while children may work in or outside the home, which leads to less investment in education, increased absenteeism, early dropout, and reliance on federal programs (Aurino et al., 2018). To alleviate the lack of access to food options, the need to survive may increase reliance on federal programs and food pantries to meet food needs (Kaiser & Cafer, 2018). In a food pantry study by Kaiser and Cafer (2018) with 2,634 participants, about 76% of participants lived in food-insecure households, 41% lived in a household with no adults working, and about half received benefits from the SNAP.

Household food insecurity is experienced twofold, by individuals and in society (Pollard & Booth, 2019b). Individually, ethnic minorities, low-income individuals, and persons with low educational attainment are disproportionately affected by food insecurity, which inadvertently affects the health of children (Mangini et al., 2015). Children living in food-insecure households were positively correlated with the odds to have asthma, which increases with higher levels of poverty (Mangini et al., 2015). In society, individuals in households that experience financial constraints or hardships may seek relief via fringe banking options, such as payday loans (Chang, 2019). Food-insecure individuals may rely on fringe banking options because better options are limited due to bad credit history, financial illiteracy, and accessibility within county lines (Chang, 2019).

Nutrition and Cognitive Performance

Cognitive functioning is an ever-changing process as the brain develops from childhood to adulthood (Misuraca et al., 2017). “Updating, or the ability to keep relevant information in working memory” (Egger et al., 2019, p. 1), shifts the cognitive process by establishing goal-oriented behaviors linked to school readiness and long-term academic achievement (Egger et al., 2019). Part of the change in cognitive functioning is linked to a proper diet and exercise regimen.

Studies have shown when a proper diet with the essential nutrients is followed, cognitive functioning improves (Misuraca et al., 2017). A diet rich in omega-3 fatty acids, folic acid, iron, and choline, and a low consumption of junk food may improve verbal intelligence, memory, attention, and concentration (Misuraca et al., 2017).

The early stages of cognitive functioning begin in the home environment of the student (Bosch & Duch, 2017). Cognitive stimulation begins within the structure of the home environment that is designed by the parents and the ability to control a child's nutrition (Bosch & Duch, 2017). The home environment is responsible for building a direct relationship with the modifiable lifestyle factors that are affected by the child's social and economic environment (Jirout et al., 2019). The correlation between modifiable lifestyle factors, such as diet and socioeconomic environment illustrates both positive and inverse relationships with cognitive stimulation (Bosch & Duch, 2017). The higher the cognitive stimulation of the home environment, the lower the consumption of junk food and more physical activity, whereas the lower the cognitive stimulation, the higher the consumption of junk food and less physical activity (Bosch & Duch, 2017). A poor diet has been proven to lead to obesity and metabolic syndrome, which have been linked to cognitive decline, behavior issues, and decreased intelligence (Proctor et al., 2017).

For a diet to be effective, children should not skip meals, especially breakfast (Corcoran et al., 2016). Children who do not consume breakfast regularly may demonstrate poorer verbal performance, lower IQ scores, and have unhealthy diets (Misuraca et al., 2017). To understand the developmental influence of an unhealthy diet on student academic achievement, students as young as kindergarteners were studied (Johnson & Markowitz, 2018a). The researchers concluded the kindergartners who experienced food insecurity were associated with

hyperactivity, conduct problems, reduced reading and math scores, and decreased socioemotional well-being (Johnson & Markowitz, 2018a).

Breakfast provides an opportunity to move beyond nutritional benefits by promoting positive cognitive and academic outcomes (Dykstra et al., 2016). A child may be able to focus more on studying when breakfast is accessible and eaten daily (Corcoran et al., 2016). A study by Corcoran et al. (2016) proved the availability and quality of school meal programs can affect the nutritional and academic outcomes via stigma reduction for participating students by reducing the stigma of eating food provided by the school. Despite the effort to erase the financial and social stigmas to eating school breakfast, the lower a student's food security, the higher the chances of eating nutrition-deficit foods, such as candy for breakfast (Dykstra et al., 2016). To counteract barriers to eating a nutritional breakfast, such as arriving early for school, schools establish breakfast in the classroom (BIC) programs, which offer breakfast to all students in the classroom prior to beginning instruction (Corcoran et al., 2016).

Nutrition and Physical Activity

Nutrition and physical activity have been linked together across many decades of research (Asigbee et al., 2018). Studies have shown a positive relationship between physical activity, nutrition, and enhanced academic success of school-age children (Asigbee et al., 2018). When successfully combined, physical activity and proper nutrition can lead to increased math, science, and reading scores (Asigbee et al., 2018). To achieve proper nutrition, proper dietary behaviors should be established (Burrows et al., 2017). The establishment of proper dietary behaviors requires a shift in lifestyle factors, such as the amount of physical activity, change in food environments, frequency of nutritional food intake, and decrease in sedentary activities (Burrows et al., 2017). One key circumstance that shifts lifestyle factors is age (Asigbee et al.,

2018). Dietary behaviors change as children approach adolescence, which decreases the consumption of nutritional foods and increases the consumption of energy-dense foods (Burrows et al., 2017).

Student access to adequate nutrition and physical activity throughout the school day can be supported by programs before and after school (Asigbee et al., 2018). Out-of-school-time programs assist with fighting youth health problems, such as undernutrition and obesity by providing snacks, meals, and physical activity before or after school (Sliwa et al., 2019). Schools were more effective with nutrition intervention and physical activity when an out-of-school-time program was provided on campus, especially among schools with high-poverty populations (Sliwa et al., 2019). When given the opportunities for physical activity provided by school programs, students display positive academic behaviors, such as increased attention and concentration, higher fitness levels, and anger control (Sullivan et al., 2017).

Socioeconomic status is a key indicator in predicting levels of physical activity and academic performance (Cosgrove & Castelli, 2018). Studies have shown the lower the SES of students, the higher the effect of obesity, improper dietary intake, and lower physical activity for at-risk groups regionally (Woodward-Lopez et al., 2018). Among adolescents across different regions of the United States, healthy eating and physical activity were linked to higher self-reported letter grades, while lower self-reported grades were linked to sedentary behaviors, substance abuse, and violence (Rasberry et al., 2017). The home environment further proved a diet low in junk food consumption and accessibility to healthy lifestyle outlets in the neighborhood improved physical activity (Bosch & Duch, 2017). Although SES looks different across regions, the necessary intervention may be done to counteract the effect of decreased nutrition and physical activity (Shen, 2017). A study by Shen (2017) proved when urban inner-

city African American girls received vigorous activity outside of school, there was a positive association with grades, increased attention span and concentration, and increased learning engagement.

Obesity

As children approach adolescence, obesity can become a larger problem due to freedom and independence with dietary choices (Reichelt & Rank, 2017). When children move from a healthy weight to being overweight, there is a significant association with a reduction in test scores, lower grade point average, and increased stress (Branigan, 2017; Burrows et al., 2017; Gu et al., 2019; Shi & Li, 2018). In the United States, being overweight has been linked to sedentary behaviors, which have a wide range of health concerns, including obesity and cardiovascular diseases (Lopes et al., 2017). Sedentary behaviors are about 75% of a child's daily life (class, study time, and leisure activities), but each sedentary activity weighs differently in at-risk behaviors (Lopes et al., 2017). When students participate in sedentary behaviors, such as watching hours of television, student health and academic performance are threatened (Lopes et al., 2017). Each sedentary behavior has the chance to alter a student's reward system, creating a new behavioral regulation for the increased appetite of energy-dense foods, deficits in learning and memory, and a reduced capacity for behavioral inhibition (Reichelt & Rank, 2017).

Obesogenic food environments can occur in any environment where children spend time eating. The three food environments for children are the home, school, and neighborhood (Kral, 2018). Each obesogenic food environment influences dietary patterns and caloric intake, which leads to obesity via overconsumption of calories (Kral, 2018).

The influence of the home environment is twofold. The household structure may influence eating patterns based on the availability of resources, educational attainment, activity

level, eating patterns, health status, and established norms (Cunningham et al., 2019). Each influence is ruled by the relationships and the number of nonparental residents in the house (Cunningham et al., 2019). Children may be less prone to obesity when biological parents are married and living under the same roof, more adults live as co-residents to monitor health, and not living with grandparents who may encourage children to eat more (Cunningham et al., 2019). With students spending at least 9 months a year in school from age 5 to 19, students may have access to energy-dense foods from breakfast and lunch programs, vending machines, and convenience stores in the proximity of the school (Kral, 2018). Neighborhood food swamp effects have a positive relationship with obesity (Cobb et al., 2015). Obesity rates are stronger in areas with less access to and affordability of grocery stores, areas with an imbalance between fast-food retailers and specialized food stores, and when unhealthy food choices are within 1 mile of schools (Cooksey-Stowers et al., 2017).

The social factors within schools can be vital to understand childhood obesity factors (Ortega Hinojosa et al., 2018). Parents may believe academic success is tied to learning and effort, without taking academic instruction and the psychological consequences of obesity into consideration (Martin et al., 2017). In elementary school, organized physical activity may occur less frequently because of the demand and pressures to fulfill academic and testing demands placed on schools, which can lead to the onset of childhood obesity (Bublitz & Rhodes, 2017). Psychologically, obesity-related deficits may begin during adolescence when puberty influences neural reorganization because adolescent girls can be judged and face body-weight stigmatization (Martin et al., 2017). There may be a negative association between obesity and academic achievement when adolescent girls face body-weight stigmatization, which can lead to lower math achievement, low self-confidence, and unhappiness (Martin et al., 2017).

Stress

The social determinants of health describe a range of social, physical, and environmental conditions that can affect the levels of stress in children (Srivastav et al., 2017). In children, stress becomes more apparent when living in impoverished and unhealthy conditions, such as food-insecure environments, single-parent households, or below the poverty level (Francis et al., 2018). Living in adverse conditions can activate trauma and toxic stress, which have been linked to household dysfunction (Srivastav et al., 2017). When households face greater levels of dysfunction, every member of the household may experience greater levels of stress, chronic diseases, poor adult health outcomes, and increased costs of health outcomes (Srivastav et al., 2017).

Behavioral health, environmental exposures, and food insecurity are three exemplars of health that can explain how the social determinants of health affect children's stress levels (Francis et al., 2018). Behavioral health can be affected by adverse family experiences, such as parent incarceration and low income, and how children respond to each stressor (Wildeman et al., 2019). Environmental exposures are tied to racial, economic, and environmental disparities caused by poverty (Francis et al., 2018). Children living in poverty have an increased likeliness to experience respiratory illness, live near toxic or hazardous waste sites, endure indoor air pollutants, such as secondhand smoke, have financial burdens of illnesses, and long-term complications into adulthood (Francis et al., 2018). Food insecurity influences caregiving practices, such as restrictive feeding, which may be responsible for increased dysregulated energy intake, high BMI, and obesity in children (Bost et al., 2018).

Stress begins in the household and can become a problem in the academic achievement of children due to health adversities (Quach et al., 2017). When children were exposed to health

adversities, individual academic performance suffered both after Year 2 and as the number of health adversities increased (Quach et al., 2017). To further examine health adversities, two studies involving college students were used to investigate the relationship. In the first study, the research determined poor dietary intake and increased pressure to perform academically led to high levels of stress, poorer mental health, and decreased optimal brain functioning (Wattick et al., 2018). Among the participants of the second study, the results revealed a significant relationship between academic stress and diet quality (Chacón-Cuberos et al., 2019). As academic stress increased, BMI and obesity scores increased, which possibly led to a change in dietary patterns linked to nonadaptive behaviors (Chacón-Cuberos et al., 2019).

Working Memory

Working memory is the amount of information that can be retained and maintained temporarily to use in cognitive tasks (Adams et al., 2018). In the classroom, students and teachers use working memory for the continual development of academic performance and outcomes via immediate storage and manipulation of information (Colmar & Double, 2017). Storing information via working memory requires appropriate adaptations in the context of learning, personal access to strategies that maximize working memory skill development, and training to improve working memory capacity over time (Colmar & Double, 2017). Without the proper intervention, decreased levels of working memory can lead to low academic performance, which increases the odds of financial hardship and poor mental and physical health (Roberts et al., 2016).

Working memory can work effectively when students are able to process information in sequential order (Gillam, 2018). For example, a student learning new vocabulary may focus on the sounds of words, the sequential order of the sounds (syllables), possible meanings of the

sounds heard (prefixes, suffixes, and root words), and comparing the pattern to prior knowledge of word or sound meanings (Gillam, 2018). A recent study indicated working memory is most effective for primary school children up to age 12 and produces a significant relationship with academic performance, and poor working memory can prevent normal language development (Pascual et al., 2019). The inability to maintain good working memory over time may lead to lower academic performance in students because language development suffers (Pascual et al., 2019). When language development suffers, behavioral distractions may influence the ability to focus and capture external stimuli, which can make the rigorous complexity of school difficult to navigate as children age (Pascual et al., 2019).

Nutrition and physical activity are key components of working memory in school-age children (Tandon et al., 2016). Children who have a higher intake of the Western diet high in saturated fat and refined sugars may have impaired cognition and brain development (Tandon et al., 2016). In younger children, the Western diet may lead to nutrient deficiencies, unhealthy dietary patterns, decreased neural development, and lowered physical activity levels (Tandon et al., 2016). The authors further found a positive association between cognitive development and fundamental movement skills, which can be improved in the physically active learning environments of the classroom (Tandon et al., 2016). As cognitive development suffers, working memory abilities suffer, which affects the learning processes of language comprehension, mathematics, reading, and problem-solving (Cowan, 2017).

Absenteeism and Attendance

In the United States, *chronic absenteeism* is defined as a student missing 10% or more of school during a school year (CRESP, 2018). Chronically absent students experience reduced academic achievement, social disengagement, feelings of alienation, and long-term adverse

health outcomes (CRESP, 2018). Studies indicated a significant negative relationship with chronic undernutrition, academic performance, and place of residence (Wolde & Belachew, 2019). Students residing in rural areas without subsistence farming were more likely to face stunting, which could lower academic achievement, increase grade repetition, and increase absences (Wolde & Belachew, 2019).

Chronic absenteeism is felt across the United States disproportionately among communities of color, students with disabilities, English language learners, and lower SES students (CRESP, 2018). Truancy, school refusal, and school withdrawal are the three types of school absences that lead to chronic absenteeism (Amalu & Abang, 2016). Truancy occurs when a student is absent from school without a parent's permission, which leads to unexcused absences (Amalu & Abang, 2016). Students with unexcused absences were strongly associated with lower academic achievement, exhibiting riskier health behaviors, and lower cardiovascular fitness levels when compared to students with excused absences (Centeio et al., 2018). Students generally refuse to go to school when an educational institution causes distress, if an absence provides an escape from difficult social situations and school evaluation, and to participate in the pleasures associated with missing school (Filippello et al., 2019). School withdrawal occurs when a parent keeps a student away from school for the needs and priorities of the family, which can lead to lower appetite, decreased adherence to social norms, and decreased focus on meaningful academic activities (Amalu & Abang, 2016).

Chronic absenteeism can have short-term and long-term effects at the elementary and secondary school level across socioeconomic backgrounds (Da Costa Nunez et al., 2015). Elementary school students who live in low income households face chronic absenteeism issues, such as lower mathematics and reading scores and an increased probability of dropping out at a

rate 75% higher than do upper income students (CRESP, 2018). When compared to peers with housing, the chronic absenteeism rate of homeless students in New York ranged from 2% to 78% and was 4 times higher for homeless students who did not receive free lunch (Da Costa Nunez et al., 2015).

Living in a food-insecure environment is detrimental to school attendance, mental development, and educational development of students (Deener, 2017). Lower income environments were found to have health behaviors shaped to overconsume energy-dense foods, not seek health-promoting opportunities, and have more difficulty maintaining healthy behaviors (Hager et al., 2017). In a study by Bernal et al. (2014), as food insecurity increased, so did the prevalence of absenteeism and stunting when compared to food-secure peers. Each factor could have a negative influence on the educational outcomes of children, such as decreased knowledge acquisition and adherence to social norms, criminal activity, and antisocial behavior (Amalu & Abang, 2016). Students who live in food-insecure environments are most likely to suffer from illnesses by the start of preschool (Tamiru et al., 2016). Students who are sick may suffer from the aftermath of poverty, poor nutrition, and poor sanitary conditions (Amalu & Abang, 2016).

When a student is not in class, learning time is lost, and the type of absence matters to the academic success of students (Centeio et al., 2018). By the ninth grade, school attendance can be a better indicator of academic success than standardized test scores for students who missed about 20% of the school year (GarcĆa & Weiss, 2018). A major component in absenteeism is funding. When students have unexcused absences, schools lose funding from the state, which can require the schools to make decisions to develop the whole child on limited funding (Centeio et al., 2018). With 58% of homeless students living in shelters and 25% living with other family members being at risk of chronic absenteeism, funding can become even more limited (Da Costa

Nunez et al., 2015). A takeaway from the study by Centeio et al. (2018) is patterns of health risk behaviors and unexcused absences follow students into adulthood, which can influence dietary patterns and the ability to make healthy choices.

Poor health and nutrition are linked to educational access and achievement (Tamiru et al., 2016). When faced with food-insecure environments and low SES, students are at risk for declines in mental and educational development, decreased academic achievement, and increased socioemotional difficulties (Tamiru et al., 2016). In a study by Bernal et al. (2014), as food insecurity increased, the prevalence of absenteeism and stunting increased when compared to food-secure peers. Mildly food-insecure children were absent from school twice as often as food-secure students, and moderate to severe food-insecure children were absent 3 times more often than food-secure students (Bernal et al., 2014). The relationship can be seen in food-insecure students who are more prone to miss school due to illness or serving as caregivers to family members, which can lead to stunting and decreased future economic development (Tamiru et al., 2016).

Gap in Literature

The gap in literature is twofold. First, a vast amount of research data exists which details the relationship between adequate nutrition and academic development. Exisiting research data may possess a limited understanding of the potential relationship between undernutrition and success at school via environments students are in daily (Cooksey-Stowers et al., 2017). Successfully analyzing the plethora of research literature across multiple environments can lead to a high standard of intersubjectivity and drawing key conclusions via conceptualization for the present study (Neuendorf, 2017). Second, the goal of the research was to add to the overall knowledge of nutrition and academic performance by exploring the sociocontextual

interpretation via theme development (Vaismoradi et al., 2016). Theme development can help discover fragmentary data hidden within the existing literature that may outline potential nutritional challenges, current trend data, and future research efforts to contribute to the overall body of knowledge (Korzun & Webb, 2015).

Chapter Summary

In Chapter 2, literature about undernutrition and its potential influence on school-age children's learning was identified and synthesized. The scholarly literature revealed the influence undernutrition has on student learning and examined the key themes of undernutrition and academic performance to gain insight, which could improve academic outcomes for K–12 students. The literature review extended knowledge about the undernutrition and academic performance of K–12 students by identifying relevant data in the literature. The literature search strategy relied on theory and rationale to find data and perspectives relevant to the study, conceptualize the data to establish potential relationships between data, and use accessible data to answer the study's research questions (Neuendorf, 2017). The criteria were used to search academic databases to find journals pertaining to child nutrition to interpret findings (Ngulube et al., 2015).

The theoretical framework of the study connected multiple perspectives about undernutrition and academic performance of K–12 students by granting a preliminary understanding of examined information (Ngulube et al., 2015). Giddens's structuration theory emphasizes the structures created by social practices and specific actions could influence the food consumption behaviors of individuals via the socioeconomic realities faced, institutional power, inequalities of a built environment, and opportunities to access different food environments (Sadler et al., 2016). The SCT indicates human behavior is reciprocal by nature

and self-regulated based on individual self-efficacy to reach the desired outcome (Torkan et al., 2018). The social-ecological theory proposes an individual's positive or negative health behaviors are influenced by external factors in social and physical environments (Safan et al., 2018).

Food deserts, or environments that lack access and affordability to healthy food options (USDA, 2019), were historically, socioeconomically, and geographically traced in the United States. Historically, public policy development, redlining, and infrastructural exclusion led to the creation of food desert communities via urbanization, suburbanization, and food inequity (Deener, 2017). Geographically, underserved communities became less desirable for businesses, which led to urban isolation and decreased economic power (Howerton & Trauger, 2017). Socioeconomically, food desert communities faced inequity in societal and employment opportunities, which led to lower income and becoming targets of social and economic exclusion (Kumanyika, 2019).

The food environments that surround children can make energy-dense foods more accessible from morning to evening (Kral, 2018). Children become targets for the consumption of energy-dense foods, which shifts based on the main food environment (home, school, or neighborhood) and level of food security in a household (Rasmusson et al., 2019). In home environments, the higher the food insecurity, the lower the fruit and vegetable intake (O'Dare Wilson & Radey, 2016). School environments provide nutritional structure in the school year, which can increase energy-dense food intake from sugary drinks and snacks available on campus (Shriver et al., 2018). The proximity and access to convenience stores and fast-food restaurants increase energy-dense food consumption in neighborhood food environments (Elbel et al., 2019).

Socioeconomic status is decisive in a household's ability to adhere to dietary

recommendations (Wright et al., 2017). The lower the SES, the greater the decline in maintaining a healthy diet (Wright et al., 2017). Poverty and household-level food insecurity occur more frequently in households with lower income, educational attainment, health literacy, and consumption of fruits and vegetables (Wright et al., 2017). Living in or below poverty increases financial barriers to healthy food options, hospital stays, and nutritional deficiencies (Loibl et al., 2017). The population disproportionately living in or below poverty is people of color (Hager et al., 2017).

Undernutrition has been linked to cognitive performance, physical activity, and obesity in children. Cognitive performance affects how the brain develops from childhood to adulthood (Misuraca et al., 2017). Cognitive performance has been correlated with a proper diet, academic performance outcomes, social development, and increased cognitive stimulation (Bosch & Duch, 2017). When physical activity levels, which can be predicted by SES, are successfully combined with a proper diet, increases in math, science, and reading scores and decreases in at-risk behaviors occur (Asigbee et al., 2018). At-risk nutritional behaviors have been linked to obesity, which reduces test scores, increases sedentary behaviors, and increases dependence on obesogenic food environments (Reichelt & Rank, 2017).

Nutrition plays an instrumental role in stress, working memory, and absenteeism of school-age children. Students exposed to health adversities due to poverty, such as poor dietary intake and household dysfunction have increased levels of stress, poor mental health, obesity, and decreased optimal brain functioning (Wattick et al., 2018). As academic stress increases, working memory is affected, which negatively influences a child's ability to process information, rely on prior knowledge for learning new information, and develop language with age (Pascual et al., 2019). The Western diet could cause a decline in working memory due to the high levels of

saturated fats and refined sugars, which may lead to impaired cognition, brain development, and optimal neural development (Tandon et al., 2016). Children who face chronic undernutrition face lower academic achievement, increased absences, and social disengagement (CRESP, 2018). Residing in a food-insecure environment can amplify chronic absenteeism, which can reduce educational development due to decreased instructional time, socioemotional difficulties, and stunting (Tamiru et al., 2016).

The following research methodology addresses the research design of the QCA study. Research methods chosen were based on the literature reviewed and the ability to conceptualize data pertaining to the influence food has on a student's ability to learn. Content of the research methodology outlines the systematic classification of the relationship between undernourishment and K–12 student learning.

Chapter 3: Methodology

The purpose of the QCA study was to analyze peer-reviewed medical journals to reveal the influence food has on a student's cognitive ability to learn. Identifying themes and patterns associated with a student's capacity to practice desired behaviors associated with student learning and the obstructions that made learning more difficult revealed the thematic relationship. The research helped understand the influence nutrition deficiencies have on the productivity of students in the classroom and the thematic relationship between food and the ability to learn (Ke & Ford-Jones, 2015).

The QCA research design systematically classified the relationship between undernourishment and K–12 student learning (Schreier, 2012). With undernourishment plaguing about 43% of American households due to poverty (Isumi et al., 2018), the QCA study was imperative to analyze the relationship between nutrition and the characteristics of K–12 student success. The problem of the QCA study was the level of undernutrition affecting a portion of K–12 students and their ability to maximize academic performance and development of cognitive skills. The extent of the problem was evident when analyzing the significant barriers that prevent adequate nutrition and the disruptions nutritional deficiencies cause in a student's self-regulatory functioning ability in the classroom (Johnson & Markowitz, 2018b).

The objective of the QCA was to systematically transcribe large amounts of data in a conceptualized manner (Erlingsson & Brysiewicz, 2017). Qualitative content analysis was an excellent research design to divide the text into meaning units and condense the meaning units to organized groups based on relation, similarities, and differences (Erlingsson & Brysiewicz, 2017). Research using existing text data on nutrition and learning was used to develop categories and themes in data with deep latent meaning (Erlingsson & Brysiewicz, 2017). The categories

and themes were utilized to determine the significance in the text data and manifest meaning to organize information appropriately based on relation, similarities, and differences (Erlingsson & Brysiewicz, 2017). The reduction of data into categories allowed stronger abstraction during concept creation, which can ensure suitable data are used to answer the research questions while strengthening the credibility of data collected (Elo et al., 2014).

The QCA study was necessary to understand the relationship between nutrition and learning in the K–12 classroom, which required the examination of factors pertaining to undernutrition and academic performance linked to K–12 students. The QCA study provided valuable information that linked a student's nutritional intake to the ability to perform well in the classroom. The potential influence of nutritional deficiencies on the ability to learn was discovered by exploring the issues through a systematic classification process of concept development. The following research questions guided the QCA study:

Research Question 1: According to research studies conducted between 2014 and 2019, how does undernutrition affect K–12 students' cognitive functioning in classrooms?

Research Question 2: According to research studies conducted between 2014 and 2019, how does undernutrition influence K–12 students' academic achievement?

The research design and rationale, researcher's role, research procedures, data analysis, reliability and validity, and ethical procedures of the QCA study are addressed. Each item was guided by the research questions. The decision to explore the issue of undernourishment in K–12 students is described with a thorough analysis of the research literature chosen based on the parameters of the QCA study. The role of the researcher was to explore research literature and condense information during the data collection and analysis process. The analysis of the research literature data was completed by examining patterns in the text analyzed and drawing

conclusions to gain insight on the relationship between undernourishment and K–12 education. With no human participants, ethical considerations during the QCA study focused on preventing misinterpretations or misuse of original authors' work.

Research Design and Rationale

The researcher utilized a QCA design. The QCA research design method was ideal to aid in systematically describing the meaning of qualitative data (Schreier & Flick, 2014). Qualitative content analysis was a viable option to consolidate the abundance of research literature and studies through the creation of coding schemes that analyzed the meanings of comprehensive data (Lin & Jeng, 2017). Successfully analyzing comprehensive data via coding schemes, QCA explores complex issues in a conceptual manner by engaging in some degree of interpretation to find meaning in data (Schreier, 2012). Rigorous QCA requires a systematic data system characterized by three features. The three features established a data reduction system that enhanced the focus on the research questions and the creation of abstracting categories, a highly systematic examination structure to test the quality of category definitions, and a flexible coding frame that matched the material (Flick, 2018).

Qualitative content analysis was an appropriate research method to explore the effects of undernourishment on K–12 student learning. The effects of undernourishment on student learning were examined by synthesizing and screening existing academic literature for reliability and validity, while eliminating the ambiguity of current concepts in the field (Chalkiadaki, 2018). Cho and Lee (2014) stated content analysis is an ideal method to classify and categorize the meaning of written material in a subjective matter due to its flexibility of using inductive or deductive analysis. Qualitative content analysis is suitable by nature due to its ability to find the underlying meaning of the written text (Cho & Lee, 2014). The flexibility grants the QCA study

researcher the ability to establish categories and themes. Categories were created to compress a broad amount of text into content-related groups of similar topics and themes to interconnect the fundamental meanings in categories (Cho & Lee, 2014). Each coding frame created was analyzed using MAXQDA (2019), an analytical software tool designed to collect, organize, and visualize data from qualitative research by breaking down data into individual components.

As a research design, QCA has advantages that made the design a suitable research method for the study. Content analysis was used as a descriptive tool to explore the manifest and latent meanings in written literature, which was useful when conducting research on the existing text on nutrition and learning (Maier, 2017). The mutualistic connection of nutrition and K–12 student learning offered the opportunity to explore the relationship through category and theme creation within the content analysis design.

The rationale for selecting the QCA design was the significance of the study's potential contributions and the nature of the topic. The QCA study was needed to examine the potential outcomes of undernourishment on a K–12 student's ability to achieve in school. Child undernutrition should be thoroughly examined to find answers to a potential global crisis that could lead to impaired cognitive abilities of students across generations and into adulthood (Goyal et al., 2015). Examining what was known about child undernutrition aided in finding key patterns and understanding the factors that follow students for many generations to come (Goyal et al., 2015).

The nature of the topic could be a sensitive subject for research participants. To protect human dignity with a sensitive topic, no human participants were part of study (Barrow et al., 2020). Having no human subjects made it more difficult to obtain quantifiable data to statistically measure academic achievement. In addition, the absence of human subjects meant

participants did not have to revisit current or past trauma, which could have caused more harm than benefit (Barrow et al., 2020). In respect for human subjects and to remain as ethical as possible, exploring expert knowledge from prior studies was chosen to analyze data which could be interpreted for deeper meaning. The exploration of data via QCA provided a different lens to the issue of student nutrition and academic achievement beyond measurable numbers. Schreier's (2012) expertise in QCA guided the exploration of student achievement in relation to student nutrition, which allowed a deep dive into how nutrition could impact student learning differently.

The QCA design was chosen to analyze peer-reviewed medical journals to reveal the affect food has on a student's cogntivie ability to learn. Rather than focusing on the statistical component that quantitative data provide, the researcher took a qualitative approach to discover the influence undernutrition has on K–12 student success. If a consensus in the field were established during the data collection and analysis process, then key thematic relationships between undernutrition and academic performance could be identified, which may reveal connections pertaining to societal factors, nutritional intake, and the ability to learn.

Role of the Researcher

Preparing information in a QCA study was essential to the appropriate collection and analysis of the data (Schreier, 2012). Exploring the relationship between undernutrition and academic performance required neutrality to prevent preunderstandings from devaluing the data collected and analyzed (Dahlberg & Dahlberg, 2019). Prior to condensing information, presumptions were eliminated by being aware of nonbias during the analysis process (Bengtsson, 2016). Preunderstandings, such as prior knowledge, occupation, and personal experiences can create bias and prevent openness to new evidence from the data collected and analyzed (Bengtsson, 2016). Openness was imperative to transcribing the data, gathering concrete

evidence, and understanding the initial impression the data provide (Bengtsson, 2016). Remaining unbiased in preunderstandings was critical to select data that could best answer the research questions and intended focus of the QCA study (Elo et al., 2014).

Information condensation was maximized when there was a general understanding of the material collected and analyzed (Bengtsson, 2016). Once analyzed, the data were condensed to shorten the text while preserving the core meaning of the information. With assistance from the reflection process, the cyclical process of condensing information remains intact during QCA (Bengtsson, 2016). The reflection process was completed by identifying and condensing meaning units, coding and categorizing data, and returning to the data to reveal possible connections and relationships (Bengtsson, 2016).

The formulation of a coding format followed the reflective process. A coding format was needed to establish descriptive codes of the meaning units (Bengtsson, 2016). The codes assisted in identifying connections in meaning units and jump-starting the initial phase to understand the data analyzed (Bengtsson, 2016). Once condensation of meaning units and code creation were complete, the process to develop information into categories and themes began (Bengtsson, 2016). Codes that appeared ideal or contained similar data regarding the same issue became part of the same category (Bengtsson, 2016). Themes were created when the abstracted categories were combined to express the underlying meaning of the data (Bengtsson, 2016).

The QCA study was centered on data collection, data analysis, and category creation. The success of the QCA study was accomplished by establishing an initial coding system to explore the relationships between undernourishment and K–12 student learning. Each piece of data collected identified and grouped categories together while staying true to the meaning in the data collected (Bengtsson, 2016). The process provided the means to systematically and objectively

organize the data collected and analyzed to make inferences about the topics (Bengtsson, 2016). Successful category creation was based on the ability to decontextualize and become familiar with the data transcribed from text to establish meaning units, recontextualizing the text to discard unimportant text, creating categorization from condensed meaning units and theme creation, and compiling data to identify meanings in the text to address the research questions of the QCA study (Bengtsson, 2016).

The pilot phase was conducted after establishing the coding format. The pilot phase begins by applying the coding frame to part of the material collected during trial coding (Schreier, 2012). To find any flaws or pittfalls that may occur prior to finalizing the main coding format of the study, trial coding was completed (Schreier, 2012). The discovery of any shortcomings allowed adjustments to be made prior to analyzing all material. Capturing any discrepancies in the data, such as overlapping categories, ensured the data analysis method was consistent and strong to prevent invalidating the results of the QCA study. To ensure the variability of the data collected, the same criteria used to create the categories of the coding frame were used for trial coding (Schreier, 2012). The variability of data was represented by the peer-reviewed literature data collected and the unidimensional characteristics for each category of the coding frame (Schreier, 2012). During the trial coding, the variability of each category was tested to determine whether the material selected was representative of the entire coding format. The more variable the material was during the trial coding, the more categories were applied to the trial coding (Schreier, 2012).

The pilot phase of the QCA study involved computer coding to analyze the material collected. Computer coding involved the automated tabulation of variables for the targeted content (Neuendorf, 2017). The computer coding of data usage required the selection of a

computer software program to analyze the sets of data and user-created dictionaries to analyze the content (Neuendorf, 2017). The QCA study researcher used MAXQDA computer coding software. MAXQDA was chosen because the program supports qualitative data analysis by systematically evaluating, interpreting, and developing theoretical conclusions from the data (Neuendorf, 2017). Once the quality of the coding frame was considered acceptable, the data tabulation and reporting phase began.

Research Procedures

Implementing a QCA design developed descriptions of the manifest content close to the text for more concrete descriptions and latent content distant from the text for hermeneutic interpretations (Graneheim et al., 2017). The QCA design did not require protecting human participants nor following the related ethical guidelines associated with human protection; rather, the data collection and analysis process required a well-maintained management system to protect the misuse of intellectual property (Mittlestadt & Floridi, 2015).

The QCA study required the use of original work to create a new distinction of the material analyzed. The misuse of original work presents an ethical challenge (Morrow et al., 2014). The original work is misused when the possible contextual meanings of the work are misrepresented or not fully understood (Morrow et al., 2014). Following are the procedures for population and sample selection, instrumentation, data collection, and data preparation.

Population and Sample Selection

The QCA study did not include participants or a research site; rather, the QCA study required an appropriate sample selection of literature. The research removed human participants and recall bias by shifting the focus from human subjects to collecting and analyzing quality data from a variety of contexts to understand the phenomenon (Maier, 2017). Quality data would be

medical peer-reviewed literature that meets the inclusion criteria, helps answer the research questions, and relates to the purpose of the study. To support the selection of academic data relating to undernutrition and K–12 academics, data collection was limited to medical peer-reviewed literature.

The abundance of peer-reviewed literature found through various mediums, such as libraries and the internet, made the content analysis process difficult (Neuendorf, 2017). The overflow of information increased the difficulty to gather, code, and navigate the data necessary for the study (Neuendorf, 2017). If information condensation were not done properly, the overflow of information could make a time-consuming process more time consuming by the replication of content across various websites, applications, and computer programs (Neuendorf, 2017).

To ensure the content analyzed was trustworthy and gathered appropriately, the QCA study selected only peer-reviewed literature from MEDLINE Complete and CINAHL Complete databases between 2014 and 2019 to be analyzed. Each database was accessible through the ACE library with proper student credentials and permissions. The MEDLINE Complete and CINAHL Complete databases provided ample opportunity to identify the breadth of good-quality references, to develop quality research questions, and to evaluate the literature available on the topic of undernutrition and K–12 student academic performance (Grewal et al., 2016). The justification for choosing MEDLINE Complete and CINAHL Complete as the databases came down to their reputations and access to top-tier material from reputable journals. MEDLINE Complete and CINAHL Complete provided access to quality material on the research topic in the biomedical field (Grewal et al., 2016).

MEDLINE Complete is a database known for its breadth of content (EBSCO Industries,

2020b). MEDLINE Complete contains the full text of over 2,400 indexed journals and over 2,500 unique journals not found in competing databases and makes substantial efforts to release full-text data simultaneously with the National Library of Medicine's release of citations to MEDLINE (Kaste, 2015). As a member of the EBSCO family, MEDLINE Complete was easily integrated with link resolvers and increased the capacity of full-text articles available across the EBSCO database subscriptions (Kaste, 2015). MEDLINE Complete is best suited for use when covering a wide range of subjects in the biomedical and health fields, including research in clinical care, public health, and health policy development (EBSCO Industries, 2020b).

CINAHL Complete is considered the world's largest source of full-text articles for nursing and allied health journals (EBSCO Industries, 2020a). CINAHL Complete provides indexing for over 4,000 journals, provides access to full-text articles from over 1,200 journals, and has over 6 million records (EBSCO Industries, 2020a). CINAHL Complete has a rich history and strong reputation over the years with journal records dating back to 1937 and provides a comprehensive database from about 800 leading journals (EBSCO Industries, 2020a).

The criteria for the publication range of 2014–2019 were threefold. From an academic context, keeping up-to-date information when using medical journals prevented an overload of outdated information (Pontis et al., 2017). The year range served as a natural filter to remove any information that misrepresented the QCA study's objective (Pontis et al., 2017). The year range aided in conceptualizing information by narrowing down the subject matter to validate and interpret the information for a deeper understanding (Pontis et al., 2017). The QCA study included national and international databases accessible via student permissions from ACE, such as Academic Search Complete, Child Development & Adolescent Studies, Education Source, and ERIC, and the public database Google Scholar. The QCA study was limited to the

categorical search terms *undernutrition* and *academic performance*, subcategories of undernutrition and academic performance, key attributes of the meaning units, and any antecedents established.

Sampling Strategy: Peer-Reviewed Literature

In research, peer-reviewed literature remains a vital pillar of trust. To conduct successful research, the content analysis design established a clear, operational definition of *peer-reviewed literature* (Neuendorf, 2017). The peer-reviewed literature in the QCA study was considered valid if it was published in a scholarly journal, used a scholarly tone in writing, had an abstract that summarized the research, contained citations by experts, contained a bibliography of credentialed authors, was affiliated with a research institute or university, and was published in reputable databases that offer access to highly recommended diverse material and scholarly communities in a given field of interest (Nicholas et al., 2015).

Peer-reviewed literature published in reputable databases, such as MEDLINE Complete and CINAHL Complete are considered trustworthy sources to scholars for three reasons. Publishers in reputable databases maintain high standards for any author who plans to publish a study in a journal to be shared in scholarly communities (Nicholas et al., 2015). Peer-reviewed literature published in reputable databases offers access to highly recommended diverse material and scholarly communities (Tenopir et al., 2015). When compared to open access journals, reputable databases were found to have higher journal rankings, maintain more extensive indexing and search systems, and follow the traditional high standards of publication which is accepted by most researchers in the field (Tenopir et al., 2015).

The rationale for choosing medical peer-reviewed literature in the QCA study was to provide consistency in the data collected. The data collected maintained consistency as the data

were from reputable sources (Flick, 2018). Analyzing medical peer-reviewed literature provided an ample amount of data to answer the research questions.

The analysis process focused on the extraction of relevant literature to address the scope of the research via the search strategy and answer the research questions. To achieve methodical rigor with the search strategy, the search for literature occurred in four stages. The first stage was an initial screening of literature and determining the most useful databases. The second stage was searching the selected databases using specific keywords to identify categorical terms of each concept. The third stage was conducting a bibliography search to identify potential sources in useful literature. The fourth stage was monitoring decision making to determine if the search strategies were used effectively (Bandara et al., 2015).

The research questions were answered by developing a reduction system to prevent cognitive overload from a surplus of information. The reduction system focused on the aspects of meaning related to the research questions. To monitor the reduction system, every part of any material analyzed was examined. With careful monitoring and examination of the reduction system, researcher bias was prevented, the coding frame remained flexible, and material clearly matched the intended meaning to create accurate categories (Schreier & Flick, 2014). Data were collected through a coding frame with categories. For comparison and contrast functions, each category created was maintained with hierarchical levels of unidimensionality to accurately sort data to the right categories based on the data characteristics. Unidimensionality helped build coding frames that were mutually exclusive by ensuring each dimension captured only aspects of the material (Schreier, 2012).

Inclusion and Exclusion Criteria

The inclusion and exclusion criteria of the study were developed to maximize the

extraction of representative peer-reviewed literature. MEDLINE Complete and CINAHL Complete were the two databases chosen to find representative peer-reviewed literature. The search criteria were limited to language, publication dates between 2015 and 2019, and literature limited to K–12 education in the United States.

The search terms used to find representative literature were related to the main concepts of the research questions, the literature review of the study, and the characteristics of the main categories in the coding frame: undernutrition and academic performance. To aid in effective database searching, two strategies were used. The first strategy was using keywords and synonyms from the main concepts of the research questions. The second strategy was using indexed subject headers of journal articles to increase the precision of the searches. The inclusion criteria of the search strategy had four elements. The peer-reviewed literature collected had to fall within the 2014–2019 publication date range. Each peer-reviewed article chosen had to focus on elements pertaining to the main concepts of the research questions and discuss factors that influenced undernutrition and academic performance of K–12 students across home and school environments. The peer-reviewed articles were from the United States only. The peer-reviewed literature collected had to exist in one or both MEDLINE Complete and CINAHL Complete databases. Peer-reviewed literature was excluded from the study when the inclusion criteria were not met.

Instrumentation

In a QCA study, gathering and accurately measuring reliable research literature is essential (Neuendorf, 2017). Selecting the appropriate content to analyze the issues assisted in finding data best representative of the thematic relationship between undernutrition and K–12 student learning (Neuendorf, 2017). One measurement method used to determine the best

meaning of the concepts was Walker and Avant's concept analysis method (Squires et al., 2015).

Walker and Avant's method was used to identify concepts to decide which characteristics assist in refining patterns in the literature analyzed (Squires et al., 2015). Deciding how the issues of undernourishment in K–12 student learning was recognized helped determine key characteristics and extract concept definitions from literature (Abdolrahimi et al., 2017). An effective method to evaluate the classification of data in the research design was Walker and Avant's method (Squires et al., 2015). The ability to determine the variance between concepts was the strength of Walker and Avant's method, which allowed the defining attributes to be distinguished from the insignificant attributes (Squires et al., 2015).

The most appropriate method for deep contextualization of undernourishment's effect on student learning was Walker and Avant's method (Yazdani & Shokooh, 2018). The Walker and Avant method included selecting a concept, deciding on the aim of data analysis, identifying the meaning of the concept, defining attributes, determining the model case, determining alternative cases, analyzing the antecedents and consequences, and defining the empirical referents (Yazdani & Shokooh, 2018). Analyzing each concept allowed a thorough investigation into the mutually exclusive topic of undernutrition, the creation of a valid and informative coding scheme, and development of categories based on relevant literature to ensure findings can be comparable across different empirical studies (Lin & Jeng, 2017). There were no participants in the QCA study and no requirements to obtain consent to conduct the research. To determine if the data were suitable for the QCA study, Walker and Avant's method was followed to assist in conceptualizing the data (see Appendix B).

Data Collection

The data collected centered on concepts created. The concepts were created based on the

potential link to child nutrition and student learning in the classroom. The data emphasized the link between nutrition, achievement in education, and income by establishing a thematic connection between nutritional realities and K–12 student learning (Demaio & Branca, 2017). Nutritional realities in children of lower income may increase the difficulty to meet established dietary guidelines and maintain the proper nutrition associated with cognitive development of children (Demaio & Branca, 2017).

The collection of data focused on systematic category creation (Bengtsson, 2016). Walker and Avant's concept analysis method was used to identify characteristics, determine patterns in literature, and discover model cases to select material appropriate for the purpose of the study. The goal was to explore the relationships of the concepts in the research through medical review journals. The collection process required the use of original work and collecting the data without misuse or misinterpretation of the original author's intended meaning. Walker and Avant's method assisted in developing unidimensional categories that were mutually exclusive, considered key attributes of the categories, and answered the research questions (see Appendix C).

Data for the QCA were collected from the peer-reviewed medical research literature available from the online databases and journals through ACE and Google Scholar. The acceptable documents for the content analysis included peer-reviewed research literature published between 2014 and 2019. In addition, the data collection was restricted to data that examined the relationship between food and learning in the K–12 classroom and possible patterns of undernourishment during a child's school years. A key goal of the data collection procedure was to reduce and analyze 120 pieces of peer-reviewed literature by sufficiently abstracting each category and segmenting each piece of material to assess the literature's

meaning in the coding frame (Schreier, 2012).

The rationale for using a sample size of 120 pieces of peer-reviewed literature was twofold. Using 120 pieces of literature decreased sampling errors, increased the level of confidence (Neuendorf, 2017), and substantiated new understandings of the issues under study (Vasileiou et al., 2018). A decrease in sampling errors and an increased level of confidence can strengthen the dependability of the results and the ability to answer the research questions of the study (Elo et al., 2014). Proving and validating new understandings of the issues required the selection of data based on the criteria of informational redundancy and information power (Vasileiou et al., 2018). One hundred and twenty pieces of peer-reviewed literature was a pragmatic amount because the volume allowed for the expansion of meaning and revealed the core properties between the thematic relationship of nutrition and learning (Vasileiou et al., 2018).

Building the Coding Frame

Criteria to build the coding frame were established to find the medically peer-reviewed literature that best fit to answer the research questions. Building the coding frame for the QCA study required the literature selected to be built around the dimensions of the coding frame's categories. Each category served as a filter for any material not covered by the main categories of the research and specified any relevant aspects of the material (Schreier, 2012). In respect to the main categories, the coding frame focused on reducing the variety of meanings in the literature, helped manage the large load of material collected, and displayed only material distinct to the categories represented (Schreier, 2012).

Qualitative research can provide a wealth of material that can be an overwhelming process without a well-established coding frame (Schreier, 2012). Building a successful data

collection plan required the development of a reliable coding frame that organized the data around the focal point of the research (Schreier, 2012). The data collected centered on concepts created in the coding frame. The concepts created were focused on characteristics that may have connections to nutrition and learning. The data emphasized the nutritional realities of K–12 students by establishing a thematic connection between nutrition realities students may face and academic outcomes.

Category Creation

The coding frame is the backbone of QCA design (Schreier & Flick, 2014). The coding frame consisted of at least one category and two subcategories with hierarchical levels that demonstrated the unidimensionality of each category (Schreier & Flick, 2014). In content analysis, a category is a representation of organization and similarity (Graneheim et al., 2017). The coding frame enabled data to be collected and sorted by similarity based on characteristics the data shared, which allowed the categories to be compared accordingly (Graneheim et al., 2017). Graneheim et al. (2017) stated constructing categories is like a store—the store has multiple departments, such as groceries or main categories, subcategories, such as fruit (subcategory of groceries), and sub-subcategories, such as apples and pears (subcategory of fruit). Similar to items being in specific departments in a grocery store, a properly constructed category contains codes to assist in the creation of themes (Graneheim et al., 2017).

In the coding frame, unidimensionality was displayed with two main categories, each with two subcategories. Categories and subcategories were created for four key reasons. The unidimensionality of each category captured one dimension of the coding frame (see Appendix D; Schreier, 2012). Each category captured one aspect of the material to prevent mixing up the dimensions in the coding frame categories (Schreier, 2012). Subcategories consisted of

specifications unique to the dimensions of each category (Schreier, 2012). Each subcategory was mutually exclusive to its category, which exemplified both the characteristics and the reliability in the coding frame through its exhaustiveness (Schreier, 2012). The coding categories are displayed in Appendix D.

The goal of the classification was to create mutually exclusive categories that display the antecedents and consequences of undernutrition and academic performance. In terms of antecedents, undernutrition and academic achievement start prior to entering the classroom, such as food insecurity in a household and its effect on study habits. In terms of consequences, the goal was to focus on the aftermath of academic performance and cognitive functioning that occurs in the classroom setting as a result of undernourishment. By establishing a clear conceptualization of both antecedents and consequences, the cyclical nature of the factors affecting undernourishment and academic performance inside and outside of the classroom was better understood.

Operational Definitions

Operational definitions were created to clarify which variables were researched during the QCA study (Neuendorf, 2017). Each operational definition allowed critical thinking on the subject matter, while clarifying each variable (the defining and measurable concept) of the QCA study. The variables aided in deciding whether attributes of concepts provided relevant information that made the concepts mutually exclusive and exhaustive (Neuendorf, 2017). The establishment of relevant information helped prevent overlapping of the categories by specifying the category description, examples, and decision rules that captured the essence of the category (Schreier, 2012). Each category description contained important features of the category, examples illustrated the category, and decision rules prevented overlapping of subcategories

while coding in a specific category (Schreier, 2012).

Coding Schemes

Coding schemes were constructed to help concepts match operational definitions (Neuendorf, 2017). Coding schemes in the QCA study served as dictionaries, or "a set of words, phrases, parts of speech, or other word-base indicators that was used as the basis for a search of texts" (Neuendorf, 2017, p. 148). The goal for the coding scheme was to measure constructs in each concept variable to see relationships emerge between categories (Schreier, 2012). When a coding scheme matched its operational definitions of concepts, the likelihood of validity increased, which signified the development of measurable, mutually exclusive, and exhaustive categories in the QCA study (Neuendorf, 2017).

The coding schemes were assisted by computer-aided text analysis (CATA) software MAXQDA, a text search tool that allowed for automated searches of text for conceptual themes and relationships between concepts (Batdi & Elaldi, 2016). MAXQDA served as the CATA program to provide key information about the sources used, analyze messages, and help create dictionaries of the coding schemes in a time-efficient manner (Neuendorf, 2017). The research data collected were uploaded into MAXQDA for storage and data management.

The data were stored and organized into MAXQDA and thoroughly read to highlight content related to the research questions, purpose of the study, definitions, and conceptual themes of the QCA study. The content highlighted initially was developed into nodes, which unveiled the underlying themes of data and assisted in coding the research literature analyzed. The data collected from the research literature documents were focused on supporting the aim of the QCA study. Data collected included the characteristics of food deserts and food insecurity, the effects of nourishment and undernourishment, and the effects of nutrition in K–12 education.

No participants were involved in the data collection process. The researcher used only research literature documents to help understand the issues of undernourishment in K–12 students.

Data Preparation

The data collection process ensured the condensed meanings were coded properly to prepare for data analysis. Qualitative content analysis is a nonlinear, reflective process that required visiting the data multiple times to reveal connections and relationships beyond the initial data analysis (Erlingsson & Brysiewicz, 2017). The content met specific conditions to be ready for analysis. The text was divided into meaning units and condensed meaning units to prevent fragmentation. The content created codes that served as descriptive labels and identified meaning in units. The meaning units developed categories that answered key questions, organized concepts into similar themes, and determined the best way to code units of condensed meaning when the units could be coded in multiple ways (Erlingsson & Brysiewicz, 2017).

The display of the concepts represented the condensed meaning of data when presented for data analysis. The data were displayed in a graphic format that allowed comprehension of the research and portrayed information beyond textual format. The graphic format provided visual access to information while telling the message in a specific manner (Verdinelli & Scagnoli, 2013). The visual representation of data allowed the researcher to synthesize inquiry through quality inquiry (Verdinelli & Scagnoli, 2013). The inquiry established connections by providing a visual representation of the original author's textual meaning and eliminating barriers to make data more engaging (Verdinelli & Scagnoli, 2013). The use of cognitive maps was intended to embody the information processed by supplying an ample amount of knowledge of the concept to develop causal relationships that connected concepts in meaningful ways to create organized understandings of the data's context (Gray et al., 2014).

Data Analysis

The purpose of qualitative content data analysis is to organize the data collected to extract meaning and draw conclusions (Bengtsson, 2016). In the qualitative analysis study, the data collected were presented as words and themes to interpret and analyze the underlying meanings found in the data (Bengtsson, 2016). When analyzing the data for meaning, the four stages—decontextualization, recontextualization, categorization, and compilation—typically occurred in a cyclical manner to maintain quality and trustworthiness of the analysis process (see Appendix E; Bengtsson, 2016).

Data analysis in the QCA research design is inductive by nature and focused on data that can be categorized and contextualized (Maxwell, 2018). The goal of qualitative data analysis for the study was to retain the data in their original form to analyze their natural narrative and contextualized character through categorization and conceptualization (Rallis, 2018). The contextualized and conceptualized data were analyzed using manifest analysis, which allowed the data's character to remain as close to the text as possible (Bengtsson, 2016).

The categories were analyzed and conceptualized through the visual representation of cognitive map analysis. The cognitive map analysis allowed the data to visually represent the relationship between undernutrition and academic performance in the K–12 classroom through the creation of the concept families that established specific knowledge domains to organize the data. Once data were organized, MAXQDA was used to tabulate the directional meaning of concept families established from the medical peer-reviewed literature examined (Le Navenec & Hirst, 2010).

The categorical analysis of the data consisted of examining the hierarchical levels of the

coding frame via the coding schemes. Each hierarchy level was representative of the coding frame's organizational system, which connected each main category to its subcategories and sub-subcategories (Graneheim et al., 2017). The connections between each category allowed the coding schemes to determine the strength and variability between each category (Schreier, 2012). To gain consensus in the field, code frequencies and co-occurrences were analyzed to determine how often the relationships between codes occurred in the literature examined.

MAXQDA was used to organize the data by identifying themes and categories. MAXQDA is a software package used for analyzing qualitative data (Oliveira et al., 2014). As a data tool, MAXQDA aided in organizing and understanding large amounts of data (Oliveira et al., 2014).

The thematic relationship between undernutrition and academic performance required an analysis of thematic proximity among the literature examined. With assistance from MAXQDA, thematic proximity was analyzed among the subcategories and sub-subcategories to identify patterns and strengths of relationships in the data gathered from the literature via co-occurrence (Armborst, 2017). The strength of co-occurrences was determined by the prevalence of categories occurring together and the influence each categorical relationship had on undernutrition and academic performance.

Prior to the content analysis, the research materials were organized and prepared to clarify the purpose of the QCA study. Clarifying the purpose of the QCA study allowed the identification of patterns in the data and meaningful meaning units focused on answering the research questions. The research questions determined the structure of the research design and created boundaries to ensure the issues was properly analyzed and not too broad to increase credibility through category creation (Bengtsson, 2016).

With the assistance of MAXQDA, categories were created through computer-assisted contextual analysis, which allowed the operationalization of the data collected and determined whether the constructed meaning from the data was relatively clear (Humphreys & Wang, 2017). If the data are clear, then rules can be set to analyze recurring patterns of language in text. The recurring patterns of language worked in conjunction with category creation to eliminate irrelevant text, determined whether data were representative of the QCA study's objective, and gave more insight to the relationship between nutrition and K–12 student learning (Humphreys & Wang, 2017).

Reliability and Validity

In qualitative research design, validity is defined by the appropriateness of the tools, processes, and data used to answer the research questions (Leung, 2015). Validation of the findings meant the research was able to accurately reflect trustworthiness (Creswell & Creswell, 2018). Internal validity established the causal relationship between undernourishment and K–12 student learning through conceptualization in the coding scheme (Maul & Katz, 2018). The goal for the coding scheme was to provide an accurate description of the issues that included objectifying the meaning units based on the intended meanings (Neuendorf, 2017). Once conceptualized, the concepts became operational to ensure the QCA study's focus was secure and internal validity occurred (Neuendorf, 2017). Each category and subcategory created maintained the QCA study's focus through mutual exclusiveness and exhaustiveness to improve operationalization guided by the creation of a codebook from the coding scheme and an appropriate code for each unit coded (Neuendorf, 2017).

The QCA study utilized peer-reviewed literature by focusing on maintaining accuracy of findings through content validity and ensuring the measures reflect full extent of the concepts

being measured (Neuendorf, 2017). The QCA study focused on maintaining content validity via the consistency of the coding frame's ability to represent the data evaluated (Schreier, 2012). The validity of the material analyzed is based on the soundness of the findings and conclusions after a close reading of the material (Schreier, 2012). In addition, the validity of the research is predicated on following the research design and methodology to answer the research questions of the study (Schreier, 2012). The coding frame of the study was considered valid if categories of the coding frame captured the analyzed data and are representative of the concepts (Schreier, 2012). The segmentation of the coding frame was used to divide and assess the material analyzed via the hierarchical levels of categories, subcategories, and sub-subcategories created, which allowed material to be assigned to its respective category while answering the research questions of the study (Schreier, 2012). The segmentation of the coding frame was used to divide and assess the material analyzed via the hierarchical levels of categories, subcategories, and sub-subcategories created, which allowed material to be assigned to its respective category while answering the research questions of the study (Schreier, 2012).

A content analysis study without reliability renders the measures useless and cannot be considered valid (Neuendorf, 2017). The reliability in the QCA study was evident when the operational definitions for each category were distinct from one another and present in the material analyzed (Schreier, 2012). Reliability in a content analysis design is based on the validation of the established coding scheme (Neuendorf, 2017). The established coding scheme was able to produce similar results if more than one individual used the scheme and was not limited to being used by one individual (Neuendorf, 2017). Alongside the coding scheme, the concept sampling method should produce purposeful data through the sampling strategy.

A strong concept sampling method can produce dependable results with the help of

reflexivity (Creswell & Creswell, 2018). The natural preunderstandings and behaviors of the researcher could harm consistency when the interpretations do not match definitions of coding categories created and the data presented (Schreier, 2012). Being aware of the threats to the unidimensionality within the coding system and the possible coding mistakes may increase reliability in the QCA study (Neuendorf, 2017). Threats of reliability in the qualitative analysis design are linked to coding schemes that are poorly executed, lack of coder training, insufficient practice during pilot coding sessions, coder fatigue from an overly long codebook and a surplus of units, and rogue coders who have not been trained properly to achieve reliability (Neuendorf, 2017). To maximize reliability via triangulation throughout the course of the QCA study's data collection and analysis processes, multiple coders may be used to perform the analysis.

The reliability of a QCA study is measured by the generalizability of the results of the data analyzed. The data analyzed from the qualitative content analysis study should have theoretical relevance, answer the research questions, and serve as a starting point for future research (Maier, 2017). The time-consuming nature of the QCA research design could complicate the generalizability of the data if representative categories of the coding frame are too difficult to create.

The accurate reassessment of the coding frame could improve the generalizability of the data if the data could reveal the influence food has on a student's cognitive ability and be applied to other cases (Neuendorf, 2017). The generalizability of the data was measured by the data analysis method's ability to move beyond an individual understanding and interpretation and accept the reflexivity of the data presented (Schreier, 2012). Dependability supports the stability and modifications of the data over time by keeping track of the coding decisions and alterations made during the data analysis (Bengtsson, 2016). Reliability in the QCA study requires

dependability because there is no definite truth in the qualitative research analysis, which makes qualitative research difficult to replicate (Bengtsson, 2016).

Ethical Procedures

Ethical collection of data was essential for completing quality secondary data sampling (Neuendorf, 2017). The process of obtaining relevant secondary data required precautionary steps prior to starting the data collection (Burles & Bally, 2018). As a personal courtesy, authors were informed their work would be used in advance. Extending a personal courtesy beforehand ensured responsible data collection and analysis was conducted, the plan of inquiry was properly developed, and ethical guidelines were maintained to create trustworthy outcomes (Sanjari et al., 2014). Each author of the research literature used was notified beforehand via the courtesy letter (see Appendix A).

Ravitch (2018) concluded ethics in educational research require the analyst to consider the issues linked to researcher reflexivity and the expert–learner binary. *Researcher reflexivity* refers to the ability to consider each person's role in the research process, which includes the specific ways of viewing the world (Ravitch, 2018). The analyst understood how a personal world view could influence the misinterpretations of a content's meaning due to personal belief systems, biases, ideologies, assumptions, and prejudices (Ravitch, 2018).

Understanding the proximate contexts of the QCA study helped overcome the challenges of misinterpretations and misrepresentations in content analysis (Morrow et al., 2014). A sufficient understanding of the proximate contexts helped lessen prejudice and data misuse from prejudice (Morrow et al., 2014). The expert–learner binary can negatively affect the latent meaning of an original author's work by undermining how the author's work and expertise are viewed (Ravitch & Carl, 2015). Assuming the researcher is more knowledgeable than the

original author of the research literature can be problematic if no new knowledge can be learned from the study (Ravitch & Carl, 2015).

Chapter Summary

A rationale for and description of the research design and methodology of the research QCA study was outlined. The rationale for examining undernourishment in K–12 students was to gain clarity about the issues through existing research literature. An aim of the QCA study was to explore peer-reviewed medical journals to reveal the influence food has on a student's ability to learn. The objective was to systematically conceptualize data in a thematic fashion to examine the underlying relationships between nutrition and K–12 student learning.

The role of the researcher in the QCA study was to condense the information collected. The condensed information was used to formulate the meaning units, category creation, and coding format to reveal possible connections between the data. The coding format served as the initial phase to both organize the data collected and to understand the abstracted data to be analyzed. Success of the QCA study design was seen in a well-structured coding frame, strong category creation, and compilation of data aimed at answering the research questions.

The selection and rationale for the use of QCA was discussed through the research procedures, data collection, and data analysis. The selection of the content analysis method was determined by the conceptualization and classification of ideas via research literature. The QCA design was necessary to provide a consolidated approach to the ample amount of existing data on undernutrition and K–12 student learning. The rationale for selecting the QCA method was to consolidate an abundance of research data, explore the issues through the research literature, and interpret large amounts of data to find possible connections. The research procedures supported the selection and rationale of the qualitative analysis study design with the development of a data

reduction system, abstracting categories, and a flexible coding frame.

Through meticulous examination, the data collection method screened and synthesized current medical research literature. Walker and Avant's (2019) method assisted in establishing a coding system to organize data. The goals of the organized data were to create unidimensional categories, prevent the misuse of the original authors' data, and limit the overflow of unnecessary data to improve data analysis. The focus of data analysis was on extracting the meaning and drawing conclusions from the data collected. Cognitive map analysis was used to conceptualize and visually represent the extracted data.

Reliability and validity of the QCA study was acknowledged. Data analyzed supported reliability and validity in the operationalized data established from coding systems created. Reflexivity helps eliminate bias by creating trustworthiness in the research process (Dodgson, 2019). Trustworthiness can be created via detailed descriptions of the research methodology processes, established research strategies during data collection and analysis, and the researcher's position in relation to the content being studied (Dodgson, 2019). The researcher's position can increase credibility when the focus of the study is knowledge creation, which requires the biases, beliefs, preunderstandings, and personal experiences to be self-monitored to prevent unconscious cognitive errors (Dodgson, 2019). Validity in the QCA study was maintained through the mutual exclusiveness of the data and using appropriate coding methods for each meaning unit. The ethical procedures were followed to prevent bias and complications from using existing literature to establish new meanings by preventing misinterpretations of the original authors' work. The ethical procedures acknowledged the expert–learner binary can negatively affect the research and prevent the creation of new knowledge beneficial to the mission of the study when recognition is not given to original authors' expertise and viewpoints.

Chapter 4: Research Findings and Data Analysis Results

The purpose of the QCA study was to explore peer-reviewed medical journals to reveal the influence food has on a student's cognitive ability to learn. K–12 students living in food desert communities or food-insecure households may lack both the accessibility and affordability of nutrition-rich food choices due to unequal access in low-income communities (Block & Subramanian, 2015) and the shift of societal infrastructures caused by policies supporting urban development and suburbanization (Deener, 2017). Communities linked to food insecurity are more likely to be occupied by non-Hispanic Blacks and Mexican Americans who are categorized below the poverty line, including caregivers who have less than a high school education (Rossen & Kobernik, 2016). When faced with food insecurity or undernutrition, children are at a greater risk of poor cognitive development, early stunting, and impaired executive functioning, all of which may impair neurocognitive ability (Perez-Escamilla & Moran, 2017).

The problem addressed in the QCA study was the lack of a deep understanding of how nutrition deficiencies influenced students' academic performance and achievement in the classroom. Based on past studies, home and school environments may have a positive influence on the nutritional and cognitive development of K–12 students when faced with economic stability, decreased stressful adversities, and well-structured nutrition programs on school campuses (Frerichs et al., 2015; Haddad et al., 2018; Johnson & Markowitz, 2018a). Chapter 4 is an outline of the key emerging themes through careful evaluation, classification, and conceptualization represented by the issues of the study. The following research questions guided the study:

Research Question 1: According to research studies conducted between 2014 and 2019, how does undernutrition affect K–12 students' cognitive functioning in classrooms?

Research Question 2: According to research studies conducted between 2014 and 2019, how does undernutrition influence K–12 students' academic achievement?

Data Collection

Data collection for the QCA study initially involved collecting 120 peer-reviewed research articles from MEDLINE Complete and CINAHL Complete to decrease sampling errors and increase the level of confidence (Neuendorf, 2017). After careful analysis of the 120 peer-reviewed articles, the final number of research articles used was reduced to 80. There were no human participants and no physical location in the study. An advantage of not using human participants and a physical location in the study was the additional time devoted to strengthening the coding frame and using better judgment to select literature that contributes to the understanding of the issues to answer the study's research questions.

Developing the Coding Frame

Walker and Avant's method (Squires et al., 2015) was utilized to build the coding frame. Each step in Walker and Avant's method was designed to develop unidimensional categories to distinguish the defining attributes of each category created, define the key attributes of the concepts, and specify categories based on the relationships between undernutrition and academic performance. Each concept and category created was based on findings from research study data. The peer-reviewed literature considered in the study restricted findings to data that revealed the characteristics of food deserts, food insecurity, and the relationship between food and K–12 student learning. The final design of the coding frame consisted of two main categories, each with two levels of subcategories (see Appendix D). The main category served as the constructed concept. The first level of subcategories was used to create themes of the constructed concept, and the second level of subcategories was used to define themes and attributes of the concept.

Following the construction of the coding frame, operational definitions were established to strengthen the unidimensionality of each category, and coding schemes were established to help the concepts match the data collected to see any possible relationship emerging from the concepts.

Each category and concept was finalized into a coding system in MAXQDA. To assist with data management and storage, MAXQDA was used as a CATA software. MAXQDA was chosen to improve efficiency and effectiveness via the automation process in the program that allows users to highlight key information in the data collected and unveil possible underlying themes (Batdi & Elaldi, 2016).

Collecting Peer-Reviewed Literature

The data collection of peer-reviewed literature was done using ACE's Library and Database system. After the initial screening of the best databases, the medical databases MEDLINE Complete and CINAHL Complete were chosen. MEDLINE Complete and CINAHL Complete were invaluable for extracting diverse and scholarly data that were essential to finalizing the coding frame.

Two strategies from the American College of Education's (ACE's) research guide were employed for effective search strategies in databases and indexes. The first strategy for effective searches embodied keywords and synonyms from the research questions or main concepts in the research questions. The second research strategy focused on precision searches by using subject headings assigned by indexers of the journal articles listed in the MEDLINE Complete and CINAHL Complete databases. The following search terms were used in both databases for peer-reviewed literature: *absenteeism, academic achievement, academic success, adolescent:13-18 years, body mass index (BMI), breakfast, child development, child nutrition, child:6-12 years*

old, cognitive development, cognitive—evaluation, cognitive functioning, cognitive impairment, diet, dietary supplementation, disparities, educational status, executive functioning, food intake, food insecurity, food security, health promotion, health status, hunger, learning environment, lunch standards, malnutrition, nutrient deficiency/ies, outcomes of education, periodontitis, poverty, school health, school health education, schools, socioeconomic factors, students—elementary, students—K-12, and *students—primary*. Each search term was used in multiple combinations to increase the probability of finding relevant material representative of the thematic relationship and research questions.

Two deviations from the original data collection plan took place while searching the databases for relevant material. Originally, the data collection process aimed to collect 120 pieces of peer-reviewed literature from both the MEDLINE Complete and CINAHL Complete databases. From the combination of both databases, 80 peer-reviewed articles were collected. Peer-reviewed literature that did not meet the inclusion criteria was not included. The second deviation pertained to articles that seemed to fit all the criteria established but slipped past the geography filter of the search. The geography filter was set to search for articles published in the United States only, but upon further investigation, the filtered search indicated many of the articles were published in other countries but had authors from the United States or items of the reference list from the United States.

MAXQDA and Data Organization

The research data collected were organized through computer-assisted contextual analysis using MAXQDA. MAXQDA was essential to the data collection process for three key reasons. Building the code system and coding frame in MAXQDA (2020) established the code system's organization for creating operational definitions of each categorical concept and

tallying the thematic categorical frequencies of undernutrition and academic performance in each piece of peer-reviewed literature. The note-taking and highlighting system of MAXQDA allowed the data collected to be carefully identified along a research timeline and revealed any possible relationships between categorical concepts as data were reworked throughout the process (Erlingsson & Brysiewicz, 2017). The synthesis of the data collected was visually represented in the features of MAXQDA's MAXMaps system, which assisted with the creation of thematic maps, displaying the frequencies of data collected and any possible co-occurrences between categorical concepts.

The main category, undernutrition, was visually represented by the frequency counts across each subcategory and sub-subcategory (see Table 1). Each frequency count displayed the occurrence of each category in the peer-reviewed literature analyzed. While the main category of undernutrition displayed a lower count, the subcategories and sub-subcategories had higher frequency counts, which helped segment the interrelations between codes and prepare to analyze any possible co-occurrences. From the food desert subcategory, income, food access, and poverty occurred most frequently. In the food insecurity subcategory, inadequate executive functioning, food consumption, and health education knowledge occurred most frequently.

Table 1

Main Category 1: Undernutrition

Category	Category level	*f*	Operational definition
1. Undernutrition	Main	16	A lack of proper nutrition that does not meet nutritional dietary guidelines stems from the overconsumption of energy-dense foods; includes development deficits, such as stunting and neurocognitive delays.

Category	Category level	*f*	Operational definition
1.1. Food desert	Sub	40	Any part of the country that lacks fresh fruit, vegetables, and healthy food affordability and accessibility.
1.1.1. Poverty	Sub-sub	164	The condition of a person, family, or community who lacks the financial means and resources essential to a minimum standard of living.
1.1.2. Food access	Sub-sub	124	The distance between residence and healthy food outlets, such as grocery stores, supermarkets, and farmer's markets.
1.1.3. Food availability	Sub-sub	71	The ability to have a sufficient amount of food for a healthy diet consistently.
1.1.4. Food affordability	Sub-sub	17	The cost of the healthy diet of a household to the household's income.
1.1.5. Location	Sub-sub	55	The situated position of the place of residence effecting the access and availability of resources essential to survival.
1.1.6. Income	Sub-sub	135	The money earned or received to cover day-to-day expenditures essential for survival and maintaining a specific quality of life.
1.2. Food insecurity	Sub	113	The economic and social conditions that limit access to food in a household.
1.2.1. Executive functioning	Sub-sub	236	The set of processes that allows a person to manage oneself and the resources to achieve a goal. The set of processes includes inhibition, mental flexibility, emotional control, initiation, organization, and self-monitoring.

Category	Category level	*f*	Operational definition
1.2.2. Household-level food insecurity	Sub-sub	104	The ability of a household to secure, produce, or purchase an adequate amount of food for all members of the household to maintain a nutrition-adequate diet.
1.2.3. Inadequate food consumption	Sub-sub	248	The lack of consuming nutrient-rich foods in a diet, which can lead to malnutrition or obesity. Inadequate food consumption can be a product of both not having enough food to eat (undernutrition) or the overconsumption of energy-dense foods that do not provide nutritional value.
1.2.4. Nutrition-deficit foods	Sub-sub	87	Foods that are high in calories but provide little to no nutritional value; also known as energy-dense foods.
1.2.5. Health education knowledge	Sub-sub	303	Any combination of learning experiences that help individuals improve their health, attitude, and behaviors to food consumption.

Note. The levels of each category type correspond to the category levels of the coding frame:

1. Main category—The constructed concept

    1.1. Subcategory—Used to create themes of the constructed concept

        1.1.1. Sub-subcategory—Used to define themes and attributes of the concept

The main category, academic performance, and the corresponding subcategories and sub-subcategories were visually represented based on frequency counts and operational definitions (see Table 2). Each frequency count of the corresponding categories was used to tally occurrences into unidimensional categories established in the data collection, data preparation, and operationalized definitions. When considering the frequencies of academic performance, the

findings validated cognitive functioning and academic achievement subcategories as most frequent. The sub-subcategory that appeared most often in the literature examined was resource access.

Table 2

Main Category 2: Academic Performance

Category	Category level	*f*	Operational definition
2. Academic performance	Main	116	Learned proficiency in basic skills and knowledge as measured by state academic standards.
2.1. Cognitive functioning	Sub	311	The mental processes that allow one to successfully carry out a task.
2.1.1. Reasoning	Sub-sub	17	The ability to logically form ideas and solve problems.
2.1.2. Planning	Sub-sub	9	The ability to think about the necessary actions to accomplish a goal or carry out a task.
2.1.3. Stress management	Sub-sub	27	The ability to effectively maintain the feelings caused by emotional, physical, and mental tension via positive actions to minimize their effects.
2.1.4. Memory	Sub-sub	28	The brain's ability to encode, store, retrieve, and process information when learning, carrying out a task, and retaining information.

Category	Category level	*f*	Operational definition
2.1.5. Information processing	Sub-sub	57	Similar to a computer, the ability to receive inputs, processes, and deliver an output of information. Information processing is broken down into three key components: 1. Sensory memory: Information taken in through the senses. 2. Working memory: Interesting information that should be remembered for a given task, such as studying for a test. 3. Long-term memory: Information that is stored and important enough to remember in the long term, such as learning to drive a car.
2.2. Academic achievement	Sub	202	The measurement of the learning process and capacity to acquire knowledge and skill mastery in the classroom setting, which is influenced by direct and indirect contextual factors across multiple environments.
2.2.1. Absenteeism and attendance	Sub-sub	57	Absenteeism is being absent too much from school or missing around 10% of the school year. Attendance is being present and on time for each school day. (Code included items that influence absenteeism and attendance, such as school suspension.)
2.2.2. Academic motivation	Sub-sub	24	The behaviors and endeavors that influence the success and efforts students put into their classes or obstacles faced.
2.2.3. Resource access	Sub-sub	128	The quality and quantity of supplemental resources, such as textbooks and nutrition items that influence the ability to perform academically negatively or positively.

Category	Category level	*f*	Operational definition
2.2.4. Graduation	Sub-sub	25	The ability to complete the school district and state course requirements to graduate high school or its equivalent.
2.2.5. College readiness	Sub-sub	15	The ability to demonstrate knowledge competencies from high school and translate the skills to complete freshman-level college courses.

Note. The levels of each category type correspond to the category levels of the coding frame:

1. Main category—The constructed concept

1.1. Subcategory—Used to create themes of the constructed concept

1.1.1. Sub-subcategory—Used to define themes and attributes of the concept

Exploring the collected data via MAXQDA required training and development of computer-assisted textual analysis software and using the program's key features to systematically organize data and prepare the data for further exploration (Kuckartz & Rädiker, 2019). For these reasons, the exploration and collection of the data took approximately 7 weeks. MAXQDA training took approximately 1 week and systematically organizing the data took approximately 6 weeks. MAXQDA training consisted of watching video tutorials and recorded workshops, reading the online manuals, and practicing with example projects accessible via a MAXQDA 2020 Analytics Pro paid subscription service for students writing a dissertation. The combination of each training method gave a synopsis of using the key features to properly code data and visually represent data in coding frames to increase validity and reliability via code correspondence with the built hierarchical coding system (Kuckartz & Rädiker, 2019).

The features used most frequently were highlighting, memos, and visual tools. Highlighting was used to make observations about data that were most relevant to the ideas of

undernutrition and academic performance, information representative of each categorical concept, and reputable programs or instruments that could help better understand the thematic relationship between undernutrition and academic performance (Kuckartz & Rädiker, 2019). The memo feature was used to explore the data collected by collecting notes, tabulating questions regarding data significance to the coding system, and expanding knowledge pertaining to the categorical concepts of the coding system (Kuckartz & Rädiker, 2019). The visual tools feature was used to create figures that visually represented the strength of relationships between the categories via the frequencies of co-occurrences between codes (Kuckartz Rädiker, 2019).

Data Organization and Preparation Process

The data preparation process involved analyzing each item of transcribed data collected and analyzed from peer-reviewed documents organized in MAXQDA. The initial step in the analysis process was to prepare data for the main coding, which requires a deep understanding of the coding frame and dividing the data into units of coding (Schreier, 2012). Segmentation of the data assisted with dividing the data into conceptualized units that fit into the coding frame (Schreier, 2012). The segmentation of data was done through memos and highlighting analysis of each document before tallying and assigning relevant data to the most relevant code (Schreier, 2012). Deciding on which data were relevant to the appropriate codes required multiple rounds of reading and reworking of the data to identify thematic relationships (Schreier, 2012). Each thematic relationship coded and examined was determined by the frequencies of co-occurrences in each peer-reviewed document.

Data Analysis and Results

Conducting a successful qualitative data analysis study required security of the data collected and analyzed (Neuendorf, 2017). All data were collected and stored in password-

protected storage systems via MAXQDA and Google Drive. MAXQDA was used to collect and analyze all data in the study, which made MAXQDA the best option to keep data stored safely through its user access management system. The personal MAXQDA license allows only one administrator user to operate the program across two computers that belong to the administrator user and does not allow the program to work simultaneously across the two computers. The administrator user is responsible for the password-protected database system and is the only user who can distribute any data stored in MAXQDA.

The initial separation of thematic relationship data collected was categorized according to the main categories and subcategories of the coding system. The analysis and results were grouped with the data exploration strategies used in MAXQDA and the research questions to gain clarity on the thematic relationship between undernutrition and academic performance (Kuckartz & Rädiker, 2019). The following sections give a detailed description of each category and subcategory as defined by memo analysis, highlighting analysis, and findings concerning each research question that sought to better understand the issues being investigated.

Main Category 1: Undernutrition

The thematic relationship between undernutrition and learning was examined through measurements of malnutrition, nutritional guidelines, and federal policy. From the studies examined, three key aspects and measurements of malnutrition emerged. The three key aspects and measurements of malnutrition that emerged were poor growth (underweight, stunting, and wasting), deficiencies in micronutrients, and overweight/obesity (Black et al., 2020; Rosemond et al., 2015; Suchdev et al., 2017).

Malnutrition was shown to have a negative reciprocal relationship with neurodevelopmental delays with psychosocial influences, such as poverty and environmental

factors (Suchdev et al., 2017). Children facing harsher environmental factors were found to suffer from hidden hunger, which led to a higher risk of micronutrient deficiencies and delays in neurodevelopment (Black et al., 2020). Micronutrient deficiencies in children further delayed development via the disruptions of self-regulatory functioning, which increased fatigue, distractions, and irritability, and decreased socioemotional development (Johnson & Markowitz, 2018a). Concerning academic performance, the findings suggested children facing malnutrition have an increased chance of neurocognitive delays, and children with neurocognitive delays are at increased risk of malnutrition (Suchdev et al., 2017). Dietary patterns high in micronutrient deficiencies were proven to lower math and English standardized test scores and lower academic achievement patterns of school-age children (Bleiweiss-Sande et al., 2019).

When considering nutritional guidelines, a comparison of the studies analyzed determined key differences between undernourished children and well-nourished children. Undernourished children with food and energy hardships are more likely to face higher levels of material hardship, emotional dysregulation, poorer caregiver health, and food insecurity (Fernandez et al., 2018). A study by Schultz and Thorlton (2019) confirmed federal laws, such as the Fruit and Vegetable Access for Children Act allow federally funded programs to substitute fresh fruits and vegetables with canned, frozen, or pureed versions, which lower fresh fruit and vegetable intake during school. Verbal fluency scores increased when children consumed a low-glycemic breakfast (Adolphus et al., 2016), and well-nourished children who fasted had better language scores when compared to undernourished children (Adolphus et al., 2016). Between undernourished and well-nourished children, self-efficacy and exposure to positive health messages via collaborations across multiple sectors proved to be a determining factor in increasing positive dietary behaviors in students (Rosemond et al., 2015).

Subcategory 2: Food Insecurity. After the analysis of multiple studies, food insecurity was determined to be related to dietary patterns and academic outcomes. As food insecurity deepened, the risk for cognitive and academic performance delays increased (Johnson & Markowitz, 2018b). The influence of food insecurity on academic performance was most evident during early childhood and key stages of child development. During early childhood, food insecurity was found to be linked to lower reading, math, and writing scores alongside decreased self-control (Grineski et al., 2018). Student food security could worsen or improve as a student got older. If food insecurity worsened during the stages of child development as a student aged, the risk for learning disabilities, episodic cognitive delays, and negative association with achievement scores increased (Burke et al., 2016; Grineski et al., 2018; Huang et al., 2018)

Main Category 2: Academic Performance

Academic performance and nutrition are closely tied together via food access, income, and school food policy. A study by Schultz and Thorlton (2019) indicated a positive relationship between healthy nutrition and academic performance and found increased academic performance when students were provided a healthy breakfast and lunch on campus. When income was a variable, studies concluded lower income equated to lower IQ scores and academic performance (Suchdev et al., 2017), higher test scores reflected higher social status that included economic prestige and parental education (Berlin et al., 2017), and increased SES predicted greater math gains for students in the first 3 years of high school (Bleiweiss-Sande et al., 2019). In terms of food policy, the wording was used to change the meaning of nutritional offerings by eliminating key words, such as *fresh* from school food policies to include substitutes with added sugars, which has the potential to harm student academic performance (Schultz & Thorlton, 2019).

Subcategory 1: Cognitive Functioning. The foundational strength of cognitive

functioning was found to be connected to early development, cognitive flexibility, income, and nutritional intake. Multiple studies analyzed revealed rapid brain development occurring in the first 3 years of life influences kindergarten readiness and future academic achievement and is dependent on a nutrient-rich environment to increase brain functioning (Cupples Cooper, 2019; Kull & Coley, 2015). Increased brain functioning was found to be linked to higher levels of cognitive functioning, which increases cognitive flexibility and academic performance (Willoughby et al., 2019). When placed in low-resource settings, students are more at risk for developmental delays (Suchdev et al., 2017), see effort as futile as effort keeps individuals in low-resource settings (Heberle & Carter, 2015), and have an increased chance to be negatively influenced by food insecurity that leads to slower growth of reading abilities and uncertainty of outcomes (Gee, 2018). To counteract negative brain maturation, nutritional intervention is imperative to shift the early childhood diet from empty calories to a diet supporting brain development (Cupples Cooper, 2019), increase collaboration between parent and student, and provide school intervention to support nutrition and cognitive development (Black et al., 2020).

Subcategory 2: Academic Achievement. A relationship between academic achievement and undernutrition has been established via food insecurity and food consumption patterns. Studies examined proved academic underachievement is linked to low consumption of fruits, vegetables, and breakfast intake (Schultz & Thorlton, 2019), which demonstrated a negative association between junk food consumption, academic achievement, and socioeconomic factors (Bleiweiss-Sande et al., 2019). To counteract the effect of inadequate nutrition intake, breakfast provides a consistent way to offer a nutritious diet, which can decrease nutrient-deficit foods effecting a range of students, including students with disabilities, students with Individualized Education Plans (IEPs), and English language learners (Ptomey et al., 2016; Suchdev et al.,

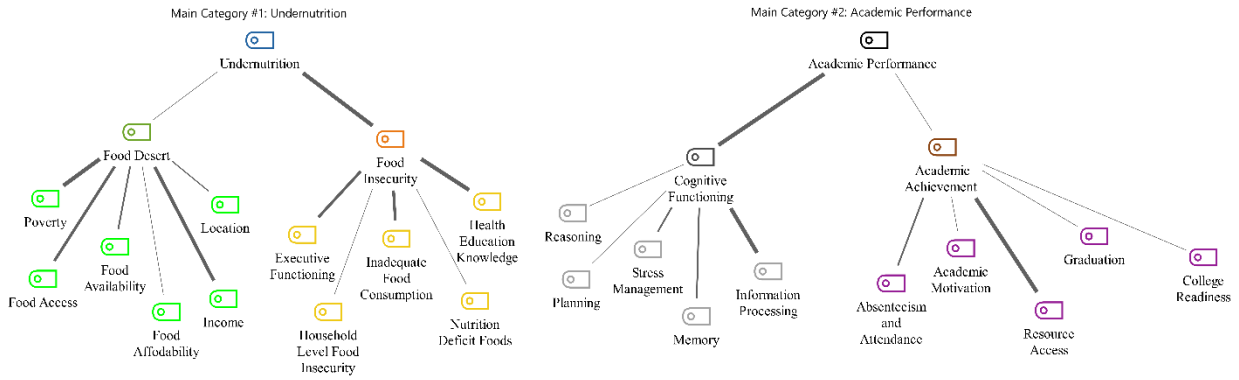
2017). Nutrient-rich breakfast consumption in elementary school set the foundation for secondary students' nutritional patterns for improved standardized test performance (Ptomey et al., 2016), which can decrease the likelihood of low school engagement, BMI, and health problems (Carey et al., 2015).

Categorical Analysis: Hierarchical Co-Occurrence

The hierarchical code model (see Figure 1) provides a visual representation of the code system used in the data collection and analysis process. Each main category is structured with its subcategories and sub-subcategories to show the relationship between coded segments in the data analyzed. The thickness of each line represents the code frequencies and co-occurrences in the data analyzed; the thicker the line connecting each category, the higher the code frequency of co-occurrences and the stronger the relationship was in the data analyzed.

Figure 1

Hierarchy Code System with Code Occurrences



Note. Line width reflects frequency and strength of relationships between code categories.

Main Category 1: Undernutrition

The hierarchical code frequencies of undernutrition represent two different strengths of the relationship between the subcategories of food desert and food insecurity. In the data analyzed, undernutrition displayed a stronger relationship to food insecurity than to food desert.

The subcategory of food desert was more strongly connected to and associated with the sub-subcategories of poverty, income, and food access. The subcategory of food insecurity had the strongest relationship with health education knowledge and strong relationships with executive functioning and inadequate food consumption.

The differences in the strength of the relationship between subcategories could exist because of resource access. Food desert was more related to location and poverty as a result of residing in low-resource settings, while food insecurity could occur across any environment, location, and income gradient and was more influenced by health education knowledge. While a student of higher SES is less likely to face food insecurity or lack access to resources, there is still an increased chance health education knowledge was lacking and inadequate food consumption occurred in the household, school setting, and neighborhood environments near home and school.

Undernutrition in the form of food consumption patterns via health education knowledge and nutrition-deficit foods effected students of low- and high-resource settings, specifically in the school environment, which granted access to approximately the same level of competitive foods on or near campus. In food desert environments, food access and food availability were linked to federal food assistance programs, such as WIC, SNAP, NSLPs, and SBPs, which were available to families who were at or below the poverty line. Families who lived in food deserts had increased odds of becoming food insecure due to living in lower resource settings and having lower SES.

Main Category 2: Academic Performance

The hierarchical code frequencies of academic performance represented two different strengths of the relationship between the subcategories cognitive functioning and academic

achievement. The data analyzed concluded cognitive functioning had a stronger relationship to academic performance than did academic achievement. In the cognitive functioning category, the information processing sub-subcategory had the strongest relationship, the memory sub-subcategory had the stronger relationship, and the stress management, reasoning, and planning sub-subcategories had the weaker relationships to cognitive functioning. The academic achievement subcategory had the strongest relationship with resource access, a stronger relationship with absenteeism and attendance, and a weaker relationship with academic motivation, graduation, and college readiness.

The differences in the strength of the relationship between cognitive functioning and academic achievement were potentially related to the process of child development. Cognitive functioning was closely tied to brain development, cognitive flexibility, and executive functioning, which had a positive relationship with school readiness, behaviors conducive to academic outcomes, and the ability to encode and decode information. Academic achievement was more closely related to child development via resource access. Resource access was responsible for making items more attainable in the school environment, such as BIC models that provided nutrient-rich breakfasts to help students maintain alertness across an entire school day and equipping schools with the health expert knowledge of a school nurse. Overall, enhancing brain development via cognitive functioning improved academic performance via information gathering and processing, while academic achievement provided resource access intervention that helped students prepare for the school day.

Thematic Analysis: Undernutrition and Academic Performance

Looking deeper into the relationship between undernutrition and academic performance required a thematic analysis of data via the co-occurrences in studies examined. Each co-

occurrence of the subcategories and respective sub-subcategories was analyzed to understand the strength of the relationship between each category and determine how each category was dispersed in the data to find patterns. The strength of each co-occurrence was measured by the line thickness, which correlated to a combination of the categorical frequencies, how often categories occurred together in each study, and the influence of each categorical relationship to undernutrition and academic performance. The thicker the line (see Figure 2), the stronger the relationship and co-occurrences in literature. If undernutrition and academic performance categorical lines were both connected to subcategories and sub-subcategories, then a relationship existed. When a subcategory or sub-subcategory was connected to only academic performance or undernutrition, no relationship was found to exist in the subcategory or sub-subcategory.

Figure 2

Thematic Relationship Between Undernutrition and Academic Performance

Note. Line width reflects frequency and strength of relationships between code categories.

Upon analysis, stronger and weaker relationships were established between undernutrition and academic performance and the corresponding subcategories and sub-subcategories. The strongest co-occurrences were seen in the subcategories cognitive functioning, inadequate food consumption, and health education knowledge. Strong co-occurrences were seen in the subcategories food insecurity and academic achievement and the sub-subcategories poverty, income, absenteeism and attendance, and household-level food insecurity.

Cognitive Functioning

Undernutrition and academic performance showed a direct relationship with student nutrition and learning. A student's ability to learn was influenced by undernutrition and academic performance. When students were undernourished, brain development and academic performance suffered from early childhood into adolescence unless the appropriate intervention took place. On the other hand, lower grades were associated with lower cognitive maturation when delays in brain development and exposure to unhealthy learning environments occurred at school and in households. Diet and learning were linked to weight, which correlated stunting and obesity to decreased cognitive development and academic performance. Starting in early childhood, the better a student's diet was, the greater the academic performance was as the student approached adolescence.

Inadequate Food Consumption

Inadequate food consumption showed a direct relationship between undernutrition and academic performance. Inadequate food consumption behavior was a by-product attributed to decreased fruit and vegetable intake and the overconsumption of energy-dense foods. When students had inadequate food consumption, the students were at increased risk for health

problems, which is linked to lower academic performance. As health declines, academic performance declines. Resource settings played a vital role in inadequate food consumption. Low-resource settings were more prone to have inadequate food consumption because of established eating habits. Learning inadequate eating habits in early childhood transitioned to inadequate eating habits and health complications into adolescence, which decreased academic performance for students over an extended period.

Health Education Knowledge

Health education knowledge showed a direct relationship to undernutrition and academic performance. Academic performance success was correlated with student nutritional decision making. When children were able to eat a nutritious breakfast daily, academic performance across math, language, and reading increased. Similar to undernutrition, parental factors played into a student's nutritional knowledge and academic performance. A parent who lacked health education knowledge and had lower educational attainment translated behaviors and norms to the student, which led to lower academic performance. Health education knowledge reflected behaviors and attitudes that followed the level of academic performance and nutritional patterns approaching adolescence.

Poverty

Poverty displayed a direct relationship between undernutrition and academic performance. Undernutrition and academic performance were both negatively connected to poverty. Children facing poverty had an increased chance to have a nutrient-deficient diet, most likely resided in food deserts, and faced low-resource settings, while academic performance suffered as SES decreased. Both undernutrition and academic performance saw improvement when resource interventions took place. As food resource intervention improved, academic

performance improved for students in low-resource settings.

Income

Gaps in undernutrition and academic performance showed a direct relationship to income. As SES increased, academic performance in school increased. A decrease in SES led to a decrease in academic performance. The SES levels were a development from parental education attainment and earnings, which showed a direct relationship to both undernutrition and academic performance. As parental educational attainment and income earnings decreased, adequate nutrition and academic performance decreased due to lack of access to quality resources for student success in learning.

Food Insecurity

Food insecurity revealed a direct relationship between undernutrition and academic performance. When students transitioned out of food insecurity, both nutrition and academic performance improved. As food insecurity increased and became more persistent, both student nutrition and academic performance suffered due to hunger. When transitioning in and out of food insecurity, the inconsistencies of being stable and unstable led to inconsistencies in diet and learning, which reflected specific behaviors tied to poor educational outcomes.

Academic Achievement

Undernutrition and academic performance displayed a direct relationship to academic achievement. Academic achievement resulted from the ability to exhibit appropriate learning behaviors, lack of hunger, and the ability to focus in the classroom. With undernutrition, students were not able to focus in class when adequate nutrition was not consumed before learning, while academic performance could not be maximized without proper nutrient intake during the school day. If proper nutrition occurred, then increases in academic achievement occurred, which meant

behaviors and hunger were regulated appropriately to focus on positive academic outcomes.

Absenteeism and Attendance

Absenteeism and attendance showed a direct relationship to undernutrition and academic performance. Student attendance was linked to fruit and vegetable intake and academic performance. As the consumption of fruits and vegetables increased, so did academic performance. A decrease in fruit and vegetable intake led to inadequate food consumption, which revolved around the pattern of decreased academic performance. Children who were often absent from school had health problems and decreased attendance to take care of health problems, which decreased academic motivation and performance. As nutrition decreased, the higher probability of health problems followed, which coincided with decreased academic performance due to the disruption of the natural routine of school.

Household-Level Food Insecurity

Household-level food insecurity greatly affected students with low resources and low SES. The direct relationship between undernutrition and academic performance can be seen in the associations between family dynamics and resource access. Being in a food-insecure home means facing nutritional and socioemotional development deficiencies. When faced with household food insecurity, nutrition decreased alongside academic performance. The inability of a family to secure resources led to decreased nutrition and academic performance. When nutrition suffers because of household food insecurity, academic performance decreased due to adversities faced by students.

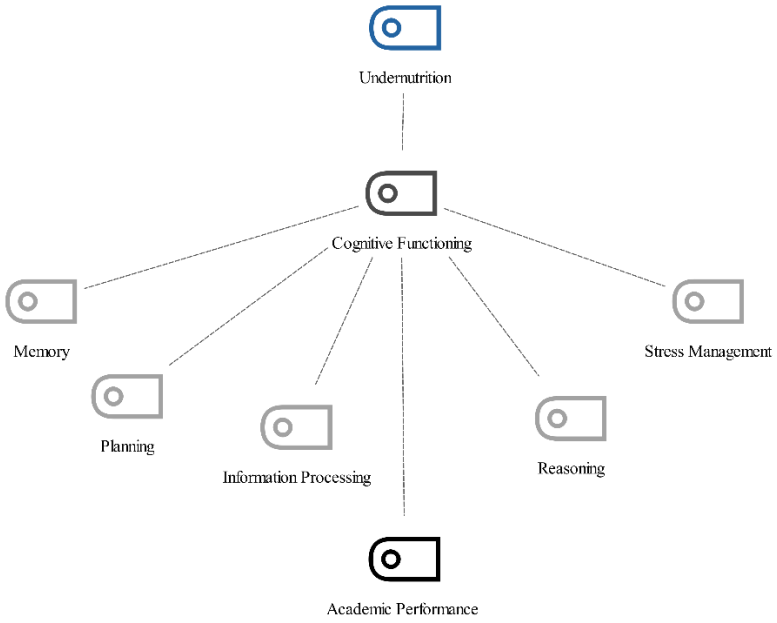
Findings in Relationship to Research Question 1

Cognitive Functioning was related to the main categories, undernutrition and academic performance. The cognitive functioning subcategory and the corresponding sub-subcategories,

memory, planning, information processing, reasoning, and stress management displayed a direct relationship to undernutrition and academic performance. Each relationship established from the categories listed illustrated how undernutrition affected cognitive functioning via the socioemotional aspects, dietary consumption patterns, SES, and self-efficacy. The connected lines displayed the relationship of each category via the co-occurrences displayed in the literature and how often the codes occurred together.

Figure 3

The Effect of Undernutrition on Cognitive Functioning



Note. Line width reflects frequency and strength of relationships between code categories.

Learning was a by-product of brain development gained via cognitive functioning in early childhood. In early child development, the rapid development of the brain proved to be crucial to school readiness, positive academic outcomes, behavior, and increased brain function at the entry of kindergarten. Students who possessed greater brain functioning in early childhood

were more likely to have greater cognitive flexibility, which increased the capacity to learn and acquire new information and knowledge as students approached adolescence. Delays in cognitive functioning occurred when children were malnourished in early childhood, had an inadequate diet rich in energy-dense foods and lower fruit and vegetable intake, and were overweight or obese. Student foundational cognitive development and diet were influenced by the health education knowledge learned in the home, which created unhealthy eating patterns for families with economic inequalities due to poverty and induced lower levels of self-efficacy belief. When self-efficacy belief was lowered, addressing or inducing behavior change was more difficult, which hurt the ability to reinforce new knowledge, nutritional practice habits, and behavioral changes in nutritional attitudes.

Reasoning ability was proven to be essential for positive cognitive development. In terms of positive cognitive development, reasoning was determined to a predictor in math and reading achievement, drawing inferences, and understanding relations between stimuli. Differences in reasoning were associated with the consistencies and inconsistencies of undernutrition and academic achievement. When the availability of fruits and vegetables increased in a student's school environment, student knowledge and reasoning abilities improved, which created positive growth in student problem solving, cognitive development, and academic achievement. On the other hand, children who had lower math and reading achievement ability were linked to energy-dense foods, which was connected to negative growth in student cognitive functioning and academic achievement.

Planning was a foundational skill to develop positive cognitive functioning outcomes in the classroom. Cognitive flexibility and self-efficacy were found to be key facilitators in the planning ability in students, which were heaviliy influenced by a student's socioeconomic

disadvantage. The more socioeconomic disadvantaged a student was, the greater the risk for undernutrition, decreased cognitive flexibility, and lowered self-efficacy. Students being faced with undernutrition had a lowered chance for positive academic outcomes, which decreased the likelihood to pick the necessary actions to accomplish a task and maintain positive expectations to improve academic performance in the classroom.

Stress management ability displayed a direct relationship with undernutrition and cognitive functioning. Students who faced moderate nutritional deficiencies during early childhood were more likely to deal with characterisitcs of poor nutrition and hunger during class. Being faced with hunger via nutritional deficiencies led to increased fatigue, irritability, and distraction, which made it more difficult to maintain a healthy socioemotional state during learning. Disruptions to a student's socioemotional state was found to decrease the ability to focus, maintain behaviors conducive to positive academic outcomes, lower self-efficacy beliefs, and decrease cognitive stimulation. Students were proven to manage stress better when healthy snacks were given during class, which helped decrease hunger and consumption of energy-dense foods while promoting positive cognitive growth.

Undernutrition in students displayed a negative impact on memory. An initial decline in memory was discovered when children skipped breakfast. Skipping breakfast was lnked to decreased memory, alertness, and attention to tasks, which made it harder to process and retain information during class. Students suffering from food insecurity were at a greater disadvantage than food secure counterparts. As food insecurity deepened, working memory decreased, which lowered cognitive functioning and students' grades. Counteracting the effects of undernutrition on working memory required solutions to maintain well-nourished students by making healthier breakfast and snack options more readily available on campus with initiatives such as breakfast

in the classroom.

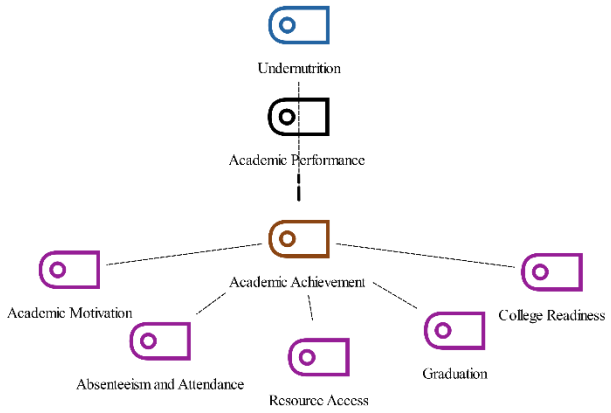
Information processing skills were more susceptible to the the negative effects of undernutrition, which harmed cognitive functioning. A student suffering from undernutrition was more likely to have poorer nutrition and information processing skills, which was linked to a lower attention span, school readiness, and decreased memory capacity. When faced with hunger, the ability to process and recall information suffered, which decreased the cognitive functioning capactity during learning. To create optimal information processing, a healthy student diet was proven to supply the necessary energy to maintain focus, which prevented the impairment of cognitive functioning via knowledge retrieved and processed from the learning environment.

Findings in Relationship to Research Question 2

Academic achievement was closely related to the main categories, undernutrition and academic performance. The sub-subcategories academic motivation, absenteeism and attendance, resource access, graduation, and college readiness showed a strong relationship to academic performance. Each relationship established from the categories listed displayed nutrition patterns, knowledge, behaviors, and SES had a clear association with academic achievement of K-12 students. The thicker line which connects academic achievement and academic performance, displays the relationship via the co-occurrences displayed in the literature and how often the codes occurred together.

Figure 4

The Influence of Undernution on Academic Achievement



Note. Line width reflects frequency and strength of relationships between code categories.

Academic motivation saw a decline when students faced undernutrition. The influence of undernutrition on academic motivation adversely affected readiness to learn, engagement, and self-efficacy ability when students were unable to maintain a nutrient rich diet. Students were more likely to be academically motivated when well nourished and within a safe classroom environment. Well nourished students who felt safe successfully engaged in the learning environment with the appropriate corresponding academic behaviors, which led to improved grades, impulse control, and academic achievement.

Absenteeism and attendance was determined to be a predictor of academic achievement. The more a student was absent from school, the more likely academic achievement would decrease. Students who were chronically absent from school had an association to undernutrition and decreased academic achievement. When absent from school, students who suffered from food insecurity were more likely to miss breakfast and school meals, which was shown to decrease positive educational outcomes, test scores, and attendance at school. Infrequent attendance to school affects a student's socioemotional well-being, which was associated with

practicing riskier behaviors, increased tardiness, and lower grades. Academic achievement further decreased if absences were unexcused and occurred during transitioning periods, such as puberty and adolescence.

Accessible resources were detrimental to the nutritional and academic well being of students because a large amount of the day is spent in classrooms and in on-campus programs. Evidence analyzed from studies revealed resource access was linked to SES and the relationship between undernutrition and academic achievement. Undernourished students from lower SES backgrounds faced a resource disadvantage when compared to higher SES students, which created a pathway for nutrition and achievement gaps to exist between poor and nonpoor students. The established resource disadvantage was responsible for creating nutritional deficiencies on lower SES campuses, which led to a decrease in available fresh food options and fruit and vegetable intake. Schools which had higher SES were linked to having access to healthier food items and snacks on campus while schools with lower SES had greater access to unhealthier food items and snacks. The differences in resource access was responsible for inadequate food consumption patterns, which were linked to lower math and reading achievement and disciplinary issues in school.

The influence of undernutrition on graduation can be seen as early as kindergarten and as late as adolescence. Students who suffered from food insecurity in early childhood exhibited signs of short term or long term academic performance and achievement delays across transitory periods until high school graduation. Within early childhood education, undernourished students were at an increased risk to not read proficiently by the third grade, which greatly decreased the odds of graduating. During adolescence, children with a history of obesity and undernutrition were linked to decreased brain development, lower math and reading achievement, and

increased odds of dropping out. Obesity caused by the overconsumption of energy-dense foods was associated with dropping out of high school, which was determined to be even higher based on SES, length of obesity and ethnic groups other than Whites.

The path to college readiness was dependent upon academic achievement, physical health, and socioemotional development. Students were at a disadvantage to become college ready when obesity caused poor academic outcomes in early childhood and high school, SES had a direct link to student health disparities, and undernutrition influenced negative executive functioning behaviors. The inability to counteract undernutrition in student success was consistently linked to negative academic performance and achievement across multiple studies, which emphasized health was a key component to college readiness and the increased probability of graduating from college.

Reliability and Validity

The reliability of the data collection and analysis method was determined by the consistency of the coding process (Schreier, 2012). Consistency to the methodology of the data collection and analysis assisted in improving the credibility and dependability of the data examined in the coding frame and the acceptability of the analyzed data (Schreier, 2012). Having multiple coders would have been ideal to compare the same coding frame and increase intersubjectivity from the results, but only one coder conducted the analysis. With one coder, MAXQDA served as a CATA software that was vital for evaluating the strength of the coding frame. To help maintain reliability while analyzing large amounts of data, the inclusion and exclusion criteria were maintained. Analyzing 80 pieces of review literature while following inclusion and exclusion criteria required rereading, reworking, removing, and reselecting new documents to be analyzed in MAXQDA. The peer-reviewed literature was excluded when the

article did not find meaningful thematic connections between undernutrition and academic performance, the article was published before 2015, pertained to a geographical region outside the United States, involved college students and adults, or the full text of the literature was not available.

To manage the consistency and credibility of the findings, MAXQDA training was completed, and a pilot study was conducted. MAXQDA training was used to learn how to use the key features, manage the frequency of the coding, and ensure the concepts were operational and unidimensional (Neuendorf, 2017). Once training was completed, a sample coding system was used to practice and learn how to effectively use MAXQDA to manage analyzed data. Before analyzing the finalized document list, pilot testing was done using one fourth of the initial peer-reviewed literature across all four subcategories (food desert, food insecurity, cognitive functioning, and academic achievement). The pilot testing was imperative to ensure the coding system categorical definitions did not overlap, find any problems early that may be harmful to the reliability and validity of the results of the study, and discover any useful descriptive data (Schreier, 2012). The pilot testing provided variability in the data by analyzing different concepts across each of the four subcategories, which increased the reliability of each category being adequately represented (Schreier, 2012).

Chapter Summary

The purpose of the QCA study was to explore peer-reviewed medical journals to determine the influence undernutrition has on the cognitive ability of students and the ability to learn. To ensure credibility, data collection for the QCA study consisted of finding articles from MEDLINE Complete and CINAHL Complete databases. The computer-assisted textual analysis software MAXQDA was responsible for the organization of data collected, serving as the access

management system, and exploring the thematic analysis in the established code system.

The findings from the research questions displayed a direct influence between undernutrition and student learning across multiple environments. Each set of findings was established by analyzing the strength of relationships between the co-occurrences found in the peer-reviewed literature. Findings from Research Question 1 showed cognitive functioning was closely related to undernutrition and academic performance when brain development was hampered by inadequate food consumption and low-resource settings. Findings from Research Question 2 illustrated undernutrition and academic achievement were closely related when the underconsumption of fruits and vegetables led to decreased academic outcomes in math, language, and reading. The discussion and conclusion of the findings are examined further in Chapter 5 alongside implications, limitations, and recommendations for further research.

Chapter 5: Discussion and Conclusion

An exploration of the relationship between undernutrition and academic performance was necessary to gain a deeper understanding of nutrition and learning. Investigating the relationship between undernutrition and academic performance granted a deeper understanding of the role of nutrition in cognitive development from early childhood to adolescence. The purpose of the QCA study was to analyze peer-reviewed medical journals to reveal the influence food has on a student's cognitive ability to learn. The results of the QCA study could create awareness and knowledge of the factors linked to undernutrition and student learning as students approach high school graduation. The following research questions guided the study:

Research Question 1: According to research studies conducted between 2014 and 2019, how does undernutrition affect K–12 students' cognitive functioning in classrooms?

Research Question 2: According to research studies conducted between 2014 and 2019, how does undernutrition influence K–12 students' academic achievement?

The review of the relevant literature uncovered undernutrition's negative effect on cognitive development via inadequate food consumption, negative health behaviors, and declining physical health (Mmari et al., 2019). The theoretical framework supported the duality of social structure, and food consumption patterns were linked to the inequalities in an environment and the behavioral regulation capabilities to overcome societal barriers to improve nutritional and academic outcomes (McCormack et al., 2017; Sadler et al., 2016; Torkan et al., 2018). The findings, interpretations, conclusions, limitations, recommendations, and implications for leadership were established from the data presented in Chapter 4. A synthesis of the information from the data served as a tool to advance knowledge on undernutrition and academic performance and reflect on the conclusive findings from the research questions.

Findings, Interpretations, Conclusions

The analysis of the research questions of the QCA study revealed and confirmed key associations between undernutrition and academic performance. The established coding frame served as the backbone for unidimensional categories, subcategories, and sub-subcategories (see Appendix D) that were used to analyze peer-reviewed literature and synthesize thematic findings between undernutrition and academic performance co-occurrences. Student nutrition and the ability to perform academically were presented in over half (approximately 67%) of the 80 peer-reviewed articles analyzed. The findings confirmed student ability and academic success were connected with undernutrition and socioeconomic factors, such as poverty via low-resource settings, which were linked to lowered brain development in children, scores on cognitive assessments, school readiness skills, and graduation rates (Hair et al., 2015; Johnson & Markowitz, 2018a; Lanza & Huang, 2015; Larson et al., 2015).

The QCA study was designed to analyze peer-reviewed literature from experts to explore key findings to better understand the undernutrition and academic performance of K–12 students. Key findings emerged from the study that were explored in the context of the theoretical framework, literature review, and results. The findings from the QCA study established the effect of undernutrition on cognitive functioning, the influence of undernutrition on academic achievement, and nutrition's role in K–12 student learning.

Findings in the Context of Theoretical Framework

The theoretical framework of the study utilized the structuration theory, SCT, and social–ecological theory to validate the relationship between food and K–12 learning. Each theory offered a unique lens to explore the problem and the purpose of the study in the context of the study's findings. The investigation of the theoretical framework could further prove the

foundation of the research and the alignment of the key concepts in the study's methodology to construct new knowledge on the thematic relationship between undernutrition and academic performance.

Structuration Theory

The structuration theory was directly connected to the research design and coding. By serving as an intersection of knowledge for the duality of society via societal and food consumption behaviors, the issues related to undernutrition, social realities, and socioeconomic factors of K–12 students were organized and analyzed (Cleave et al., 2016; Collins & Stockton, 2018). To prevent misinterpretation of the data, the structuration theory provided a way to connect data to the coding system of the main categories, undernutrition and academic performance. With emphasis on the social structures, the structuration theory aided to embed societal factors, such as socioeconomic factors into the coding of the study. Exploring the data served as a method to illuminate the thematic relationship between undernutrition and academic performance via the analysis of peer-reviewed literature regarding social structures and behaviors associated with food consumption patterns (Canary & Tarin, 2017).

The duality of social structure in the structuration theory showed a direct connection to the thematic relationship between undernutrition and academic performance. The structuration theory proved societal behaviors, norms, and power suggest behaviors and actions are aligned with a person's social reality (Canary & Tarin, 2017). Concerning the findings from the research, undernutrition was a by-product of one's social reality via SES and vulnerability to inequalities created in low-resource environments unable to effect change (Canary & Tarin, 2017; Sadler et al., 2015). When faced with undernutrition, students are more readily exposed to nutrient deficiencies and socioeconomic household stressors that can lead to delays in cognitive and

socioemotional development, decreases in positive academic outcomes, and health disparities (Jirout et al., 2019; Johnson & Markowitz, 2018a).

Social Cognitive Theory

The SCT informed the coding of the study by extending the existing knowledge on the role of executive functioning and human behavior. The complexities of the SCT strengthened the unidimensionality of the categories created by highlighting the role of executive functioning, human behavior, environmental factors, and self-efficacy in nutritional choice and outcome expectations (Hall, Chai, & Albrecht, 2015). The SCT further shifted the direction of the coding frame to find existing peer-reviewed literature that could reveal the influence food has on a student's cognitive ability to learn. By developing a coding system that supported and informed data analyzed via the interlocking of concepts, the SCT was able to explore the thematic relationship between undernutrition and academic performance by validating the issuesthrough peer-reviewed literature (Collins & Stockton, 2018).

The validation of executive functioning behaviors being influenced by personal, behavioral, and environmental factors could be seen in the findings from the study (Hall et al., 2015). The thematic relationship between undernutrition and academic performance validated executive functioning behaviors were associated with a combination of health education knowledge, self-efficacy, and resource access. Higher levels of student self-efficacy were associated with higher positive outcomes or outcome expectations, while lower levels of self-efficacy led to higher negative outcomes or outcome expectations, which influenced the riskier behaviors and lower levels of self-regulation (Larsen et al., 2015), Families in low-resource environments were more likely live in segregated poor communities with low levels of economic privilege, experience housing mobility, and reside in crowded housing facing intergenerational

poverty that heavily decreased access to quality resources conducive to healthy child development (Duncan et al., 2017; Fowler et al., 2015; Heberle & Carter, 2015).

Social–Ecological Theory

The social–ecological theory examines the natural factors influencing health from four systematic levels that are by-products of the individual and the environments (Safan et al., 2018). The multileveled nature of the social–ecological theory guided the coding frame by organizing and analyzing data from multiple surroundings and environments of K–12 students that may influence nutrition and learning. The theory directly influenced coding by understanding how influences in the environment may influence the nutrition and learning of K–12 students via individual behavior, social environment, physical environment, and macrolevel environment (Kilanowski, 2017). The strong influences of K–12 students, whether negative or positive, provided insight to the thematic relationship between undernutrition and academic performance by connecting data to modifiable changes in the individual and across environments (Schölmerich & Kawachi, 2016).

Findings in the Context of Literature

The connections between the findings in the context of the literature review and the results of the data confirmed and validated the thematic relationship between undernutrition and academic performance. In context of the literature review, the main categories of the coding frame were assessed against the literature review. The confirmed claims found in the literature review are outlined in this section. The findings from the thematic relationship between undernutrition and academic performance were identified, which assisted with extending knowledge displayed in the literature review. The thematic connections direct to the literature review and study findings reaffirmed undernutrition was linked to a K–12 student's ability to

perform academically. Analyzing academic performance in the literature review and findings from the study data displayed a connection to a K–12 student's ability to perform academically.

Undernutrition

In the context of the literature, undernutrition was largely a by-product of SES and level of resource access. A student of lower SES was more likely to face food insecurity due to living in poverty and lacking sufficient income to improve social standing (O'Dare Wilson & Radey, 2016). Poverty and lower income were related to lower educational attainment, decreased fruit and vegetable consumption, and increased financial barriers to improve quality of life (Hager et al., 2017; O'Dare Wilson & Radey, 2016). The findings from the study revealed families of lower SES may be stuck in the intergenerational cyclical patterns of poverty, which can be associated with environmental toxins, neighborhoods with high rates of risk factors, and a natural division of neighborhoods based on level of economic privilege (Barr, 2015; Heberle & Carter, 2015; Rausch et al., 2015). The literature review indicated communities of poverty were rife with food deserts, which limited accessibility to affordable and healthy food options, excluded societal opportunities for self-improvement, and increased access to obesogenic food environments (Kral, 2018; Kumanyika, 2019; USDA, 2019). The findings from the study supported children facing food insufficiencies are more likely to suffer more from hidden hunger and may develop coping mechanisms to deal with daily hunger (Black et al., 2020; Gee, 2018).

The findings from the study validated undernutrition occurred when students faced income instability, which limited access to educational resources and enrichment opportunities, created poorer health via adverse childhood experiences, and created episodic bouts with food insecurity (Fowler et al., 2015; Johnson & Markowitz, 2018b; McDonough et al., 2019). The literature reviewed in Chapter 2 displayed food insecurity can have negative effects on students'

health educational outcomes from infancy to adolescence when families face income uncertainty and inflexible income associated with basic needs of survival (Miller et al., 2019; Nettle et al., 2017). Cohesively, the literature review and study findings were able to reinforce SES influenced uncertainty among families and the possibility of establishing a survival lifestyle, which induced unpredictable dietary behaviors, the inflexibility of financial resources, and lifestyle choices detrimental to healthy child development (Loibl et al., 2017; Miller et al., 2019; Robson et al., 2017). The findings from the study revealed the school environment was an excellent catalyst for increased fruit and vegetable intake, positive health behavior changes, and parental involvement for guidance on nutrition behavior (Murimi et al., 2018; Rausch et al., 2015).

Academic Performance

The context of the literature reaffirmed academic performance was attributed to cognitive functioning, stressors influencing academic achievement, and executive functioning. The literature reviewed in Chapter 2 indicated cognitive development was linked to school readiness, cognitive stimulation, and long-term academic achievement (Bosch & Duch, 2017; Egger et al., 2019). Declines in the cognitive development process were traced to school readiness via cognitive stimulation, diet in the student's home environment, and whether the student faced food insecurity (Jirout et al., 2019). When a student experienced food insecurity during early childhood, school readiness and cognitive flexibility suffered, which led to socioemotional behavioral issues, a reduction in test scores, and increased health adversities (Bosch & Duch, 2017; Johnson & Markowitz, 2018b; Srivastav et al., 2017). The findings from the study validated the greater a student's cognitive flexibility, the greater the potential for academic achievement in math and reading (Willoughby et al., 2019). When living in a low-resource setting or faced with food insecurity, brain development was determined to be less mature in

poor or near-poor students compared to middle-class and higher income children (Suchdev et al., 2017). In addition, cognitive development suffered when parents were in disadvantaged situations and suffered from food insecurity (Beauregard et al., 2018).

The Effect of Undernutrition on Cognitive Functioning. The peer-reviewed literature validated the thematic connection between undernutrition and cognitive functioning. The literature review revealed cognitive functioning was affected by students' accessibility to different food environments (Kral, 2018). Students in lower socioeconomic settings had greater access to food environments with unhealthy food options at home or in the neighborhood, which developed the cyclical patterns of unhealthy eating, such as decreased fruit and vegetable intake and increased energy-dense food intake (Kral, 2018; Rasmusson et al., 2019). An unhealthy diet of energy-dense foods was counterproductive to cognitive functioning and was linked to reduced test scores, hyperactivity, and decreased socioemotional well-being (Johnson & Markowitz, 2018a).

Early nutrition and cognitive intervention were common themes that emerged from the literature review and findings from the study. The results of the study were able to extend knowledge of the association between decreased cognitive functioning and decreased nutritional intake throughout a student's K–12 schooling. The study's findings indicated when children were faced with low-resource settings or disadvantaged environments, the potential for developmental delays in cognitive functioning increased (Suchdev et al., 2017). Analysis of the peer-reviewed literature reaffirmed inadequate nutrition could harm cognitive development when environmental factors, such as living in poverty are not conducive to healthy child development (Fowler et al., 2015). Both the literature review and the study's findings concluded rapid brain development occurred early in childhood and was enhanced when a student had a nutrient-rich

diet with decreased junk food consumption (Cupples Cooper, 2019; Misuraca et al., 2017).

The Influence of Undernutrition on Academic Achievement. The findings from the study concluded students from food-insecure households had lower levels of academic achievement (Ptomey et al., 2016). In addition, skipping breakfast proved to be detrimental to academic achievement, considering students were more likely to consume unhealthy snacks and less likely to eat the recommended number of fruits and vegetables (Ptomey et al., 2016). The literature reviewed in Chapter 2 substantiated this finding. The literature review reasserted students skipping meals, especially breakfast, potentially led to poorer verbal performance, IQ scores, and unhealthy diets (Misuraca et al., 2017). Alongside skipping meals, the literature review confirmed children who consumed a Western diet high in nutrient deficiencies may experience impaired cognition and brain development (Tandon et al., 2016). The findings from the study confirmed transitioning out of food insecurity led to greater gains in academic achievement, whereas deepening food insecurity or transitioning into food insecurity led to lowered interpersonal skills, less self-control, and more externalizing behaviors (Gee, 2018).

Recognizing the need for nutrition intervention, breakfast and lunch programs have the opportunity to reverse food insecurity trends. The study's findings on school breakfast and lunch consumption were twofold. When starting the day eating breakfast, students started the school day with an adequate amount of energy, which had positive effects on the students' cognitive load (Adolphus et al., 2016). Au et al. (2019) discovered younger Hispanic and Spanish-speaking students were more likely to consume breakfast and lunch at school. The literature review and the study's findings both revealed nutritional intervention and increased health education knowledge improved adequate nutritional intake in students, which was reaffirmed by consumption behaviors designed to increase healthy nutritional intake motivation (Folta et al.,

2016; Murimi et al., 2018).

Analysis of the peer-reviewed literature confirmed executive functioning was associated with the necessary behaviors linked to undernutrition and successful academic achievement. The study found students faced with low-resource settings, poverty, or low SES were more likely to face undernutrition, hunger, and the likelihood to have difficulty maintaining the behaviors necessary for positive educational outcomes (Suchdev et al., 2017). In addition, the study concluded students unable to maintain the appropriate behaviors conducive to positive educational outcomes were more likely to have disciplinary problems, absenteeism, and participate in riskier behaviors (Centeio et al., 2018; Suchdev et al., 2017). The literature review highlighted chronic absenteeism, which is linked to reduced student achievement and chronic undernutrition, was disproportionately higher in communities of color and lower SES (CRESP, 2018).

Nutrition's Role in Learning Linked to Food Insecurity. The literature review validated food insecurity in students was linked to an inadequate diet (Loibl et al., 2017). The literature review and the study's finding both confirmed food-insecure students with inadequate diets were faced with iron deficiency, hunger, and a decline in general health (Jirout et al., 2019; Loibl et al., 2017). Jirout et al. (2019) confirmed one in five children may experience food insecurity and one in three may not meet the minimum proficiency standards in reading, math, and science upon school entry. In addition, the study's findings revealed different levels of food insecurity were attached to different impairments, and students with chronic or deepening food insecurity were more likely to suffer mental disorders, struggle with interpersonal skills, and had decreased scores in math, reading, and language due to lower self-control (Burke et al., 2016; Grineski et al., 2018). The greatest significance of food insecurity was found to be the ability to

change over an extended period. A family could move from poverty to upper class, while an upper-class family could move into poverty on a monthly or yearly basis, which can create environments full of inconsistencies and uncertainty in student development from early childhood until high school graduation (McDonough et al., 2019).

The literature review and the study's findings concurred; participation in nutrition intervention services was an equitable solution to decreasing food insecurity and improving student learning. The literature review validated participation in federal benefit programs, such as SNAP decreased food insecurity by about 30% for children and allowed families to make larger investments in nonfood options, such as education (Aurino et al., 2018; Cox & Wallace, 2016). The study's findings validated nutrition intervention services were effective in changing unhealthy nutritional behaviors that were modifiable, increasing graduation rates, and decreasing stunting (Jirout et al., 2019; Rausch et al., 2015).

Limitations

The limitations of the study were issues with sample size and population selection, intercoder reliability, and time constraints. The sample size of the study was reduced from 120 to 80 peer-reviewed documents. While no universally accepted sample size exists, not maintaining the intended 120 peer-reviewed articles decreased confidence via the inability to maintain a sampling frame and possibly represent the general population (Neuendorf, 2017). The sample population of the study did not reflect a variety of population sources. Rather, the study reflected the findings discovered by analyzing peer-reviewed literature. Analyzing multiple sources of data in qualitative research could provide better insight into the problem explored in the study. Including key instrument data in the form of interviews, surveys, and observations could allow monitoring of the problem in a more natural setting and across more generalizable populations

(Creswell & Creswell, 2018).

Completing the study with one human coder and computer-assisted textual analysis software via MAXQDA decreased intercoder reliability. Having more than one human coder allows the creation of a more diverse research team, which grants the possibility to discuss new perspectives, interpretations, and disagreements in the data analyzed (Schreier, 2012). While computer coding is useful for organizing the data collected and analyzed into well-designed visual representations, the lack of human representation may be overlooked, or the program used may not fully comprehend aspects of human understanding (Neuendorf, 2017). Extra coders could help create clear operational definitions that help establish unidimensionality between categories and potentially identify parts of the literature that were coded differently between coders (Schreier, 2012).

Analyzing, reading, and rereading 80 peer-reviewed documents to build thematic connections between concepts in a short period could cause time constraints. The QCA process is labor intensive and requires a rigorous systematic process to accurately reflect on data being analyzed and successfully classify codes to reveal possible patterns and themes (Renz et al., 2018). Using MAXQDA assisted with the management of data but still required deep reading of each peer-reviewed article analyzed. Time constraints have the potential to create inaccuracies in the data analyzed, which could result in missed opportunities to systematically build strong thematic relationships between undernutrition and academic performance (Renz et al., 2018). Any data missed or overlooked may cause a misrepresentation or underrepresentation of the data analyzed.

Recommendations

The study's author explored the thematic relationship between undernutrition and K–12

student academic performance. Each recommendation discussed was based on the thematic data gathered and analyzed and offers insight for future qualitative research that could provide new emerging themes and data. The three recommendations are focused on analyzing transition periods for students from early childhood to adolescence, school breakfast and lunch programs, and nutritional data from Title I and non-Title I schools.

Recommendation 1: Transition Period Analysis

The first recommendation is to conduct a more thorough analysis of undernutrition and academic performance across the transition periods from early childhood to adolescence. Nutrition and brain development were proven to be most essential in early childhood and can shape future cognitive development as students approach adolescence (Johnson & Markowitz, 2018a). The nutrition and cognitive development of students could change based on hardships, resource access, familial stress, and cultural perspective (Duncan et al., 2017). Accounting for potential hardships as students transition from primary to secondary school alongside puberty, capturing data via interviews, surveys, or observations could provide conclusive longitudinal data needed regarding the influence of hardship on nutritional intake and academic performance (Galler et al., 2017). Understanding each phase could provide valuable information to develop incremental intervention services to improve the nutrition and academic performance of students before high school graduation.

An added human participant aspect via qualitative analysis could improve the analysis of undernutrition and academic performance across the transition periods of K–12 students. Monitoring and understanding the human behaviors associated with undernutrition and academic performance via participant observations and interviews could enhance the findings in a more natural setting. The naturalistic settings of observations and interviews could provide quality

interpretive data that allow the human participants to bring deeper meanings and connections to the research findings. Adding the human perspective could help find new themes and experiences associated with the socioeconomic realities of individuals, families, and groups that could influence the ability to maintain adequate nutrition and perform academically.

Recommendation 2: School Breakfast and Lunch Program Analysis

The second recommendation is to conduct a deeper analysis of SBPs and NSLPs. A historical and geographical analysis of SBPs and NSLPs could be vital to understand each program's effectiveness and role in nutrition intervention and academic performance since being created in the 1960s. Historical exploration of nutritional intervention services could give more insight into the effectiveness of nutrition intervention across student demographics that could go overlooked for students who are homeless, in foster care, and classified in special education with an IEP or 504 plan. The connection between public policy, laws, and federal programs, such as NSLPs could be explored to determine the relational effect on students of lower SES and schools in general. Lastly, each school lunch program varies at the local, regional, state, and national levels. A geographical analysis could provide an in-depth comparative examination of undernutrition and academic performance across local education agencies, state education agencies, and national education agencies.

The reasons for recommending further qualitative analysis of school breakfast and lunch programs are twofold. Historically, exploring the school and breakfast programs via past and current participant interviews could provide quality interactions that display the effectiveness of school breakfast and lunch programs. Each participant interview could provide insight into the value and perceptions of nutrition programs, while generating suggestions to improve the programs for future participants. Geographically, qualitative observations of school breakfast and

lunch programs, such as BIC can provide assessments of usability and transferability of suggestions to identify strategies that support student nutritional and academic needs. The qualitative observations could provide an analysis of the strengths and weaknesses of school breakfast and lunch programs across different demographics and SES levels to reveal applicable solutions for nutritional improvement in schools.

Recommendation 3: Nutritional Data Analysis Between Title I and Non-Title I Schools

The third recommendation is to analyze nutritional data and academic performance between Title I and non-Title I public schools. The types of school students attend could provide a deeper understanding of the resource settings and nutritional status of students. Analyzing the key differences between schools could give insight into potential outcomes caused by undernutrition and academic performance in schools, such as the school-to-prison pipeline; the negative health implications, such as decreased physical activity, cardiovascular diseases, and disorders; and the difficulty to improve health when faced with a variety of constraints across multiple environments (Kolbe et al., 2015; Laird, 2018). Each outcome provides an opportunity to look deeper into the school health experiences and services established via collaborative efforts of school stakeholders to reduce unhealthy nutritional behaviors and increase student academic performance.

Further exploration of the issues via qualitative interviews with school stakeholders can provide deeper knowledge of the nutritional behaviors and services provided by schools. The in-depth interviews of school stakeholders at Title I and non-Title I schools can provide insights into key differences between school lunch programs, such as funding, nutritional scheduling, menu choices, nutrition and academic environment, parental involvement, and access to resources. If stakeholders were employed in or attended either Title I or non-Title I schools,

interviews could provide a deeper connection, valuable knowledge, and unique perspectives. Understanding the key differences could be instrumental in developing new policies geared toward socioeconomically disadvantaged students who attend Title I and non-Title I schools.

Implications for Leadership

The implications for leadership are threefold and targeted toward school administrators, teachers, and parents. The results of the study were indicative of stakeholders' ability to influence nutritional patterns, learning, and positive executive functioning behaviors. Practices developed from the results of the study could create positive nutritional and learning changes across multiple student environments. Understanding the roles key leaders play in nutrition intervention may establish food consumption patterns and behaviors that could influence cognitive development from early childhood to high school graduation.

Implications for School Administrators

School administrators serve as the gatekeepers for food services delivered on a school's campus. The implications for school administrators could be collaboration and engagement opportunities. The results of the study discovered SES, low-resource settings, and food insecurity played an instrumental role in nutritional intake and positive student outcomes. Administrators could conduct a financial analysis of the foodservice operations to find ways to increase participation and improve the action steps needed to set and maintain goals over a school year. Collaboration between stakeholders could provide a golden opportunity to build camaraderie and transparency and collect data to provide adequate nutrition intervention services for students.

The implications could provide a spark to the nutritional culture on campus by engaging parents, students, teachers, and cafeteria workers to provide continuous feedback to make changes that reflect each stakeholder and encourage participation. While school programs are

federally funded and may face regulations, administrators should partner with neighboring schools, community organizations, and nutritional experts to establish a quality nutritional plan and approach to nutritional intake on campus. Lastly, if administrators viewed nutritional intake as a safety issue, then certain practices and priorities may be shifted when considering changes in nutritional plans or policies.

Implications for Teachers

The findings from the study have implications for teachers who want to implement nutrition intervention practices on campus. The most consistent way to positively influence nutrition on campus is participation. Teachers can learn the eating patterns of students by participating in BIC programs and eating lunch with students in the cafeteria. Allowing BIC can create an environment of routinized behavior for students. Breakfast in the classroom can allow teachers to go beyond the traditional classroom routine and start the day with eating, discussion, mini nutrition lessons, and healthy socialization practices to start the day right. Eating lunch with students can help teachers determine the quality of the lunch being served on campus, the amount of food being wasted, and social behavioral dynamics, and have a transparent dialogue with students about food choices made on and off campus (Laird, 2018). If successful teachers have the opportunity to share what was learned from social interactions in the cafeteria and classroom and how the interactions influenced positive nutritional practices and academic outcomes.

Implications for Parents

Parental habits and influences were found to have an influence on student nutritional choices and behaviors (Barr, 2015). The implications for parents would be to seek assistance when needed and increase participation. Parents have the opportunity to get food intervention

services when parents qualify and take advantage of the available programs, such as free or reduced lunch. As students are on campus over 5 hours a day and 5 days a week, seeking assistance from the school breakfast and lunch programs could provide two adequate meals per day, especially during the summer months. Increased participation on campus could lead to productive volunteer opportunities and the creation of parental programs on campus. Volunteering to pass out lunch, eating breakfast with students in a classroom, and using expert knowledge to develop health intervention programs could provide a spark of change in behaviors, attitudes, and social relationships to boost morale on campus. By serving as a nutritional guide and role model, parental involvement could lead to more confident student nutritional decision making, regulated meals, and new knowledge to establish new food routines.

Conclusion

As income gaps widen and nutritional intervention services become more needed, schools have the responsibility to maintain the health of students and coordinate nutrition programs (including summer) on campuses across America (Kolbe et al., 2015). Without the proper intervention services to counteract undernutrition, academic performance could suffer as early as kindergarten due to decreased school readiness, decreased cognitive functioning, neurodevelopmental delays, and behavioral patterns shaped by economic stressors (Heberle & Carter, 2015; Suchdev et al., 2017). The findings from the study reaffirmed the theoretical framework was useful for determining the negative relationship between undernutrition and academic performance via learned behavioral patterns, socioeconomic stressors in the household, and decline in cognitive functioning skills needed for positive student outcomes (Cleave et al., 2016; Torkan et al., 2018).

The findings from the study indicated food insecurity was a strong factor in the

relationship between undernutrition and academic performance. From early childhood into adolescence, food insecurity was validated as a cause for decreased brain development and academic impairments, which became worse if food insecurity deepened over time (Suchdev et al., 2017). Cognitive functioning was crippled by undernutrition when factors, such as poverty were driving forces for declines in nutritional resource access, which could lead to a reduction in positive academic achievement outcomes and cognitive flexibility (Willoughby et al., 2019).

FImproving undernutrition and academic performance requires nutritional stability alongside equitable and sustainable actions in the K–12 school community. Nutritional stability was proven to increase attendance, educational attainment, and college attendance and graduation, which could lead to increased social mobility for students transitioning into adulthood, reduce the school-to-prison pipeline, and break the intergenerational chains of poverty for families (Barr, 2015; Galler et al., 2017; Laird, 2018). In the equitable and sustainable actions of stakeholders in K–12 education, factors causing undernutrition in students can improve with simple positive changes via learned nutritional behaviors, school wellness policies, school food environments, and professional development opportunities for school staff.

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Appendix A

Courtesy Letter

Date: _____**Name of Researcher**: _____**Title of Research Article Requested:** _____

Dear {Name of Researcher},

My name is Ronnie Arnold and I am a doctoral candidate at American College of Education (ACE). As a common courtesy to researchers and their corresponding public research articles, I am writing to give notice of the public research articles used. The research article I would like to review is listed above. This information will be used for my dissertation research related to Child Nutrition and Cognitive Development in K-12 Education. The purpose of the qualitative content analysis research design study will be to analyze peer-reviewed medical journals to reveal the impact nutrition has on a student's cognitive ability to learn in the classroom.

Additional information could include:

Number of Literature Review Studies/Articles Requested to Be Analyzed: 120 total.

Important Contacts for this Study Include:

Principal Investigator: Ronnie Arnold

E-mail: rarnoldace@gmail.com

Phone: 510-776-3206, cell

Dissertation Chair: Dr. Imani Akin

E-mail: Imani.akin@ace.edu

Phone: (877) 670-4522

Thank you for your attention to this issue and prompt response. I appreciate your time and consideration of my request.

Regards,

Ronnie Arnold

American College of Education Doctoral Candidate

Appendix B

Walker and Avant's Method

Walker and Avant Step Number	Description
1. Select a concept	The concept is interesting, associated with the concepts, and includes words which seem abstract but may not have clear-cut meaning ready to be interpreted.
2. Deciding on the Purpose of Data Analysis	Clarifying meanings of an existing concept, develop operational definitions, and determine personal interest in the process.
3. Identifying the conceptualization of data	Determine all uses of the concepts during the data collection process.
4. Defining attributes	Determine all of the defining characteristics of the concepts and cluster the attributes which are best associated with the concept
5. Determining the model case	Simulate a model case representative of a real life example of the concept being used while including the attributes of the concept.
6. Determining alternative cases	Examining existing cases and distinguishing attributes which best fit the concept of interest
7. Analyzing the antecedents and consequences	Define the events which occurred prior to or as a result of the occurrence of the concept.

	The events the concepts refer to.
8. Defining the empirical referents	Bringing the attributes and empirical referents in the real world.

Note: The table describes the Walker and Avant method, originally created by Lorraine Olszewski and Kay Coalson Avant. Information in the table from "Methods of Concept Analysis—A Comparative Study," by A. Nuopponen, 2010, *LSP Journal–Language for Special Purposes, Professional Communication, Knowledge Management, and Cognition*, pp. 9–11.

https://rauli.cbs.dk/index.php/lspcog/article/view/2970/3051

Appendix C

Eight-Step Method for Concept Evaluation in Qualitative Content Analysis

Step	Brief Description	Use in Qualitative Content Analysis Study
1	Choosing a concept	Choosing main categories (undernutrition and academic achievement) and subcategories (food deserts, food insecurity, cognitive functioning, and academic achievement
2	Determine the purpose of the concept, creating operational definitions, and clarifying the meaning	Undernutrition: Nutrient deficiency due to insufficient food substances which are needed for normal growth and development Academic Performance: A student's ability to achieve and acquire learning skills in a classroom setting as measured by evaluation methods, such as grade point average and independent factors, such as home environment.
3	Identifying all uses of the concept	Searching up-to-date and reputable journals.
4	Defining key attributes	Examining literature to see the different instances of the concepts in literature reviewed.
5	Identifying model cases	Looking at real life examples of the concepts in literature
6	Identifying additional cases	Finding additional cases which may relate, not relate, or contain attributes of the concepts
7	Identifying antecedents and consequences	Considering the events which occur before the concept and as a result of the concept
8	Defining Empirical References	Finding the issues which exists or is present to prove the concepts occur

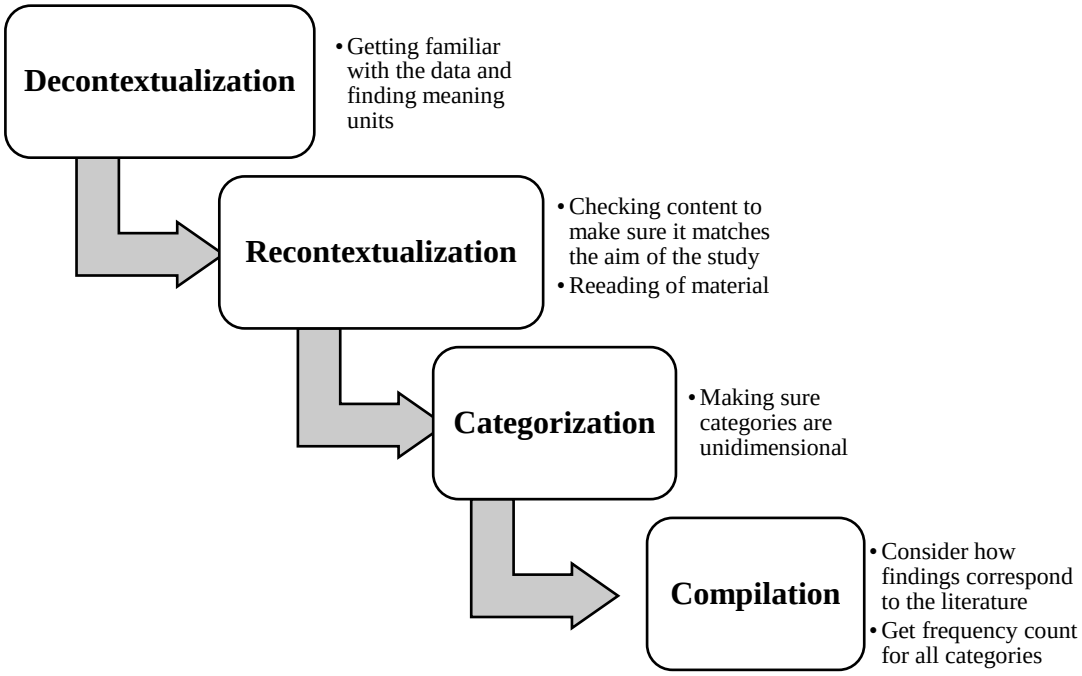
Appendix D

Coding Frame: Categories Created

Main Category	Undernutrition	Academic Performance
Sub Category #1	Food Deserts a. Poverty b. Food Access c. Food Availability d. Location e. Food Affordability f. Income	Cognitive Functioning a. Reasoning b. Planning c. Stress Management d. Memory e. Information Processing
Sub Category #2	Food Insecurity a. Executive functioning b. Household level insecurity c. Inadequate food consumption d. Nutrition Deficit foods e. Health Education Knowledge	Academic Achievement a. Absenteeism and Attendance b. Academic Motivation c. Resource Access d. Graduation e. College readiness

Appendix E

Qualitative Content Analysis: Data Analysis Process



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https://doi.org/10.1016/j.npls.2016.01.001