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The Relationship Between Nutrient Intake and Social Emotional Functioning in Preschool Children

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Dissertation Submitted in Partial Fulfillment

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Abstract

Mental health disorders are rising in children and being referred to as an epidemic. Numerous studies have shown micronutrient deficiencies and poor diet quality are suspected of playing a contributory role in the escalation of certain disorders. However, there is no research in young children focusing specifically on social emotional disorders and possible links to nutrition. Conventional treatment for social emotional disorders in children typically involves medication. Parents are increasingly turning to complementary and alternative medicine to treat their children with a method that is individualized and holistic. The biopsychosocial model provided the theoretical framework for this correlational study that investigated the association between nutrient intake and social emotional functioning. Multiple regression analyses were conducted to determine if diet/health indicators were significant predictors of any of the subscale scores on the Behavior Assessment System for Children – Second Edition (BASC-2), Parent Rating Scale -Preschool social emotional variables. Intake of food categories was measured by the amount reported by a sample of 119 parents over a three-day period. Higher levels of processed food consumption significantly predicted higher scores of atypicality. Additionally, reporting a family history of mental illness was associated with lower levels of hyperactivity and depression. The relationships between the other diet quality/health indicators and social emotional functioning in children were non-significant. The results of this study offer an alternative or supplemental treatment modality to psychotropic drugs. With the increasing health and economic burden of mental health disorders in children, the investigation of risk factors such as nutrient intake, is an essential and pressing research initiative.

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Dedication

I dedicate this dissertation to my dear friend, Krista. Even though she lives in another state she was there for me every day while writing this dissertation. She supported me in person at residencies and even cheered me on at the New York City marathon. Over the years she supported me either on the phone or in our private dissertation Facebook group. Krista is a wonderful friend and colleague and without her I couldn't of finished this study. I dedicate this dissertation to Dr. Krista Butland.

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I would like to express my sincere gratitude and appreciation to all those who were instrumental in helping me along the way, either academically or otherwise. This includes, my daughter Kennedy, who put up with me essentially working nights and weekends for several years. Dr. Krista Butland for being an invaluable resource and friend. Dr. Anthony Perry for agreeing to be my chair when the other professors rejected my proposal. Travis Heimer who provided emotional and financial support while I recovered from hip surgery. His support enabled me to finish the last two chapters of my dissertation.

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Chapter 1: Introduction to the Study

The focus of this research was the link between social emotional functioning and nutrient intake. In this study, I explored this association and specifically examined the relationship between diet/health indicators and eight social emotional constructs. It is important to understand the relationship between nutrient intake and social emotional functioning in preschool children as their brains are not fully developed. Optimal brain development is reliant on micronutrients, making this a critical developmental period (Benton, 2012). There is currently limited research that has investigated preschool children's diet and how it impacts their emotional well-being. To the researcher's knowledge there is no research, in this age group, that has focused on all of the social emotional constructs eight subscales of anxiety, aggression, attention problems, atypicality, somatization, depression, hyperactivity, and withdrawal. In recent years, mental health problems, including Autism and Attention Deficit Hyperactivity Disorder have significantly risen (Ryrie, Cornah, & Van de Weyer, 2006). This rise in mental health diagnoses in children has paralleled the changes in the food industry. It is difficult to measure nutrient intake in small children, which has contributed to a lack of research focus in this area, especially in the United States.

Mental health problems in children will likely increase through the years as the United States food industry continues to produce food that is nutritionally dense and heavily processed. The relevancy of this study will likely increase as well in upcoming years, food production and an increase in eating organic whole foods are at a forefront of societal and political discussions (Pellow, Solomon, & Barnard, 2012). The first lady, Michelle Obama, developed a health initiative aimed at decreasing obesity through movement and improving school lunches (Pellow, Solomon, & Barnard, 2012). This initiative was passed by the Congressional majority and has received positive press. The legislation now requires the National School Lunch Program (NSLP) to decrease calories, increase fruits and vegetables, and offer fewer processed foods with less sodium. By researching the link between diet and social emotional functioning in preschool children at a critical developmental period, an increase in knowledge will result, which will influence and guide decisions regarding food choices. This will result in positive social change as it will lead to better choices regarding nutrient intake, a reduction in medical visits, an increase in health, and additional mental health treatment options that are aimed at correcting deficits instead of reducing symptoms.

In chapter 1, I review the background of the study and explain the problem statement. The research questions are listed, along with the nature of the study. This chapter concludes with a discussion of assumptions, delimitations, and significance of the study.

Background

For over 1000 years it has been established that psychological functioning may be associated with nutritional deficiencies. In ancient Greece, 2500-years ago, Hippocrates asserted the mind and body are one interrelated system. The wisdom of the past is reflected in the words of Hippocrates who said, “Let thy food be thy medicine.” These words are more true today than ever before as society begins to realize the importance of diet.

In the 1800‘s, pellagra, caused by a niacin deficiency resulted in dementia, fatigue, and depression (Sydenstricker, 1958). Niacin is a B vitamin and when levels are depressed symptoms, including agitation, anxiety, and mental slowness can occur. Magnesium was a treatment for affective psychosis in Europe in the 1930s and ‘40s (Deans, 2011). Magnesium aides in all energy reactions in the body and when deficient, symptoms such as anxiety, agitation, and hallucinations occur. Scurvy, a historical disease occurring mainly in the 15th to 18th centuries, happened when people had limited accessibility to foods rich in vitamin C. Examples, include, the great Potato Famine in 1845, the American Civil War, and the California Gold Rush (Velandia, Centor, McConnell & Shah, 2008). Vitamin C was used to treat scurvy, which has early symptoms of irritability and lethargy. Pellagra, affective psychosis, and scurvy were all the result of micronutrient deficiencies that resulted in psychological symptoms, but when treated with micronutrients, the symptoms subsided.

The concept that diet may be affecting children’s behavior gained public attention in the 1970s. In 1973, Feingold, pediatrician and allergist, created controversy asserting that 50 percent of children he treated improved following an elimination diet of all artificial food colors, flavors, preservatives and salicylates (Tomlinson, Wilkinson, & Wilkinson, 2009). Feingold reported food additives, including dyes and salicylates, which are chemicals that occur in some fruits, were the cause of behavioral problems in children (Schardt, 2000). Since then, research has attempted to determine the validity of his claims in various ways. Studies have compared restrictive diets to regular diets or put children on restrictive diets and then gradually introduced food dyes or additives into the diet. Thus far, the studies have been inconclusive and leave multiple important questions to be answered (Prinz, Roberts, Hantman, 1980). To date, there are very limited studies on nutrient intake and social emotional functioning. Additionally, the literature to date has focused on children over the age of ten with minimal research on children under the age of five. Thus, the focus of this research was to look at nutrition intake and social emotional variables in children aged 3 to 5. Early childhood is a critical time period due to the significant nutritional needs that promote neurological growth. This study filled this research gap by exploring the relationship between social emotional functioning and nutrient intake in a preschool population.

Problem Statement

Nutrition is an under-recognized factor in the development of mental health disorders in children (Tomlinson, Wilkinson, & Wilkinson, 2009). Evidence supports the significant contributing role of diet in the treatment of certain mental health problems, including Attention Deficit Hyperactivity Disorder (ADHD), depression, anxiety, and autism (Ryrie, Cornah, & Van de Weyer, 2006). Low amounts of dietary elements, such as B vitamins, omega-3 fatty acids, folic acid, and zinc have been linked with a higher risk of developing depression (Nemets, Nemets, & Apter, 2006). The child's diet should contain foods that are in their natural states with limited chemicals, but this is typically not the case in most Western diets (Tomlinson, Wilkinson, & Wilkenson, 2009). Multiple studies have looked at the influence of nutrition on depression in adults; however, few have investigated the effects of nutrition on children (Davidson & Kaplan, 2012; Torres, Nowson, Worsley, 2008).

Mental health problems are increasing in the pediatric population, with limited studies demonstrating the efficacy of complementary alternative medical strategies for young children, including nutrition (Ryrie, Cornah, & Van de Weyer, 2006). The majority of studies on the relationship between diet and mental health have explored the relationship between ADHD and the increase of depression in elementary-aged children or adolescents (Sarris, Kean, Schweitzer, & Lake, 2011; Schnoll, Burshteyn, & Cea-Aravena, 2003). However, a younger population has not been studied, nor have multiple variables, such as aggression, anxiety, somatization, atypicality, withdrawal and attention problems. A study on the effects of diet on 7,114 adolescents found that the subjects who had a diet made up of unhealthy processed foods had higher levels of self-reported depression when compared to subjects eating a healthy diet (Jacka, Kremer, Leslie, Berk, Patton, Toumbourou, & Williams, 2010a). Sawada and Yokoi (2010) report that research has demonstrated a negative relationship between zinc blood levels and severity of depression symptoms in females in their late teens, when compared to a placebo. Schnoll, Burshteyn and Cea-Aravena (2003) assert that nutritional components such as food sensitivities, additives, and sugars have been associated with ADHD since the 1970's. Substances that commonly cause behavioral reactions in children include: wheat, dairy, soy, and artificial colors. A central component contributing to ADHD symptoms is lack of adequate nutrition.

There is very limited research on the relationship between a multitude of social emotional functioning variables and the intake of processed foods. Kaplan (2004) studied providing nutrient supplementation to determine efficacy of such supplementation on similar variables, but did not look at the diet or vitamin and mineral deficiencies of the children. Kaplan's research examined eight variables: Withdrawn Behavior, Somatic Complaints, Anxious/Depressed, Social Problems, Delinquent Behavior, and Aggressive Behavior. The results showed significant improvements in anxiety and mood in all nine subjects who took the broad based nutrient treatment. Improvements were noted in seven variables (Withdrawn Behavior, Anxious/Depressed, Social Problems, Delinquent Behavior, and Aggressive Behavior). Somatic complaints did not show a significant change. Additionally, Kaplan's study used the Child Behavior Checklist (CBCL), Young Mania Rating Scale (YMRS), and Youth Outcome Questionnaire (YOQ) as measurements of outcome and a small convenience sample of children with unstable mood and behavioral problems. This research explored the relationship between nutrient intake and social emotional functioning that may be linked to the nutrient deficiencies instead of nutritional interventions to improve functioning. Additionally, the Behavioral Assessment System for Children - Second Edition (BASC-2) was used to determine social emotional functioning, parents completed information pertaining to their children. Therefore, this research focused on dietary practices and whether there was a relationship between diet quality and a multitude of variables, including depression, hyperactivity, aggression, anxiety, somatization, atypicality, withdrawal, and attention problems. Previous research has only focused on limited variables or nutrient supplementation to improve psychological functioning. Additionally, most studies have used children over age ten; this study examined children below the age of six (Kaplan, Fisher, Crawford, Field, & Kolb, 2004). Age is an important factor due to the significant amount of neurological growth that occurs in early childhood coupled with this developmental period being a time social learning occurs, therefore setting the stage for life long eating habits that may hinder or enhance mental health. Further validation for the uniqueness of this study is validated by the difficulties that arise in investigating young children's food intake. There is limited availability of age appropriate and valid dietary assessment measures for children ages 3-5, thus making this an under researched area (Magarey, Golley, Spurrier, Goodwin, & Ong, 2009).

Purpose of the Study

The purpose of this quantitative study was to discover if diet quality/health indicators were linked to social emotional functioning in children. More specifically, it sought to determine if a relationship existed between diet/health indicators and (1) depression, (2) hyperactivity, (3) aggression, (4) anxiety, (5) somatization, (6) atypicality, (7) withdrawal, and (8) attention. Intake of fruit and vegetables (as measured by the number and amount of fruits and vegetables consumed by the child and reported by parents over a three-day period) was one predictor variable related to diet quality; the other was processed food (measured in an identical manner to fruit and vegetable consumption). Additional health-related predictor variables were BMI, family history of mental disorders, education levels of parents, socioeconomic status and whether the child was breastfed.

Research Questions and Hypotheses

Following are the research questions and hypothesis for this study:

RQ1: Is the consumption of processed foods, as measured by a 3-day diet record, a significant predictor of social emotional functioning (anxiety, depression, hyperactivity, aggression, somatization, atypicality, withdrawal, and attention), as measured by the BASC-2, PRS-P?

H1: Consumption of processed foods, as measured by a 3-day diet record, is a significant predictor of social emotional functioning.

HO: Consumption of processed foods as measured by a 3-day diet record is not a significant predictor of social emotional functioning.

RQ2: Is consumption of fruits and vegetables, as measured by a 3-day diet record, a significant predictor of social emotional functioning (anxiety, depression, hyperactivity, aggression, somatization, atypicality, withdrawal, and attention) as measured by the BASC-2, PRS-P?

H2: Consumption of fruits and vegetables as measured by a 3-day diet record is a significant predictor of social emotional functioning.

HO: Consumption of fruits and vegetables as measured by a 3-day diet record is not a significant predictor of social emotional functioning.

RQ3: Is Body Mass Index (BMI) a significant predictor of social emotional functioning?

H3: BMI is a significant predictor of social emotional functioning.

HO: BMI is not a significant predictor of social emotional functioning in children.

RQ4: Is family history of mental illness a predictor of social emotional functioning?

H4: Family history of mental illness is a significant predictor of social emotional functioning.

HO: Family history of mental illness is a not significant predictor of social emotional functioning.

RQ5: Is breast feeding a significant predictor of social emotional functioning:

H5: Breast feeding is a significant predictor of social emotional functioning.

HO: Breast feeding is not a significant predictor of social emotional functioning.

RQ6: Is parent education level a significant predictor of social emotional functioning?

H6: Parent education is a significant predictor of social emotional functioning.

HO: Parent education is not a significant predictor of social emotional functioning.

RQ7: Is socioeconomic status a significant predictor of social emotional functioning?

H7: Socioeconomic status is a significant predictor of social emotional functioning.

HO: Socioeconomic status is not a significant predictor of social emotional functioning.

Biopsychosocial Model

The biopsychosocial model asserts that psychological, social, and biological processes are intertwined subsystems, which influence physical and mental health (Suls, Krantz, & Williams, 2013). The model further contends that the mind and body influence each other; therefore, processes of the body affect the mind, and the processes of the mind can affect the body. Food intake reflects biological, psychological, and sociocultural influences. The biological component of the biopsychosocial model attempts to understand how the cause of the illness comes from the functioning of the individual's body, whereas the psychological factor seeks psychological reasons for a problem, including, emotions and behaviors. Biologically, micronutrients, such as vitamins and minerals are needed for appropriate brain functioning (Kaplan et al., 2004). Jacka et al. (2010b) reports diet affects underlying biological components that are implicated in depression. The social aspect explains how social factors, such as poverty, technology and socioeconomic status can affect health. A comprehensive understanding of the link between diet and social emotional functioning required elements from a multidisciplinary system ranging from biological to psychological due to the interplay of psychological and physiological variables that contribute to social emotional problems in children.

Nature of the Study

The nature of the study was quantitative. Quantitative research was appropriate due to the large amount of data that needed to be analyzed to determine if a relationship between variables was present. Research questions were evaluated by looking at the relationship between diet/health indicators and the eight subscales (1) depression, (2) hyperactivity, (3) aggression, (4) anxiety, (5) somatization, (6) atypicality, (7) withdrawal, and (8) attention. Multiple regression analyses were used to determine if variables related to health and diet quality predicted these social emotional subscales and the overall composite outcome variable. Intake of fruit and vegetables (as measured by the number and amount of fruits and vegetables consumed by the child and reported by parents over a three-day period) was one predictor variable related to diet quality; the other was processed food (measured in an identical manner to fruit and vegetable consumption). Additional health-related predictor variables were BMI, family history of mental disorders, education levels of parents, socioeconomic status and whether the child was breastfed.

Definitions

Attention Problems: A broad term often used to describe a collection of behavioral problems that include: inattentiveness, distractibility, and poor concentration (Friedman, Haberstick, Willcutt, Miyake, Young, Corley, & Hewitt, 2007).

Anxiety: An emotion characterized by feelings of nervousness, fear, or worry about real or imagined problems (Horwitz, 2013).

Atypicality: The tendency to behave in ways that are unusual or commonly associated with psychosis (Rosenblatt, Gorantla, Torres, Yarmush, Rao, Park, & Levine

2011).

Hyperactivity: The tendency to be overly active, rush through work or activities, and display excessive movement (Smith, 2011).

Somatization: The report of relatively minor physical problems and discomforts that impairs everyday life (Lambert, 2008).

Withdrawal: The consistent display (across situations and over time) to evade others and to avoid social contact (Rubin & Asendorpf, 1993).

Depression: Feelings of unhappiness and stress that may bring on thoughts of suicide (Beck, 1967).

Fruits and vegetables will be grouped into detailed food categories that yield the ounces or cups of fruits and vegetables eaten over the 3-day diet record and analyzed using the Food Processor SQL and Food Prodigy Nutrition and Fitness Software (ESHA Research, Salem, OR, 1995).

Processed food is a broad term encompassing a wide variety of foods. For this study processed foods will refer to foods that are ultra processed meaning; the foods will have been industry prepared for take-out or require no preparation, only eating or heating (e.g., breads, breakfast cereals, fast food, cakes). Processed foods will be measured by trans fatty acids and sodium using ESHA Food Processor SQL (ESHA Research, Salem, OR, 1995). Trans fatty acids are high in foods that contain solid fats such as pastries, cookies, and artificial creamers (Mulder, Ferninands, Richardson, and Innis 2013).

Body Mass Index (BMI): a number calculated from a person's height and weight (Benson, Williams, & Novick, 2012). BMI will be reported by parents and calculated by the researcher.

Assumptions

I chose to use a 3-day diet record and the BASC-2, Parent Rating Scale – Preschool form in order to learn about personality variables and nutrient intake in children aged 3 to 5-years-old. The first assumption I had regarding the parents completing the rating scale and diet record is that they would be honest when filling out not only the rating scale, but the 3-day diet record as well. I assumed they would not have any concerns about privacy or secrecy as I had taken steps to inform them of confidentiality and anonymity; therefore the participants would be able to clearly report their children's behavior by marking the appropriate ratings. I assumed all participants would speak and read English and understand the questions on the rating scales. I assumed the parents would be willing to spend 40 minutes in training and the time necessary to complete a diet record for 3-days.

These assumptions were necessary in order to set up the study. Individuals who choose to take part in a study that involves tracking diet and completing a personality assessment should realize questions will be asked of them regarding their child and they will need to respond. This is a necessary assumption regarding using a rating scale for data collection. The assumption that the parents will speak English is also necessary. If they are able to read and respond to communications in English, it seems logical that unless otherwise noted, they will be able to complete the tasks requested of them in English as well. Assuming the parent will be honest in their ratings and when completing the diet record, is also significant. Without this assumption, the results would be invalid.

Scope and Delimitations

The focus of this research was to examine the relationship between nutrient intake and social emotional functioning in young children. Investigating nutrient intake in this population was significant due to the western diet lacking in proper nutrients. The United States Department of Agriculture and Health and Human Services' guidelines provide information about food groups children need to include in their diets. Currently, children are not meeting the recommended guidelines, fruit, vegetables, and whole grains intake needs to be significantly increased. Presently, less than 2 percent of adolescents and children eat the minimum amount of recommended servings from food groups. This has resulted in decreased consumption of micronutrients, such as calcium, potassium, and magnesium. All of which are needed during this critical developmental period for optimal brain maturation and functioning.

In order to participate in this study the individual had to fulfill the following criteria: (a) be the parent of a child aged 3 to 5-years-old (b) be able to speak and read English fluently (c) the child must not be on a restrictive diet (d) the respondent must own a computer and have access to an internet connection and (e) the child must not have a medical condition that could impede the results of the study. Anyone who did not fit the criteria listed will not eligible to participate and excluded from the study.

The theoretical framework used for this study is the biopsychosocial model. Due to the complexity of the relationship between nutrient intake and social emotional functioning, a model that was comprehensive and, not only acknowledged the biological contribution, but the psychological and social components, as well, was needed. The biopsychosocial model encompasses the idea that attention must be paid to biological, psychological, and social needs in order to maintain a healthy diet and appropriate social emotional functioning The biomedical model was a model that was not used. The biomedical model is a reductionist model that reduces phenomena to low-level processes. The biomedical model does not incorporate social or psychological processes, but is a single-factor model. It condenses illness to biological malfunction instead of acknowledging that a multitude of factors, only a few of which are biological, may be responsible for social emotional functioning. Additionally, the biomedical model asserts that the mind and body are distinct entities. This model, while applicable to biological processes related to diet, does not take into consideration that the mind and body are related, which is significant to this study.

Delimitations of this current research included only investigating children aged 3 to 5-years-old. Another delimitation is that children's behavior and diet must be reported by their parents due to their age. Thus, the children were not interviewed, observed or given a voice in this research. For purposes, of time and requirements, the children do not need to be observed or interviewed for this study. All data can be gained through parents. A final delimitation is that the social-economic status of the participants was not explored. This is beyond the scope of this this study; this study attempts to explore the relationship between diet and social emotional functioning and is not attempting to investigate the origin or why the diet is nutritionally dense.

The sample will be taken from three different sources including, Walden University participant pool, local developmental centers (Pediatric Connections, Hiersteiner Center, PlayAbilities), and the researcher's website. The researcher wants variability in the population to represent different social economic status, and other characteristics of the population to enhance the generalizability of the results.

Limitations

Parent rating scales rely on participants being honest and detailed, as was the case in this study. Even though the BASC-2 system has validity indexes built into it, honest and accurate responding cannot be guaranteed. Social desirability on the part of the participant completing the BASC-2 may result in individuals responding more favorably or “faking good” resulting in less social emotional elevations.

Diet records also depend on the participant completing an honest representation of what the child has consumed. Again, social desirability bias, may result in participants over-reporting the consumption of foods perceived to healthy and under-reporting consumption of foods perceived to be unhealthy. Additionally, the accuracy of diet records tends to decrease with time, resulting in increased errors, inaccuracies, or omissions. This is why a 3-day diet record was chosen over a 7-day record. Also, errors in estimation of portion sizes on the diet record could limit the findings. The researcher stressed the importance of accurate reporting during the training session. Confidentiality was also reviewed so that participants do not believe they are being judged in anyway and feel free to be accurate and honest in their responses.

Significance

Research into current diet quality and its relation to social-emotional functioning in an early childhood population is unique due to the lack of investigation of diet quality in children under the age of five. Literature indicates this lack of exploration may be due to participant availability, children not being able to swallow pills, and young children not being capable of reporting dietary habits and emotional status (Kaplan et al., 2004).

Additionally, multiple social emotional variables were examined that have not been investigated in this manner, including withdrawal, atypicality, and somatization. With the continued increase of mental health disorders in children (Loscalzo, 2004), the results of this research give important insights into how diet quality is associated with young children's mental health. Information gained will help parents and mental health professionals to develop much needed interventions to improve nutrition in children at a critical time when nutrients are needed for optimal neural growth.

Summary

Chapter 1 reviewed the purpose of the study, which was to investigate the relationship between nutrient intake and social emotional functioning in children aged 3 to 5-years-old. Despite current psychological interventions, mental health problems are rising in children. Chapter 1 also discussed the background, problem statement, and the purpose the current study. Nutritional deficiencies have been affecting mental health for a 1000-years, yet it is an under recognized contributor to mental health issues. Chapter 1 described the 7 research questions, the conceptual framework, and the nature of the study. The assumptions, limitations, delimitations and the scope of the study were shared. Finally, chapter 1 concluded with a section on the significance of the study.

Chapter 2 of this study will include a thorough review of current literature pertaining to nutrient intake and its relationship to social emotional functioning. A discussion of micronutrients, including nutrient deficiencies and how they relate to mental health will be shared.

Chapter Two: Literature Review

Introduction

Chapter 2 presents an overview of the link between micronutrients and social emotional functioning in children, which is the purpose of this quantitative investigation. The literature review that follows was guided by a search to assess how nutrient intake is related to social emotional functioning in preschool age children; however, since this is an under researched area, studies regarding adults and children of all ages have been included.

Literature Search Strategy

A computerized search strategy was implemented using PsycINFO, Sage, and PsychARTICLES, and Nursing and Allied Health Source databases. The following search terms were applied: diet quality, magnesium, inattention, iron, depression, essential fatty acids, attention deficit hyperactivity disorder, autism, B vitamins, body mass index, mental health, biopsychosocial, behavior assessment system for children-second edition, 3-day diet record, diet patterns, mental health, socioeconomic status and breast feeding.

The relationship between diet and mental health continues as the child grows; however there are limited studies in early childhood that have studied this phenomenon. The majority of studies in children regarding diet and social emotional functioning have centered on depression, autism and ADHD. Even though there is emerging evidence that diet may affect aggression, anxiety, as well as, many other psychiatric disorders. Additionally, a preponderance amount of information pertaining to diet and mood disorders comes from adult based studies (Quirk et al. 2013). This literature review will discuss the limited studies that are available.

This chapter begins with a discussion of the literature collaborating a link between neuropsychiatric disorders, such as autism, Attention Deficit Hyperactivity Disorder (ADHD) and micronutrients intake and deficiencies. It goes further to discuss the importance of the micronutrients as precursors to neurotransmitters. The discussion continues by examining family history for mental illness, breast-feeding, parental education, and how body mass index relate to emotional functioning. The literature review summarizes the essential features of micronutrients and the major social emotional variables that have been studied, including anxiety, depression, hyperactivity, and inattention, with emphasis placed on effectiveness of nutrient interventions in combating children's mental health. The literature also examines the theories, limitations, and relationship to nutrient intake deficiencies in terms of social emotional functioning in children. The chapter concludes with how diet deficits relate to the current study.

Nutrition and Neuropsychiatric Disorders

For over 1000 years it has been established that psychological functioning may be associated with nutritional deficiencies. Hippocrates described food as medicine. In the 1800's, pellagra, caused by a niacin deficiency, resulted in disorientation, fatigue, and depression. Magnesium was a treatment for affective psychosis in Europe in the 1930s and '40s. Vitamin C was a used to treat scurvy, which has early symptoms of irritability and lethargy. In 1973, Feingold, pediatrician and allergist, created controversy asserting that 50 percent of children he treated improved following an elimination diet of all artificial food colors, flavors, preservatives and salicylates (Tomlinson, Wilkinson, &

Wilkinson, 2009). Consequently, nutrient deficiencies have been known to affect psychological functioning for more than a century; however, research pertaining to it is scarce.

Mental health problems in children are associated with multiple factors, such as genetics, environment, and age. The incidence of childhood mental health disorders, which include autism and attention deficit hyperactivity disorder (ADHD), are increasing worldwide. Studies are showing an association between diet and mental health, including cognition and depression (Quirk et al. 2013). Nutrition involves the physical and chemical preparations and reactions required for development and maintenance of adequate body processes (Weinberg, 1963) The body and mind are interrelated and good health maintained by an adequate intake of essential nutrients is linked with good mental health, thus anything that affects one will affect the other. Deficiencies or too much of certain micronutrients result in chemical changes that affect the nervous system and, in turn, the development of the brain.

The brain needs certain amounts of essential micronutrients to function properly and is sensitive to nutritional intake, especially during early periods of maturation. Research has shown that deficiencies in nutrient intake at critical stages of development can result in long lasting changes in brain structure causing cognitive and social impairment (Benton, 2011). In children less than ten-years-old, brain structures use twice the rate of glucose than adult brains; therefore the brain's functioning is dependent on the intake of micronutrients. Nutrient intake forms the building blocks the brain is built on and supplies the energy it needs for adequate functioning.

Higher levels of depression, anxiety, hyperactivity, and inattention are associated with lower intakes of zinc, magnesium, foods rich in B-vitamins, and fish consumption (Murakami et al. 2008). Sarris, Kean, Schweitzer, and Lake (2011) report 50% of parents of ADHD children are using an alternative or complementary medicine, including vitamins and minerals. Parents of children with social emotional problems are increasingly turning to alternative or complementary medicines to treat or supplement their child's current treatment. With the increasing use of diet to improve social emotional functioning it is important to determine the efficacy of such approaches.

Theoretical Foundation

There has been a significant increase in the recognition that a powerful relationship is present between health and behavioral development. The introduction of the biopsychosocial model (Engel, 1977) resulted in the identification of important behavioral and lifestyle influences on physical health and social development. The biopsychosocial model was devised as an alternative to the biomedical model, a reductionistic, dualistic model that was advanced in Western medicine to explain disease. Engel, the founder of the biopsychosocial model, reported it does little to identify a biochemical defect in psychopathology if the clinician does not understand how it relates to psychological, social, and cultural determinants of how the patient perceives or communicates their symptoms of the disease. The biopsychosocial model evaluates several components contributing to illness instead of only focusing on biological factors. Holman wrote, "While reductionism is a powerful tool for understanding, it also creates profound misunderstanding when unwisely applied. Reductionism is particularly harmful when it neglects the impact of non-biological circumstances upon biological processes." Historically, Sigmund Freud and Adolf Meyer, both physicians, provided references to psychological processes in disease conceptualization.

There are limited theoretical models that bridge multidisciplinary perspectives and take into account the multitude of factors that influence the emergence of social emotional problems in children. As a result, there is a gap in knowledge in respect to how diet is linked to social emotional functioning in early childhood. The biopsychosocial model acknowledges the importance of social, biological, and psychological factors in the development of social emotional functioning in preschool children.

Biologically, the child's brain matures rapidly during the early childhood years and nutrient intake supplies the foundation for brain functioning. Nutrient intake during this critical period aids in long term structural changes (Surkan et al., 2013). Brain development occurs at differing rates dependent on a variety of factors. Some brain areas are functional in development and others mature progressively though adolescence, forming intricate neural networks and higher order processing and emotional regulation. Emotional regulation is linked to the experience of an emotion or how the child perceives it. Studies suggest there is a cognitive and behavioral component that aide in the regulation of emotions, which is dependent on frontal lobe interaction with brains areas, such as amygdala and anterior cingulate. Emotional regulation develops though the preschool years. Micronutrient deficiencies during critical periods when the brain is forming can cause long lasting damage (Benton, 2012).

The child's social interactions during the preschool years are restricted by the family's social environment. Research has documented that diet and social emotional functioning are linked to socioeconomic factors. Children in depressed social conditions lack access to stimulating environments, which can result in poorer adjustment and outcomes in the school setting. Zhang, Jones, Ruhm,and Andrew (2013) report low income American children have less access to foods, consequently their diets are high in calories, but low in micronutrients. Also, obesity levels are higher in low-income children and obesity is associated with food insecurity (Wye, Seoh, Adjoian, & Dowell, 2013). Children's eating patterns are generally associated with the family's culture. Social factors such as, ethnicity, religion, food availability, and advertising will affect the child's diet.

It is difficult to separate sociocultural influences from psychological ones. Diet may serve as an escape from life's responsibilities, a reward or punishment. Some of children's food preferences are learned behaviors. Preschool children may see their older siblings reject certain foods and mimic the behavior. Additionally, incentives may be given so that children eat vegetables and fruits. Eating behaviors can be associated with emotions. For example, if a child is hurt a parent may give them a cookie to distract them from the pain. Stress levels may influence diet. Oliver and Wardle (1999) reported individuals vary their nutrient intake during times of stress and anxiety, by increasing or decreasing what they eat. Additionally, the choice of food tends to change from typical meal-type foods to foods that are high in fat. The anxiety-diet interaction is believed to be due to the drive induction hypothesis, which reports stress induces increased levels of glucocorticoids, which cross the blood brain barrier and activate brain pathways involving appetite behaviors. The increased consumption of nutrients supposedly reduces the stress response.

In summary, the complex neural system of the brain is cultivated during the early years and is vulnerable to dysfunction, which can occur through internal or external forces. Social emotional functioning is a contribution of biology (brain development, diet), psychological (thinking, learning), and social factors (environment). The research questions for this study incorporates all three components of the biopsychosocial model by focusing on diet, social emotional functioning, education level, breast feeding and mental health history; therefore a multidisciplinary theoretical framework is needed to address the complexity of the different variables.

Fats

Dietary fat is an essential nutrient, important vitamins are found in fats and essential fatty acids that must be included in the child's diet. Omega-3 long-chained polyunsaturated fatty acids are essential to typical brain development and functioning (Joshi et al., 2006). The amount of lipids in the brain is partially due to nutrient intake of various lipids. Phosopholids containing polyunsaturated fatty acids, including omega-3 and omega-6, are essential components of the neuronal cell membranes of the brain, and are believed to initiate the transmission of signals across neurons (Johnson et al., 2009). Approximately, 35% of the nervous system and brain tissue are polyunsaturated fatty acids, including the essential fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). EPA and DHA develop phospholipids in brain cell membranes; therefore, both are involved in signal transduction. EPA and DHA are called essential omega fats because they are not made in the body and only come from the diet, including plants and marine organisms.

DHA and EPA are a crucial part of cell membranes that surround the cells of the nervous system and brain, and decrease inflammation in the body. Cell membranes regulate substances that flow in and out of cells, which is essential for normal cell function. In the nervous system and brain, cell membranes will affect neurotransmitter levels, the development or creation of neural pathways and signals between cells. Omega-3 fatty acids are fluid and their malleability is why they are a critical component of cell membrane functioning. Omega-6 fatty acids are not as fluid and are minimally present in the brain. Essential fatty acids control corticotrophin, enhance serotonergic processes, and support cerebral blood circulation. A deficit in essential fatty acids causes the body to use other forms of fatty acids, which weakens cellular networks and brain stability.

Omega-3 fatty acids are dietary essentials; however the intake is low in Western diets compared to Omega-6 (Montgomery, Burton, Sewell, Spreckelson, & Richardson, 2013). Omega-3 fatty acids are found in flaxseed oil, walnuts, and fish. Essential fatty acids are synthesized in plants, so vegetables are one significant source. Phytoplankton, which is found in ocean waters are full of essential fatty acids that pass through the food chain. Ocean fish, including sardines and salmon are sources of EFAs; however, free water fish and pond-raised fish are not. Pond raised fish have diets containing corn and corn oil. Omega-6 fatty acids are concentrated in corn, soy, eggs, and meat. The Western diet is low in omega-3 fatty acids and may contain up to 25 times more omega-6 fatty acids. This imbalance can contribute to depression, behavior disorders, dementia, and schizophrenia (Joshi et al., 2006). This EFA imbalance is due to the Western diet being high in foods cooked in oil, thus processed foods, fried foods, and junk foods.

Omega-3 fatty acids are anti-inflammatory, whereas, Omega-6 fatty acids are pro-inflammation and tend to increase inflammation. Omega-3s decrease inflammation in whatever part of the body they operate in. In order for systems to process adequately there needs to be a balance between Omega-3s and Omega-6s to create the inflammatory response and suppress it. This balance is important because Omega-3s and Omega-6s both fight for the same enzymes in the body. The enzymes are the biochemical components that allow fats to do their jobs.

Clinical and observational studies support essential fatty acids (EFAs) of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), in the prevention and improvement of social emotional functioning in children (Martinsen & Raglin, 2007; Montgomery et al., 2013). Cognitive and neural growth is dependent on omega-3 essential fatty acids, which are often lacking in the child's diet. Omega-3s are depressed in children's diets in the United States, which may result in not only atypical behaviors, but chronic health problems as well. When there is an imbalance between omega-3 and omega-6 fats the body has increased inflammation and it changes the balance of fats available to the brain and nervous system, which hinders the child's brain function and may result in social emotional problems. Recent evidence demonstrates that this imbalance may be associated with a variety of physical and mental health disorders, such as ADHD and autism (Montgomery et al., 2013).

Research in adults has linked EFAs with the reduction and prevention of mood disorders, including major depressive disorder and bipolar disorder. In areas of low fish consumption depression rates have been shown to be 40 times greater (House, 2009). A study with participates aged 6-to-12-years found that supplementation with fatty acids improved depressive symptoms (Nemets et al., 2006). Additionally, omega-3 fatty acids may be helpful when supplemented with a psychotropic medication in the treatment of mood disorders. Peet (2004) demonstrated that an increase in fish and starchy roots was associated with decreased depression. Multiple studies have shown a negative relationship between diets high in seafood and the prevalence of depression, which is thought to be due to the increased intake of omega-3 fatty acids (Peet, 2004; Nemets et al., 2006). A study on the effects of diet on 7,114 adolescents found that the subjects who had a diet made up of unhealthy processed foods, which are high in omega-6 fatty acids, had higher levels of self-reported depression when compared to subjects eating a healthy diet (Jacka, et al. 2010).

Omega-3 (fish oil, DHA or flaxseed oil) is the most researched complementary and alternative medicine in ADHD children (Sarris, Kean, Schweitzer, & Lake, 2011). Consequently, research supports the use of omega-3 supplementation in children with ADHD (Raz, Carasso, & Yahuda, 2009). Low blood Omega-3 amounts have been found in children with ADHD and related behavior problems with improvements noted from dietary supplementation (Montgomery et al., 2013). It is hypothesized that children with ADHD are not able to metabolize or absorb essential fatty acids normally, which results in lower concentrations in the plasma polar lipids and in red blood cell total lipids (Brue & Oakland, 2002).

Johnson et al. (2009) found that a subgroup of ADHD children and adolescents (8-18 years), given an omega 3/6 supplement showed a more than 50% improvement in symptom reduction. The subgroup of ADHD children who responded to the supplement was inclined to have the inattentive type of ADHD and associated neurodevelopment disorders; therefore, researchers concluded omega 3/6 supplementation may be suitable for children with deficits in perception, motor control, and attention. These findings correspond to earlier research, which have found children respond differently to omega 3/6 fat supplementation, with some having significant reductions, others having marginal gains in improved behavior, and some showing little to no improvement on the behaviors that were being studied.

Montgomery et al. (2013) investigated whether lower blood Omega-3 and Omega-6 were linked to decreased behavior and cognitive performance. Both parents and teachers in a general population of children aged 7-9 years in a mainstream school assessed ADHD symptoms. Researchers found inverse relationships between DHA and/or EPA plus DHA on the Connors' Global Index, Emotional Lability scale, oppositional, anxiety, and psychosomatic complaints scales. This relationship between blood levels of Omega-3 and ADHD-type symptoms was found in a sample of healthy underperforming children with no subcategories or even diagnosis of ADHD. In a similar study, Stevens et al. (1996) administered Conner's rating scales to teachers and parents to determine ADHD in 53 boys. Students were placed in a control or experimental group based on their scores. The experimental group consisted of boys with ADHD. Blood serum levels of EFAs were significantly decreased in the ADHD group compared to the control group. In a later study, Stevens (2003) assessed the effects of essential fatty acid supplementation on ADHD symptoms using olive oil as a placebo, improvement in the essential fatty acid group was only marginal in comparison to the placebo, which was hypothesized to be due to the choice of placebo since both groups showed improved plasma phosolipids and red blood cell lipids. Similarly, Raz (2009) attempted to reduce ADHD symptoms using essential fatty acids and a placebo of vitamin C and negative results were found. Negative results were attributed to the poor choice of placebo, since vitamin C is associated with decreasing externalizing problems.

Sinn and Bryan (2007) investigated the effects of essential fatty acid supplementation on ADHD symptoms using the Conners ADHD Index in a double blind, randomized, placebo-controlled intervention. The subjects consisted of 104 Australian children from 7 to 12-years-old. Positive treatment results were discovered on parent ratings of inattention and hyperactivity in the essential fatty acid groups when compared with the placebo. In an additional, continuation 15-week study the placebo group was treated with essential fatty acids and demonstrated significant improvement in core symptoms on the parent rating scale. Significant effects were not found on the teacher rating scales.

Amminger (2007) and Maguid et al. (2011) both have shown benefits of omega-3 fatty acid supplementation with or without other vitamins in children with autism. Maguid et al. reports children with autism have decreased antioxidants when compared to controls. In light of this deficiency, assessment of antioxidant levels before the age of six and supplementation of essential fatty acids would improve prognosis by lowering the oxidative stress before brain damage occurs.

Studies that used blood levels have more consistent results regarding EFA deficiencies and neurodevelopmental disorders, including ADHD and autism, whereas, supplementation studies have been contradictory. Therefore, evidence supports the link between children with ADHD and autism demonstrating deficiencies of essential fatty acids, especially, omega-3 fatty acids (Gilles, Lad, Reach, & Ross, 2012). It can be reasoned that supplementing essential fatty acids may decrease symptoms related to ADHD and autism in children. However, investigations of the efficacy of Omega-3 supplementation while promising are inconclusive, due to methodology limitations and differences. The studies that have demonstrated improvements used a combination of omega-3 and omega-6 supplementation. Also, it is important for studies to include both DHA and EPA. Studies have shown that EPA may result in increased reduction of attention and hyperactivity symptoms (Loscalzo, 2004). Weaknesses in research studies included: different types of dosage and supplementation, limited follow-up duration, and inappropriate placebos. Additional rigorous studies are needed to replicate positive findings to conclusively report that supplementation is beneficial in children with social emotional problems.

Regarding the present study, evidence supports reduced blood levels of EFA in children with ADHD, depression, and autism, which is hypothesized to be due to the Western diet being high in foods processed in corn oil. Additionally, children with these disorders exhibit elevated inattention, hyperactivity, depression, somatization, withdrawal and atypicality, which are six of the variables being investigated in this study.

Micronutrients

The balance and amount of nutrients available for brain function are dependent on the action of enzymes and coenzymes. Enzymes govern and direct the required metabolic functions in cellular activity. Micronutrients are a fundamental part of multiple coenzyme systems and aide in the activation of enzymes that synthesize neurotransmitters. For example, iron, riboflavin, and vitamin B6 are needed for the synthesis of biogenic amines. Deficits in specific micronutrients have resulted in documented neuropsychiatric effects (Rucklidge, Gately, & Kaplan, 2010). Common examples include thiamin (B_1) deficiency link to Wernicke encephalopathy, niacin (B_3)

deficit resulting in pellagra, and cyanocobalamin (B_{12}) deficiency association to psychosis of pernicious anemia.

Current data from the National Diet and Nutrition Surveys (NDNS) on micronutrient intake in children found deficit intakes of nearly all minerals and vitamin A in adolescent males and females, and riboflavin and folate in adolescent females (Weichselbaum & Buttriss, 2011). Zinc was reduced in the younger age group. Depressed levels of riboflavin (B_2), thiamin (B_1), vitamin C, folate, vitamin D and iron were found overall with deficits increasing in lower income families (Weichselbaum & Buttriss). Kranz, Siega-Riz, and Herring (2004) report the prevalence of obese children under age five was approximately 22% in 1998. The diets of children below the age of five do not contain the recommended or adequate servings of fruits and vegetables and surpass the recommended intake in fat, saturated fat, and juice (Kranz et al., 2004). The micronutrients most widely researched regarding children and social emotional disorders are discussed here.

Vitamins play a fundamental role in the development and functioning of the brain. Vitamins are organic matter that forms a catalyst in the enzymatic action of metabolism for typical tissue growth (Weinberg 1963). The brain has the highest metabolic activity, requiring approximately 20% of the energy available in the body (Benton, 2011). Nutritional deficiencies decrease energy potential resulting in the brain's high energy needs not being met. This reduces functioning and results in psychiatric problems. Energy needs are especially critical when the brain is developing. Mental health stability requires substantial amounts of vitamins to develop neurotransmitters, decrease mood instability, and enhance sleep.

Several of the B vitamins are important for energy and mood regulation. For example, Niacin (B_3) and pyridoxine (B_6) aide in the manufacturing of the neurotransmitter, serotonin, which maintains sleep and mood (Kidd, 2000). Vitamin B6 aids in the transformation of dopamine to norepinephrine, and tryptophan to serotonin, which enhances serotonin levels (Levy & Hyman, 2005). Of these B vitamins, folic acid (B_9), and cyanocobalamin (B_{12}) have been associated with depression and autism. Vitamins that have been studied in children's social emotional functioning includes: riboflavin, thiamin, vitamin C, and vitamin D.

B Vitamins and Vitamin C. When B vitamins are deficient it is detrimental to the brain, which may result in problems focusing, depression, anxiety, and irritable mood. If thiamine (B_1) is deficient the uptake of glucose in the brain is disturbed, affecting mood instability and fatigue. Folate (B_9) has been associated with depression in adults. Folate (B_9) crosses the blood brain barrier, changes form, and aides in the production of neurotransmitters, including serotonin, dopamine, and norepinephrine. A lack of pyridoxine (B_6) can result in depressed mood and confusion because it is needed in the production of serotonin and dopamine.

Deficiencies of various nutrients, including Vitamins B_6, B_9 and B_{12} have been linked to autism (Al-Farsi, 2013; Vogelaar, 2000). The Autism Research Institute conducts surveys to determine parental preferences regarding therapeutic interventions. The most frequently cited vitamins included pyridoxine (B_6), vitamin C, and magnesium (Levy & Hyman, 2005).

Cyanocobalamin ($B_{12)}$ is found in animal products. Cyanocobalamin ($B_{12)}$ aids in the production of red blood cells and if deficient, problems with oxygen circulation can lead to mania, irritability, and dementia. Additionally, Cyanocobalamin (B_{12}) aides in the metabolism of fatty acids required to develop myelin. A cyanocobalamin (B_{12}) deficiency can result in brain damage making it an essential vitamin in pregnant and breastfeeding women as well as infants. Children who are breastfed from a vegetarian mother are at increased risk for cyanocobalamin (B_{12}) deficiency. When cyanocobalamin (B_{12}) is lacking in infants it can result in a clinical syndrome that results in irritability, anorexia, and reduced brain development, which leads to detrimental long lasting effects (Benton, 2012).

It is hypothesized that higher levels of oxidative stress may result in metabolic abnormalities in autistic children. James et al. (2004) administered folic acid (B_9) and cyanocobalamin (B_{12}) to children with autism. Blood serum levels of metabolic abnormalities improved from baseline and improvements were noted in autistic behaviors Similarly, Al-Farsi et al. (2013) conducted a study to determine if folate (B_9) and cyanocobalamin (B_{12}) were low in children with autism. Al-Farsi and colleagues compared 40 preschool children with autism spectrum disorder to 40 controls. The children with autism spectrum disorder had significantly lower serum levels of cyanocobalamin (B_{12}) and folate (B_9) compared to controls; however, this study has limited generalizability due to a clinical population being used as subjects. Parents of children with autism frequently cite the combination of pyridoxine (B_6) and magnesium as a common supplement. Research has not conclusively demonstrated the efficacy of these micronutrients due to methodological problems, such as small sample size and placebo effects.

Studies are demonstrating B vitamins reduce ADHD symptoms, anxiety, as well as other social emotional disorders (Shaw, Rucklidge, & Hughes, 2010). It is hypothesized B vitamins may reduce ADHD symptoms due to the structural similarities they share with dopamine (Shaw, Rucklidge, & Hughes, 2010). This similarity may result in pharmacological effects; however additional research is needed to determine if B vitamins and methylphenidate do share a neurochemical mechanism of action.

Vitamin C has the highest concentrations in the nerve ending in the brain after the suprarenal glands. Vitamin C deficiencies have been associated with depression, mania, and aggression. An experimental double blind study found that detention bound juveniles demonstrated a 47% improvement in antisocial behavior after 6-months of orange juice exposure (Schoenthaler, 1983). Dolske et al. (1993) evaluated the effectiveness of vitamin C on 18 children with autism for 30-weeks in a double blind, placebo-controlled study and noted a significant decrease in stereotypical behaviors.

Joshi et al. (2006) supplemented flax oil with 25mg of vitamin C to 30 children diagnosed with ADHD in a clinical setting. Flax oil is rich in ALA and is a precursor fatty acid that is changed to DHA. Significant improvements were found on parent ratings on ADHD symptoms, including impulsivity, restlessness, inattention, hyperactivity and self-control. It is unclear to what extent the antioxidant aided in the reduced ADHD ratings since it was mixed with flax oil. Additionally, the lack of a placebo group and using only parents, as raters of behavior are limits of this study.

Iron. Iron is a fundamental trace metal, which is involved in many biological processes, including brain functioning (Donfranscesco et al., 2011) Iron supplies electron carriers during the forming of adenosine triphosphate (ATP) and is essential to hemoglobin due to it's role in providing appropriate amounts of oxygen in the brain for oxidative metabolism. Iron aides in the development of dopamine, serotonin, norepinephrine, and epinephrine. For example, iron plays a role in the metabolism of tyrosine to dopamine. It is also thought to enhance the binding of dopamine and serotonin to serotonin proteins in the frontal cortex. Research reports ADHD may be due to genetic influences, which result in lower levels of dopamine and serotonin (Sarris, Kean, Schweitzer & Lake, 2011).

Iron is found in red meat, fish, and nuts. Vegetables, such as kale, spinach, swiss chard and mustard greens are high in iron. In addition, black cherries, dried fruits and beets are sources of iron. Worldwide, iron is the most deficient nutrient.

Iron deficiency is believed to play a role in the pathophysiology of mood disorders and ADHD symptoms (Donfranscesco et al., 2011). The iron deficiency hypothesis of ADHD proposes that iron is a cofactor of enzymes that are essential for the forming and breaking down of neurotransmitters, which are connected to ADHD. Additionally, iron is linked to depressed dopamine and associated with a deficiency in the basal ganglia, which is linked to the pathophysiology of ADHD. Finally, iron deficiency has been found in children with social emotional problems, such as attention problems and hyperactivity (Donfransceco et al., 2011)

Eighty-four percent of children with ADHD have significantly reduced ferritin (marker of iron storage) when compared to eighteen percent of controls (Konofal et al., 2008). Kidd (2000) reports 40% of children with autism have atypical elevations of blood serotonin with lower concentrations being found in some brain regions and others areas being elevated. This demonstrates uneven development of brain networks.

Konofal et al. (2008) investigated the effects of iron supplementation on ADHD symptoms in a double blind, placebo-controlled study with a randomized design. Subjects consisted of 23 outpatient children aged 5-8 years with ADHD. The subjects in the iron supplementation group demonstrated significant improvements on hyperactive/impulsive and inattention scales on the ADHD Rating Scale. Restless leg symptoms also improved in the iron treatment group, but not in the placebo. The small sample size is a limitation of this study.

Cortese et al. (2009) discovered an association between children with ADHD's severity of sleep-wake transition disorders and serum ferritin levels, indicating low ferritin levels may be related to sleep disturbances in ADHD children. Low levels of iron, and severity of ADHD and Restless Legs Syndrome (RLS) were found to be linked (Konofal, et al., 2008). It is believed RLS is comorbid with ADHD. RLS is characterized by the need to move the legs while at rest. Due to this similarity, it is hypothesized RLS and ADHD share similar underlying pathophysiological functioning involving iron metabolism and dopamine (Cortese et al., 2009; Konofal et al., 2008).

Studies on the link between iron and ADHD have investigated the relationship between ADHD symptoms and serum ferritin levels. The results from the research studies on school age children have been mixed, but the majority of studies have demonstrated a relationship. Children from all three subtypes of ADHD have been studied. It is noted that pharmacological treatment with medications can result in a reduced appetite, which may result in the child consuming less foods rich in iron. However, Konofal et al. (2008) subjects were not on stimulant medications and ferritin levels were significantly low, but not anemic at baseline. Research involving ADHD children, not on stimulants, is an area that needs to be explored to determine if medication use is related to decreased serum ferritin levels in children with ADHD. Additionally, studies completed on iron supplementation in ADHD children have provided mixed results, when using rating scales. Teacher's ratings showed limited improvement, whereas parent ratings showed a decrease in ADHD symptoms: it is important to determine why differences occurred and to validate conclusively whether iron is reducing symptoms of ADHD.

Magnesium. Magnesium is found in dark green leafy vegetables, beans, and peas. Dietary intake of magnesium is low in the Western diet. Recent reports indicate that 68% of Americans intake less than the recommended daily allowance (RDA). Processed foods, which are predominant in the Western diet, are low in magnesium. Magnesium is typically taken out of foods when they are processed and tap water used for cooking and drinking.

Magnesium has a structural role in cell membranes and is needed for the movement of potassium, calcium and other ions, this affects the conduction of nerve impulses. Magnesium is involved in over 300 enzymatic reactions (Morris, 1992). Multiple systems in the pathophysiology of depression are associated with magnesium. Magnesium decreases the distribution of adrenocortico-trophic hormone (ACTH) and influences adrenocortical sensitivity to ACTH (Sartori, Whittle, Hetzenauer, & Singewald, 2012). Additionally, magnesium regulates calcium intake into the neuron. If calcium and glutamate levels are increased and magnesium is deficient in brain areas, such as the hippocampus, brain functioning may be interrupted, resulting in depression or other social emotional problems.

Magnesium deficiencies have been linked with depression and stress (Derom, Sayon-Orea, Martinez-Ortega, & Martinez-Gonzalez, 2013). Magnesium may be depleted from the body during stress; thus, children dealing with chronic stress may be at-risk for a magnesium deficiency. Signs of magnesium deficiency include anxiety, muscle spasms, constipation, and insomnia.

There are few studies of magnesium in mental health. The studies on magnesium intake in adults and depression have been contradictory; however, this may be due to the methodology variations between studies. For instance, the subjects used in the studies have been diverse with some studies using inpatients and others using outpatients. Also, some subjects have been on medications and diagnosed with chronic conditions, including diabetes and schizophrenia(Barragan-Rodrigues, Rodrigues-Moran, & Guerreo-Romero, 2008). Researchers have reported limited information on socio-demographics of subjects and used differing measures to assess magnesium levels. The results of cerebrospinal fluid magnesium have differed from the results found using blood magnesium levels. No differences were noted in the cerebrospinal fluid magnesium studies, whereas, serum/plasma studies results were split with half the studies finding an association between depression and magnesium levels and the other half finding no relationship (Derom, Sayon-Orea, Martinez-Ortega, & Martinez-Gonzalez, 2013).

Barragan-Rodriquez, Rodriguez-Moran, and Guerreo-Romero (2008) compared Imipramine to magnesium in a randomized clinical trial. Researchers randomly assigned elderly subjects diagnosed with Type 2 Diabetes, Depression and low serum levels of magnesium to receive either magnesium or Imipramine for twelve-weeks. At the conclusion of the study both groups had improved equally on measures of depression, providing support for magnesium treatment in depressed individuals with magnesium deficiencies. Similarly, researchers using a double-blind randomized study found that supplementation with magnesium, when combined in a herbal formula, decreased anxiety and somatic scores on the Hamilton anxiety scale in 256 patients with mild to moderate generalized anxiety over three months when compared to a placebo (Hanus, Lafon, & Mathieu, (2003).

Jung, Ock, Chung, and Song (2010) found that women with decreased serum magnesium levels had a higher risk of onset of depression. However, another study found higher levels of magnesium in men with depression (Widmer et al., 1993). It is hypothesized there is a narrow therapeutic window for magnesium, which may explain this phenomenon.

Research using animals has provided more consistent results than studies using humans. In mice, a low intake of magnesium increased depression-like behaviors. Also, magnesium supplementation in mice had an antidepressant effect (Singewald, Sinner, Hetzenauer, Sartori, & Murck, 2004).

No studies were found that singled out magnesium in children; however, it has been noted in multi-ingredient micronutrient studies to be low in ADHD and depression (Brue & Oakland, 2002). The research to date on the relationship between magnesium and depression in adults is contradictory and requires more in-depth research. Studies involving children are needed to determine if magnesium is related to social emotional functioning.

Zinc. Zinc is in significant concentrations in brain regions, such as the hippocampus. It is the second most abundant trace metal in the brain next to iron. Zinc is involved in the function of upwards of 100 enzymes and overall brain function. Zinc is found in foods, such as spinach, pumpkin seeds, and nuts. Early manifestations of a zinc deficiency result in mood swings, with depression and impaired cognitive ability (Sawada &Yokoi, 2010). Low zinc is believed to play a role in the pathophysiology of ADHD, autism, and depression. Yasuda and Tsutsui (2013) report the majority of infants with autistic symptoms suffer from a moderate to severe zinc deficiency. Children with ADHD have been shown to have 50% lower zinc levels than children without ADHD (Arnold et al., 2005).

Sawada and Yokoi (2010) investigated whether zinc supplementation improved mood in a double blind, randomized, placebo study. Researchers found a negative relationship between zinc blood levels and severity of depression in females in their late teens, when compared to a placebo. Somatic complaints were marginally reduced as well. This study suggests zinc may be effective in decreasing anger and depression. Similarly, Armani et al. (2010) demonstrated that serum zinc levels are inversely linked to depression scores. If zinc was low in blood levels then depressive symptoms tended to be higher.

A double blind study involving 674 Guatemalan children compared zinc supplementation to a placebo of glucose to determine the efficacy of zinc supplementation on the mental health of school age children (DiGirolamo et al., 2010). Subjects were given a 10 mg zinc supplement or a placebo (10 mg glucose) for 6-months. The zinc-supplemented group was not significantly different from that of the placebo on measures of externalizing problems (i.e., hyperactivity and conduct disorder). However, decreases in internalizing problems, including anxiety, depression, and social skills were seen as zinc concentrations rose in a sample of children with a zinc deficiency.

Zinc increases serotonin and has been shown to have an antidepressant effect (Nowak et al., 2003). Additionally, when zinc is augmented with an antidepressant the efficacy of the antidepressant is increased in patients who are resistant to antidepressant treatments (Nowak et al., 2003). It is hypothesized low zinc levels are the result of a poor diet in depressed individuals, not the causative factor. Regardless, zinc can augment antidepressant medication and improve the course of depression due to its ability to enhance the speed and strength of psychotropic drugs.

Zinc deficiency is believed to be associated with ADHD symptoms. Sarris, Kean, Schweitzer, and Lake (2011) report studies involving zinc supplementation and ADHD demonstrate positive findings. Zinc is fundamental in the development and regulation of melatonin, which aides in dopamine functioning. Dopamine function is a significant component in ADHD and treatment considerations (Akhondzadeh, Mohammadi, & Khademi, 2004).

Bilici et al. (2004) conducted a double-blind treatment using zinc sulfate and a placebo to determine the efficacy of zinc sulfate on ADHD symptoms using the Conners Teacher Questionnaire, and Du Paul Parent Rating scales. The zinc sulfate group had significantly reduced hyperactive, impulsive, and impaired socialization symptoms in children with ADHD; however, zinc sulfate was only effective in children with a high BMI score coupled with decreased zinc and fatty acid levels.

In a study, which compared two groups of children one group who received Ritalin and a second group that received zinc combined with Ritalin, the subjects who received zinc with Ritalin scored better on Attention Deficit Hyperactivity Disorder scales (Loscalzo, 2004). In a 6-week, placebo, double blind study researchers used 44 outpatient children ages 5-11 to determine the effects of zinc coupled with methylphenidate to treat children with ADHD (Akhondzadeh, Mohammadi, & Khademi, 2004). Parent and Teacher Rating scores improved in the zinc sulfate group. Limitations to this study included lack of full placebo group, small number of participants, and lack of serum plasma levels.

Studies suggest ADHD children with zinc deficiency may benefit from changes in nutrient intake or zinc supplementation. Improvements were noted when using zinc as an adjunctive therapy to stimulate medication in both ADHD and depression. This may be due to an association between zinc deficiency and pathophysiology of ADHD and low intake of food high in zinc, thus zinc may be beneficial in the treatment of ADHD and depression, but additional studies are needed in this area.

Multi-Ingredient Formulas

Micronutrients (vitamins and minerals) are part of enzymatic reactions that are involved in the synthesis and metabolism of neurotransmitters (Shaw, Rucklidge, & Hughes, 2010). If deficiencies or depletions occur this may result in deficiencies of neurotransmitters needed for optimal brain functioning. Research has shown that adding vitamins and minerals, such as zinc, iron, and omega-3 supplements to the diets of individuals suffering from mental health problems improved their social emotional functioning (Kaplan, Fisher, Crawford, Field, & Kolb, 2004; Shaw, Rucklidge, & Hughes, 2010). Multiple examples of single-nutrient supplementation have been presented, demonstrating the relationship between B vitamins, magnesium, essential fatty acids, iron, and vitamin C and mental health functioning. It is hypothesized that in multi-ingredient supplementation the nutrients work together in the central nervous system. It is believed that by giving an assortment of micronutrients several deficiencies will be corrected and result in optimal brain functioning (Kaplan & Scott, 2007).

Children with autism have multiple deficiencies to many vitamins and minerals. Xia et al. (2010) assert children with autism prefer a “sameness” of food items that limits their nutrient intake. This results in limited dietary intakes of calcium, vitamin D, vitamin B6, folic acid, and pantothenic. Children with autism have digestion problems, approximately 25% have constipation, and 25% have frequent diarrhea. Beneficial bacteria may be reduced in the intestines due to antibiotic treatment for food-allergy related ear infections. Autistic children typically produce less vitamins; therefore, many are deficit and need a micronutrient supplement such as EMPowerplus. However, copper supplementation should be avoided since there is an excessive amount of it found in children with autism.

In the past, researchers tried to treat ADHD with mega does of vitamins, including vitamin C, pyridoxine, niacin, sometimes in an excess of 100 times the recommended daily intake (Shaw, Rucklidge, & Hughes, 2010). These studies yielded minimal positive results, which are thought to be due to the high dosage level and the limited trials for evaluating the effects on ADHD symptoms. Studies in the last 13-years have shown positive results, which may be due to the combination of micronutrients and lower dosage levels.

EMPowerplus contains 14 vitamins, 3 amino acids, 16 minerals, and 3 antioxidants and has been proven to improve psychological symptoms. Kaplan et al. (2004) reduced psychiatric symptoms in children with behavioral disorders by introducing EMPowerplus for eight weeks. Six out the eleven children given the broad-based nutrient formula showed significant improvements. The findings of the study demonstrated improvement on attention, anxiety, delinquency, mood, and aggression. However, it should be noted that the sample size was small and parents gave ratings on all the outcome measures (Kaplan et al.) Rucklidge, Gately,and Kaplan (2010) found similar significant improvements in 120 children (7-18) with pediatric bipolar disorder (PBD) and ADHD and an alternative sample of 41 children with just ADHD, who were given EMPowerplus for 6-months. The symptom decrease for the entire sample (120 children) was a 59% reduction on the symptom checklist based on the median score.

A study on the nutrient status of children with autism, found over half demonstrated low amounts of vitamins B_1, B_3, B_5, A and biotin (O'Hare & Szakacs, 2008). Minerals such as zinc and magnesium were low, as well as, amino acids and essential fatty acids. Improvement in language and behavior in children with autism have been noted when vitamin B6 and magnesium have been combined and supplemented. Vitamin B6 is essential for neurotransmitters such as serotonin, gamma-amino-butyric (GABA), dopamine, epinephrine and norepinephrine (Kidd, 2003).

Mehl-Madrona et al. (2010) found that core symptoms of autism improved when children with autism were given micronutrients. Using both the Childhood Autism Rating Scale and the Childhood Psychiatric Rating Scale significant decreases were found in aberrant Behavior Checklist scores. The micronutrient group had significantly lower self-injurious behaviors. Additional micronutrient treatment advantages included: decreased anger, lower irritability, and decreased social withdrawal.

Other Nutritional Compounds

It is recommended that foods containing refined sugar be reduced or taken out of children's diets. Refined sugar does not contain nutrients except for carbohydrates. When sugar is processed it loses minerals such as chromium, manganese, zinc, and magnesium. The body must then use its reserves of minerals to digest the sugar. Depletion of important nutrients that are responsible for regulating chemical processes does not allow the nutrients to prevent anxiety and depression.

It is important to have blood sugar levels remain stable by limiting the child's sugar intake. Sugared foods result in blood-sugar changes that can cause anxiety symptoms. If a sugary diet is eaten for long periods of time the pancreas, which is involved in blood-sugar stabilization, can become damaged. If the pancreas is weakened it will not be able to regulate the sugar in the blood. When refined sugar is eaten it results in a spike and drop in blood sugar levels, this blood sugar cycle can result in anxiety, irritability and nervousness. Additionally, sugar intake can result in heightened lactate in the blood, which may result in anxiety and even panic attacks. Anxiety may also be due to a sensitivity to lactate.

Werbach (1991) reported that in a study of fourteen children given the sugar equivalent of two frosted cupcakes for breakfast all subjects experienced a blood adrenalin level of 10 times their baseline levels. In adults tested, a significant rise was not observed. This study claims that children may experience increased anxiety, irritability, and impaired concentration after intake of a sugary breakfast. Caffeine, food sensitivities and low levels of vitamins and minerals can result in high lactate levels as well. It is recommended children eat minimally processed foods, small amounts of sugar, and drink fresh water.

Dietary Sensitivities and Allergies

Dietary sensitivities and allergies have been around since the 1920s. Dietary interventions for sensitivities and allergies include special diets with restriction diets being the most popular. Feingold's diet, which restricted salicylate and additives, is the most controversial. Feingold reported that by eliminating salicylate and additives from hyperactive and learning disabled children 50% of subjects improved (1976).

Some children with ADHD and autism have allergies and/or are sensitive to certain foods and show significant gains with dietary interventions. Thus, modifying a child's diet may aide in the efficacy of other treatments. Children with autism have been shown to have sensitivities to casein and gluten (Carton, 2005). This may be due to an inability to digest certain foods, which results in a byproduct that acts similar to an opiate (Hecht, 2003). Responses to removal of gluten and casein are individualized with some children showing dramatic results in days and others taking weeks to show progress. When children have sensitivities to foods, and the food is removed, symptom reduction in aggressive behavior, tantrums, and self-stimulating behaviors are seen (Hecht, 2003). Additionally, language, sleep, eczema, attention and social skills may improve (Xia, Zhou, Sun, Wang, & Wu, 2010).

Casein sensitivity symptoms include eczema, ear infections, and respiratory disorders that resemble asthma (Kidd, 2000). There is a link between autism symptoms and the lack of ability to digest food containing dairy and wheat (Hecht, 2003). The opioid excess theory suggests that peptides that are not completely digested result in autism symptoms due to the accumulation of molecules that are small enough to pass the blood brain barrier. The molecules cause opioid effects on the brain. Evidence for this theory has been found in the urine and cerebro-spinal fluid of autistic children (Kidd, 2003). Additional confirmation is found in the gastrointestinal symptoms that are present in most autistic children (O'Hare & Szakacs, 2008). These gastrointestinal problems are only relieved by taking casein and gluten out of the child's diet. However, critiques report the opioid-effect hypothesis is speculative and lacks data to support it (Levy & Hyman, 2005). It is argued that placing dietary restrictions on a population that is typically food selective could result in further nutrient deficiencies (Levy & Hyman)

Elder et al. (2006) tested the effectiveness of a gluten and casein free diet in children with autism. The subjects were 15 children diagnosed with autism 2-16 years-old. Urinary peptide levels and autistic symptoms were used as data during the 12-week study. This study found no significant differences as the result of a gluten and casein free diet on autistic symptoms, even though parents reported subtle improvements in language and behavior skills that may not have been measured by the instruments used. However, Kidd (2003) reports 80% of autistic children demonstrated improved behavior problems and seizures after a regimented dietary exclusion of casein and gluten was initiated. In addition, improvements were noted in gross motor, social contact, eye contact and ritualistic behaviors. Similarly, O'Hare and Szakes (2008) contend 66% of autistic children improve with a gluten and casein free diet.

Research reports Attention Deficit Hyperactivity Disorder may be due to genetic influences, which result in lower levels of dopamine and serotonin (Sarris, Kean, Schweitzer & Lake, 2011). In addition, exposure to harmful substances during prenatal, perinatal, postnatal and early childhood may result in Attention Deficit Hyperactivity Disorder. In utero exposure to drugs and excessive amounts of alcohol is associated with an increased chance of Attention Deficit Hyperactivity Disorder. Food sensitivities and allergies are typical in children with ADHD. Research shows that 25 to 50 percent of attention deficit disordered children have sensitivities to foods and show dramatic improvements when the foods are removed. Schnoll, Burshteyn and Cea-Aravena (2003) assert nutritional components such as food sensitivities, additives, and sugars have been associated with Attention Deficit Hyperactivity Disorder since the 1970's. A central component contributing to Attention Deficit Hyperactivity Disorder symptoms is lack of adequate nutrition.

The most controversial research related to artificial food colors, flavorings, preservatives, and naturally occurring salicylates came from Dr. Feingold (Feingold, 1976). In a review of research pertaining to the Feingold diet, Mattes Kavale, and Forness found it was of no value and only helped a few children decrease hyperactivity (Rimland, 1983). However, other researchers disagree (Rimland, 1983). Reportedly, such a conclusion is not acceptable and an arbitrary negative conclusion. Rimland asserts that the studies reviewed had very small dosage levels of colorings and failed to recognize the role of the subject's nutritional status. The Feingold diet may work for some children; however, it is not a cure all and does not work for all children. Additionally, most studies have only excluded a small number of colorings instead of the 3,000 additives in the Feingold proposal; therefore an actual legitimate comparison has not been made. Feingold is considered a pioneer, by some, for recognizing the nutrition and dietary sensitivity connection to behavioral problems. However, other researchers report his findings have not been replicated and lack reliability.

Research has indicated that an oligoantigenic diet can decrease hyperactive behavior by 24% (Brue & Oakland, 2010). Egger (1985) studied 76 ADHD children on an oligoantigenic diet. An oligoantigenic diet is one in which only a few foods may be consumed. Egger found that ADHD symptoms improved in 62 subjects. Egger then used 28 of the children who had shown ADHD symptom improvements to further test his results using a double blind study. Egger placed the 28 subjects on one of two kinds of drinks; either a drink that contained an allergic food or a drink without the allergen. The children who received the drink with the allergen, behavior problems returned, whereas the children without the allergens, behavior showed no regression. It was found that artificial colors, wheat, dairy, and soy lead to the most behavior problems.

Research indicates desensitization treatment is also an effective treatment for Attention Deficit Hyperactivity Disorder. Children respond favorable to dietary changes when used to desensitization. Carter (1993) found that 59 out of 78 children's behavioral symptoms improved in a desensitization study. Following this study, Carter placed his subjects in a double-blind study, which demonstrated that allergenic food resulted in an increase in behaviors, whereas the placebo did not. In a study by Boris (1994) a multiple food elimination diet was used. Improvements were noted in 19 out of 26 Attention Deficit Hyperactivity Disorder children.

Studies reveal that avoidance of artificial colors, flavors, and preservatives is effective in decreasing ADHD symptoms (Sarris, Kean, Schweitzer, & Lake, 2011). Bateman (2004) gave 273 hyperactive children one of two drinks. One drink contained food coloring and sodium benzoate, which is a common preservative. The placebo only contained juice. The students who had the artificially colored drink with sodium benzoate had increased hyperactivity. Reportedly, a different set of typical children were given drinks with artificial components. Results showed increased hyperactive behaviors in typical children (Brue & Oakland, 2002). England and the European Union have asked for a ban on six food colorings, indirectly validating the food colorings may be detrimental to health and/or mental health. Research on food dyes has not been conclusive. Again, parent rating scales showed decreases in aberrant behaviors when children did not have dyes, but teacher rating scales did not change. Additionally, another study on the ingestion of dyes showed only a small change in behavior following the dye ingestion (Brue & Oakland, 2002).

Diet Patterns

Research has demonstrated a link between the intake of specific nutrients, including, iron, essential fatty acids, B vitamins, and zinc, along with single food groups such as fish consumption and depression (Quirk, Williams, O'Neil, Pasco, Jacka, Housed, Berk, & Brennan, 2013). Due to the complexity of nutrient intake it may be related to more than a single nutrient or food group. Moreover, nutrient intake and its effect on mood may be linked to diet patterns.

Diet patterns have been assessed concerning anxiety and depression. Australian women had lower rates of anxiety disorder, depression, and dysthymia if they scored higher on a healthy dietary pattern, including lean red meats, vegetables, fruits, fish. The "Western diet" (i.e., pizza, salty snacks, sugars, sweets, soft drinks, margarine, and fried foods) pattern was linked with higher levels of depression and an increased likelihood of anxiety (Sarris, Moylen, & Camfield, 2012).

Quirk, et al. (2013) conducted a systematic review to assess the link between diet patterns and depression. This review produced inconclusive findings due to methodology issues. Eleven of the studies demonstrated that an increased adherence to a healthy diet was associated with decreased depression scores; however, five of the studies showed no association. The studies differed in how "healthy diet" was defined and used a wide variety of instruments to measure diet quality and patterns. Additionally, depression was measured in various ways with different instruments. For example, some studies used self-report, whereas others used only a formal diagnosis. Quirk et al. (2013) assert that this is the first review to explore associations between diet quality and depression. Future studies should consider a standard definition for diet quality and patterns to improve future research in this area.

While rigorous studies are currently limited, evidence is emerging to support adopting a diet with increased lean protein, complex carbohydrates, fruit, and vegetables. Refined carbohydrates, saturated fats, and processed foods should be avoided. Presently, no clinical trials have been done to demonstrate the effect of a healthy diet compared to a control, to determine if dietary change is effective in combating anxiety.

Parental Education

Socioeconomic factors, including education level and income affect eating patterns such as the quality of the food eaten and eating at restaurants. Education, especially knowledge of nutrition, affects eating behavior. Higher education levels are also linked with better health and longevity (Cutler et al., 2008). It is argued that due to increased knowledge and skills individuals lead a healthier lifestyle. Additionally, higher levels of education may be related to better psychosocial attributes that enable the individual to deal with stress more effectively (Saroni, 2013).

Research to document the relationship between higher education and mental health is limited. Sironi (2013), using information from the European Social Survey, administered in 2006 in 24 countries, found a significant relationship between the attainment of higher education and better mental health. Sironi reported that every additional year of education lowered the mental ill-health score by 0.6 percent. Additionally, individuals with secondary or tertiary education had a 7 percent lower score. This suggests, that attaining a higher education may have benefits to mental health disorders such as depression. Similar results were reported in studies conducted in Spain, Britain, and the United Kingdom in regards to educational attainment and depression (Chevalier & Feinstein, 2007; Costa-Fon & Gil, 2006) However, Johansson et al. (2009) reported education length was not related to mental health problems in Finland.

Breast Feeding

The gestation period and the first three years of a children's life are crucial to the development of the brain. The mother's diet is connected with the infant's birth weight. Infants who are born full-term and healthy have advantages in cognitive and physical domains over infants who are low-weight or unhealthy (Ryrie, Cornah & Vandeweyer, 2006). Differences between those infants born full term and low birth weight premature infants have been found in intelligence quotients and language ability. Infants who are born with low birth weight may exhibit decreased alertness and be less cooperative than typical weight infants (Ryrie, Cornah & Vandeweyer, 2006).

Research has shown that infants who are breast-fed have neurological advantages over those who were not (Tomlinson, Wilkinson, & Wilkinson, 2009). Also, the duration of breast-feeding has been linked to cognitive development in children (Smith, 2003). This is believed to be due to the higher consumption of essential fatty acids through the mother's breast milk. Additionally, infants who are breast-fed have less infections compared to those who are formula-fed. Julvez et al. (2007) investigated the effects of breast-feeding on behavior, including executive function, social competence, attention, and hyperactivity, using the California Preschool Social Competence Scale and McCarthy Test. Results indicated long-term breast feeding (22.9-weeks) was related to less attention and hyperactivity symptoms with an increase in neuropsychological and socio-behavioral outcomes.

Body Mass Index

Obesity in the United States has risen from 7% in 1980 to 20% in 2008 in children aged 6 to 11 years. Obesity is a chronic condition that begins early in life and continues into adulthood and causes adverse health effects. It is a significant concern, especially in children due to the higher risk of not only medical issues, but psychiatric problems as well (Phillips et al., 2012). The most common measure of obesity is body mass index (), which, is calculated by dividing a person weight by the person's height and squaring the sum. Research has shown obesity is related to parental education and socioeconomic status. Additionally, depression during childhood is hypothesized to be a causative factor in obesity with research corroborating it is a contributing factor to obesity in adulthood.

Benson, Williams, and Novick (2012) investigated whether a correlation exists between depression and obese body mass index (BMI) in 117 children aged 7 to 17 years old, using the Children Depression Index (CDI). A correlation between depression and higher BMI was not found. Park et al. (2009) also found that prevalence of depressive symptoms was not affected by BMI in 2,503 elementary students.

Phillips et al. investigated a large clinic based sample (n=249) of children aged 6-years to 17-years that were greater than the 95th percentile of obese. The extremely obese

(99th percentile and above) end of the BMI spectrum children had increased levels across the psychosocial variables. However, limitations of this study included not being able to determine conclusively if obesity worsens psychosocial issues or psychosocial issues worsen obesity. Additionally, a clinic sample was used; therefore, there may be an increased rate of psychological problems than would be found in a community based sample.

Research pertaining to BMI and psychosocial functioning is inconclusive. Some research indicates an association between BMI at the extreme end of the BMI spectrum and internalizing problems (Phillips et al., 2012). However, other studies have found no relationship. Phillips et al., asserts that studies that use large community samples have insignificant results due to the number of children who are classified as obese being too small. However, using a clinical sample increases bias as well. Thus, it appears there is not consistent evidence that BMI is related to social emotional functioning.

Genetic Influences of Mental Health

A broad range of research, including twin, family and adoption studies corroborates genetic influences on the etiology of internalizing disorders (Kendler, Myers, Maes, & Keyes, 2011). Studies have discovered a moderate relationship between heritability and mental health. Kendler et al. 2010 found a significant amount of the inverse relationship between internalizing psychopathology and mental well-being was from genetic factors. This statement means it is harder to achieve increased levels of well-being if an individual inherits genetic risk factors such as anxiety and depression, but not impossible. Twin studies indicate genetic influences play an important part in familial aggregation of anxiety and depression, with heritability estimates of 30-60% for depression, 28-50% for social phobia, 30-40% for panic disorder, and 30-40% for agoraphobia (Mosling et al., 2009).

Socio-economic Status

Socioeconomic status (SES) is a significant indicator of health and mortality. Risky health behaviors such as smoking, lack of exercise, and obesity are linked with low socioeconomic status (Lantz, House, Lepkowski, Williams, Mero, & Chen, 1998). Research indicates nutrient intake that is similar to the recommended dietary guidelines is typically found in individuals with higher education and higher socioeconomic status (Raffensperger et al., 2010). Individuals with higher socioeconomic status have lower intakes of fat and sugar and increased amounts of fruits and vegetables. Shahar, Shai, Vardi, Avner, and Fraser (2005) interviewed 206 participants from the high SES and 206 from low SES to determine eating habits in relation to SES. Researchers found participants in the low SES group were older, more obese, less educated, and engaged in less physical activity. A cause for the difference was not found, which provided grounds for additional research. However, Raffensperger et al., (2010) report nutrient intake differences in socioeconomic status are due to food availability, selection, preparation, and culture. Education was found to be the most significant predictor of diet quality.

Langevin et al., (2007) conducted a cross-sectional study to investigate weight status and diet quality in 248 low-income urban children, aged 7 to 13 years. Results showed these low-income urban children were "at risk," based on the high percentage who were overweight (36%). Furthermore, 75% of the participants did not meet recommended servings of fruits, vegetables, grains, and dairy. Thus, children living in low-income households are more "at risk" for obesity and insufficient micronutrient intake.

Summary

In chapter 2, I reviewed the current pertinent literature related to nutrient intake/health indicators and social emotional functioning. The information highlighted the various theories related to nutrient intake, nutrient deficiencies, diet patterns, dietary sensitivities, and other nutritional components. I also covered research related to health indicators, including genetic influences of mental health, body mass index, breastfeeding, and parental education.

Further in-depth exploration is warranted to examine the link between nutrient intake and social emotional functioning. Methodology shortcomings and differences in measurement instruments render the research inconclusive. A link between dietary deficits and social emotional functioning is promising; however the research is scarce and needs to be expanded upon. In chapter 3, I will provide information on how this quantitative study was performed, the identification of participants, measurement instruments, and details of the research methodology that was used.

Chapter 3: Research Methods

Introduction

This research focused on dietary practices and whether there was a relationship between diet quality and variables, including depression, hyperactivity, aggression, anxiety, somatization, atypicality, withdrawal, and attention problems in children aged 3 to 5-years-old. This chapter explains the research design, sample and population, measurement, data collection, and statistical analysis.

Data Analysis Plan

This quantitative study was designed to determine if nutrient intake and health indicators affect social emotional functioning in preschool school children. The statistical data was analyzed using the SPSS 18.0 software package. Research questions were evaluated by looking at the relationship between diet/health indicators and the eight subscales of a measure of social emotional functioning: (1) depression, (2) hyperactivity, (3) aggression, (4) anxiety, (5) somatization, (6) atypicality, (7) withdrawal, and (8) attention. Multiple regression analyses were used to determine if variables related to health and diet quality predicted these social emotional variables. Intake of fruit and vegetables (as measured by the number and amount of fruits and vegetables consumed by the child and reported by parents over a three-day period) was one predictor variable related to diet quality; the other was processed food (measured in an identical manner to fruit and vegetable consumption). Additional health-related predictor variables were BMI, family history of mental disorders, education levels of parents, socioeconomic status, and whether the child was breastfed.

Research Questions

RQ1: Is the consumption of processed foods, as measured by a 3-day diet record, a significant predictor social emotional functioning (anxiety, depression, hyperactivity, aggression, somatization, atypicality, withdrawal, and attention), as measured by the BASC-2, PRS-P?

H1: Consumption of processed foods, as measured by a 3-day diet record, is a significant predictor of social emotional functioning.

HO: Consumption of processed foods as measured by a 3-day diet record is not a significant predictor of social emotional functioning.

RQ2: Is consumption of fruits and vegetables, as measured by a 3-day diet record, a significant predictor of social emotional functioning (anxiety, depression, hyperactivity, aggression, somatization, atypicality, withdrawal, and attention) as measured by the BASC-2, PRS-P?

H2: Consumption of fruits and vegetables as measured by a 3-day diet record is a significant predictor of social emotional functioning.

HO: Consumption of fruits and vegetables as measured by a 3-day diet record is not a significant predictor of social emotional functioning.

RQ3: Is Body Mass Index (BMI) a significant predictor of social emotional functioning?

H3: BMI is a significant predictor of social emotional functioning.

HO: BMI is not a significant predictor of social emotional functioning in children.

RQ4: Is family history of mental illness a predictor of social emotional functioning?

H4: Family history of mental illness is a significant predictor of social emotional functioning.

HO: Family history of mental illness is a not significant predictor of social emotional functioning.

RQ5: Is breast feeding a significant predictor of social emotional functioning:

H5: Breast feeding is a significant predictor of social emotional functioning.

HO: Breast feeding is not a significant predictor of social emotional functioning.

RQ6: Is parent education level a significant predictor of social emotional functioning?

H6: Parent education is a significant predictor of social emotional functioning.

HO: Parent education is not a significant predictor of social emotional functioning.

RQ7: Is socioeconomic status a significant predictor of social emotional functioning?

H7: Socioeconomic status is a significant predictor of social emotional functioning.

HO: Socioeconomic status is not a significant predictor of social emotional functioning.

Population

The target population consisted of parents of children aged 3-5 years with and without preexisting disorders. Existing disorders may include: ADHD, Autism, Anxiety, Depression, and Developmental Delays. Whether the child had an existing disorder was determined by the BASC-2 Structured History form. The structured history asks questions pertaining to whether the child has had neurological and psychological exams. If the questions are answered yes, further questions are asked concerning the reason for the exam.

The Walden University participant pool, local development centers (Hiersteiner Center, Pediatric Connection, Playabilities), and the researcher's website were used to recruit participants. The Hiersteiner development center is located on a community college campus and is for students who take classes at the community college to use to help with their educational pursuits. The researcher's website is for public use for parents in need of holistic services, including yoga and behavioral nutrition for their children with behavior problems. The participants were male and female and from all ethnicities.

A power analysis completed using the G Power 3.1.7 software package, with an alpha level of .01 and seven predictors variables (fruits/vegetables, processed food, breast feeding, parental education, parental history of mental disorders, socioeconomic status, and BMI) recommends a sample size of 109, given a predicted effect size of .15. However, Tabachnick and Fidell (1989) recommend in their multivariate text, using a minimal number of participants for each predictor to determine appropriate power. For a regression analysis, using seven predictor variables (fruits/vegetables, processed food, breast feeding, parental education, parental history of mental disorders, socioeconomic status, and BMI) it is suggested that the researcher use a sample size that is 20 times the number of predictor variables. Green (1991) asserts due to the width of errors of estimating correlation with samples that are small, power will be inadequately low if less than 100 cases are used. This study was completed with a target *n* of 120, which provided sufficient power an alpha level of .01. This study used a .01 alpha level due to the possibility of an inflated alpha level with running eight separate multiple regression analyses using the same variables. In addition, to using a more conservative alpha level if the study does find a significant predictor one way to assess it is to examine the effect size. If the effect size is small it may be type I error.

The parents of a child between the ages of 3 to 5-years-old were included in the study. Subjects were excluded from participation if the child was on a medically restrictive diet or receiving long-term medical care that required a feeding apparatus. The exclusion criteria pertained to children whose medical care interfered with their diet. For example, a child receiving cancer treatment or a child with severe food allergies depending on the type of allergy and how it impacts diet, were excluded due to the illness having the potential to affect results of the study. The BASC-2 structured history form was examined for possible exclusions that impeded results of the study (Reynolds & Kamphaus, 1992).

Procedures for Recruitment and Participation

After Internal Review Board (IRB) permission was granted, a notice discussing the study was distributed to recruit participants (see Appendix A). Participants were recruited through the researchers professional website, Walden University participant pool, and through a local child development centers. The parents met with the researcher in a group setting to discuss the purpose of the study and to give their informed consent

Instrumentation and Operationalization of Constructs

The Behavior Assessment System for Children, Second Edition

The Behavior Assessment System for Children, Second Edition (BASC-2) is a multidimensional system that evaluates the behavior of children and young adults aged 2 through 25 years (Reynolds & Kamphaus, 2004). The BASC-2 assesses multiple aspects of behavior and personality such as positive (adaptive) as well as negative (clinical). The BASC-2 was developed to facilitate the differential diagnosis and educational classification of a multitude of emotional and behavior disorders of children and to help develop treatment plans. When given individually, the BASC-2, assessments are reliable and psychometrically complex tools that yield a significant amount of data.

The Parent Rating Scale-Preschool (PRS-P) is a subcomponent of the BASC-2. For this study, the following scales were used: Depression, Aggression, Anxiety, Somatization, Atypicality, Withdrawal, Hyperactivity, and Attention Problems. The PRS-P is a comprehensive assessment of a child's adaptive and problem behaviors across settings. The PRS-P targets children aged 2 through 5. The PRS-P contains descriptors of 134 behaviors that the parent rates on a four-point scale of frequency, ranging from *Never* to *Almost Always*. Reynolds and Kamphaus (2004) estimate completion time to be 10 to 20 minutes. The PRS-P is written at a fourth-grade reading level, and is available in Spanish and English. Results are provided in the form of T scores (M=50; SD=10) for eight clinical scales (i.e. Depression Aggression, Anxiety, Somatization, Atypicality, Withdrawal, and Attention Problems).

The PRS-P measures the wide domains of Externalizing Problems, Internalizing Problems, and Adaptive Skills. The primary scales include: Adaptability, Activities of Daily Living, Aggression, Anxiety, Attention Problems, Atypicality, Depression, Functional Communication, Hyperactivity, Social Skills, Somatization, and Withdrawal. Additionally, the PRS-P yields an overall composite, the Behavioral Symptoms Index (BSI), which measures the overall level of problem behaviors. The Behavioral Symptoms Index consists of the Hyperactivity, Aggression, Depression, Attention Problems, Atypicality, and Withdrawal Scales, and reflects the overall level of problem behavior. This scale acts in much the same way as the DSM-IV Global Assessment of Functioning (GAF) code. The BSI estimates the general level of functioning or the presence of a significant impairment for an individual with a disability or diagnosed condition.

The PRS-P includes three validity indexes (e.g., F index, Consistency Index, and Response Pattern Index). The F Index ("faking bad") is designed to detect a negative response on the part of the parent doing the rating. The Response Pattern Index identifies forms that may be invalid due to the parent disregarding the content of the items. The Consistency Index identifies forms whose responses are not consistent. Also, critical items that may deserve additional attention may be interpreted individually.

Two types of normative scores are given for each scale: T scores and percentiles. T scores show the distance of scores from the norm-group mean. T scores are standard scores with an average of 50 and a standard deviation of 10. For example, a T score of 70 indicates a score is two standard deviations above the mean. Reynolds and Kamphaus (2004) reported 500 two- and three-year-olds and 700 four-and five-year-old were used to form norms for the PRS-P

Forms are scored using the BASC-2 ASSIST Plus computer software program and report PRS-P results. The computer program provides profiles, computes validity indexes, and identifies strengths and weaknesses.

Internal Consistency on the PRS-P for the General norm samples for the individual scores is high. The median values range from .80 to .83 on the PRS-P. Hyperactivity, Attention Problems, Social Skills, and Functional Communication scales have the highest reliabilities across age levels (Reynolds & Kamphaus, 2004). Coefficient alpha reliabilities of scales for ages 2-3 using the General norm sample were as follows: .83 for Hyperactivity, .78 for Aggression, .77 for Anxiety, .78 for Depression, .79 for Somatization, .77 for Atypicality, .82 for Withdrawal, and .86 for Attention Problems. For ages 4-5 General norm combined sex coefficient alpha reliabilities of scales were as follows: .85 for Hyperactivity, .84 for Aggression, .81 for Anxiety, .80 for Depression, .79 for Somatization, .75 for Atypicality, .83 for Withdrawal, and .87 for Attention Problems.

Test-retest reliability was determined by having the parent or caregiver rate a child twice during an interval of time ranging from 9 to 70 days. For the individual PRS scales the median test-retest reliabilities are .77 (Reynolds & Kamphaus, 2004).

Interrater reliability was evaluated for the PRS, which is the agreement of scores from different parents or caregivers who gave ratings at about the same time. The median interrater reliability for the PRS-P is .74.

Validity of the PRS-P was assessed by three methods. The first method consisted of scale intercorrelations and factor analysis for the groupings of scales into composites. The second method of validity assessment looked at patterns of correlations of the PRS composite and scale score with scores obtained from other measures. The final measure of validity used PRS score profiles of groups of children with specific clinical diagnoses or education classifications.

Multiple studies were conducted to correlate the PRS with other behavior rating scales (Reynolds & Kamphaus, 2004). The PRS and the Achenbach System of Empirically Based Assessment (ASEBA) Child Behavior Checklist for children aged 2 to 5 was completed on 53 children (Achenbach & Rescorla, 2000). The average PRS scores demonstrate that the samples approach average in their degrees of behavior problems. The PRS and ASEBA composites and scales with similar names correlate highly. Correlations between the Behavior Symptom Index (overall PRS score) and the ASEBA Total Problems range from .73 to .84. The Internalizing Problems are slightly lower with correlations ranging from .65 to .75. At the scale level, correlations were moderate to high, including the aggression scales of both measures range from .67 to .77 with the attention problems scales demonstrating a similar relationship (Reynolds & Kamphaus, 2004).

Three-Day Diet Record

A 3-day diet record was completed by the parent or caregiver regarding their child's diet by recording dietary intake for two consecutive weekdays followed by one consecutive typical weekend day (e.g. Thursday, Friday, Saturday or Sunday, Monday, Tuesday) that was representative of their child's normal intake. Studies concluded a 3-day record should be used instead of a 7-day diet record due to the quality of the record decreasing over the number of days recorded and 3-day diet records are more appropriate for studies with moderate to large participants (Bergman, Boyungs, & Erickson, 1990).

Parents attended a 30-minute group training session to familiarize them with the procedures described below for completing a 3-day diet record using the Food Prodigy (ESHA Research, Salem, OR, 1995). The Food Prodigy is the online companion to The Food Processor. The Food Prodigy allowed participants to document their children's diets for 3-days from their personal computer. Dietary intake is organized by day and meal and averaged over three-days. In addition, a handout with instructions on how to enter the child's 3-day diet record in the Food Prodigy via the internet was given to each parent.

A profile containing personal information was added to the Food Prodigy by the parent at the group training section. Personal information consisted of gender, activity level, age, height, and weight. Participants were instructed to prompt the program to search for specific food items then enter the selected food into a list. The participant typed the food or drink they have eaten in the search box and press enter or click the search button. This opens the select recipe or ingredient window. The participant scrolled down and selected the item that best described what they have eaten or drank by double clicking or highlighting and clicking select. After the food was selected the cursor automatically appeared in the quantity box. The participant selected a quantity from the list, press tab, and selected day one, day two, or day three. Next the meal, such as breakfast, lunch, or dinner was selected. Once an item was entered the cursor reappeared in the "search for" box, ready for the next item to be entered. The subject continued to enter the remaining items in the same manner. Different days were added by selecting "add day" and then selecting the correct day folder and appropriate meal folder on the "modify food item" screen. Items could be copied and dragged to other days by holding down the control key and dragging the item to the day and meal folder. Diet recalls were saved often by clicking on the save button.

The record was sent to the researcher by clicking the send e-mail tab at the bottom of the analysis page. The investigator used the Food Processor SQL and Food Prodigy Nutrition and Fitness Software (ESHA Research, Salem, OR, 1995) to analyze the 3-day diet record to assess the quantity of specific nutritional dietary intake of processed foods and fruits and vegetables. Each of the 163 nutritional components was individually sourced. Quantity of specific nutrients was measured in grams, international units, milligrams, and micrograms. In addition, the Food Processor provided several calculated fields, such as the percent of calories from fat and niacin equivalents. Food was grouped into detailed food categories that yielded the ounces or cups of fruits and vegetables eaten over the 3-day diet record. Body Mass Index (BMI) was calculated by the Food Processor SQL and Food Prodigy Nutrition and Fitness Software.

Data Collection

A 20-minute tutorial was given and parents were allowed to complete the BASC-2, PRS-P. Parents were instructed on how to complete the parent rating scale-preschool. Following the instructions parents were given 20 minutes to complete the PRS-P. Parents were read the following directions.

"As part of this research study, I have forms for you, the child's parent, to complete. I am asking that you complete the forms and return them to me. The BASC-2 rating forms ask questions about your child's overall social, emotional, and behavioral functioning. The PRS-P will take 10 to 20 minutes to complete. Look at the directions at the top of the PRS-P. Rate your child on the four-point scale of frequency, ranging from *Never* to *Almost Always.* Please note that a response of "Never" does not indicate that the respective item is never true, only that you have never witnessed that specific behavior. "

Parents met with the researcher for an additional 20 minutes in a group setting and received the following directions on how to develop a profile on the Food Prodigy.

"Launch the Food Prodigy program. Click on the person icon and select New. In the First Name field, type your child's first name, in the Last Name field, type your child's last name. In the Age field, type your child's age. Under Gender, select either male or female. Under Activity level, select your child's activity level. In the Height field, type your child's height in feet and inches. In the Weight field, type your child's weight in pounds. Enter a user code. Select English. "

One the profile has been completed, Parents were given instructions on how to complete a 3-day diet record.

" Please record your child's diet by recording dietary intake for two consecutive weekdays followed by one consecutive typical weekend day (e.g. Thursday, Friday, Saturday or Sunday, Monday, Tuesday) that is representative of your child's normal intake. Prompt the program to search for specific food items then enter the selected food into a list. Type the food or drink your child has eaten in the search box and press enter or click the search button. This opens the select recipe or ingredient window. Scroll down and select the item that best describes what your child has eaten or drank by double clicking or highlighting and clicking select. After the food is selected the cursor will automatically appear in the quantity box. Select a quantity from the list, press tab, and select day one, day two, or day three. Next the meal, such as breakfast, lunch, or dinner will be selected. Once an item is entered the cursor reappears in the "search for" box, ready for the next item to be entered. When you begin your 3-day diet record continue to enter the remaining items in the same manner. Different days can be added by selecting "add day" and then selecting the correct day folder and appropriate meal folder on the "modify food item" screen. Items can be copied and dragged to other days by holding down the control key and dragging the item to the day and meal folder. Diet recalls should be saved often by clicking on the save button. After the 3-days the record will be sent to the researcher by clicking the send e-mail tab at the bottom of the analysis page. If your have questions you may call me at 913-660-8219 or e-mail me Tracyl.daniel@gmail.com. If you would like information pertaining to the study please e-mail me and I will send a debriefing statement with the results of the study"

Time and Resource Constraints

Diet assessment in children presents with many unique challenges to time and resources. Due to the age of the participants the researcher was dependent on parent participation to complete the study. As children increase in age, more time is spent out of the home; therefore, some of the child's meals were consumed away from home thereby potentiating a decrease in accuracy of parental report. The information on dietary intake in this population was completely reliant on parent report, which increased the potential for bias.

Filling out a three-day diet record was time consuming to subjects and accuracy may have decreased over the length of days. Additionally, parents needed to attend a training to learn how to use the diet program. Therefore, participants needed to be motivated to participate in the study due to the burden of completing the diet record.

Additional bias relative to reported diet intake could result as parents primarily control the amounts and types of foods available. In addition to dietary intake, parental stress, emotional responses and family food preferences are factors that possibly influence a child's eating behavior and may confound diet assessment.

In summary, the diet record required high respondent burden, affected eating behavior and intake may have been underreported. Also, participant training was needed to use the software, which required increased motivation and a knowledge of how to use a computer. These issues were addressed by providing training to parents prior to collecting data and screening the 3-day diet record for missing data. The training consisted of approximately a 30-minute session, which included teaching parents how to input the food intake data, answering questions, and filling out the BASC-2. The researcher was able to screen the data that was entered regarding food intake. If a meal was missed it was noticeable and the participant was queried about the missing data through e-mail.

Ethical Procedures

Informed Consent

This study was initiated after permission is gained from Walden University's Institutional Review Board (IRB). To gain permission, an IRB application was required. The IRB application necessitated a comprehensive account of the foreseeable risks and benefits for participants in the study, voluntary participation and issues of protection such as confidentiality.

Regarding informed consent, ethically and legally the researcher needs to make sure the participant is informed of their rights. Principle E of the American Psychological Association (2002) code of ethics is respect for people's rights and dignity. This code requires psychologists to have respect for all the individuals they work with, and the rights of individuals to privacy, and confidentiality. Thus, when a researcher is seeking informed consent the individual's rights must be reviewed and the limits of confidentiality should be comprehensively shared. The participant should know that they are free to revoke their consent and end their participation at anytime. The participant must sign an informed consent before the process is initiated. The limits of confidentiality should also be reviewed before the participant takes part in the study. The researcher should fully explain the informed consent and the study process. Once informed consent is signed it is important to validate participant concerns and assure problems will be taken care of if they arise.

Confidentiality

The researcher took precautions to ensure participant information was kept confidential. All assessments and data were kept in a locked file cabinet in the researchers professional office. All assessments were labeled with the participant's last name and assigned a number. The diet records were sent electronically and stored on the researcher's MacBook. The BASC-2 was scored electronically on a password protected system, Q-Global. All data was stored on the researchers MacBook, which is password protected. Only the researcher had access to the MacBook, file cabinet key and research data. As the American Psychological Association requires, all data, including electronic, protocols, and printed, will be destroyed after 5-years.

Summary

Chapter 3 reviewed the research method and approach. It discussed the rationale for choosing a quantitative study and the research questions that will be investigated. Personal biases were addressed, as well as, inclusion criteria for the sample, sample size, and recruitment procedures. The instruments used in the study were discussed in detail. Specifically, attention was paid to the validity and reliability of the BASC-2, PRS-P. The chapter concludes with ethical procedures, including informed consent and confidentiality.

Chapter 4 will describe the data collection process such as demographic characteristics of the sample. The results will be reviewed, including descriptive statistics and statistical analysis findings that are organized by research questions and hypotheses. Tables and figures were used to illustrate results.

Chapter 4: Results

Introduction

The purpose of this quantitative study was to discover if diet quality/health indicators were linked to social emotional functioning in children. More specifically, it sought to determine if a relationship existed between diet/health indicators and (1) depression, (2) hyperactivity, (3) aggression, (4) anxiety, (5) somatization, (6) atypicality, (7) withdrawal, and (8) attention problems. Intake of fruit and vegetables (as measured by the number and amount of fruits and vegetables consumed by the child and reported by parents over a three-day period) was one predictor variable related to diet quality; the other was processed food (measured in an identical manner to fruit and vegetable consumption). Additional health-related predictor variables were BMI, family history of mental disorders, education levels of parents, socioeconomic status and whether the child was breastfed.

Research Questions and Hypotheses

RQ1: Is the consumption of processed foods, as measured by a 3-day diet record, a significant predictor of social emotional functioning (anxiety, depression, hyperactivity, aggression, somatization, atypicality, withdrawal, and attention), as measured by the BASC-2, PRS-P?

H1: Consumption of processed foods, as measured by a 3-day diet record, is a significant predictor of social emotional functioning.

HO: Consumption of processed foods as measured by a 3-day diet record is not a significant predictor of social emotional functioning.

RQ2: Is consumption of fruits and vegetables, as measured by a 3-day diet record, a significant predictor of social emotional functioning (anxiety, depression, hyperactivity, aggression, somatization, atypicality, withdrawal, and attention) as measured by the BASC-2, PRS-P?

H2: Consumption of fruits and vegetables as measured by a 3-day diet record is a significant predictor of social emotional functioning.

HO: Consumption of fruits and vegetables as measured by a 3-day diet record is not a significant predictor of social emotional functioning.

RQ3: Is Body Mass Index (BMI) a significant predictor of social emotional functioning?

H3: BMI is a significant predictor of social emotional functioning.

HO: BMI is not a significant predictor of social emotional functioning in children.

RQ4: Is family history of mental illness a predictor of social emotional functioning?

H4: Family history of mental illness is a significant predictor of social emotional functioning.

HO: Family history of mental illness is a not significant predictor of social emotional functioning.

RQ5: Is breast feeding a significant predictor of social emotional functioning:

H5: Breast feeding is a significant predictor of social emotional functioning.

HO: Breast feeding is not a significant predictor of social emotional functioning.

RQ6: Is parent education level a significant predictor of social emotional functioning?

H6: Parent education is a significant predictor of social emotional functioning.

HO: Parent education is not a significant predictor of social emotional functioning.

RQ7: Is socioeconomic status a significant predictor of social emotional functioning?

H7: Socioeconomic status is a significant predictor of social emotional functioning.

HO: Socioeconomic status is not a significant predictor of social emotional functioning.

In Chapter 4, I will review the data collection process and report baseline descriptive characteristics of the sample. This chapter will include statistical assumptions and results from the study such as descriptive statistics and statistical analysis findings that pertain to research questions with table and figures to illustrate results. The chapter will conclude with a summary of answers to research questions.

Data Collection

The timeframe for data collection began in December of 2014, following Internal Review Board (IRB) approval of data collection. Data collection spanned the course of December 2014 to October of 2015. The population consisted of 119 parents of children aged 3-5 years with and without preexisting disorders.

Recruitment and Response Rates

The Walden University participant pool, local development centers (Pediatric Connections, Playabilities, Hiersteiner Development Center), and the researcher's website were used to recruit participants. Response rates were initially small with 100% occurring through the researcher's website. After limited responses from the recruitment pools the researcher contacted local developmental centers (Pediatric Connections, PlayAbilities) and placed a flyer in the lobby. This led to an influx of participants, allowing the researchers to obtain the minimum amount of participants needed to run data analysis.

Descriptive Data

In Table 1, the frequency and percentage of the categorical data are reported that describe the demographic characteristics of the sample. The sample included a significantly higher percentage of females (96%) to males (3%). The predictor variable, level of education, has a high number of participants with post college education (46.2%), followed closely by those with a college degree (38.7%), and a much lower number of participants with only a high school diploma (15.1%). There was a higher number of participants without prior history of mental illness (66.4%) than those with a history of mental illness (33.6%). The majority of participants reported breastfeeding their child (65.5%), which is significantly greater than those who were not breastfed (34.5%).

The demographics of this population does not generalize to the general U.S. population because it is female dominated, very highly educated, and wealthy; therefore, the statistics do not reflect the population of interest exactly. In particular the study results are unlikely to be legitimately generalized to men, individuals with lower education levels, or those who have low socioeconomic status, as the numbers included are low.

Table 1
Demographics Data for Participants

		Frequency	Percent
Gender	Female	115	96
	Male	4	3
Parent's Highest Level of Education			
	School High School	18	15.1
	College Degree	46	38.7
	Post College	55	46.2
Mental Illness			
	History of Mental Illness	40	33.6
	No History of Mental Illness	79	66.4
History of Breast Feeding			
	Child was Breast Fed	78	65.5
	Child was not Breast Fed	41	34.5

As mentioned previously, a power analysis was performed using G Power 3.1.7 software package, with an alpha level of .01 and seven predictors variables (fruits/vegetables, processed food, breast feeding, parental education, parental history of mental disorders, socioeconomic status, and BMI), results of the analysis indicated a recommended sample size of 109, given a predicted effect size of .15. However, Tabachnick and Fidell (1989) recommend using a minimal number of participants for each predictor to determine appropriate power. For a regression analysis, using seven predictor variables (fruits/vegetables, processed food, breast feeding, parental education, parental history of mental disorders, socioeconomic status, and BMI) the researcher should use 20 times more cases than predictor variables. Green (1991) asserts due to the width of errors of estimating correlation with samples that are small, power will be inadequately low if less than 100 cases are used.

This study was completed with a target *n* of 120, to provide sufficient power an alpha level of .01. This study had an *n* of 119 with seven predictor variables (fruits/vegetables, processed food, breast feeding, parental education, parental education, parental history of mental disorders, socioeconomic status, and BMI). The socioeconomic variable was to identify low income or poverty and its relationship to the independent variables. The majority of the sample had income in the average to wealthy. This study was completed using a .01 alpha level due to the possibility of an inflated alpha level with running nine separate multiple regression analyses using the same variables. Table 2 shows the means and standard deviations of the interval demographic data.

Table 2
Means and Standard Deviations for all Variables

Scale	N	Min	Max	Mean	Std Deviation
Hyperactivity	119	35	99	60.87	1.17
Aggression	119	33	95	57.58	1.10
Anxiety	119	33	95	60.55	1.09
Depression	119	33	95	59.34	1.22
Somatization	119	35	91	59.68	1.00
Atypicality	119	37	105	59.09	1.13
Withdrawal	119	33	95	58.34	1.13
Attention	119	35	91	60.77	.96
Income	119	7,900	500,000	83,864.71	6,618.77
Processed Food	119	1000	3241	1780.63	52.76
Fruits/Vegetables	119	0	12	4.44	15.56
BMI	119	11	19	.23	.15

Statistical Assumptions

Skewness and kurtosis were analyzed on the numerical scale variables to check for normal distribution. In order to use the proposed statistical analyses the variables are assumed to be normally distributed. Hyperactivity was approximately normally distributed, with a skewness of .24 (*SE* = .22) and a kurtosis of -.014 (*SE* = .44). Aggression was approximately normally distributed with a skewness of .40 (SE = .22) and a kurtosis of .14 (SE = .44). Anxiety was also approximately normally distributed with a skewness of .09 (SE = .22) and kurtosis of .31 (SE = .44). Depression was approximately normally distributed with a skewness of .40 (SE = .22) and kurtosis of -.31 (SE = .44). Somatization was approximately normally distributed with a skewness of .41 (SE = .22) and kurtosis of .11 (SE = .44). Atypicality was approximately normally distributed with a skewness of .94 (SE = .22) and kurtosis of 1.3 (SE = .44). Withdrawal was approximately normally distributed with a skewness of .36 (SE = .22) and kurtosis of .11 (SE = .44). Attention Problems was approximately normally distributed with a skewness of .18 (SE = .22) and kurtosis of -.10 (SE = 44). Income was positively skewed with a skewness of 3.53 (SE = .22) and kurtosis of 14.38 (SE = .44); therefore, the median is a better representation of this variable (M = 64,000). Consumption of processed foods was approximately normally distributed with a skewness of .80 (SE = .22) and kurtosis of -.49 (SE = .44). Fruits/vegetables was approximately normally distributed with a skewness of .34 (SE = .22) and kurtosis of .08 (SE = .44). Body Mass Index (BMI) was approximately normally distributed with a skewness of -.43 (SE = .22) and kurtosis of .40 (SE = .44).

Linear regression assumes the relationship between the independent variables and the dependent variables are linear. A visual inspection of the boxplot indicated a linear relationship, which showed points that were not completely on the line, but close for the numerical variables.

Homoscedasticity is the assumption that the dependent variable exhibits similar amounts of variance across the range of values for an independent variable. The scatterplot of standardized predicted values showed that the numerical variable data met the assumptions of homogeneity of variance and linearity (see Appendix C).

Mulitcollinearity assumes there are high intercorrelations or associations among the predictor variables. Tests to determine if the data met the assumption of collinearity indicated that multicollinearity was not present for predictor variables (Processed Foods, *Tolerance* =.926, *VIF* 1.08; Fruits/Vegetables, *Tolerance*= .904, *VIF* 1.10; Family History of Mental Illness, *Tolerance* = .958, *VIF* 1.04; BMI *Tolerance* = .908, *VIF* 1.10; Breast Feeding *Tolerance* =.939, *VIF* 1.06; Parent Education *Tolerance* = .85 *VIF* 1.17).

Study Results

Research Question 1

Research Question 1 asked: Is the consumption of processed foods, as measured by a 3-day diet record, a significant predictor of social emotional functioning (anxiety, depression, hyperactivity, aggression, somatization, atypicality, withdrawal, and attention), as measured by the BASC-2, PRS-P. The null hypothesis stated that consumption of processed foods as measured by a 3-day diet record is not a significant predictor of social emotional functioning. The alternative hypothesis stated that consumption of processed foods, as measured by a 3-day diet record, is a significant predictor of social emotional functioning.

Across the eight multiple linear regressions in which it was entered as a predictor, consumption of processed foods was only a significant predictor of atypicality (t = 3.934, p = .00, β =.23). This result indicates that higher levels of processed food consumption was associated with higher scores of atypicality. In the remaining multiple linear regressions, consumption of processed foods was not a significant predictor of anxiety (t =1.28, p = .20, β = .121), depression (t = 1.50, p = .134, β = .140), hyperactivity (t = 1.508, p = .134, β = .137), aggression (t =1.64, p = .10, β = .152), somatization (t = 1.055, p = .294, β = .102), withdrawal (t = 2.128, p = .0346, β = .199) or attention problems (t = 2.110, p = .037, β = .203), These findings provided support to reject the null hypothesis for the atypicality variable. The results failed to reject the null hypothesis for the anxiety, depression, hyperactivity, aggression, somatization, withdrawal and attention variables.

Research Question 2

Research Question 2 asked: Is consumption of fruits and vegetables, as measured by a 3-day diet record, a significant predictor of social emotional functioning (anxiety, depression, hyperactivity, aggression, somatization, atypicality, withdrawal, and attention) as measured by the BASC-2, PRS-P? The null hypothesis stated that consumption of fruits and vegetables as measured by a 3-day diet record is not a significant predictor of social emotional functioning. The alternative hypothesis stated that consumption of fruits and vegetables as measured by a 3-day diet record is a significant predictor of social emotional functioning.

Across the eight multiple linear regressions, in which it was entered as a predictor, fruit and vegetable consumption was not a significant predictor of hyperactivity (t = 1.767, p = .080, β = .163), aggression (t = 2.39, p = .018, β = .225), anxiety (t = -.034, p = .973, β = - .003), depression (t = 1.232 p = .221, β = .116), somatization (t = 1.207, p = .230, β = .119), atypicality (t = 2.211, p = .029, β = .199), withdrawal (t = .668, p = .505, β = .063), or attention problems (t = -487, p = .628, β = -.047). These results indicated fruit and vegetable consumption was not a significant predictor of social emotional functioning; therefore, the findings failed to reject the null hypothesis.

Research Question 3

Research Question 3 asked: Is Body Mass Index (BMI) a significant predictor of social emotional functioning? The null hypothesis stated that BMI is not a significant predictor of social emotional functioning in children. The alternative hypothesis stated that BMI is a significant predictor of social emotional functioning.

Across the eight multiple linear regressions in which it was entered as a predictor, BMI was not a significant predictor of hyperactivity (t = .185, p = .853, β = .017), aggression (t = -.997, p = .321, β = -.093), anxiety (t = .165, p = .869, β = .016), depression (t = -.520, p = 604, β = **-.**049), somatization (t = -.380, p = .705, β = -.037), atypicality (t = -1.918, p = .058, β = -.172), withdrawal (t = .434, p = .665, β = .041), or attention problems (t = .593, p = .555, β = .058). Body Mass Index did not have a significant influence on predicting social emotional functioning. Therefore, the findings failed to reject the null hypothesis.

Research Question 4

Research Question 4 asked: Is family history of mental illness a predictor of social emotional functioning? The null hypothesis stated that family history of mental illness is a not significant predictor of social emotional functioning. The alternative hypothesis stated that family history of mental illness is a significant predictor of social emotional functioning.

Across the eight multiple linear regressions in which it was entered as a predictor, family history of mental illness was a significant predictor of hyperactivity (t = -3.117, p = .002, β = -.279) and depression (t = -2.878, p = .005, β = -.263). Reporting a family history of mental illness was associated with lower levels of hyperactivity and depression. Family history of mental illness was not a predictor of aggression (*t* = -1.398, *p* = .165, β = -.127), anxiety (*t* = -2.293, *p* = .024, β = -.212), somatization (*t* = -.637, *p* = .525, β = -.061), atypicality (*t* = -1.250, *p* = .214, β = -.109), withdrawal (*t* = -2.246, *p* = .027, β = -.207), or attention problems (*t* = -1.118, *p* = .266, β = -.106). These findings support the rejection of the null hypothesis for the hyperactivity and depression variables. The findings failed to reject the null hypothesis for the aggression, anxiety, somatization, atypicality, withdrawal, and attention problem variables.

Research Question 5

Research Question 5: Is breast-feeding a significant predictor of social emotional functioning? The null hypothesis stated that breast-feeding is not a significant predictor of social emotional functioning. The alternative hypothesis stated that breast-feeding is a significant predictor of social emotional functioning.

Across the eight multiple linear regressions in which it was entered as a predictor, breast-feeding was not a significant predictor of hyperactivity (*t* = .052, *p* = .959, β = .005), aggression (*t* = .562, *p* = .575, β = .052), anxiety (*t* = 2.195, *p* = .030, β = .205), depression (*t* = .557, *p* = .579, β = .051), somatization (*t* = .962, *p* = .338, β = .093), atypicality (*t* = .822, *p* = .413, β = .073), withdrawal (*t* = .593, *p* = .554, β = .055), and attention problems (*t* = .005, *p* = .996, β = .000). These findings failed to reject the null hypothesis.

Research Question 6

Research Question 6: Is parent education level a significant predictor of social emotional functioning? The null hypothesis stated that parent education is not a significant predictor of social emotional functioning. The alternative hypothesis stated that parent education is a significant predictor of social emotional functioning.

Across the eight multiple linear regressions in which it was entered as a predictor, parent education was not a significant predictor of anxiety (t = .318, p = .751, β = .031), depression (t = .835, p = .406, β = .081), somatization (t = .115, p = .908, β = .012), atypicality (t = .382, p = .703, β = .035), withdrawal (t = 1.178, p = .241, β = .115), or attention problems (t = .944, p = .347, β = .095). These findings failed to reject the null hypothesis.

Research Question 7

Research Question 7: Is socioeconomic status, as measured by income, a significant predictor of social emotional functioning? The null hypothesis stated that socioeconomic status is not a significant predictor of social emotional functioning. The alternative hypothesis stated that socioeconomic status is a significant predictor of social emotional functioning.

Across the eight multiple linear regressions in which it was entered as a predictor, income was not a significant predictor of hyperactivity (t = -1.972, p = .051, β = -.188), aggression (t = 1.771, p = .079, β = -.172.), anxiety (t = 1.178, p = .241, β = .115), depression (t = -.064, p = .949, β = -.006), somatization (t = -.551, p = .583, β = -.056), atypicality (t = -2.318, p = .022, β = -.216), withdrawal (t = -.537, p = .592 β = -.053), and attention problems (t = -.620, p = .537, β = -.061), These findings failed to reject the null hypothesis.

Summary

In this study, I hypothesized that there was a relationship between nutrient intake and social emotional functioning. Results indicated that nutrient intake was a significant predictor for a component (subscale) of functioning; that is, higher levels of processed food consumption predicted higher scores of atypicality. Additionally, reporting a family history of mental illness was a significant predictor of lower levels of hyperactivity and depression. There were no significant relationships between the other diet quality/health indicators and social emotional functioning in children.

In the final chapter, I will discuss how these findings are important to the community as a whole, limitations of the study, and the potential social impact of this research.

Chapter Five: Discussion, Conclusion, and Recommendations

The purpose of this study was to discover if diet quality/health indicators were linked to social emotional functioning in children. More specifically, it sought to determine if a relationship exists between diet/health indicators and (1) depression, (2) hyperactivity, (3) aggression, (4) anxiety, (5) somatization, (6) atypicality, (7) withdrawal, and (8) attention in children. Intake of fruit and vegetables was one predictor variable related to diet quality; the other was processed food. Additional health-related predictor variables were body mass index, family history of mental disorders, education levels of parents, socioeconomic status (income), and whether the child was breastfed.

The nature of the study was quantitative. Research questions were evaluated by looking at the relationships between diet/health indicators and the eight subscales (1) depression, (2) hyperactivity, (3) aggression, (4) anxiety, (5) somatization, (6) atypicality, (7) withdrawal, and (8) attention. Multiple regression analyses were used to determine if variables related to health and diet quality predicted social emotional functioning as measured by the eight subscales of the BASC-2 (Preschool version).

The key findings of this study demonstrated that few of the diet/health variables predicted social emotional indicators. Across the eight multiple linear regressions in which it was entered as a predictor, processed food consumption, was only a significant predictor of the atypicality subscale. Additionally, across the eight multiple linear regressions, the predictor variable of family history of mental illness was only associated with lower levels of hyperactivity and depression. All other diet/health indicators did not significantly predict the eight social emotional subscales.

Interpretation

Nutrition and Neuropsychiatric Disorders

Davis and Kaplan (2012) noted the lack of studies on nutrient intake and psychiatric functioning. Specifically, there are very few studies on the relationship between a multitude of social emotional variables and the intake of processed foods. Previous research has only focused on limited variables or nutrient supplementation to improve psychological functioning. Several researchers have stressed the importance of and need for additional studies regarding nutrient intake in children and social emotional functioning. For example, Kaplan (2004) studied nutrient supplementation on variables (Withdrawn Behavior, Somatic Complaints, Anxious/Depressed, Social Problems, Delinquent Behavior, and Aggressive Behavior), which are similar to the current study variables, but supplementation was examined instead of processed foods or fruit/vegetable intake. Results demonstrated improvement as the result of nutrient supplementation in seven of the variables (Withdrawn Behavior, Anxious/Depressed, Social Problems, Delinquent Behavior, and Aggressive Behavior). In addition, Jacka et al. (2009) found that adolescents who had a diet made up of unhealthy processed foods demonstrated higher levels of self-reported depression when compared to subjects eating a healthy diet; however, atypical behaviors were not specifically researched. Dolske et al. (1993) evaluated the effectiveness of vitamin C supplementation in children with autism and noted a significant decrease in stereotypical behaviors.

In the current study, it was expected that processed foods would be a predictor of social emotional functioning (anxiety, depression, hyperactivity, aggression, somatization, atypicality, withdrawal, and attention). The consumption of processed foods was only a predictor of atypicality. Atypicality is the tendency to behavior in ways that are unusual or commonly associated with psychosis (Rosenblatt, et al., 2011). As reported above, past research supports improved mental health and higher levels of psychological functioning being associated with a greater intake of dietary minerals, but there is not research to date that has demonstrated a relationship between atypicality in relation to processed food consumption. This study adds to the known research in this area by confirming a relationship between nutrient intake and atypicality. Also, the results extend knowledge in this area since prior studies have examined this relationship. However, this study only explored a relationship between variables, not causality. A methodology limitation of this study is it does not allow for causality to be assumed.

It is hypothesized that insignificant results regarding the other psychosocial disorders may be partially due to the demographic make-up of the sample. It was hoped that the sample would include a wide range of income levels. However, the sample participants who completed the study were from higher income levels, which did not provide a representative sample. Children from high-income homes have more access to foods higher in micronutrients and are less likely to be obese (Wye, Seoh, Adjoian, & Dowell, 2013). Given a low-income sample with less food security, I would expect elevated scores on processed food consumption and social emotional subscale disorders.

Research has demonstrated that adding vitamins and minerals to the diets of individuals suffering from mental health problems improved their psychological functioning (Shaw, Rucklidge, & Hughes, 2010). Therefore, it was expected that fruit/vegetable consumption would be a predictor of social emotional functioning (anxiety, depression, hyperactivity, aggression, somatization, atypicality, withdrawal, and attention). However, the current findings showed that fruit/vegetable consumption was not a predictor of social emotional functioning. Past research provides strong evidence that supplementation results in improved social emotional functioning when there is a vitamin or mineral deficit that is corrected with supplementation (Mehl-Madrona et al., 2010; Kidd, 2003). For example, Rucklidge, Gately, and Kaplan (2010) demonstrated significant improvements in children with ADHD who were given EMPowerplus, a multi-vitamin supplement, showed a 59% decrease of ADHD symptoms. The data in the current study was from parents with a high level of income, thus they may have had better access to healthcare; therefore, nutritional deficits may not have been present. In the current study only the amount of fruit and vegetable consumption was accessed. The three-day diet record does not measure specific nutritional variations, which is a limitation of this study. Given the research importance of vitamin supplements this may be an area for future research on supplements relationship to social emotional functioning.

Studying nutrient intake in young children is a complex topic. Parents may resist buying new foods for fear their children will not eat them, thus the children in the current study may have been eating the same fruits and vegetables over the course of their diet record instead of a wide variety. However, there is no way of knowing which fruits and vegetables were eaten, only the amount, as it is not in the data. A wider variety of fruits and vegetables would offer more health benefits. Children with autism and ADHD prefer a “sameness” to their diets that limits nutrient uptake (Xia et al., 2010). It is not known which fruits and vegetables the participant’s children consumed, just the amount that was eaten over three-days. Looking at more detailed dietary patterns may shed light on why results were not significant as the insignificant results may be due to lack of variety in fruit and vegetable consumption.

It is hypothesized that eating a wider range of fruits and vegetables may have demonstrated a link between fruit and vegetable consumption and social emotional functioning. Not knowing what exactly was eaten is a limitation of this study. Past researchers have reported nutrient intake collection is costly and time-consuming (Bazzano, et al., 2002). The collection of accurate and precise nutrient intake often requires labor-intensive interviewing techniques, which place a significant burden on the participants. In addition, when using a software program the selection of the appropriate food codes may be a limitation with nutrient intake programs and limit the availability of food composition. The process is further complicated when parents are asked to report on their children's diet. The three-day diet record used in the current study provided an analysis of the food categories and amounts eaten not the exact food that was consumed. A more sensitive diet measure utilizing new technology such as digital photography of food would have provided more detailed information about the variety of the participant's nutrient intake and perhaps collaborated this hypothesis. Digital photography is being to be used in dietary assessment approaches with children. This measure is reportedly more accurate than diet records in which parents are asked to recall what their child has eaten (Bazzano, et al., 2002). Using this technology in future studies would add valid information to this study expanding upon this area of research.

Parental Education

The level of education variable had a high number of participants with post college education (46.2%), followed closely by those with a college degree (38.7%), and a much lower number of participants with only a high school diploma (15.1%), indicating a highly educated population. Sironi (2013) found that every additional year of education decreased the mental ill-health score by 0.6 percent in adults, suggesting that higher education may have benefits to mental health. The current study examined parental education level as a significant predictor of social emotional functioning. The results indicated that education level was not associated with social emotional functioning. Similarly, Johansson et al. (2009) found education was not linked to mental health problems in adults. Since the known research is inconclusive this research neither confirms, disconfirms, or extends knowledge in the literature. As explained earlier, the variance in education and income in this sample may have limited the analysis of this variable.

Breast Feeding

The majority of participants reported breast feeding their child (65.5%). Research has demonstrated that infants who are breast-fed have neurological advantages over those who were not (Tomlinson, Wilkinson, & Wilkinson, 2009). Investigations of breast feeding on social emotional functioning have demonstrated reduced attention and hyperactivity symptoms (Julves et al. 2007). Breast feeding was examined to determine if it was a significant predictor of social emotional functioning. Breast feeding was not a predictor of social emotional functioning. Although the results failed to reject the null hypothesis, past research indicates the duration of breast feeding is associated with cognitive development due to the higher consumption of essential fatty acids through the mother's breast milk. The duration of breast feeding was not examined in this study. While the results of this study may appear to be contradictory to the known research, there are too many variables that make the aforementioned studies different from this study to make a valid comparison. Adding the duration of breast feeding to the study and a measure of cognition such as an intelligence assessment would make it more comparable to past research and may have yielded different results. This makes it a topic for future research initiatives in this area.

Body Mass Index

In the current study, there was a low number of participants falling in the obese category (1%), which is categorized as the 95^{th} percentile on a body mass index for age percentile chart. Research studies examining the relationship between depression and body mass index in children found there was not a link (Benson, Williams, & Novick, 2012; Park et al., 2009). Phillips et al. (2012), found that extremely obese children demonstrated higher levels of psychosocial distress. However, a clinical sample was used and it was impossible to determine conclusively that obesity worsens psychosocial issues. In the current study, body mass index did not have a significant influence on predicting social emotional function. It is difficult to determine if obesity causes psychosocial problems or if psychosocial instability is due to obesity. Methodology issues such as the use of a clinical sample make it difficult to compare results between studies, but this study does confirm past research findings that indicate there is not a conclusive relationship between body mass index and psychosocial functioning. This study had a significantly low number of obese children, which makes it difficult to determine if a relationship was present between these variables.

Genetic Influences on Mental Health

In the current study, there were a higher number of participants who did not report a prior history of mental illness (66.4%) than those that did report a history of mental illness (33.6%). Reporting a family history of mental illness was a significant predictor of hyperactivity and depression. However, this relationship was the opposite of what was predicted. Parents who reported a family history of mental illness demonstrated lower levels of hyperactivity and depression.

Past research corroborates a moderate relationship between genetic influence and psychopathology (Kendler et al., 2010). Thus, it was expected that a history of mental illness would result in higher levels of psychosocial problems, not lower. It is hypothesized these contradictory results may be due to the participants consisting of educated parents. Research has demonstrated parent education is associated with a lower risk of anxiety (McLaughlin, Costello, & Kessler, 2012). Therefore, the participants in this study may be more aware of their child's social emotional functioning and have sought treatment at an early age. Also, using self-report measures may also have resulted in biased reporting by the parents. Even when participants are doing their best to be forthright and insightful regarding their child's behavior, their self-reports are subject to various forms of inaccuracy. Such inaccuracies such as "faking good" can skew assessment results and may have contributed to contradictory findings in this study.

Socioeconomic Status

The average income for this study was $83,864.71. The majority of the participants in the sample fell in the average to wealthy range. Socioeconomic status was not a significant predictor of social emotional functioning. Raffensperger et al. (2010) asserts nutrient intake that is consistent with recommended dietary guidelines is typically found in individuals with higher socioeconomic status. Individuals with low SES are more obese, less educated, and engaged in less physical activity (Shahar et al., 2006). There are differences in social classes in regard to food choice. Individuals within higher social classes tend to have healthier diets with more intake of raw vegetables, lean meat, and oily fish compared to manual workers. Given a sample that is more representative of the full range of income levels in the U.S., I would expect that low socioeconomic status would be associated with increased scores on the social emotional functioning subscales (anxiety, depression, hyperactivity, aggression, somatization, atypicality, withdrawal, and attention). Again, a more sensitive diet measure that has the ability to match the data with nutritional health standards would have provided additional insight into the results of the analysis of this variable, but this is a topic for future research as this study was only looking for a relationship between the amount, not the variation of nutrients.

Theoretical Framework

This research is based on the theoretical foundation of Engel's biopsychosocial model (1977), which provided support for the hypothesis that health is related to social emotional functioning. This study's results, both significant and insignificant, lend credence to the biopsychosocial theory.

The biopsychosocial theory bridges multidisciplinary perspectives and accounts for the multitude of factors that contribute to social emotional functioning in children. The biopsychosocial model focuses on the significance of social (environment), biological (brain development, diet), and psychological factors (thinking, learning) in the development of social emotional functioning in children. Research has shown that the neural system is vulnerable to dysfunction, which may occur though internal or external forces (Oliver & Wardle, 1999). This model views health and illness as the consequence of the complex interplay between mind and body.

The social aspect of this model asserts that culture, social context, and social class are interwoven with biological factors (diet) and psychological factors (learning). The cost of food and the ability of the individual to afford certain foods are determinates of food choices. Low income groups are reported to have unbalanced diets with less fruits and vegetables. An individual's environment influences their food choices. Increased education is related to increased knowledge regarding "healthy eating" and enhances the likelihood of applying knowledge to healthier food choices, which involves learning. The higher social class and higher educational attainment of participants in this study may have contributed to the lack of significant findings, which is consistent with this theoretical model.

Significant results also substantiate this theory. This study's findings showed higher consumption of processed food was related to higher scores on the atypicality subscale, which indicates that consuming processed foods in childhood could be a risk factor in the development of that social emotional dysfunction, supporting the multidisciplinary aspect of this theory. The significant findings could have been the result of inflated error due to the number analyses that were run. However, the use of a conservative alpha level of .01 was used to avoid such error.

Limitations and Future Recommendations

There were several notable limitations of this study. Given that I used a correlational design for this study, a strong causal claim regarding the effect of consumption of processed foods on atypicality subscores could not be made. However, this limitation does open up questions for further research. For example, it may be possible to conduct an experimental study to examine causation by controlling specific nutrient consumption and track related changes in social emotional functioning.

The findings from the 3-day diet were subject to a type of food recall bias that is linked with the process of recording foods, which may affect the way people eat during the recall time period. Using an online diet record (a self-report measure), is subject to responder bias. Thus, participants may have eaten and reported a healthier diet during the three-day reporting period. Additionally, the BASC-2, Parent Rating Scale-Preschool (PRS-P) is a self-report measure that may not be as accurate as other forms of measurement. There is a risk of inaccurate reporting and social pressure to respond in desirable manners on both self-report measures. In reality, the BASC-2, PRS-P, has built in measures of validity, which help maintain accurate responding. The BASC-2, PRS-P, provides a measure of honesty on the self-report, which refers to the likelihood of faking good. This measure indicated that all the data related to the child's social emotional functioning were valid.

Although the study found that processed food consumption was a predictor of atypicality this relationship needs to be further explored within a larger and more diverse sample in order to increase generalization of the findings. While the sample size was sufficient, the proportion of male (3%) to female (97%) parents differed significantly. The lower proportion of males coupled with the higher socioeconomic status, and higher level of education in the sample may limit the generalizability of the findings. While there is no evidence in the literature that males respond differently, there is a possibility that males may have less knowledge of what their children eat especially if they do not shop for groceries or prepare food. A stay at home mother who shops and prepares food will have more knowledge of food intake than a father who is working and does not take care of the child during the day.

Recommendations

As a result of the limitations in the existing body of knowledge, key areas for future research have been identified. The association between diet/health indicators and social emotional functioning in children has not been studied extensively in the published literature, with studies often examining vitamin and mineral supplementation in an adult population. A more in-depth study investigating the possible effect of processed foods on social emotional development might use a mixed-method, longitudinal study that would follow a large group of children from birth to adolescence. Nutrient intake and personality measures could be tested at several intervals throughout their childhood with the addition of qualitative interviews, intelligence tests, and quantitative teacher rating scales. This would allow for cognition to be measured along with social emotional functioning expanding the breadth of knowledge. Additionally, using a more sensitive diet measure that can detect specific diet, mineral, and nutrient information coupled with interviews may have detected the specific nutrients mentioned in the literature review that are critical to early childhood development adding depth to this research study.

Implications

There appears to be some hesitancy among medical professionals, academics and the government to support alternative health practices. In recent years, neuropsychological disorders, including ADHD and autism have significantly risen (Ryrie, Cornah, & Van De Weyer, 2006). This increase in mental health disorders in children has paralleled the changes in the food industry. In this study, I looked for evidence to support the effect nutrient intake has on social emotional constructs, but found minimal evidence to support nutritionally dense or processed foods being associated with social emotional functioning. It is my hope that the results of this study will be shared with educators, parents, and medical professionals who have an impact on children's social development.

Medical Professionals/Educators

Medical professionals and educators should use the information in this study and specifically the body of research described in Chapter 2 to inform the public about the implications of diet and social emotional functioning during critical developmental periods. At this time, there is enough evidence to support the claim that micronutrient deficits affect social emotional functioning however, much of the existing research has methodological limitations, which facilitates the need for more conclusive studies.

School systems, both public and private, have the ability to provide an environment where consistent healthy eating messages can be broadcast and applied as part of the whole school approach to healthy choices. Interventions within the school setting should include behavior change strategies to improve eating behavior and diet quality along with ways to increase physical activity. The programs should address lifestyle within the family and social environments in order to invoke social change in all areas of the child's life.

Parents

Good nutrition is of crucial significance for the wellbeing and development of young children. Food patterns in childhood set the stage for long-term dietary preferences. The role of the family, in particular family support, in influencing children's dietary preferences is essential to making positive social change. Parents have the most impact regarding their children's nutrient intake. Parents can potentially support or facilitate a healthy diet by modeling and using positive reinforcement to encourage their children to make healthy dietary choices. However, initiatives need to be taken to educate parents on the mental health implications of a nutrient dense diet. Thus, parent education support groups that focuses on prevention as well as management of social emotional disorders would result in significant positive social change.

When looking for treatment options for children with mental health problems, parents should be knowledgeable of alternative methods such as dietary intervention. Parents need to be informed of the effect of micronutrient deficiencies on psychological symptoms. A reduction in psychological symptoms has been conclusively demonstrated in the past research in children with nutritional deficits, which indicates parents should be advised of the current research so that informed decisions can be made regarding clinical treatments. Treatment should be tailored to each individual as each child has different nutritional needs. Individualized treatments will aide in facilitating social change. Dietary corrections and nutritional supplement all offer potential benefits to children with mental health problems and should be offered as a viable alternative or supplement to pharmacotherapy. For example, Cortese et al. (2009) discovered an association between children with ADHD's severity of sleep-wake transition disorders and serum ferritin levels, indicating low ferritin levels may be related to sleep disturbances in ADHD children. Low levels of iron, and severity of ADHD and Restless Legs Syndrome (RLS) were found to be linked (Konofal, et al., 2008). Therefore, if a child with Attention

Deficit Hyperactivity disorder presents with restlessness at night or having disruptive sleep patterns that are affecting his or her functioning a ferritin blood test to determine if iron is low may be warranted. Additionally, a teenager with high levels of stress and depression that is resulting in extreme fatigue may want to have their vitamin D level checked. Vitamin D is a precursor to serotonin and has been linked with depression (Laudano & Bhakta, 2010).

Government Initiatives

Advertising can have a direct effect on children's food and drink preferences (Welchselnsum & Buttriss, 2011). In the United States, the Federal Communications Commission (FCC) is the primary authority for media regulations. Having an FCC advisory committee review the evidence on the association between nutrient intake and mental health, in addition to, the research on the effect of food and drink advertising on dietary behavior in children, could lead to a restriction in further advertising of processed foods that are high in sodium, fat, and sugar. Positive social change would occur if restrictions were placed on what types of food were broadcasted on children's television channels. Replacing highly processed food ads with ads promoting fruit and vegetable consumption may influence children's dietary decisions at a macro-level.

In recent years the provision of food in school systems has been improving (Pellow, Solomon, & Barnard, 2012). This is the result of evidence demonstrating the choice of foods available was of low nutritional value and thus not meeting children's nutrient needs (Nemets, Nemets, & Apter, 2006). This coupled with increasing obesity rates and growing micronutrient deficits led the government to intervene with the national school lunch program (Welchselnsum & Buttriss, 2011). This program calls for gradual reductions in sodium and increases in the availability of fruits, vegetables, and whole grains in the school menu. While school lunches are mandated to meet federal meal requirements, the decision about what specific foods to serve and how the foods are prepared are left to local school authorities. To promote positive social change, standards involving food preparations specifically addressing the reduction of processing of foods should be set. Food preparation standards that are based on research findings, would ensure improved nutrient intake in the millions of children that are served food during the school day and in afterschool educational programs, thus promoting positive social change across the nation.

Conclusions

This investigation examined the relationship between nutrient intake and social emotional functioning in preschool children. This study provided limited support to the increasing awareness that nutrient intake is important for children's mental health, particularly the development of atypicality. It is evident that in the treatment of children with mood disorders, factors of importance include the assessment of nutrient intake. Well-designed, rigorous studies are needed to determine if poor nutrition contributes to psychosocial functioning in children. There is a growing interest in alternative interventions for preschool children with disorders such as ADHD, but the efficacy of such treatments must be evaluated through various research studies. Understanding the relationship between nutrient intake and social emotional functioning in young children will promote improvements in offering intervention services to parents by mental health providers and medical professionals.

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Appendix A: Informed Consent Form

You are invited to take part in a research study investigating nutrient intake and social emotional functioning in preschool children. The researcher is inviting parents of children ages 3 to 5 to be in the study. This form is part of a process called "informed consent" to allow you to understand this study before deciding whether to take part.

This study is being conducted by a researcher named Tracy Daniel who is a doctoral student at Walden University. You may already know the researcher as a psychologist/early childhood coordinator, yoga instructor, but this study is separate from that role.

Background Information:
The purpose of this study is to determine if diet quality is related to social emotional functioning in preschool children.

Procedures:
If you agree to be in this study, you will be asked to:

- Record your child's diet for 3-days via internet using the Food Prodigy. This should take approximately 30 minutes daily.
- Complete a Parent Rating Scale –Child (PRS-C) rating form. This will take approximately 10 to 20 minutes to complete.
- Attend a training on recording diet and complete background information/profile on Food Prodigy. This will take approximately 20 to 30 minutes.

Voluntary Nature of the Study:
This study is voluntary. Everyone will respect your decision of whether or not you choose to be in the study. No one will treat you differently if you decide not to be in the study. If you decide to join the study now, you can still change your mind later. You may stop at any time.

Risks and Benefits of Being in the Study:
Being in this type of study involves some risk of the minor discomforts that can be encountered in daily life, such as minor stress due to fill out a diet record for three-days. Being in this study would not pose risk to your safety or wellbeing.

The benefit to this study is gaining knowledge pertaining to your child's diet and social emotional functioning.

Payment :
There will be no payment for participation in this study.

Privacy:
Any information you provide will be kept confidential. The researcher will not use your personal information for any purposes outside of this research project. Also, the

researcher will not include your name or anything else that could identify you in the study reports. Data will be kept secure by being stored in a locked file cabinet. Data will be kept for a period of at least 5-years, as required by the university.

Contacts and Questions:
You may ask any questions you have now. Or if you have questions later, you may contact the research via tracy.daniel@waldenu.edu or 913-660-8219. If you want to talk privately about your rights as a participant, you can call Dr. Leilani Endicott. She is the Walden University representative who can discuss this with you. Her number is 612-312-1210. Walden University's approval number for this study is IRB number and it expires on IRB expiration date.

The researcher will give you a copy of this form to keep.

Statement of Consent:

I have read the above information and I feel I understand the study well enough to make a decision about my involvement. By signing below, I understand that I am agreeing to the terms described above.

Printed Name of Participant
____

Date of
consent____
____

Participant's
Signature____
_

Researcher's
Signature____
_

Appendix B: Explanation of the Study

The Relationship Between Nutrient Intake and Social Emotional Functioning in Preschool Children

By

Tracy L. Daniel, Ed.S

Explanation of the Research Study

You are invited to participate in a research study that will examine the link between social emotional functioning and nutrient intake in preschool children. Currently, there is no research that examines the health indicators and social emotional variables in this age group that this study is investigating.

The purpose of this research is to gain understanding of the relationship between diet quality and health indicators. All participants in this study need to have children aged 3 to 5-years-old. The children must not be on a restrictive diet or have a medical condition that interferes significantly with nutrient intake.

I am interested in learning more about your child's diet and social emotional functioning. More specifically, I would like you to complete a diet record, structured history, and behavior rating scale. The information you share will be kept confidential. As the researcher, I hope that by sharing this information it will allow those who read my study to understand the complex relationship between nutrient intake and social emotional functioning.

Appendix C: Assumptions of Heteroscedasticity

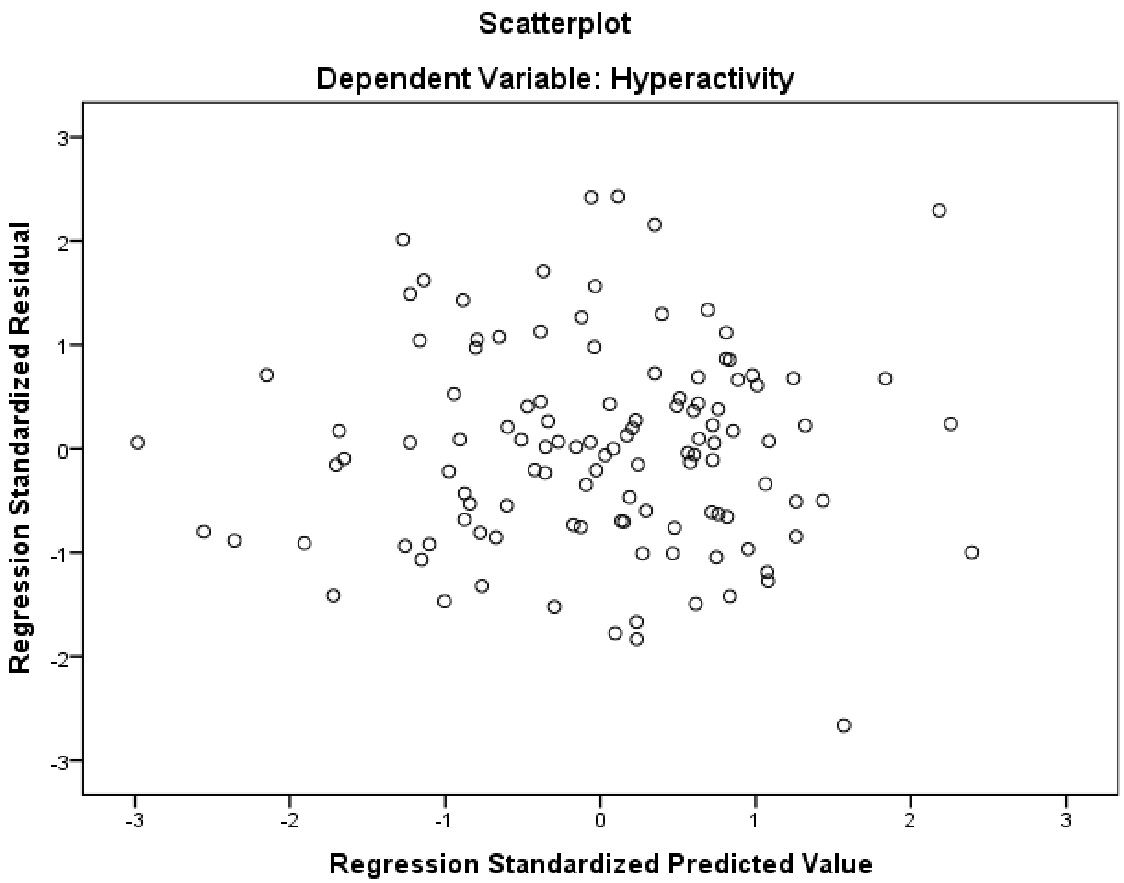

Figure 1. Assumption of heteroscedasticity for hyperactivity

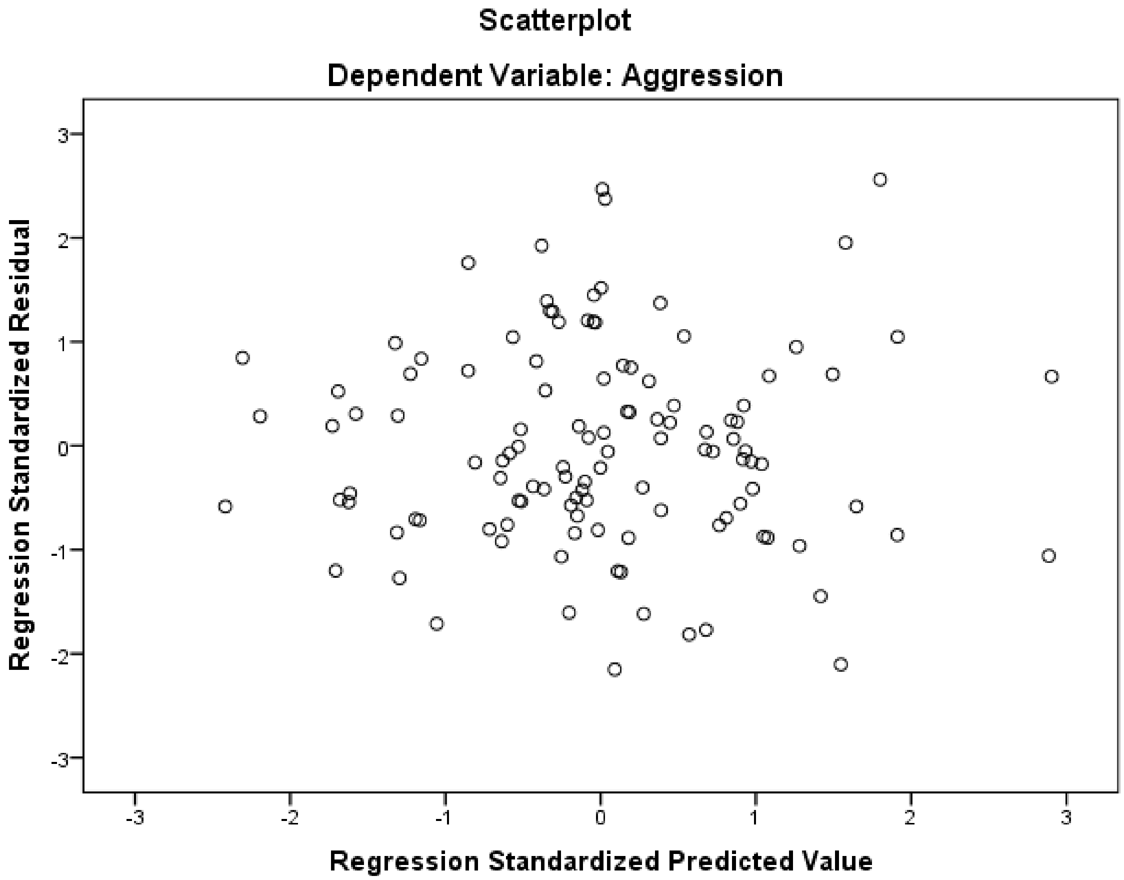

Figure 2. Assumpton of heteroscedasticity for aggression

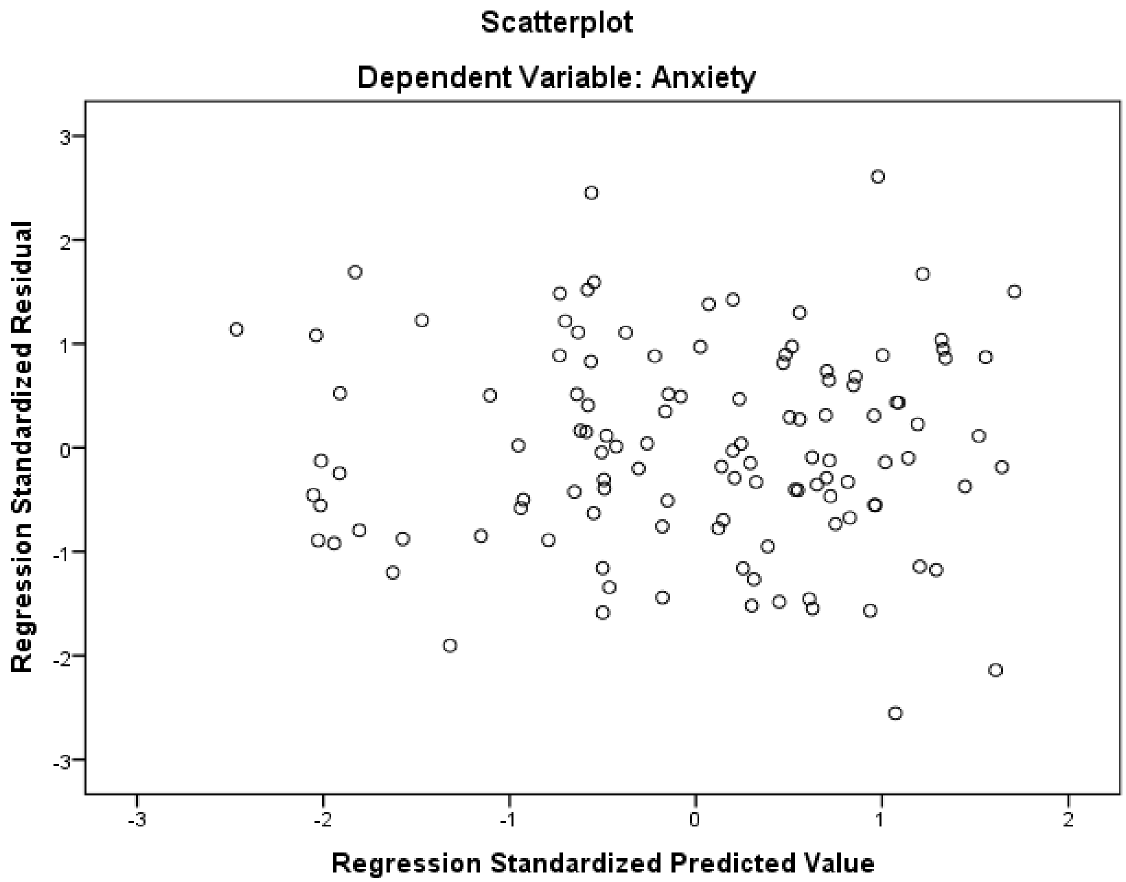

Figure 3. Assumption of heteroscedasticity for anxiety

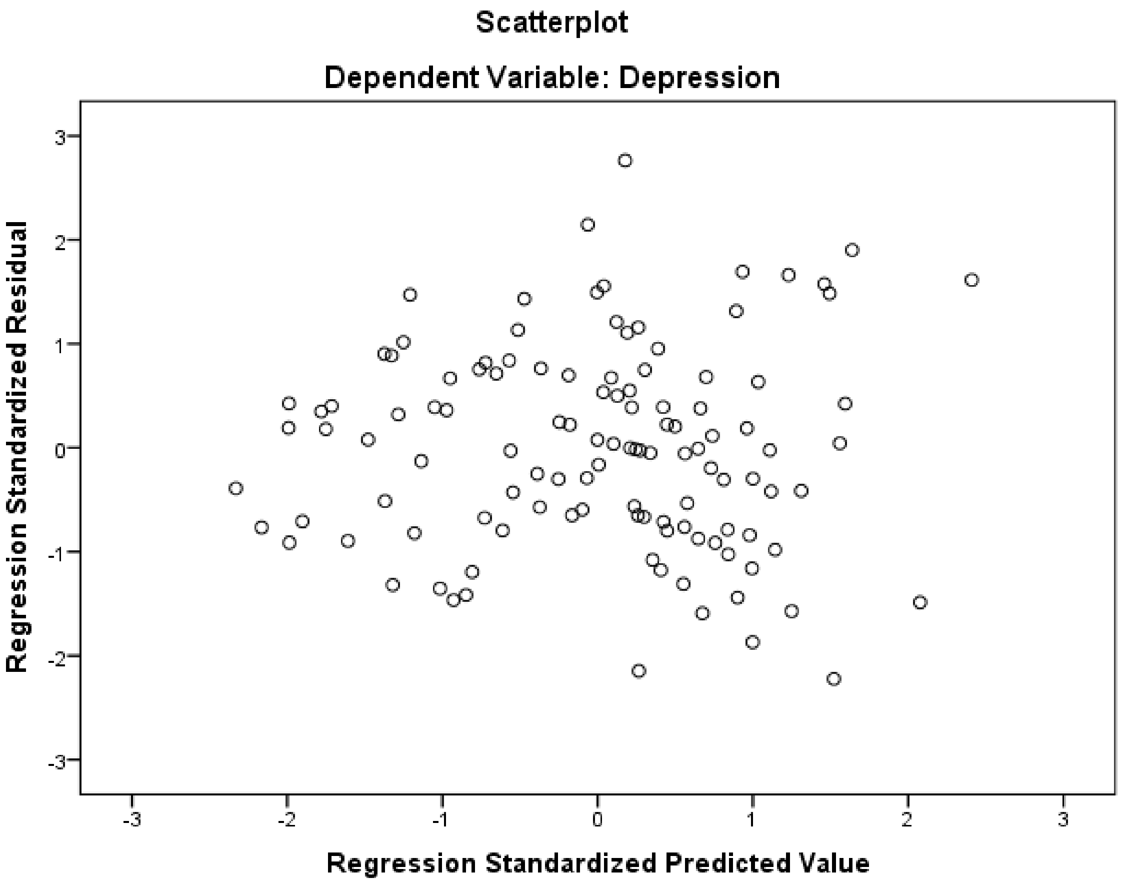

Figure 4. Assumption of heteroscedasticity for depression

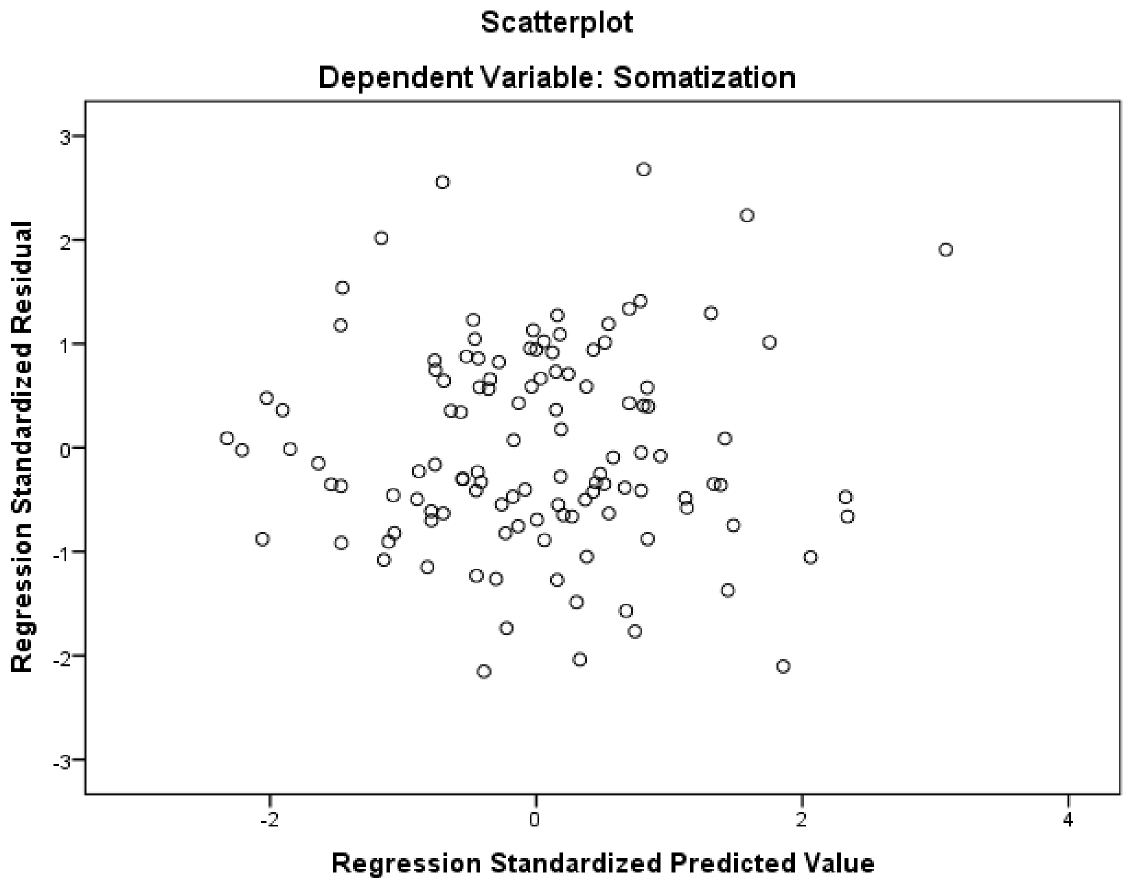

Figure 5. Assumption of heteroscedasticity for somatization

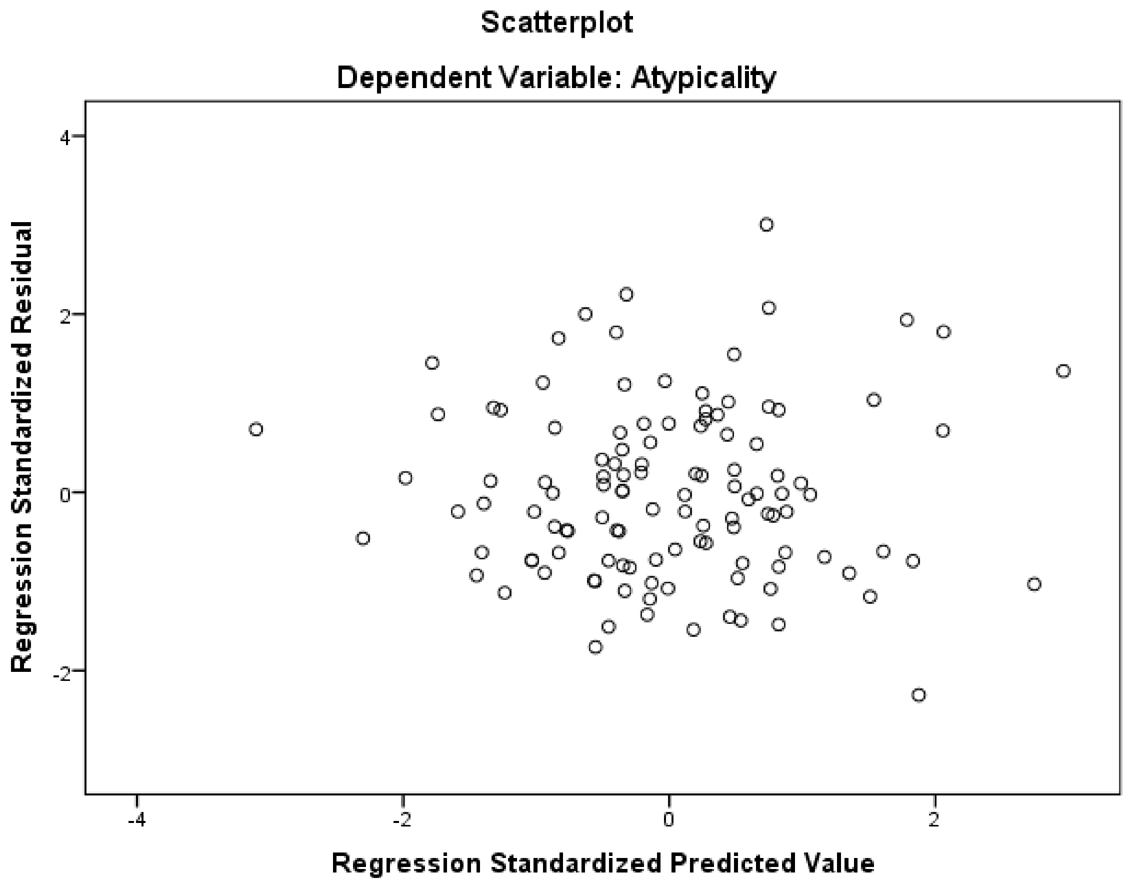

Figure 6. *Assumption of heteroscedasticity for atypicality*

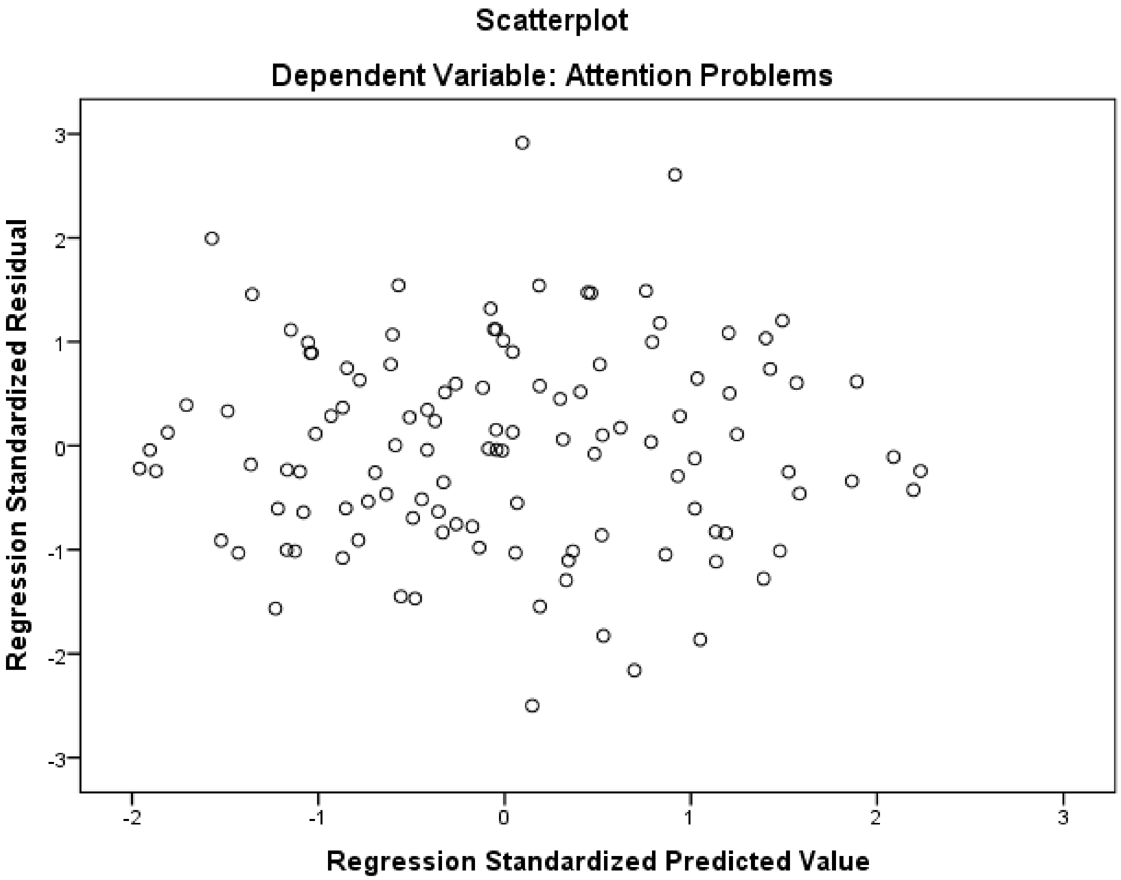

Figure 7. Assumption of heteroscedasticity for attention problems

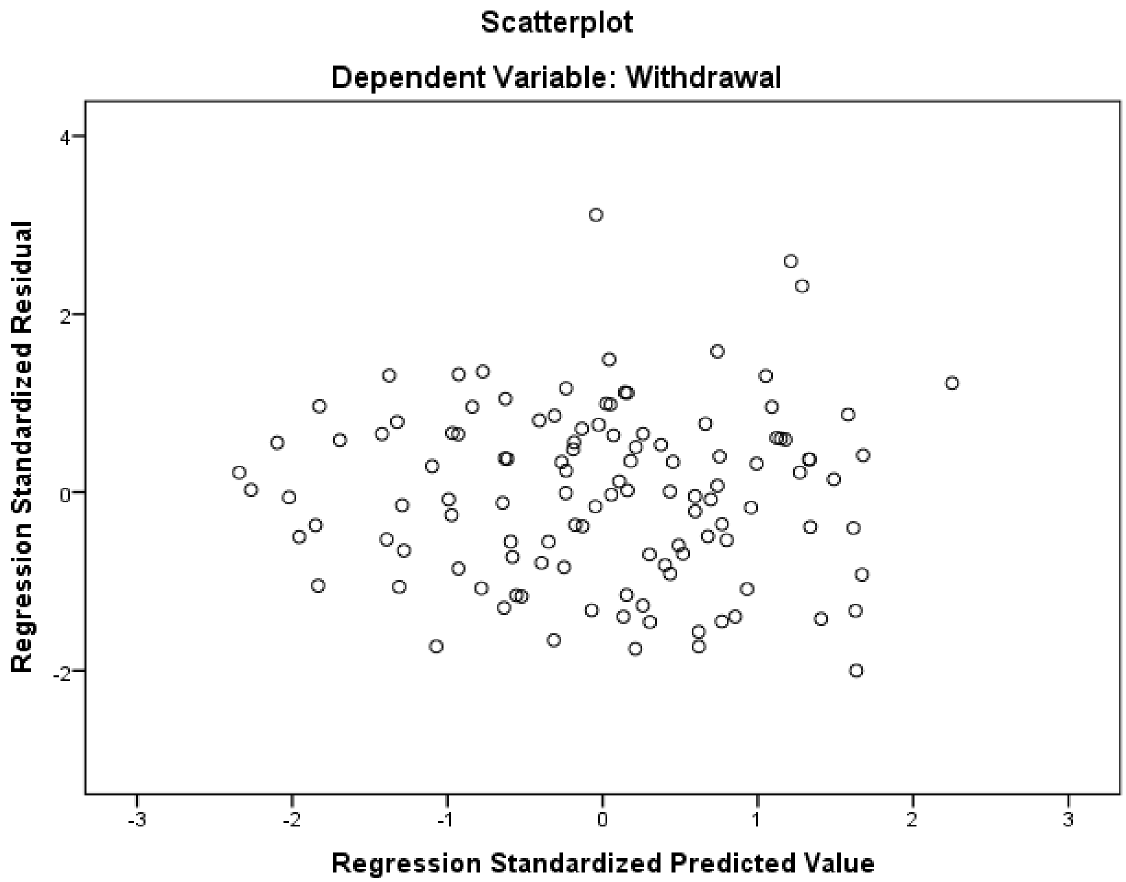

Figure 8. Assumption of heteroscedasticity for withdrawal