PHYSICAL ACTIVITY AND NUTRITION DURING KINDERGARTEN AND LATER ACADEMIC ACHIEVEMENT

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Dedication

I would like to dedicate the following dissertation to my husband and my parents. Thank you to my loving husband for being by my side for all these years, softly encouraging me to keep pushing through and not give up. Thank you to my parents for always being there to cheer me on and care for my children when I needed time to work. Because of you all and the sacrifices you have made, I have the opportunity to live out my dream of holding the title of Doctor and take the knowledge I have gained through this process to help children and adolescents achieve their dreams.

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Abstract

The current study investigated the relationship between kindergarten physical activity, kindergarten nutrition, and fourth grade academic achievement. The study utilized a publicly available national data set, the Early Childhood Longitudinal Study-Kindergarten 2010-2011 (ECSL-K2011). The use of this dataset allowed for examination of longitudinal effects of physical activity and nutrition as well as generalization of the results. Scales were created for the kindergarten physical activity and nutrition variables since they do not exist in the original dataset. The dependent variable was the academic achievement of the students during fourth grade. Control variables were gender, SES, race, and kindergarten achievement. Structural equation modeling was used to investigate the relationships among the variables. Physical activity during the kindergarten year was found to have a significant direct effect on fourth grade achievement, but with higher activity levels predicting lower achievement. Although there is a current focus on encouraging children to be active, these findings suggest that activity level may at times take away from an academic focus. Kindergarten nutrition was not related to fourth grade achievement. Kindergarten achievement was highly related to fourth grade achievement and had a positive relationship with physical activity and nutrition. Additionally, girls had lower fourth grade achievement than boys, but this may have been because there was a greater focus on mathematics and science in measuring achievement in the study. Further longitudinal research in this field would be needed to better understand the impacts that physical activity and nutrition have upon children's academics and well-being as a whole.

Chapter 1: Introduction

Physical activity level and nutrition are important factors that contribute to living a healthy lifestyle. Children who are characterized as being of a healthy weight and living an overall *healthy lifestyle* meet the following requirements defined by researchers: being moderately to vigorously physically active for a minimum of 60 minutes a day, eating nutritious food for all meals, and eating the appropriate amount of food every day (Byington et al., 2014; Kirk & Kirk, 2016). According to researchers, starting a healthy lifestyle early in life is beneficial in setting up good habits, attitudes, and behaviors towards academics, eating, and physical activity (Alderman & Fernald, 2017; Korenman et al., 2013). Children who eat in a less healthy manner and are minimally physically active may be more likely to have poorer health, higher rates of obesity, and lower levels of academic achievement (Asigbee et al., 2018; Center for Disease Control, 2016; Khan et al., 2012). Unfortunately, there has been a documented decrease in physical activity and increase in the consumption of fast foods, frozen foods, and heavily processed foods among children, which suggest more children are living a less healthy lifestyle than in previous years (Khan et al., 2012). A review of the literature, which follows, will demonstrate the importance of physical activity and nutrition and the impact they have on a student's academic achievement.

Physical Activity and Achievement

Physical activity has been linked to improvements in attention, long-term memory, thinking, processing information, and improved behavior in the classroom (Davis et al., 2007). All of these processes have been associated with higher levels of overall academic achievement, higher Math and Reading tests scores, and higher end-of-

the-year grades (Kirk & Kirk, 2016). Researchers have studied how current physical activity is related to current levels of academic achievement (Coe et al., 2006; Edwards et al., 2011; Eveland-Sayers et al., 2009). However, there has been only one study to date that has examined the relationship between physical activity during early childhood and later academic achievement (Carlson et al., 2008). In this one study, the researchers used the Early Childhood Longitudinal Study-K 1999 to examine the longitudinal relationship between physical activity and academic achievement. Their study aimed to examine the influence of physical education on direct measures of academic achievement in Math and Reading from kindergarten to fifth grade. When controlling for demographic variables (i.e., race/ethnicity, mother's education, and family income), it was found that girls who participated in physical education for 70 or more minutes per week had significantly higher achievement scores in Mathematics and Reading than girls who were enrolled in physical education for 35 or fewer minutes per week. Among boys, greater exposure to physical education was found to have no relationship with achievement scores in the areas of Mathematics and Reading. One suggestion made by the authors for further research was to examine a broader scope of physical activity level, rather than focusing solely on physical education. In order to address that suggestion, the current study focused on any physical activity children experienced during their kindergarten year. Additionally, the current study examined sedentary behaviors, such as TV viewing and computer use.

Nutrition and Academic Achievement

Maintaining a healthy lifestyle is more than staying physically active. A healthy lifestyle also involves proper daily nutrition, which consists of the daily consumption of a

variety of foods consisting of plant-based [including fruits and vegetables], grains, proteins, dairy, and oils, as well as eating the right amount of food, and proper micro and macronutrients (O'Dea & Mugridge, 2012; Rosales et al., 2009). Unhealthy diets, malnutrition, and overeating in elementary students have been found by researchers to be associated with lower achievement levels (Li & O'Connell, 2012). A majority of the research conducted related to proper nutrition centers around breakfast intake. Breakfast consumption has been associated with higher cognitive and academic performance in children and adolescents (Rampersaud et al., 2005).

Breakfast is said to be the most important meal of the day; however, a child's overall daily nutritional intake is the most important to cognitive growth and academic achievement. Overall diet quality has been found to have positive effects on overall school performance and self-esteem (Wang & Veugelers, 2008). A large part of diet quality involves food security. Food security is defined as a household's access to food due to financial, environmental, and/or geographical constraints. It is directly related to the types and amount of nutritious food that is available to children (Faught et al., 2017). Food insecurity (inadequate access to food) has been shown to be negatively associated with later academic achievement. Alaimo et al. (2001) and Jyoti et al. (2005) found that children who experienced food insecurity in their household had lower scores in Reading and Math; additionally, they were more likely to repeat a grade. Only in the Jyoti et al. (2005) was SES controlled for, which is echoed in this current study.

Similar to the research conducted looking at the relation between physical activity and academic achievement, most of this research has looked at current nutrition and current achievement levels. A longitudinal study that examines nutrition during

kindergarten and its relationship with later academic achievement may give more insight about the long-term impact of eating nutritious meals during the kindergarten year.

Interaction between Physical Activity and Nutrition on Academic Achievement

There have been few studies that have looked at both physical activity level and nutrition in relation to academic achievement. Researchers who have studied the influence of physical activity and nutrition on academic achievement have found them both to be associated with academic achievement. Specifically, higher levels of physical activity and proper nutrition were each related to higher levels of academic achievement (Asigbee et al., 2018; O'Dea & Mugridge, 2012).

O'Dea and Mugridge (2012) examined both the correlation between physical activity and academic achievement and the correlation between breakfast quality and academic achievement. Specifically, they studied the current levels of physical activity and breakfast quality on the relationship with literacy scores and the relationship with numeracy scores in 824 students in grades 3 to 7. Physical activity and breakfast quality were measured by a questionnaire given to mothers and a self-report completed by the students in the sample. Students reported on the number of hours they slept, their general level of physical activity, and what they had to eat or drink the day before the study was conducted. Academic achievement was measured by the National Assessment Program for Literacy and Numeracy (NAPLAN), which is a standardized test all students in the sample were required to take. They found that higher levels of physical activity and lower levels of fast food consumption were related to higher levels of academic achievement. Additionally, both physical activity and breakfast quality were found to be positively correlated with both literacy and numeracy scores, even when SES was controlled for.

The researchers in this study did not examine the interaction between physical activity and breakfast quality in relation to academic achievement. This interaction is important to examine, because it would give the field a better understanding of the impact living a healthy lifestyle has on academic achievement.

Only one study (Asigbee et al., 2018) has examined the interaction of physical activity and nutrition on academic achievement. Asigbee et al. (2018) examined the link between physical activity and nutrition with academic achievement using the ECLS-K 1998-1999 data set. They concentrated on wave 7, which was when the students were in 8th grade. They focused on current physical activity, current nutrition, and current achievement levels. Their findings suggested that physical activity in combination with proper nutrition was related to academic performance. Specifically, the results showed that a non-active, unhealthy nutrition group scored lower on Reading (Mean score = 139.48), Math (Mean score = 111.56), and Science (Mean score = 61.98) tests than the active, healthy nutrition group on Reading (Mean score = 173.69), Math (Mean score = 143.05), and Science (Mean score = 88.45) standardized test scores. When researchers examined physical activity (active vs. non-active group) and nutrition (healthy nutrition vs. unhealthy nutrition group) separately, they found the healthy nutrition and the active groups had higher academic achievement than the unhealthy and non-active group. These scores occurred while controlling for SES, age, and sex.

Studying the interaction between physical activity and nutrition on academic achievement would help establish a case for increasing physical education and nutrition education in schools (Asigbee et al., 2018). Both Asigbee et al. (2018) and O'Dea and Mugridge (2012) did not use longitudinal data, but used a cross section of data from the

8th grade year of the ECLS. It would be important to examine this relationship using recent longitudinal data because it could give further insight for parents, caregivers, and schools to set up beneficial programs and policies during kindergarten. These programs could enhance later academic achievement that would be beneficial for all students, regardless of SES, gender, and racial/ethnic background. It is important to focus on the physical activity and nutrition of kindergarten students because this is the time when most children start attending school daily, which allows for them to have more access to beneficial programming that can be created by the education system.

Demographic Variables related to Physical Activity, Nutrition, and Academic Achievement

Several demographic variables, such as socioeconomic status, gender, race and ethnicity have been found to be related to physical activity, nutrition, and academic achievement. Additionally, kindergarten achievement is included in the current study as a control variable, as it relates to later academic achievement (Kurdek & Sinclair, 2001). The research about this is described below.

Socioeconomic Status

Socioeconomic status (SES) is the social standing or class of an individual (American Psychological Association, 2017). SES is often measured by the combination of education, income, and occupation of the child's parent. According to multiple researchers' theories, SES may be a factor in differences in physical activity, nutrition, weight status, and academic achievement in children (Li & O'Connell, 2012; Walton et al., 2010). Lower reported physical activity has been reported to be associated with lower SES (Jiménez Pavón et al., 2010). Higher rates of childhood obesity, under nutrition, and

a higher intake of fast foods are also associated with lower SES (Center for Disease Control, 2016; Rosales et al., 2009). Lower SES is also associated with lower achievement scores in Reading and Math (Sue & Sue, 2016). Since there is a large amount of research supporting the effects of SES on physical activity, nutrition, and academic achievement, SES was used as a demographic variable in this study.

Gender Differences in Physical Activity, Nutrition, and Academic Achievement

Many studies have found a gender difference in the amount of physical activity, foods that children eat, and overall academic achievement. Not all research is in agreement related to the relationships gender has on each of these factors, but researchers are in an agreement that gender does have some influence (Hallal et al., 2012; Pearce et al., 2012; Telford, Telford, Olive, Cochrane, & Davey, 2016).

In one study, higher levels of physical activity and consumption of protein, carbohydrates, lactose, and vitamin-rich food were found in males, whereas females tended to have greater levels of water intake, as well as lower levels of overall food intake and physical activity (Merkiel-Pawlowska & Chalcarz, 2017). Carlson et al. (2008) found that girls with a high exposure to physical education (70–300 minutes per week) had a small academic benefit in both Math and Reading compared to those with a lower level of exposure of physical education (0–35 minutes per week). Girls in the high exposure physical education group had a larger academic benefit than boys in either of the high or low exposure physical education group. In another study, males tended to have higher scores on Math achievement assessments, whereas females tended to have higher levels of Reading achievement scores (Datar & Strum, 2006). Similar to SES,

there is a large body of research that has shown correlations between gender and physical activity level, nutrition, and academic achievement.

Racial and Ethnic Discrepancies in Physical Activity, Nutrition, and Academic Achievement

Race has been documented as a significant factor in academic achievement outcomes, physical activity level, obesity, and nutrition intake (Center for Disease Control, 2016). A weakness in early literacy and a classification of an unhealthy weight status are more common among nonwhite children than white children in the United States (Center for Disease Control, 2016). In one study, black and Hispanic youth were found to have lower levels of physical activity and fruit/vegetable intake, and higher levels of screen time and fast food intake, than peers from other racial backgrounds (Berlin et al., 2017).

Kindergarten Achievement

Kindergarten achievement in the areas of Math and Reading is a powerful predictor of later primary school achievement in later grades. Researchers have found Kindergarten cognitive skills--mainly receptive vocabulary and number knowledge--are associated with academic achievement by the end of fourth grade (Duncan et al., 2007; Pagani et al., 2011). Additionally, kindergarten readiness has been linked to a student's later academic achievement regardless of their age or gender (Kurdek & Sinclair, 2001). Considering the predictability of kindergarten achievement on later academic achievement, it is important to include kindergarten achievement as a control variable.

Current Study

Most studies have found a relationship between physical activity and nutrition with academic achievement. Asigbee et al. (2018) is the only study that has looked at the interaction between physical activity level and proper nutrition in relation to academic achievement. They found a significant relationship with academic achievement. However, that study did not examine the long-term effects of physical activity and nutrition on later academic achievement. Rather it looked at current levels of physical activity and nutrition on current levels of academic achievement.

Physical and nutritional habits are learned and formed at an early age and tend to stay constant throughout later childhood and adolescence (Lynch, 2011; Thompson et al., 2010). Kindergarten is an important time for parents, guardians, doctors, and school personnel to focus on giving children the opportunity to learn, engage, and practice eating healthily and being active. The research cited above has shown that physical activity and nutrition have an impact on academic achievement; therefore, instilling these healthy habits at an early age is important for long-term academic achievement and growth. Considering there have been no studies that have examined this longitudinal effect, the purpose of the current study was to examine the link between physical activity and nutrition level during kindergarten and academic achievement in fourth grade.

The current study utilized a publicly available data set created by the National Center for Education Statistics (NCES). Specifically, the data set used was the Early Childhood Longitudinal Study-Kindergarten 2010-2011 (ECSL-K2011). The ECSL-K is a longitudinal study following a United States national sample of children, their parents, teachers, and schools from grades kindergarten through eighth grade (Berlin et al., 2017; Jackson, 2016). The benefit of using the ECSL-K is that it provided a large sample size of

participants from across the nation, which helps with the ability to generalize the results. An additional benefit of using the ECSL-K dataset is that it is longitudinal. Examining eating and activity behaviors longitudinally, and in multiple environments, can provide insights into relationships between, physical activity, nutrition, and academic outcomes (Bellows et al., 2010).

Previous research, such as Asigbee et al. (2018), used an earlier ECLS –K 1998 dataset to study the interaction between physical activity, nutrition, and academic achievement. The current study used updated data that is more relevant to current societal views, norms, and ideals. It is important to add updated information to the field because there have been many changes in laws, policies, program initiatives, and overall views on obesity, physical education, and nutrition in recent years.

In this study, the following hypotheses were examined, which were believed to occur regardless of SES, gender, and race/ethnicity. It is important to include demographic variables as control variables in order to better understand all the factors that may contribute to physical activity level, nutrition, and academic achievement in children. It was hypothesized that:

1. Physical activity level during kindergarten will correlate with academic achievement in the fourth grade.
2. Nutrition during kindergarten will correlate with academic achievement in the fourth grade.
3. Physical activity level during kindergarten will relate more strongly to fourth grade academic achievement than nutrition will relate to fourth grade academic

achievement. This is thought to occur because of a large amount of research that indicates positive impact physical activity has on academic achievement.

4. Having both greater physical activity levels and better nutrition will have a greater influence on academic achievement than having higher levels of either variable alone. Other research using an earlier dataset has shown a positive relationship between the combination of better nutrition and greater physical activity with academic achievement (Asigbee et al., 2018).

Chapter 2: Literature Review

Initial sections of this chapter give a more detailed discussion of the literature about the effects of physical activity level and nutrition on academic achievement. This literature review also provides a more detailed discussion of the demographic variables used in the current study and a review of contemporary laws and regulations related to physical activity and nutrition in schools across the United States. The final section of this chapter is a review of the literature related to physical activity and nutrition programming developed for use in schools.

Physical Activity

In most schools, participation in physical education classes, school sports, and recess are the only methods that students are physically active (Kohl & Cook, 2013). Since the implementation of some federal and state laws, the amount of time that students spend in physical education and recess has decreased due to the increased time requirements for other core curriculum subjects, such as Reading and Math (Edwards et al., 2011). On average, school-aged children have two physical education class periods per week, each for about 30 minutes. However, not all of the time spent in gym class involves physical activity; some of the time is spent changing and being sedentary while listening to instruction or waiting for their turn (Kohl, & Cook, 2013). Additionally, not all states have a required amount of time for elementary students to participate in physical education class; many states only have recommendations (Shafer & Whitehouse, 2017). The importance and the effect of physical activity on academic achievement have been studied by various researchers and is described in the next section.

Academic Achievement

As discussed in the introduction, higher levels of physical activity among children correlate with higher levels of academic achievement. This is due to the fact that physical activity increases brain activity, increases attention in children, helps as a mood stabilizer, and helps with brain development (Etnier et al., 1997).

Various studies have found that a threshold of physical activity needs to be reached before academic achievement is significantly impacted (Coe et al., 2006; Kirk & Kirk, 2016; Let's Move, 2016). For example, Kirk and Kirk (2016) studied HeadStart preschool classrooms in order to gain a better understanding of the impact that 60 minutes per day of physical activity would have on early literacy skills in preschoolers. The researchers evaluated academic lessons, which were taught while children were being active. This consisted of getting students to dance, move around the room, and/or 60-second movement breaks throughout the day. The researchers found that the experimental classrooms, which were the classrooms that taught lessons in conjunction with movement, had an overall higher average on early reading skills. The control classrooms had the minimum required amount of physical education (i.e., 30 minutes per day).

Eveland-Sayers et al. (2009) also studied current levels of physical fitness and current levels of academic achievement in students in grades three to five. They found that physical activity, measured by a time on the 1-mile run and number of curl-ups and sit and reach completed, were related to academic achievement. Reading and Math scores on the TerraNova measured academic achievement. The TerraNova is a series of standardized achievement tests designed to assess K-12 student achievement in Reading,

Language Arts, Mathematics, Science, Social Studies, Vocabulary, Spelling, and other areas.

Edwards et al. (2011) had 800 students, ages 11 to 13 years, at a public school complete a survey related to their current physical activity. This survey was adapted from the Youth Risk Behavior Surveillance Survey (YRBSS). National samples of high school students take the YRBSS every other year. Questions on the YRBSS relating to nutrition, physical activity, and television watching were used. Additionally, the researchers used the FitnessGram Pacer Test to measure aerobic capacity (timed mile run), muscle strength (push-ups and sit-ups), height, and weight. Height and weight were taken in order for the researchers to identify each student's body mass index (BMI). BMI is a measure of a person's weight taking into account their height. The researchers found that physical activity, measured by the FitnessGram Pacer Test, was associated with academic achievement. Academic achievement was measured by the Measure of Academic Progress (MAO) achievement tests, which is a computerized adaptive test that looks at student academic growth. The researchers also found a negative correlation between physical activity and BMI. In their study, sixth-grade students who were active for a minimum of 60 minutes per day had the lowest BMI. Researchers suggest being moderately to vigorously physically active for a minimum of 60 minutes a day should be a requirement in order for a child to be considered living a healthy lifestyle (Byington et al., 2014; Kirk & Kirk, 2016).

Coe et al. (2006) examined the relationship between the level of activity within physical education classes and overall academic achievement in middle school students. They also examined the effectiveness of light, moderate, and vigorous physical activity to

corroborate previous research that indicates at least 60 minutes of moderate to vigorous physical activity is needed to maintain a healthy lifestyle in children. In order to examine level of physical activity, Coe et al. (2006) used 3-D physical activity recall (3DPAR), which asks children to recall the previous days' physical activity using specific activity codes, which is then converted into light, moderate, and vigorous activity defined by the Healthy People 2010 guidelines. They also used the System for Observing Fitness Instruction Time (SOFIT) to record student activity levels. Results showed that participation in the traditional physical education enrollment (federal mandated physical education class time) did not significantly correlate with academic achievement (grades in Math, Science, English, and World Studies and the Terra Nova standardized test). The researchers hypothesized that there was no relationship because only 19 of the 55 minutes of physical education class were spent doing moderate to vigorous physical activity (i.e., running, engaging in a sport, and weight lifting). The remainder of the class was categorized as light physical activity (i.e., listening to instruction, stretching, and walking). The study found that those students who participated in more vigorous physical activity, such as after-school sports or additional gym time, in addition to the traditional physical education class had a higher GPA and higher scores on the Terra Nova than students who did not participate in additional physical activity. Their results also indicate a level of vigorous physical activity (at least 30 minutes of high intensity activity) may need to be reached in order for the level of physical activity to affect academic achievement. Similar to the previous studies mentioned in this section, Coe et al. (2006) examined the current level of physical activity level and achievement within their sample.

They did not study the long-term effects physical activity would have on academic achievement.

In a later study, Coe et al. (2013) examined the relationship between physical fitness and academic achievement in elementary, middle, and high school students. Specifically, they examined scores from the Michigan Education Assessment Program in the areas of Math, ELA, and Social Studies. In order to examine physical fitness levels, the researchers used the results of the FITNESSGRAM test, PACER test, and BMI. The main finding was that there was a significant positive correlation between physical fitness and academic achievement in middle and high school, but not elementary school. Higher fitness scores are related to better performance in academic areas. The association between fitness and academic achievement remained significant even when SES was controlled for, but only for Math and Social Studies.

The studies discussed above all looked only at current levels of physical activity and the relationship to current levels of academic achievement. They did not examine long-term effects of physical activity on academic achievement, nor the influence nutrition can have on academic achievement. Like physical activity, nutrition is also an important factor in brain development and overall health (Bunketorp-Kall et al., 2015).

Nutrition

Research has found that exposure to healthy foods, such as vegetables and fruits, during toddlerhood and the preschool years, are a good predictor of healthy eating and liking of fruits and vegetables later in life (Skinner et al., 2002). Research has also found exposure to unhealthy food and eating behaviors are good predictors of unhealthy eating and obesity among children. Sedentary behaviors, such as watching television while

eating, are correlated with higher weight status (Gubbels et al., 2012). If young children do not receive proper nutrition, then areas of the brain which control attention, executive functioning, working memory, and reasoning will not develop properly, affecting their overall cognitive ability (Jackson, 2016; Rosales et al., 2009). Nutritional habits are learned and formed at an early age and tend to stay constant throughout later childhood and adolescence (Lynch, 2011; Thompson et al., 2010). Like physical activity, children's nutrition has been examined in relation to their academic achievement.

Breakfast Consumption and Academic Achievement

Eating breakfast is another way to prompt long-term healthy eating habits. According to the U.S. Department of Agriculture (2014) and Korenman et al. (2013), the recommended amount of food for children ages three to five for breakfast is three-fourths cup of milk, one-half cup of fruits and vegetables, and one-half slice or one-half serving of grains. They also recommended the following serving amounts for lunch or supper: three-fourths cup of milk, two-half cup servings of fruit or vegetables, one serving of grain or bread, and one serving of meat or meat alternative (a serving of meat is 1.5 ounces). Breakfast consumption has been suggested to enhance cognition and academic performance, both for standardized scores and grades (Rampersaud et al., 2005).

Rampersaud et al. (2005) conducted a meta-analysis searching for all articles published between 1970 through February of 2004 with the word *breakfast* in combination with *children* or *adolescents*. There were a total of 47 articles reviewed in this study. Rampersaud et al. (2005) found a consensus in the research that breakfast consumption has been declining over time, especially as students get older. Breakfast eaters have a higher overall energy throughout the day than breakfast skippers. Children

and adolescents who eat breakfast also are more likely to meet nutrition intake guidelines throughout the day. Additionally, Rampersaud et al. (2005) found three articles suggesting breakfast consumption enhanced memory function for several hours after eating.

Adolphus et al. (2013) conducted a meta-analysis reviewing all articles on this topic published between the years 1950 and 2013 on various databases. The search was conducted using keywords such as *breakfast* or *school breakfast* combined with *children* or *adolescents* combined with *academic performance*, *scholastic performance*, *academic achievement*, *school grades*, *school achievement*, or *educational achievement*. Twenty-two studies examined academic performance measures to investigate the effects of breakfast on academic outcomes. Twenty-one of the twenty-two studies demonstrated that eating breakfast had a positive relationship with academic performance, pointing to its importance. Yet, eating breakfast is only one part of daily nutrition.

Nutrition and Academic Achievement

Better nutrition improves physical health and decreases the risk of obesity (Asigbee et al., 2018; Center for Disease Control, 2016). In recent studies, nutrition has shown to have a positive correlation with academic performance (Hoffman et al., 2010). Years of research on the school breakfast program, observational studies, and national surveys support the premise that better-nourished children do better in school (Adolphus et al., 2013; Hayes & Dodson, 2018).

Burrows et al. (2017) conducted a meta-analysis examining the broader effects of dietary intake and behaviors on school-aged children's academic achievement. Studies were included if they met the following requirements: participants were school-aged

children (5-18 years), the studies included a measure of dietary intake/behavior and a measure of academic performance, and reported the association between dietary intake/behaviors and academic performance. A total of forty studies were included in the review. Few studies examined the dietary intake/behaviors and academic performance within younger age groups; most of the studies examined children greater than 10 years of age. The dietary outcome most commonly reported to have positive associations with academic achievement was breakfast consumption, whereas negative associations were reported with *junk*/fast food consumption.

In the Edwards et al. (2011) study described above, the researchers also examined the relationship between nutrition and academic achievement. Nutrition was measured by students' self-reports using questions adapted from the Youth Risk Behavior Surveillance Survey. It was found that sixth-grade students who consumed more milk and fewer sugary beverages had higher MAP Math and Reading scores. Students who ate breakfast were found to have higher overall MAP Math scores than those who did not eat breakfast. However, there were no significant findings regarding the relationship between nutrition and students' MAP Reading scores. Eating breakfast was also found to be associated with improved attendance and reduced tardiness.

In summary, the relationship between nutrition and academic achievement has not been studied as extensively as the relationship between physical activity and academic achievement. Most research has been focused on children's breakfast consumption. This research has found positive associations with academic achievement (Burrows et al., 2017; Edwards et al., 2011; Gubbels et al., 2012).

Relationship between Physical Activity and Nutrition

There has not been any research conducted on what the relationship between physical activity and nutrition is among children. However, there has been some recent research in regard to how physical activity may influence dietary preferences in young adults. Research conducted by Jayawardene and colleagues (2015) suggested that being more active does influence young adults to eat in a healthier manner. They suggested this occurs due to the transfer effect. This means that the new engagement in healthy exercise behavior transfers over time into a higher level of fruit/vegetable consumption.

Joo and colleagues (2018) studied young adults in a 15-week exercise program to examine if this program had an influence on their dietary patterns. Changes in dietary preferences were evaluated by using a pre- and post-test, which accounted for the effects of gender, race/ethnicity, and BMI. Within all seven of the dietary preferences, there was a decrease in the amount of food participants ingested and there was an overall decrease in snacking. Researchers also saw an increase in preferences for foods that are healthier (e.g., fruits, vegetables, milk). One suggested reason for this change in dietary preference might be due to hormonal changes that the body goes through when one increases exercise amount and intensity. However, the researchers suggested the regulation of dietary patterns might become more regulated due to the positive body changes that are observed by those who increased their exercise regimen.

In summary, the relationship between nutrition and academic achievement has not been studied as extensively as the relationship between physical activity and academic achievement. Research that focuses on children's breakfast consumption has found positive associations with academic achievement. Additionally, research that has studied nutrition more broadly has found nutrition to be important (Burrows et al., 2017;

Edwards et al., 2011; Gubbels et al., 2012). There is little research regarding the longitudinal effects of nutrition during kindergarten on later academic achievement (Burrows et al., 2017). When examining these variables, it is important to take into account various child characteristics that may influence them, such as demographic variables.

Demographic Variables

The demographic variables that appear to be relevant to children's physical activity, nutrition, and academic achievement are socioeconomic status, gender, and race and ethnicity. Although the studies listed below are not all of the studies that have been conducted examining the demographic variables in this study, they are a representation of the general consensus of the research.

Socioeconomic Status in Physical Activity, Nutrition, and Academic Achievement

Socioeconomic status (SES) is an important factor that impacts a child's physical activity, nutrition, and academic achievement. SES often determines where one lives and what educational and recreational options (e.g., parks, pools, schools, youth organizations, and YMCAs) parents have for their children. Access to these facilities is linked to the type of neighborhood one lives in, and generally access to these facilities is unequally distributed toward higher income communities (Gordan-Larsen et al., 2006). It is also linked to physical activity behavior of youth; the more access, the higher rate of physical activity is recorded (Burton & VanHeest, 2007).

According to Sue and Sue (2016), there has been a significant rise in students who are in the lower SES since the 1960s. Jiménez Pavón et al. (2010) found that adolescents in Europe from a higher SES level had significantly higher fitness levels (assessed by

speed-agility, muscular strength and cardiorespiratory fitness) than their peers of the lowest SES level. In the United States, chronic under-nutrition has been found to occur more frequently in children from families within the lowest level of SES (Rosales et al., 2009).

Differences in achievement and testing scores have been found within all academic areas between students in high, moderate, and low SES levels. For example, Coe et al. (2013) found Math, ELA, and Social Studies achievement scores were higher for the mid and high SES groups than the low SES groups. Sirin (2005) conducted a meta-analysis, which found that family SES was one of the strongest correlates of academic performance (e.g., standardized test scores, GPA, academic assessments) across multiple grade levels. Additionally, research has suggested that kindergarten readiness impacts academic achievement. Research has found children from lower income households have a smaller vocabulary and score lower on school readiness tests than children from average and high-income households (Evans, 2005).

In general, children from a lower SES are least likely to be physically active, have overall poorer nutrition, and tend to score lower on academic achievement assessments. Additionally, children from lower SES households score lower on kindergarten readiness tests.

Gender Differences in Physical Activity, Nutrition, and Academic Achievement

Unlike the research conducted examining SES and academic achievement, research that has examined the relationships between gender and physical activity has not produced consistent results. Some research suggests girls are overall less active than boys (Hallal et al., 2012; Pearce et al., 2012; Telford et al., 2016). However, other research has

found there to be no gender difference in physical activity level among girls and boys (Loprinzi et al., 2013).

Few studies have been conducted examining the relationship between gender and nutrition. Those that have been conducted have shown that boys ate more protein, carbohydrates, lactose, and vitamin-rich food, and drank less water than girls (Huybrechts & De Henauw, 2007; Merkiel-Pawlowska & Chalcarz, 2017).

A large number of studies have been conducted that have shown that gender is a significant predictor in academic achievement. For example, Datar and Sturm (2006) compared girls and boys scores on Math and Reading tests across a number of school years using a national data set. They found that girls achieved lower in Math than boys, but no difference was found in the area of Reading. Chomitz et al. (2009) found similar findings; in addition, they also found that females tend to have higher English grades than males. In contrast, Matthews et al. (2009) examined gender differences in five areas of early achievement: applied problems (Math), general knowledge, letter-word identification, expressive vocabulary, and sound awareness. No significant gender differences were found on the five academic achievement outcomes, as measured by the Woodcock-Johnson III Tests of Achievement.

In summary, researchers have not been in agreement about the effects of gender on physical activity level and little research has been conducted examining gender differences in nutrition over time. However, there has been a significant amount of research conducted indicating a gender difference in academic achievement.

Racial and Ethnic Discrepancies in Physical Activity, Nutrition, and Academic Achievement

The prevalence of children being classified within an unhealthy weight status has been found to be higher among white, black, and Hispanic youth than children from Asian backgrounds (Ogden et al., 2015). Children who are considered to be within one of the following minority groupings (Black and Hispanic) are more likely to be obese and have lower levels of physical activity and higher levels of caloric consumption of energy dense foods (e.g., sugar cereals, soda, high sugar snacks) than white children (Burton & VanHeest, 2007). Additionally, an increase in television viewing and computer use has been associated with a decrease in physical activity and has been recorded to be higher in minority children (Gordan-Larson et al., 2002).

Moreno, Johnson-Shelton, and Boles (2013) stated Hispanic children might be at the highest risk for low academic achievement. Other research has shown that black and Hispanic students have lower average Reading, Mathematics, and Science scores than their white peers. The magnitude of these gaps is found to increase across time and grade levels (Mickelson et al., 2013; White et al., 2016).

Overall, race and ethnicity have been connected to SES, physical activity level, nutrition, and academic achievement. Children from the minority groups (primarily black and Hispanic groups) are at the highest risk for low physical activity level, poorer nutrition, and lower levels of academic achievement.

School-related Laws and Policies

The above research has found links between physical activity, nutrition, and academic achievement; thus, laws and policies were created at the federal level because there was a need for established guidelines for these domains. Although some of these laws and policies were created many decades ago, the federal government has attempted

to change standards and guidelines to match the changes in society. However, many are still out of date and may not correlate with findings from the research focused on the importance of physical activity and nutrition programming. This section is a discussion of the current school-related laws and policies that are in place and the effects they have on physical activity, nutrition, and academic achievement of students.

National Physical Education Standards

The United States has five standards that schools must follow related to physical education: (1) students must demonstrate they have competence in a variety of motor skills and movement patterns; (2) students must be able to apply knowledge of concepts and strategies to movement and performance; (3) students must demonstrate and maintain a health-enhancing level of physical activity; (4) students should be taught to respect their self and others; and (5) students should be able to recognize the importance of physical education for health (National Standards & Grade-Level Outcomes for K-12 Physical Education, 2014). The goal of physical education in the United States, according to the federal standards, is to give students the knowledge, skills, and confidence to participate in physical activities.

According to the U.S. Department of Health and Human Services (2010), 60 minutes of daily physical activity is recommended. The 60 minutes of physical activity should be a combination of structured (i.e., physical education class) and unstructured (i.e., recess) physical activity that should be light (<3.0 metabolic equivalent task) to moderate (3.0-6.0 metabolic equivalent task). Similarly, researchers recommend that students should have 60 minutes of moderate to vigorous (>6.0 metabolic equivalent task) physical activity per day (Coe et al., 2006; Kirk & Kirk, 2016). The National

Physical Education Standards do not have any guidelines related to nutrition or the instruction of nutrition. Still, several school programs were established to promote better nutrition in children.

National School Lunch Program

In 1966, the federal government legislated the Child Nutrition Act, which mandated all schools that receive federal funding provide a free breakfast for students whose families met specific poverty standards. The purpose of the Child Nutrition Act was to ensure students are not starting the school day hungry and are receiving a well-balanced meal (United States Department of Agriculture, 2014). The Child Nutrition Act of 1966 is now part of the National School Lunch Program.

The National School Lunch Program is a federal-assisted meal program for public and private schools that receive federal funding. This program requires schools to provide students who meet the criteria for a free or reduced lunch with nutritionally balanced, low cost, or free lunches. In 2012, the National School Lunch program was updated to include more nutrition standards for school meals (Guthrie & Ralston, 2017; National School Lunch Program, 2016). Now lunches must include fruits, vegetables, whole grains, meat or a meat alternative, and milk. Students can also qualify for a free or reduced breakfast, which must include fruits, whole grains, and milk. The new nutrition standards place a greater emphasis on vegetables, fruits, and whole grains because of the nutritional value that these food groups have for children. Though the National School Lunch Program was created for students whose parents cannot provide them with lunch or breakfast, the nutritional standards for school lunches must be followed for students who are buying their lunch as well. Although students must be served the required food

on their plate, they are not forced to eat all of that food (School Nutrition Standards, 2016).

Though the United States government does recognize the need for proper nutrition for all students, but some critics have argued that the government and schools are not providing adequate food choices to meet the students' nutrition requirements (Guthrie, & Ralston, 2017). Critics have argued that one of the major problems with the nutritional guidelines is that the foods sold in school are still high in sugar content and are not of good quality. Critics suggested one of the reasons for these foods still being sold in schools is because the school can make money from the sale of these low-cost foods, by inflating the prices at which they are sold (School Nutrition Standards, 2016). Using whole-wheat products and fresh vegetables and fruits is more expensive to schools than the use of more processed foods (Gurley, 2016). Although the above programs have addressed physical activity and nutrition, the main focus of policy has been about education itself.

No Child Left Behind Act of 2001

The No Child Left Behind Act of 2001 (NCLB) was federal legislation that is based on the theory of standards-based education. The NCLB intended to ensure all children have a fair, equal, and significant opportunity to receive a high-quality education and be competitive and proficient in state academic standards and assessments. Although the NCLB did not specifically relate to physical education or nutrition programming, it did have an effect on the amount of time and funding attributed to physical education and nutrition. NCLB introduced a stronger emphasis on academics, which required some administrators and/or school districts to shift their focus and resources away from

physical education, after-school sports, health classes, and after-school programming (Trost & Van Der Mars, 2009). Still, Trudeau and Shephard (2010) found that adding extra time for physical education during the school day did not diminish students' academic performance (e.g., grades and standardized test scores).

Due to this paradigm shift in schools, health and physical education became a secondary concern. Government and school officials took the stand that health and physical education should be primarily taught at home and only supplemented at school (Kohl & Cook, 2013). A study conducted by Chomitz et al. (2009) also found that the general belief of the participants was that health and nutrition should be a primary focus of the parents and not that of schools. Although the No Child Left Behind (NCLB) act has since been replaced with the Every Student Succeeds Act (ESSA), it is important to discuss the NCLB because it has been the framework for elementary and secondary education for recent years.

Every Student Succeeds Act

In December of 2015, the U.S. passed the Every Student Succeeds Act (ESSA). This piece of legislation replaced the No Child Left Behind (NCLB) act and it now provides the framework for elementary and secondary education in the United States (U.S. Department of Education, 2017). According to SHAPE America (2016), the ESSA aims to shift the focus from *core academic subjects* to *a well-rounded education*. Unlike NCLB, ESSA aims to include health and physical education in order for students to obtain a *well-rounded education*. Subjects that include health and physical education are now more able to receive federal funding through Titles I, II, and IV. However, there is

still a lag in schools embracing ESSA and instituting programs and/or interventions that include educating students on the importance of staying active and eating healthy.

Physical Activity and Nutrition Programming and Interventions

Although there is a lag, some schools have been developing programs to help combat childhood obesity by educating children about nutrition and the importance of being active. Many programs were created so that children not only learn about physical activity and good nutrition, but also engage in these behaviors (Byington et al., 2014; Drapeau et al., 2016). These programs attempt to incorporate the education of physical activity and nutrition into the children's everyday school routine. Considering that research has indicated the most effective time to introduce the ideas and practices of being active and eating nutritious foods is during early childhood, many of the programs have been developed to target students during the pre-K and kindergarten years (Halfon et al., 2001; Jackson, 2016). Although there has been research on the immediate effects of the programs on academic achievement, there is little to no research on the long-term effects of these programs.

The following are some, not all, examples of programs and studies that have been developed and implemented in school settings that are designed to promote increases in students' knowledge about and experience with being physically active and eating healthy foods.

Programming with a Physical Activity Focus in Schools

My School in Motion. The My School In Motion program is a school-wide daily fitness, nutrition, health, and wellness program performed at the beginning of every school day. This program was designed to increase students' movement throughout the

school day in the academic setting. The movement routines integrate cardio-respiratory, muscular conditioning, and flexibility exercises. The cognitive components of the program are delivered through *repeat-after-me/do after me*, and *call-and-response* techniques, which aim to link messages with kinesthetic movement. The cognitive components are all designed to foster student learning. My School In Motion was designed to support Common Core State Standards for grades K-12 and is aligned with the National Physical Education Content Standards and the National Health Education Content Standards, as well as state physical education and health education content standards (My School in Motion, 2018).

A study conducted in Sweden by Bunketorp-Kall et al. (2015) examined the effects of the My School in Motion program in grades pre-k through 6th grade. In this study, KidScreen-27, which had four domains (i.e. psychological well-being, autonomy and parents, peers and social support, and school environment) and the Strengths and Difficulties Questionnaire for children older than fourth grade were used to assess the students' overall well-being. Students' academics in schools that used the My School in Motion program (therefore, these students were engaged in more physical activity than the control group) were compared to students' academics in schools that did not use the program. Students who attended schools that used the My School in Motion program had higher scores in Math and English on achievement tests than students in schools that did not use the program.

Get Movin' with Mighty Moves. Mighty Moves is a school-based program that has been implemented in a number of schools across the United States. The Mighty Moves program is based on social learning theory, which is built upon the idea that there

is an interaction between one's environment, behavior, and personal factors. The Mighty Moves program is designed to enhance preschool children's gross motor skill development, in an effort to develop confidence in movement and increased physical activity levels (Let's Move, 2016).

In a study conducted by Bellows et al. (2010), the researchers used data from the Colorado Longitudinal Eating And Physical Activity (LEAP) Study, which is an intervention study designed to prevent early childhood obesity. LEAP utilized a social-ecological approach to explore individual, family, and environmental factors and their relationship to child weight status over three years. One interest of the researchers in this study was if behavior changes were positively influenced by the Food Friends® program and if the same behavior would continue throughout early elementary school. The Food Friends® program is a combination of Fun with New Foods, a 12-week intervention that allows students to become more engaged and learn about healthy foods, and the Get Movin' with Mighty Moves program. The Food Friends: Get Moving with Mighty Moves program addresses the importance of physical activity during early childhood. This program is one of a few that speak to both nutrition and physical activity in the preschool population. Findings from this research showed the Mighty Moves' parent education materials were successful at increasing physical activity within the home environment.

There are many school-based programs that aim to increase students' physical activity throughout the school day. Although researchers have studied the initial effects of the programs' success on increasing physical activity, there are few studies that have

examined the programs' long-term effects of increased physical activity or the effect physical activity programs have on the achievement of students.

Programming with a Nutrition Focus in Schools

There are many programs that have a focus on physical activity (including the focus in schools to give students recess and physical education classes); however, there are few programs that also include a nutritional component. Most of the studies in this section did not examine the possible effects that nutrition has on academic achievement.

All 4 Kids Program. Byington et al. (2014) developed the All 4 Kids program, which runs for eight weeks and consists of 21 lessons with three family events built into the program. The All 4 Kids program is designed to promote healthy eating, physical activity, and an enriched learning experience. The program was developed to target preschool children and their families. The developers of the program emphasized three main themes: Be Active, Eat Smart, and Live Healthy at all Sizes. These themes emphasize the importance of children being active for a minimum of 60 structured active minutes and 60 unstructured active minutes per day, education and practice about eating nutritious food, and loving the body that one has.

In a study conducted by Sigman-Grant et al. (2004), the researchers wanted to determine if preschoolers were able to distinguish between unhealthy and healthy food after participation in the All 4 Kids program. There were a total of 319 preschool students across four states that participated in the study. In order to determine if there was any improvement in the ability to distinguish between healthy and unhealthy foods, the experiment used a pre- and post-test assessment. Intervention preschoolers received the program, whereas comparison preschoolers received their usual food grouping activities.

Results indicated there was a statistically significant improvement in the ability of these preschool children to identify healthy foods. There was also a significant outcome for children in the All 4 Kids group to prefer healthier food options. These results indicate that exposing children to healthier food options will not only teach them what those options are, but will also encourage them to choose healthier food options. This study did not examine the effects the All 4 Kids program had on students' academic achievement.

Team Nutriathlon. In Canada, Drapeau et al. (2016) reviewed the impact of an intervention program called Team Nutriathlon. The focus of this intervention is on student planning and engaging in improving their eating habits by eating more fruits, vegetables, and dairy products. This intervention is based upon the structure of the popular school program known as Team Pentathlon, which is designed to promote physical activity among children. Both programs are designed to not only promote a healthy lifestyle, but also teamwork and self-reflection. The Team Nutriathlon intervention was developed for students from 6 to 11 years of age. In a Canadian school, the Team Nutriathlon intervention was implemented for an eight-week period. There were three phases of this intervention. The first phase is the pre-implementation phase; with the help from the teacher, the researchers carried out a short information session (30 minutes) for the students to demonstrate standardized serving sizes of vegetables, fruits, and dairy products based on Canada's Food Guide for Healthy Eating. Researchers also introduced how to record foods the children eat on a record sheet. The implementation phase was next, which involved more instruction on healthy foods and daily recording by the students of the food they eat. During the post-implementation phase, there was a follow-up by the researchers two weeks after the program ended. There were two groups

in the study: the experimental group received nutrition training, but the control group did not. Both groups were observed and the researchers recorded what the students ate during the school day. Results indicated no differences at baseline between the control and experimental groups' SES or consumption of fruits, vegetables, and dairy products. At the final follow up (end of ten week-program), the experimental group consumed more vegetables, fruit, and dairy products than the control group. The largest changes were that there was an increase in the consumption of dairy products, such as milk and yogurt, and a steady decrease in the number of sugary snacks that children ate during snack time.

In recent years, there have been some school-based programs that aim to increase students' nutrition knowledge and engagement with healthy foods. There are not as many nutrition-based programs as programs to help increase physical activity.

Summary and Statement of Problem

In summary, past studies have focused on the benefits of current physical activity level as well as proper nutrition on cognitive functioning and academic achievement. Many studies demonstrate that there are correlations between physical activity and academic achievement, as well as nutrition and academic achievement. There have been few studies that have looked at the interaction between physical activity level and proper nutrition on academic achievement. Even fewer studies have examined the longitudinal effects of physical activity and nutrition on academic achievement. Longitudinal studies are needed to help identify relationships between children's physical activity level and nutrition behaviors with academic achievement.

A limitation to the research in the area of nutrition and academic achievement is that the majority of literature has focused on breakfast consumption, as opposed to the

types and amount of foods children eat throughout the day. Another limitation of the research centered on breakfast consumption is that it has not examined the longitudinal effect of breakfast during early years of education (e.g., kindergarten) on later academic achievement.

The current study adds information to the research field using updated data that is more relevant to current societal views, norms, and ideals. It also focused on the longitudinal relationships between physical activity, nutrition, and academic achievement, which fill a gap in the research field.

There were four hypotheses for the current study. First, it was hypothesized that children with higher physical activity levels during kindergarten will have higher levels of academic achievement in the fourth grade. Second, it was hypothesized that children who received proper nutrition during their kindergarten year will have higher levels of academic achievement during their fourth grade year. Third, it was hypothesized that physical activity will have a greater relationship with academic achievement than nutrition. Lastly, it was hypothesized that children who have both greater physical activity and better nutrition during kindergarten will have greater academic achievement in fourth grade.

Chapter 3: Methodology

This was a longitudinal study that used data from the Early Childhood Longitudinal Study, ECLS-K:2011 to examine the relationship between children's physical activity and nutrition level in kindergarten and their academic achievement during fourth grade. This data set is discussed in detail in this chapter. The hypotheses were examined by conducting structural equation modeling.

Database Overview

The ECLS-K:2011 was sponsored by the National Center for Education Statistics (NCES), which is within the Institute of Education Sciences (IES) of the U.S. Department of Education. The ECLS-K:2011 was a longitudinal study that followed a nationally representative sample of children from kindergarten through fourth grade (fall of 2011-spring of 2016). The data assessed children's early school experiences and cognitive, social-emotional, and physical development obtained through multiple sources. The multiple sources included interviews with parents, questionnaires completed by teachers and school administrators, and individual assessments of children. During the base year of data collection (2010-2011 school year), 20,250 kindergarteners from 968 schools and their parents, teachers, school administrators, and before- and after-school care providers participated in the ECLS-K:2011 study. During the last year of data collection (2015-2016 school year), 18,174 fourth graders from 1,352 schools and their parents, teachers, and school administrators participated. Some of these students were transfer students and not in the original round of data collection. Some of the individuals included in the fourth grade sample were not in the original population due to the students having moved into the participating districts (Tourangeau et al., 2015). This database suited the needs of the

current study because it covers early nutrition habits and physical activity in children, as well as their later academic achievement.

ECLS-K:2011 database sample selection

Participants in the ECLS-K:2011 study were selected using a three-stage process. In the first stage of sampling, the country was divided into primary sampling units (PSUs), or geographic areas that are counties based on the 2007 Census Bureau population estimates (3,141 counties in the United States). Ninety PSUs were sampled for inclusion in the ECLS-K:2011 study. In the second stage, samples of public and private schools with kindergarten programs or other places that educated kindergarten-age children were selected within the sampled PSUs. Primary sampling units and schools were selected with probability proportional to the population size, which included the desirable oversampling of Asians, Native Hawaiians, and other Pacific Islanders. In the third stage of sampling, children enrolled in kindergarten and five-year-old children in ungraded schools or classrooms were selected within each school sampled. The 2010 National Assessment of Education Progress (NAEP) assisted in the selection of public and private schools. Public schools were selected from Common Core of Data (2007-07 CCD) and private schools were selected using the Private School Survey (2007-08 PSS). Elementary and secondary schools were sampled from CCD and PSS and were retained for ECLS-K:2011 use if they were a school with a kindergarten program or served five-year-old children and were in the 90 PSUs. Public schools with fewer than 23 children and private schools with fewer than 12 were clustered together for sampling. This was done to give smaller schools a greater chance of being selected (Tourangeau et al., 2015).

ECLS-K:2011 database sample weight development

Sample weights are necessary and were developed by the database researchers in order to compensate for a sample design that may over or under represent particular parts of the population. Some samples may oversample certain subsets of the population, such as an ethnic or racial minority, in order to have enough cases to analyze. Weights produce estimates that are representative of the cohort children who were in kindergarten in 2010-2011, of schools educating kindergarteners. Weights are provided at the child and school levels for the base year. The development of the sample weights was done in three stages. In the first stage, weights equal to the inverse probability of the selection of primary sampling units were assigned. In the second stage, weights were assigned to the schools sampled within the primary sampling units, or counties. In the third stage, weights were provided for each student. The weight was calculated by the school nonresponse-adjusted weight multiplied by the within-school child weight. Asian, Native Hawaiian, and other Pacific Islander (API) children were oversampled. The within-school child weight was calculated separately for API and non-API children. For API children, the within-school child weight is the total number of API kindergarten children in the school divided by the number of API kindergarten children sampled in the school. For non-API children, the within-school child weight is the total number of non-API kindergarten children in the school divided by the number of non-API kindergarten children sampled in the school. Replicate weights, constructed using a jackknife replication (a method for estimation of variance), were used by the ECLS-K:2011 researchers to estimate the standard error of survey estimates (Tourangeau et al., 2015).

ECLS-K:2011 database data collection

When participating students were in kindergarten during 2010-2011 (base year),

data collection began. In this base year, data collection included students receiving direct child assessments individually, with cognitive and physical measurement components. Parent interviews were conducted in the kindergarten year during the fall and spring. The parent interviews took about 45 minutes and were mostly conducted over the telephone with the person in the household who knew about the child's education, health and well being, food security (having consistent access to an adequate amount of affordable and nutritious food), and child's level of physical activity (Tourangeau et al., 2015).

In the fall and spring of the kindergarten year, children's general classroom teachers completed a teacher-reported questionnaire about themselves, their classroom, as well as a questionnaire that asked questions about individual children in the classroom who were part of the ECLS-K:2011 study. The teacher-level questionnaire focused on collecting information about children's classroom experiences since they related to children's academic and social development. The child-level questionnaire collected information about each individual child and their experiences and performance in class. Questions included the teacher's assessment of the child's academic and cognitive abilities, behaviors, social skills, and relationship with the teacher, as well as information about parents' involvement at school and program placements and services that each child may have received. Similarly, in the spring of kindergarten year, special education teachers of students with Individualized Education Programs (IEP) or Individualized Family Service Plans (IFSP) completed a self-administered teacher questionnaire and one about the individual child in the study. In the spring, a school administrator questionnaire was completed (Tourangeau et al., 2015).

Data collection procedures used in fourth grade sampling were the same as those

used during the previous years, with the exception of some revisions made to the instruments that had been used in the earlier rounds.

Participants

There were 6,577 participants in this study; more information about the specific demographics of these participants is described in detail below. These participants were a subset of the larger ECLS-K:2011 dataset, which included a total of 20,250 participants. In this study, children whose parents filled out the fall 2010 parent interview, whose kindergarten teachers completed the spring classroom teacher child-level questionnaire, and who completed the Reading/Literacy, Mathematics, and Science assessments at the fourth grade level were included in the sample. Further, exclusionary criteria in the current study were as follows: students who reported having a severe physical illness that prohibited them from attending school regularly and students who did not have kindergarten or fourth grade data. There were 18,174 potential participants in the fourth grade sample. Even with all of the exclusionary criteria, when the variables were analyzed, there was a lot of missing data detected. This will be seen in the sample sizes reported for each of the variables that are described below. Participants were only included if they gave an answer to every question in the scales; this was done through a listwise deletion.

Measures and Variables

The independent variables were the levels of physical activity and nutrition during kindergarten. These scales do not exist in the original dataset (ECLS-K:2011); therefore, they were created using individual items in the dataset. In order to determine the final scales, reliability and factor analysis were performed to determine the most relevant

questions to be used. The dependent variable was the academic achievement of the students during fourth grade. The control variables were the gender of the child, SES, race, and kindergarten achievement. All of the descriptions of the following variables were found in the *User's Manual for the ECLS-K: 2011 Kindergarten Data File and Electronic Codebook, Public Version* (Tourangeau et al., 2015; Tourangeau et al., 2018). Items were selected based on the literature and what would appear to comprise a strong measure.

Physical Activity

During the fall 2010 and spring 2011 parent interviews, parents provided information about their child's activity level. From this information, two physical activity scales were developed: an active and non-active scale.

The Active Scale. The Active Scale (see Appendix A) consisted of nine items examining if the child is involved in organized sports, dance, and if the family plays a sport or exercise together outside of school. Some items were on a "Yes" or "No" scale (Yes = 1 and No = 0). One of the items was on a Likert Scale (1 = less active to 4 = more active than others). The Likert Scale was recoded as 1 = 0, 2 = .33, 3 = .66, and 4 = 1. The Likert Scale items were recoded in this manner to have the same range as the yes/no items. This would ensure that each item was counted equally in the total. None of the items on the active scale were reversed scored. All items had the option of Refuse and Don't Know responses, which were counted as missing data. All items were added, with a possible range from 0 to 9. For this sample, the mean was 4.98 (SD = 1.48, Range = 0 to 9).

The Non-active Scale. The Non-active Scale (see Appendix B) consisted of two items examining the amount of TV watched by the child. Both questions had subsections that were answered individually by the parents. Therefore, in total, there were five separate answers. Items were reversed scored so that healthier behaviors were scored higher. This was done to match the way the Active Scale was coded. Both questions asked parents to list the specific amount of time their child watches TV. The actual data was examined and divided into quartiles. Quartiles were created in order to keep all ranges in the study consistent, ranging from 0-1, in order to ensure each item is counted equally in the total sum of the physical activity scale (see Table 1). Parents' actual responses were re-coded into one of these ranges. Possible scores ranged from 0 to 9. For this sample, the mean was 3.47 (SD = 1.04, Range = .33 to 5).

Nutrition

During the fall 2010 and spring 2011 parent interview, parents provided information about their child's food intake and food security. A nutritional composite was developed using information from data collected from the parents/guardians during the kindergarten wave in the following categories: food security and breakfast/evening meal information. On this scale, higher sum scores indicated higher levels of nutrition.

Food security. Food security status for the kindergarten sample was determined by five food security questions asked in the spring 2011 parent/guardian interview (see Appendix C). Questions on this scale related to how secure the respondents felt in being able to provide meals for their children, how often they ran out of food for their children during the week, and quality of food they could afford to give to their children. Food security is not a direct measure of nutrition, but it is helpful in determining a child's

nutritional habits because families that are more secure in their food sources can provide their children with the appropriate amount of foods with the needed micronutrients for development.

All of the score items were on a Likert Scale, which were coded as follows: Often True = 1, Sometimes True = 2, and Never True = 3 (Tourangeau et al., 2015). In this study, the Likert scales for the food security questions were recoded as follows: 1 = 1, 2 = .5, and 3 = 0. The Likert Scale items were recoded in this manner to have the same range as the yes/no items. This ensured that each item was counted equally in the total. The Likert Scale was reverse coded in order to have higher scores represent better nutritional habits. Items were added to create one sum for food security, with a possible range from 0 to 5. In this sample, the mean was 4.75 (SD = .63, Range = 0 to 5).

Breakfast and evening meal status. Breakfast and evening meal status for the kindergarten sample were determined by five questions asked in the fall 2010 parent/guardian interview (see Appendix D). Breakfast and evening meal consumption was not a direct measure of nutrition, but based on previous research, breakfast consumption has shown to be a precursor for well-developed nutritional habits. Therefore, in theory, children who are indicated as eating breakfast every morning should have better nutritional habits than those who do not eat breakfast every morning (Rampersaud et al., 2005). Additionally, consuming meals as a family prompts a more positive relationship and interest in food. The respondents were asked about the number of days that they had breakfast at school, as a family, and at a regular time. Respondents were also asked how often in a week did the family eat evening meals together and at a regular time. For questions that asked for a specific amount of time, the actual data was

examined and divided by five or seven depending on if the question asked about weekdays or the whole week. Scored were recoded as follows: 0 = 0, 1 = .14, 2 = .28, 3 = .42, 4 = .57, 5= .71, 6 = .85, & 7 = 1 or 0 = 0, 1 = .2, 2 = .4, 3 = .6, 4 = .8, & 5 = 1. Therefore, higher scores on this indicated more time spent eating breakfast/meals together. The sum of these scores created this scale, with a possible range from 0 to 5. The mean for the sample was 3.70 (SD = .97, Range = 0 to 5).

Fourth Grade Academic Achievement

In spring of the fourth-grade data collection, children were assessed in Reading, Mathematics, and Science. The majority of the items included in the fourth-grade assessments in these subjects had been included in the earlier assessments. However, to ensure that these assessments adequately measured the knowledge and skills of the children as they progressed through school, new, more difficult items were added to the assessments in fourth grade, and easier items reflecting lower level skills were omitted. All children received the assessments designed for the fourth-grade collection, regardless of their actual grade level. Trained and certified child assessors administered the Reading, Mathematics, and Science assessments directly to the sampled children on an individual basis. This battery of assessments was designed to be administered within 60 minutes per child. The assessor entered child responses into a computer-assisted interviewing (CAI) program (Tourangeau et al., 2018).

The Reading assessment included questions measuring basic skills (e.g., word recognition), vocabulary knowledge, and reading comprehension. Reading comprehension questions asked the child to identify information specifically stated in text, such as definitions, facts, and supporting details; make complex inferences within

texts; consider the text objectively; and judge the texts' appropriateness and quality. The Reading assessment began with a set of 19 routing items, with the child's score on these items determining which second-stage form (i.e., low, middle, or high difficulty) the child received (Tourangeau et al., 2018).

The Mathematics assessment was designed to measure skills in conceptual knowledge, procedural knowledge, and problem solving. The assessment consisted of questions in the following areas: number sense, properties, and operations; measurement; geometry and spatial sense; data analysis, statistics, and probability; and patterns, algebra, and functions. A set of 17 routing items was administered to all children, and the score on these items determined which second-stage test (i.e., low, middle, or high difficulty) a child received. The assessor, to reduce the likelihood that the children's reading ability would affect their Mathematics assessment performance, read most of the text that the children could see on the easel pages to them. Paper and pencils were offered to the children for use during the Mathematics assessment. Reminders were given to the children that the paper and pencil could be used if needed (Tourangeau et al., 2018).

The Science assessment included questions about physical sciences, life sciences, earth and space sciences, and scientific inquiry. The Science assessment included 15 routing items that all children received, followed by one of three second-stage forms (i.e., low, middle, or high difficulty). As with Reading and Mathematics, the second-stage form children received depended on their responses to the routing items. The questions, response options, and any text the children could see on the easel pages were read to the children similar to the Mathematics assessment, to reduce the likelihood that the

children's reading ability would affect their Science performance (Tourangeau et al., 2018).

Broad-based scores were calculated using item response theory (IRT) procedures, which is a method of modeling assessment data that makes it possible to calculate an overall score for each domain measured for each child that can be compared to scores of children regardless of which specific items a child is administered. IRT uses a pattern of right and wrong responses and the characteristics of each item to estimate ability. Additionally, IRT can adjust for a low-ability child guessing several difficult items correctly. Finally, IRT scoring makes possible longitudinal measurement of gain in achievement, even when the assessments that are administered to a child are not identical. The ECLS-K:2011 used theta scores for each child who participated in the assessments for each domain (Reading, Mathematics, and Science). The theta score is an estimate of each child's ability in each domain. The theta score range for each domain is -8 to 8, with lower scores indicating lower ability and higher scores indicating higher ability (Tourangeau et al., 2018). A latent variable composite was created in order to measure overall achievement for each child. Thus, the potential range for all three domains is -24 to 24. For this sample, the mean was 4.72 (SD = 1.17, Range = -3.58 to 7.38).

Socioeconomic Status (SES)

The SES composite represents the SES of the household at the time of data collection from parents who completed the parent interview in fall 2010 or spring 2011. It is important to note that composite for socioeconomic status was not created in the spring of 2013, 2014, or 2015 because not all data for the composite were collected (in spring 2013, parents were not asked for education information; in spring 2014 and 2015, parents

were not asked for occupation information). There are five components that make up the SES variable: household income; parent 1/guardian's education; parent 2/guardian's education; parent 1/guardian's occupation prestige score; and parent 2/guardian's occupational prestige score (Tourangeau et al., 2015). Parent 1 is the mother and Parent 2 is the father in households that contained both a mother and a father. According to the ECLS-K:2011 data, 26% of students came from poor households or those with income below 100 percent of the federal poverty level, 23% came from households with income between 100 and 199 percent of the federal poverty level, and 51 percent came from households with income above 200 percent the federal poverty level (non-poor). Related to parent's education, 31% of students had parents whose highest level of education was a high school diploma or below, 34% had parents with some postsecondary education, and 35% had parents with a bachelor's degree or higher (Redford et al., 2018). The SES variable is a continuous variable with families' scores ranging from -2.33 to 2.6, with a mean score of .00. The SES variable was mean centered by the ECLS-K:2011 researchers. The larger the score is, the higher the SES of the family (Tourangeau et al., 2018). The ECLS-K:2011 combined these variables and gave one SES variable (M = .17, SD = .79, Range = -2 to 2.4). Additional information about each variable within the SES is described in the following paragraphs.

Household income and poverty. Household income was reported by the parent in spring 2011 and was again collected each year during the spring. Parents were asked to report their income by broad range (i.e., $25,000 or less, more than $25,000) and by a more detailed range of categories described in Appendix E. If parent respondents reported a household income that was close to or lower than 200 percent of the U.S.

Census Bureau poverty threshold for a household of its size, the parent was asked to report their exact household income to the nearest $1,000. Not all parents were asked to report their exact income, so the midpoint of the detailed income range was used to figure the household's level of poverty in these cases (Tourangeau et al., 2015).

Parents' highest level of education. The parent reported Parent/guardian's education in fall 2010. For non-respondents, education information was collected in spring 2011. Parents' highest level of education is the highest level of education achieved by each individual parent, or by one parent or guardian in a single-parent household. This variable reflects the education level of both parents (i.e., birth, adoptive, step-, and foster) and non-parent guardians. If educational information was missing from the parent interview, the ECLS-K:2011 researchers conducted a statistical procedure, called imputation, which replaced the missing data with substituted values. Each parent is coded into one of the following categories: 8th grade or below, 9th-12th grade, high school diploma/equivalent, vocational/tech program, some college, bachelor's degree, graduate/professional school-no degree, and master's degree or higher, based on their highest educational level obtained (Tourangeau et al., 2015).

Parent occupation. Another component of SES is parent occupation. The parent reported Parent/guardian's occupation in the fall of 2010. Occupational information was not collected in the spring of 2011 for non-respondents. Several measures regarding parents' occupation were collected in order to determine an overall parent occupation rating. Work status of each parent, including the number of hours worked each week was determined. Name of employer, type of business or industry, job title, and important activities of the job were collected to contribute to this measure. Work status was coded

as the number of hours each parent worked or if they were looking for a job. Job activities were coded based on information about the employer, type of business or industry, job title, and duties on the job. Lastly, job prestige was recorded to reflect the average of the 1989 General Social Survey prestige scores. Appendix F represents the occupation categories and assigned prestige scores (Tourangeau et al., 2015).

Gender

The child's gender was collected from multiple sources, including the child's school, reported by parents in the fall parent interview, and confirmed by parents in the spring parent interview. The Field Management System (FMS) was used by researchers to collect information in one place from multiple levels, such as school level, teacher level, and child level. The child's gender was derived from these three sources. Priority for determining the child's gender was placed in the following order: spring 2011 parent interview, then the fall 2010 parent interview, and then the FMS. If discrepancies occurred, the ECLS-K:2011 researchers looked to other data sources collected to rectify the discrepancy. The child's first name was examined if discrepancies occurred. If the FMS value for the child's gender and the parent interview value were different and there was only one parent interview, or in instances when there were two parent interviews that were inconsistent, children's first names were examined to see if the FMS value appeared to be more accurate than the parent report (Tourangeau et al., 2015). The gender variable was coded as 0 = Male and 1 = Female (Male n = 3,359, 51.07%; Female n = 3,218, 48.9%).

Race and Ethnicity

This variable was developed from information collected from parents in the

parent interview or the school, if the parent-reported information was missing. Parents were asked to report that their children belonged to one or more of the following races: White (n = 3,774, 57.38%), Black or African American (n = 565, 8.59%), Asian (n = 548, 8.33%), American Indian or Alaska Native (n = 41, .62%), and Native Hawaiian or other Pacific Islander (n = 36, .55%). A sixth additional variable was created to identify those who had indicated that their child belonged to more than one race category (n = 302, 4.59%). Data was also collected about the child's ethnicity. Specifically, parents were asked whether or not their child was Hispanic (n = 1,311, 19.93%). A child is classified as Hispanic if a parent indicated the child's ethnicity was Hispanic, regardless of a race being identified. The race/ethnicity composite variable was created by ECLS-K:2011 researchers based on the six-race dichotomous variables and the Hispanic ethnicity variable (Tourangeau et al., 2015). In this study, the race and ethnicity variables were transformed into a dummy variable with the reference category being White (n = 3,774) and the other category being non-White (n = 2,803).

Kindergarten Achievement

Kindergarten achievement was assessed in the same way as the fourth grade achievement. All children received the assessments designed for the kindergarten collection, regardless of their actual grade level. Trained and certified child assessors administered the Reading, Mathematics, and Science assessments directly to the sampled children on an individual basis (M = -.80, SD = 1.61, Range = -8.80 to 3.58).

Analysis

The data from the ECLS-K:2011 was analyzed using structural equation modeling (SEM). Structural equation modeling uses a variety of models to depict relationships

among observed variables. SEM can be used to determine the influences which one or more presumed causes have on one or more presumed effects (NCRMUK, 2016; Schumacker & Lomax, 2004). This type of analysis allows the researcher to examine the main variables of interest while controlling for selected other variables. Typically, a path diagram represents a SEM model; therefore, a path diagram was created to represent the data collected in this study. The orders of variables in the model are based on time precedence and research backing the influence from one set of the variables to the next (Maslowsky et al., 2016). The control variables are first in the model, followed by the independent variables, and then the dependent variables.

The Model (see Figure 1)

As is common practice in SEM, cited by NCRMUK (2016), rectangles represent measured variables or variables that will be obtained directly from the responses in the data set. The latent variables are represented by ovals. Latent variables are inferred from at least two measured variables that are not directly observable. Error variance or disturbances were included in the model and signify all other influences on the variables that are not accounted for in the model. A circle represents error variances/disturbances. Curved lines with a double-headed arrow represent presumed correlations within the data collected and straight lines with arrows will represent presumed influences.

Exogenous variables are caused by variables outside of the system and are presumed to have causal effects on other variables within the system (NCRMUK, 2016). Because of this, the exogenous variables are placed first in the model. In this study, the exogenous variables that were examined are gender and race/ethnicity. Research has shown that these two variables have correlational relationships with academic

achievement at all ages and grade levels. These two variables are also considered control variables in this study. Additionally, race and gender are characteristics with which the children are born. Race has an arrow to SES since research shows that whites tend to have higher SES than non-whites (Sue & Sue, 2016). In the model there is an arrow going from race and gender to both kindergarten achievement and fourth grade achievement. This relationship is thought to occur based on past studies, which examined race and gender (Datar & Sturm, 2006; Moreno et al., 2013). Since control variables are thought to have influence on all the variables within the model, there is a path from gender and race to both the independent variables (kindergarten physical activity and kindergarten nutrition) as well as the dependent variable (fourth grade achievement).

Two additional control variables in this study are SES and kindergarten achievement. These two variables are not considered exogenous variables because they are influenced by gender and race; therefore, they come second in the model, after the exogenous control variables. Both SES and kindergarten achievement are considered to be endogenous control variables in this study. Endogenous variables are variables that are influenced by or influence other variables within the model (NCRMUK, 2016). Since control variables are thought to have influence on all the variables within the model, there is a path from SES and kindergarten achievement to both the independent variables (kindergarten physical activity and kindergarten nutrition) as well as the dependent variable (fourth grade achievement).

In this current study, the other endogenous variables are physical activity level during the participants' kindergarten year, nutrition during participants' kindergarten year, and academic achievement level during the participants' fourth grade year. In the

model, physical activity and nutrition are acting as independent variables. The exogenous and control variables have arrows going to both physical activity and nutrition. Research has also shown a positive correlation between physical activity and nutrition. People who have higher levels of physical activity have also shown to have healthy eating habits (Jayawardene et al., 2015; Joo et al., 2018). An arrow from physical activity and an arrow from nutrition go to the dependent variable of fourth grade academic achievement. This is because research has shown that children with higher physical activity levels will have higher levels of academic achievement, leading to the belief that physical activity over time will have an impact on academic achievement (Byington et al., 2014; Coe et al., 2006; Kirk & Kirk, 2016). Additionally, research has shown children who have been exposed to proper nutrition have higher levels of academic achievement when these variables are measured simultaneously (Adolphus et al., 2013; Asigbee et al., 2018; Hayes & Dodson, 2018; Hoffman et al., 2010). Therefore, it is also reasonable to assume that the impact of nutrition will also be seen longitudinally.

Analysis of Hypotheses

1. To determine the influence physical activity level has on academic achievement in the fourth grade, the direct path from the latent variable of physical activity level to the latent variable of academic achievement was examined for direct effects.
2. To determine the influence of nutrition during kindergarten on academic achievement in the fourth grade, the direct path from the latent variable of nutrition to the latent variable of academic achievement was examined for direct effects.

3. To determine if physical activity level has a more significant influence on academic achievement than nutrition the regression coefficients were compared.
4. To determine the influence of the interaction between physical activity and nutrition in kindergarten on academic achievement in fourth grade, a third interaction term was created. In order to determine the significance of the interaction term, an evaluation of model fit was conducted using a logistic regression analysis. An analysis of the model without the interaction was conducted, then an analysis of the model with the interaction coefficient added was conducted to examine if there is an improvement in the r-squared term, fit statistics, and if the logistic regression coefficient was significant (per Maslowsky et al., 2016).

Chapter 4: Results

This chapter provides the results of the analyses to address the four research hypotheses, examining the relationships of physical activity and nutrition in Kindergarten with academic achievement in the Fourth Grade. It also includes information regarding the reliability and factor analysis of the scales created and used in the model.

Reliability and Factor Analysis of Created Scales

Multiple scales were created in this study in order to examine the relationship between physical activity, nutrition, and later academic achievement. The Kindergarten Physical Activity variable was made up of two scales--an Active Scale and Non-active Scale. Cronbach's Alpha was used to measure the reliability of the scales. A rotated component matrix suggested that SPSS wanted to group the active scales into three separate groups. This was not done because it would not have aligned with the original hypothesis and not allowed for one physical activity scale to be created. The goal of this hypothesis was to determine if any (not a specific form) of physical activity was correlated with academic achievement in fourth grade. The alpha coefficient for the nine items on the Active Scale was .44 suggesting the items within this scale may have a relatively low internal consistency.

A rotated component matrix was also examined for the Non-Active Scale; this suggested the Non-Active Scale should be split into two separate groupings. This was not done for similar reasons as stated above for the Active Scale. Again the goal of the hypothesis was to determine how any form of activity status correlated to fourth grade achievement. The alpha coefficient for the six items on this scale was .305, suggesting this scale has relatively low internal consistency. The Non-Active Scale was originally

planned to include questions regarding the amount of time a child was on the computer, but these questions were excluded due to the small number of parents who answered these questions.

The Nutrition Scale was made up of two scales. The two scales that made up this variable were Meals Eaten Together and Food Security. The reliability for the 5 items of Meals Eaten Together was an alpha coefficient of .579, suggesting the items within this scale may have a relatively low internal consistency. The original plan for this scale was also to include questions related to the number of meals a child may skip in a day. These questions were excluded from the overall Nutrition Scale because of the small number of parents who answered these questions. The Food Security Scale had a total of five items, with an alpha coefficient of .803, suggesting this scale has relatively high internal consistency.

Overall, inter-item reliability of the scales was low, suggesting that the questions, which made up the scales, may not be measuring the same things.

Fit Statistics

The goodness of fit describes how well the model fits the data. One looks for a goodness of fit statistic (RMSEA) to be below .05. For this model is the RMSEA = .088, indicating that the goodness of fit for this model may not be a good fit. The Comparative Fix Index (CFI) and the Tucker-Lewis Index (TLI) are other measures of goodness of fit. Both of these indices should be .95 or higher in order to indicate a good fit. For this model, the CFI = .914 and the TLF = .87, again indicating that this model may not be a good fit. This information indicates a different model may fit the data better, which

suggests that the variables may have different relationships than what was originally hypothesized.

The Model Statistics

The following sections include the statistical results of the model. The pictorial results can be seen in Figure 2 and the path values can be seen in Table 2 (direct, indirect, and total effects). Additionally, a correlation matrix of the variables can be seen in Table 3.

Control Variables

This section describes the results of the control variables in this study, which include the demographic variables and kindergarten achievement. They were entered into the model first and are considered to be important factors when interpreting the model, based on past research indicating the impact of SES, gender, and race on physical activity, nutrition, and achievement. It should be noted that the control variables were reported at the kindergarten level and assumed to stay the same at the fourth grade level.

Gender. The effects of gender on kindergarten achievement were not significant (direct effect: □ = .01, SE = .01, $p > z = .24$).

The direct effect of gender on fourth grade achievement was significant (□ = -.06, SE = .00, $p \leq .001$). Given the low standard error of measurement, this suggests that the estimate of the beta coefficient is very precise. This indicates that females had a lower achievement than males. The total effect of gender on fourth grade achievement was also significant (□ = -.04, SE = .01, $p \leq .01$). This indicates that with the inclusion of the indirect effects, females continued to have lower achievement than males.

The total effect of gender on kindergarten physical activity was not significant (= 0.01, SE = 0.01, p > z = .0.29). The total effect of gender on kindergarten nutrition was not significant (= 0.01, SE = 0.01, p > z = .0.29). The total effects of gender on SES were not significant (= 0.01, SE = 0.02, p > z = .0.28).

Race. The direct effect of race on kindergarten achievement was significant (= -.04, SE = .00, p ≤.01). The total effect of race on kindergarten achievement was also found to be significant (= -.08, SE = .00, p ≤ .001). This indicates that for both direct and total effects, participants who were non-White tended to have a lower kindergarten achievement scores than those who were White.

The direct effect of race on fourth grade achievement was significant (= .03, SE = .00, p ≤ .001). Given the low standard error of measurement, this suggests that the estimate of the beta coefficient is very precise, and indicates that participants who were non-White scored higher than those who were White. The total effect of race on fourth grade achievement was also significant (= -.03, SE = .00, p ≤ .01). However, for total effects, participants who were White scored higher than those who were non-White.

The total effect of race on kindergarten physical activity was significant (= -.07, SE = 0.00, p ≤ .001). This indicates that participates who were White were more physically active than participants who were non-White. The total effect of race on kindergarten nutrition was significant (= -.08, SE = 0.00, p ≤ .001). This also indicates that participants who are White have better nutrition than those who are non-White.

The direct effects of race on SES were significant (= -.09, SE = 0.01, p ≤ .001). This indicates participants who are non-White were in a lower SES than participants who were White.

SES. The direct effect of SES on kindergarten achievement was found to be significant (□ = .44, SE = .01, p ≤ .001). This indicates those participants from a higher SES tended to have higher overall achievement.

The direct effect of SES on fourth grade achievement was significant (□ = .11, SE = .01, p ≤.01). The total effect of SES on fourth grade achievement was also significant (□ = .44, SE = .00, p ≤ .001). In terms of both direct and total effects, those participants from a higher SES tended to have higher overall achievement.

The direct and total effects of SES on kindergarten physical activity were significant (□ = .54, SE = 0.02, p ≤ .001). This indicates that participants from a higher SES tended to have higher levels of physical activity. The direct effects of SES on kindergarten nutrition were significant (□ = .57, SE = 0.01, p ≤ .001). This indicates that participates from a higher SES tended to have better nutrition.

Kindergarten Achievement. The direct effect of kindergarten achievement on fourth grade achievement was significant (□ = .92, SE = .01, p ≤ .001). The total effects of kindergarten achievement on fourth grade achievement were significant (□ = .88; SE = .01; p ≤ .001). This indicates that for both direct and total effects, participants who had a higher level of kindergarten achievement tended to have a higher level of fourth grade achievement.

The direct effect of kindergarten achievement on kindergarten physical activity was significant (□ = .35, SE = .03, p ≤ .001). This indicates that participants who had higher levels of kindergarten achievement had higher levels of physical activity. The direct effect of kindergarten achievement on kindergarten nutrition was significant (□ =

.18, SE = .02, $p \leq .001$). This indicates that participants who had higher levels of kindergarten achievement had higher levels of nutrition.

Analysis of Hypotheses

As mentioned above, the hypotheses were examined using structural equation modeling.

Hypothesis One. The first hypothesis examined the relationship between physical activity level during the kindergarten year and fourth grade academic achievement scores. It was hypothesized that kindergarten physical activity would have a significant positive direct effect on fourth grade achievement. The direct effect of kindergarten physical activity on fourth grade achievement was significant (= -.14, SE = .03, $p \leq .01$). This indicates having a higher physical activity level during kindergarten was associated with lower fourth grade achievement. Considering the relationship between kindergarten physical activity was significant, the hypothesis was not supported.

Hypothesis Two. It was hypothesized that kindergarten nutrition would have a significant positive direct effect on fourth grade achievement. The direct effect of kindergarten nutrition on fourth grade achievement was not significant (= .05, SE = .02, $p>z = .06$). Considering the direct relationship between kindergarten nutrition was not significant, the hypothesis is not supported.

Hypothesis Three. The third hypothesis examined whether physical activity level has a more significant influence on academic achievement than nutrition. It was hypothesized that kindergarten physical activity would have a greater significant positive direct effect on fourth grade achievement than kindergarten nutrition. This hypothesis was not supported given that the direct relationship between kindergarten physical activity and

fourth grade achievement was negative and the direct relationship between kindergarten nutrition and fourth grade achievement was not significant. Based upon the correlation matrix, there was a strong relationship between kindergarten nutrition and kindergarten physical activity ($r = .62$, $p < .001$).

Hypothesis Four. The fourth hypothesis examined the combined relationship of physical activity and nutrition in kindergarten and the influence on fourth grade academic achievement. It was hypothesized that the interaction between kindergarten physical activity and kindergarten nutrition would have the greatest positive effect on fourth grade achievement. A model with the interaction term was created and an LR test was run to determine if the addition of the interaction term created a significant difference in the model (LR chi2(1) = -56228.31, prob > chi2 = 1.00). The addition of the interaction did not create a significant difference; therefore it was determined that the model was not significantly better with the interaction term. Therefore, the combination of more physical activity and better nutrition did not influence fourth grade achievement more than either alone. Therefore, this hypothesis was not supported.

Chapter 5: Discussion

This study examined the association between physical activity and nutrition levels during children's kindergarten year and their fourth grade achievement outcomes, using the ECLS:K-2011 database. The goal of this research was to improve upon existing literature related to the effects of physical activity and nutrition on academic performance by examining the effects of early physical activity and nutrition on later academic achievement. A discussion of the findings as they relate to and extend prior research is further described below.

A major strength of this study was the use of the ECLS:K-2011 database. The ECSL-K provided a large sample size of participants from across the nation, which allows for researchers and readers to generalize the findings across multiple domains. An additional benefit of using the ECSL-K dataset is that it is longitudinal. Examining eating and activity behaviors longitudinally, and in multiple environments, can provide insights into relationships between physical activity, nutrition, and academic outcomes (Bellows et al., 2010).

Previous research, such as Asigbee et al. (2018), used an earlier ECLS –K 1998 dataset to study the interaction between physical activity, nutrition, and academic achievement. For the current study, the most updated dataset was used, which was more relevant to current societal views, norms, and ideals. However, that data collection ended in 2016, so further exploration could be done with the new ECLS-K data set (ECLS-K 2024), once it is available. It is important to add updated information to the field because there have been many changes in laws, policies, program initiatives, and overall views on obesity, physical education, and nutrition in recent years.

A strength of using structural equation modeling (SEM) is that one can look at all of the variables in a study in relation to one another. Additionally, it allows for the creation of interaction terms, which allows for one to examine how two variables' relationship effects, another variable. SEM also allows for the researcher to account for measurement error and goodness of fit. Unfortunately, in this case, the fit statistics indicated that the model might not be the best fit for the data. Therefore, the findings should be taken with a degree of caution.

Discussion of Hypotheses

Hypothesis one. The first hypothesis stated that kindergarten physical activity would directly relate to fourth grade achievement. Although the original thought was that higher levels of physical activity in kindergarten would directly lead to higher levels of achievement in fourth grade, this was not the case. This study found that students with higher levels of physical activity in kindergarten tended to have lower levels of achievement in fourth grade.

This finding is different from past research that has indicated that higher levels of physical activity correlated positively with academic achievement (Coe et al., 2006; Edwards et al., 2011; Eveland-Sayers et al., 2009). One reason for this difference may be that much of the past research focused on the current levels of physical activity and academic achievement, but did not looked at the relationship between them longitudinally. The current study had similar findings as previous research when examining all the variables during the participants' kindergarten year. That is, kindergarten PA and kindergarten achievement were positively correlated.

Those elementary-age students who have continued with higher levels of physical activity could see a negative long-term impact on achievement because of the increased amount of time they spend focusing on those sports or activities. Participation numbers have increased for team or individual sport participation from 72.9% in 2012 to 78% in 2021 with youth ages 6 to 12. Before COVID, youth ages 6 to18 on average participated in 13.6 hours a week playing their sport(s), whereas in September of 2022 the average amount of time youth in this age group spent participating in their sport(s) was 16.6 hours a week (Youth Sports, 2022). The extra time students put into these sports could take time away from their academics.

Additionally, there were limits to the items on the scale used to measure physical activity level. The questions on the original Non-active Scale did not include information regarding computer use, only TV viewing, due to the low participant response to these questions. It is theorized at the time of data collection (2010 and 2011), computer use was less than we see today. Today, participants answering the computer use questions may answer differently, especially related to how COVID has changed technology use for students across all grade levels. The addition of this variable to the scale may have impacted the overall outcome of the Non-active Scale, which was part of the overall kindergarten Physical Activity Scale. If this study were conducted now, another element that could be added to the scale would be overall use of technology, which would include phones, Chromebook, tablets, etc. Computer is no longer a popular term used for the technology used by students. Since COVID, schools have had to look for more ways to integrate technology in and outside of their classroom. Many schools across the country are at a 1:1 ratio when it comes to technology, allowing students of all ages to have even

more access to technology, leading to more sedentary behaviors. According to Bushweller (2022), by March of 2021, 90% of schools surveyed were providing a device for every middle and high school student, and 84% said they were providing a device for every elementary school student.

Hypothesis Two. The second hypothesis stated that students with higher nutrition levels would have higher fourth grade achievement. This hypothesis was not supported when looking at the direct effect of kindergarten nutrition on fourth grade achievement. Past research has indicated that nutrition has an effect on academic achievement; however, the majority of these studies were not done longitudinally (Wang & Veugelers, 2008). When looking at the results from the current study, kindergarten nutrition did have a significant positive relationship on kindergarten achievement, thus supporting the past research.

In the original ECLS study, there were multiple questions related to meals skipped, eating, and whether or not families were able to afford food. There were a significant number of participants who did not answer these questions, thus making the scale in this study have a low C-Alpha leading to the exclusion of these questions. It is the theory of the researcher that parents may have felt uncomfortable answering these questions because they were related to their ability to provide food for their children. This theory is supported by the high numbers on the food security scale (mean was 4.75 out of 5), suggesting that only people who could respond positively answered, or they may have responded in a socially acceptable manner. Something additional to consider is that food insecurity is more likely for individuals with low SES, so the exclusion of participants who did not answer the questions may have altered the overall pool of participants (Alaimo et al., 2001; Jyoti et al., 2005).

Additionally, it would have been more aligned with previous research to be able to ask questions related to what type of food the students were eating. For example, participants may be asked how many carbohydrates, sugar, and fats a student would intake in a given day (O'Dea & Mugridge, 2012; Rosales et al., 2009). However, due to the use of an existing data set, questions could not be added to the study.

Hypothesis Three. The third research hypothesis examined whether physical activity level has a more significant influence on academic achievement than nutrition. Given that the direct relationship between physical activity and fourth grade achievement had a significant negative relationship and nutrition had no direct effect significance, it indicates that physical activity does have a more significant relationship. However, it was thought that the physical activity would have a positive relationship; meaning that the more active children were in kindergarten the higher their achievement would be in fourth grade.

As stated in a previous section, this could be due to the increasing time young students spend in athletics and on travel teams. It may also be that the longitudinal effect of physical activity is different from the current levels of physical activity on achievement.

Hypothesis Four. The fourth hypothesis examined the influence of the interaction between physical activity and nutrition during kindergarten on academic achievement in fourth grade. It was hypothesized that physical activity and nutrition would have an additive effect, so that students with the highest level of both physical activity and nutrition would have the highest level of fourth grade achievement. It was determined that this interaction was not significant. It may be that if more detailed questions were

asked of the parents related to physical activity and nutrition, there may have been a significant interaction. Previous research demonstrates that those who are more active have better nutrition, for the simple fact that they need the energy to continue to be active. Additionally, this study and others before it have shown that current levels of both physical activity and nutrition have a positive significant relationship with current levels of achievement. This study showed that kindergarten physical activity and kindergarten nutrition were highly correlated, indicating that they have a strong relationship. It has been assumed that if current levels of physical activity and nutrition are significant, and then they will be significant in the future.

Control Variables

Although not directly related to the hypotheses, this study did demonstrate some significant findings with the control variables. Past research has supported that gender, SES, and race have a significant impact on achievement. Kindergarten achievement was extremely highly related to fourth grade achievement (= .91). This relationship is heavily supported by past research (Duncan et al., 2007; Pagani et al., 2011). Kindergarten achievement also had a significant positive relationship with physical activity and nutrition in kindergarten, indicating that those with higher levels of achievement have better nutrition and higher physical activity levels.

Gender was found to have a significant effect on fourth grade achievement, with males having slightly higher levels of achievement in fourth grade. This was a surprising finding considering that most of the past research supports females having overall higher levels of achievement, especially in the area reading. However, some research has indicated that males have higher levels of achievement in the areas of math and science

(Chomitz et al., 2009; Datar & Sturm, 2006). The fourth grade achievement variable was created from three different academic assessments, which includes reading, math, and science (Tourangeau et al., 2018). The fact that math and science accounted for two thirds of the achievement variable and reading only one third may have contributed to the slightly higher recorded achievement performance for males in this study. Gender was not found to have a significant relationship with kindergarten physical activity or nutrition, which is not surprising considering the mixed findings of past research. Additionally, when thinking about children at kindergarten age, most physical activities are gender neutral and inclusive to all students. As students get older, they make more of their own choices and more discrimination occurs.

Race was significantly related to SES, physical activity, nutrition, and achievement at the kindergarten level and achievement at the fourth grade level. At the kindergarten level, White students showed higher levels of achievement, physical activity, and nutrition. A similar finding was shown at the fourth grade level, indicating White students have higher levels of fourth grade academic achievement. Past research supports that White participants tend to achieve higher than the minority groups (non-White) at all levels (e.g., Potter & Morris, 2016). Additionally, this study showed that non-White students were more likely to be from a lower SES than White students.

Students in the higher SES had higher levels of achievement at both the kindergarten and fourth grade level, when looking at the total effects. The one area that was not significant was the direct effect of SES on kindergarten achievement. This may be due to the fact that SES differences become more prevalent as children age and the gap widens. For example, children from low SES households entering high school are on average five

years behind in their literacy skills than those of high-income students. This may be due to differences in the access to books at home throughout elementary school, the level of reading ability of the parents, and the quality of the teachers and school districts the students are attending during elementary school (Gimber et al., 2007; Orr, 2003; Reardon et al., 2013).

Limitations

There were several limitations to this study. The first related to the scales created, as their inter-item reliability was not sufficient. This indicates that the items used in the scales were too unrelated. The correlation statistics suggested that grouping the items differently would result in better internal consistency amongst those scales. One example was for the Active Scale; the correlation statistic output suggested grouping the Active Scale into three separate groupings (i.e., Outdoor Sports, Group Sports, and Individual Sports), which would lead to better internal consistency. However, the type of sport for this study was not examined because the interest was in the quantity of physical activity, not the type. This would be an interesting addition to a future study in order to determine if the type of physical activity a student participates matters more than the quantity.

Another limitation of the scales was that the exact questions that would have examined the hypotheses in more detail were not asked. This was because of the use of the existing dataset and that some of the questions had too much missing data. For example, in the Nutrition Scale, only questions related to breakfast and meal consumption and food security were asked because that is what was available through the dataset. However, questions that investigated the type of foods the students ate or the quantity of the food eaten at one meal may have given more reliable and valid nutrition information.

Another limit to this study was the weak goodness of fit to the model. This could be due to the way the scales were created and/or the questions used in this study. One thing that was missing from the model was the correlation between kindergarten physical activity and kindergarten nutrition. Based on the correlation matrix (Table 3), one can see that kindergarten physical activity and kindergarten nutrition are highly correlated.

Other limitations include the exclusion of some demographic information, such as geographical location (i.e., rural, urban, or suburban). Geographical location has been shown to be correlated with some of the control variables used in this study (i.e., SES and race) (Mitchell, 2020). Geographical location may also impact one's ability to access healthy foods, physical activity programming/equipment, and academic programming.

This study was solely based on parent reports of students' physical activity level and nutrition. Parents have been shown to both under and over report information specifically to fit into the societal norm or expectation, also known as the social comparison theory (Bennetts et al., 2016; Festinger, 1954). Additionally, parents may not always be aware of the amount of physical activity a student is getting or how often the student is eating, especially when students are in school for the majority of the day. Future studies could ask teachers, coaches, and students about their perceived levels of physical activity.

Future Research

It is important to continue to add longitudinal research about physical activity and nutrition to the field. Although it is difficult and time consuming to do longitudinal research, it allows for readers to understand the long term affects these variables have on children. It may lead to more development in community and school based programs that can support young children and their parents in building healthy habits. One way to

continue adding updated longitudinal research to the field would be to examine the updated ECLS-K when it is available.

Future research should include more variables in order to get a better representation of the students and the overall impacts on them. As discussed above, geographical location should be included because of the correlation with the other control variables in the current study. More technology-based variables should be included in the study, considering the growing use of technology across all age levels. Additionally, variables regarding the type of food that one consumes would be important in considering nutrition level. These could be included in the form of questionnaires that include more specific questions related to nutrition and physical activity would be used.

It may also be important to include more information from the teachers of young students related to the activity level in school, academic information, and observations of food intake. Parent reports can be biased, so having an additional source of information may lead to more accurate representation of the students.

Other types of research would also be important to add more information to the field; for example, implementation of programs for students and/or parents and the measuring the outcomes of that program. Completing a study like this would allow for one to have more control over the variables in the study. This type of study could also allow for longitudinal research if the researcher would to follow the group of students over an extended period of time.

Implications

This study may provide parents, educators, and policymakers more up-to-date findings concerning the implications of physical activity and nutrition across a period of time. Given these findings, it is important to continue to give students options to be physically active and to have access to nutritious food. Considering that the findings in

this study indicate that physical activity has a negative impact on achievement long term, it is important to monitor children's activity level as they grow. Some things to consider are whether they are being too active, the amount of time away from academics, time the students are involved in sports, the relationship between the amount of time students spend in sports and how easy/hard school is for them, and/or the amount of time students are spending on their electronics.

Given the findings related to gender and achievement, it is important for educators to continue to grow and expose female students to Science, Technology, Engineering, Art, and Math (STEAM) activities. There has been a large societal push for females to engage more in STEAM activities in order to close the gap between males and females in the workforce in these areas. More schools are offering STEAM classes during the school year and free summer activities that are all inclusive for their students.

Given the findings related to SES, it is important for educators and policy makers to understand the impact of SES and continue to create programs to close that educational gap between the SES classes. Creating free programs for students in low SES areas and offering free transportation to these programs would increase the access for many more children and their families.

Summary

This study analyzed the relationship between physical activity and nutrition levels during kindergarten and fourth-grade academic achievement using the ECLS-K:2011 database. The study aimed to improve upon existing literature by examining the effects of early physical activity and nutrition on later academic achievement. This study found that students with higher levels of physical activity in kindergarten had lower levels of achievement in fourth grade. There were no significant findings when examining the

relationship between kindergarten nutrition and fourth grade achievement. Many control variables were found to have a significant effect on fourth grade achievement, such as Race, Gender, SES, and Kindergarten Achievement.

There were several limitations to this study, including issues with inter-item reliability in the scales used and missing questions that would have provided more detailed information. The study solely relied on parent reports, which may not always be accurate. Despite these limitations, the study's findings suggest the need for continued access to physical activity and nutritious food for children, as well as attention to factors such as gender and SES.

Future research should include more variables, such as geographical location and more specific questions related to nutrition and physical activity, and additional sources of information, such as teachers' observations. Longitudinal research is also needed to understand the long-term effects of these variables on children.

References

Adolphus, K., Lawton, C.L., & Dye, L. (2013). The effects of breakfast on behavior and academic performance in children and adolescents. *Frontiers in Human Neuroscience,7*(425)*,* 2-28. doi. 10.3389/fnhum.2013.00425

Alderman, H., & Fernald, L. (2017). The nexus between nutrition and early childhood development. *Annual Review of Nutrition, 37,* 447-476. doi. 10.1146/annurev-nut-071816-064627.

Alaimo K., Olson, C.M., & Frongillo, E.A. (2001). Food insufficiency and American school-aged children's cognitive, academic, and psychosocial development. *Pediatrics 108*(1), 44–53.

Asigbee, F.M., Whitney, S.D., & Peterson, C.E. (2018). The link between nutrition and physical activity in increasing academic achievement. *Journal of School Health, 88*(6), 407-415. doi. 10.1111/josh.12625

American Psychological Association. (2017). Socioeconomic status. Retrieved on March 29, 2017 from http://www.apa.org/topics/socioeconomic-status/

Bellows, L., Silvernail, S., Caldwell, L., Bryant, A., Kennedy, C., Davies, P., & Anderson, J. (2010). Parental perceptions on the efficacy of a physical activity program for preschoolers. *Journal of Community Health, 36*, 231-237. doi. 10.1007/s10900-010-9302-1

Bennetts, S. Mensah, F., Westrupp, E.M., Hackworth, N.J., & Reilly, S. (2016). The agreement between parent-reported and directly measured child language and parenting behaviors. *Frontiers in Psychology, 7.* doi. 10.3389/fpsyg.2016.01710

Berlin, K.S., Kamody, R.C., Thurston, I.B., Banks, G.G., Rybak, T.M., & Ferry, R.F.JR.

(2017). Physical activity, sedentary behaviors, and nutritional risk profiles and relations to body mass index, obesity, and overweight in eighth grade. *Behavioral Medicine, 43*(1), 31-39. http://dx.doi.org/10.1080/08964289.2015.1039956

Bunketorp-Kall, L., Malmgren, H., Olsson, E., Linden, T., & Nilsson, M. (2015). Effects of a curricular physical activity intervention on children's school performance, wellness, and brain development. *Journal of School Health, 85*(10), 704-713. doi: 10.1111/josh.12303

Burrows, T., Goldman, S., Pursey, K., & Lim, R. (2017). Is there an association between Dietary intake and academic achievement: a systematic review. *Journal Of Human Nutrition &Dietetics*, *30*(2), 117-140.

Burton, L.J., & VanHesst, J.L. (2007). The importance of physical activity in closing the achievement gap. *Quest, 59*(2), 212-218. doi: 10.1080/00336297.2007.10483549

Bushweller, K. (2022). *What the massive shift to 1-to-1 computing means for schools, in charts*. Education Week. Retrieved May 7, 2023, from https://www.edweek.org/technology/what-the-massive-shift-to-1-to-1-computing- means-for-schools-in-charts/2022/05

Byington, T. B., Lindsay, A. L., & Sigman-Grant, M. (2014). Healthy choices start early. *Young Children, 69*(5), 14-21. Retrieved from: http://ezproxy.alfred.edu:2345/ehost/pdfviewer/pdfviewer?sid=64f893b4-205e-4291-99d4-b81a786c7492%40sessionmgr104&vid=17&hid=126

Carlson, S. A., Fulton, J. E., Lee, S. M., Maynard, L. M., Brown, D. R., Kohl III, H. W., & Dietz, W. H. (2008). Physical Education and Academic Achievement in Elementary School: Data From the Early Childhood Longitudinal

Study. *American Journal Of Public Health*, *98*(4), 721-727.doi: 10.2105/AJPH.2007.117176

Center for Disease Control and Prevention. Childhood Obesity Facts. (2016). Retrieved October 12, 2016, from http://www.cdc.gov/obesity/data/childhood.html

Chomitz, V. R., Slining, M. M., McGowan, R. J., Mitchell, S. E., Dawson, G. F., & Hacker, K. A. (2009). Is There a Relationship Between Physical Fitness and Academic Achievement? Positive Results From Public School Children in the Northeastern United States. *Journal Of School Health*, *79*(1), 30-37. doi: 10.1111/**j**.1746-1561.2008.00371.x

Coe, D.P., Peterson, T., Blair, C., Schutten, M.C., & Peddie, H. (2013). Physical fitness, academic achievement, and socioeconomic status in school-aged youth. *Journal of School Health, 83*(7), 500-507. doi: 10.1111/josh.12058

Coe, D. P., Pivarnik, J. M., Womack, C. J., Reeves, M. J., & Malina, R. M. (2006). Effect of physical education and activity levels on academic achievement in children. *Medicine & Science in Sports & Exercise,* 1515-1519. doi:10.1249/01.mis.0000227537.13175.1b

Datar, A., & Sturm, R. (2006). Childhood overweight and elementary school outcomes. *International Journal Of Obesity*, *30*(9), 1449-1460. doi:10.1038/sj.ijo.0803311

Davis, C. L., Tomporowski, P. D., Boyle, C. A., Wailer, J. L., Miller, P. H., Naglieri, J. A., & Gregoski, M. (2007). Effects of Aerobic Exercise on Overweight Children's Cognitive Functioning: A Randomized Controlled Trial. *Research Quarterly For Exercise & Sport*, *78*(5), 510-519. doi: 10.1080/02701367.2007.10599450

Drapeau, V., Savard, M., Gallant, A., Nadeau, L., & Gagnon, J. (2016). The effectiveness

of a school-based nutrition intervention on children's fruit, vegetables, and dairy product intake. *Journal of School Health, 86*(5), 353-362. doi:10.1111/josh.12385

Duncan, G. J., Dowsett, C.J., Claessens, A., Magnuson, K., Huston, A.C., Klebanov, P., Pagani,L.S., Feinstein, L., Engel, M., Brooks-Gunn, J., Sexton, H., Duckworth, K., & Japel, C. (2007). School readiness and later achievement. *Developmental Psychology, 43*(6), 1428-1446, doi: 10.1037/0012-1649.43.6.1428

Edwards, J. U., Mauch, L., & Winkleman, M. R. (2011). Relationship of nutrition and physical activity behaviors and fitness measures to academic performance for sixth graders in a midwest city school district. *Journal Of School Health*, *81*(2), 65-73. doi:10.1111/j.1746-1561.2010.00562.x

Etnier J.L., Salazar W., Landers D.M., Petruzzello S.J., Han M., & Nowell P. (1997). The influence of physical fitness and exercise upon cognitive functioning: a meta-analysis. J Sports Exerc Psychol.19:249-277.

Evans, R. (2005). Reframing the achievement gap. *Phi Delta Kappan, 86,*(8)*,* 582-595. doi.org/10.1177/003172170508600806

Eveland-Sayers, B. M., Farley, R. S., Fuller, D. K., Morgan, D. W., & Caputo, J. L. (2009). Physical fitness and academic achievement in elementary school children. *Journal Of Physical Activity & Health*, *6*(1), 99-104. http://ezproxy.alfred.edu:2345/ehost/detail/detail?vid=3&sid=64f893b4-205e-4291-99d4-b81a786c7492%40sessionmgr104&hid=126&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d

Faught, E., Williams, P., Willows, N., Asbridge, M., & Veugelers, P. (2017). The

association between food insecurity and academic achievement in Canadian school-aged children. *Public Health Nutrition*, *20*(1-8). doi: 10.1017/S1368980017001562.

Gimbert, B., Bol, L., & Wallace, D. (2007). The influence of teacher preparation on student achievement and the application of national standards by teachers of mathematics in urban secondary schools. *Education and Urban Society, 40,* 91-117. doi:10.1177/0013124507303993

Gordan-Larsen, P., Nelson, M.C., Page, P., & Popkin, B.M. (2006). Inequality in the built environment underlies key health disparities in physical activity and obesity. *Pediatrics,117*, 417-424. doi: 10.1542/peds.2005-0058

Gordan-Larsen, P., Adair, L.S., & Popkin, B.M. (2002). Ethnic differences in physical activity and inactivity patterns and overweight status. *Obesity Research, 10*, 141-149. doi: 10.1038/oby.2002.23

Gubbels, J. S., Kremers, S. J., Stafleu, A., Goldbohm, R. A., de Vries, N. K., & Thijs, C. (2012). Association between parenting practices and children's dietary intake, activity behavior and development of body mass index: The KOALA Birth Cohort Study. *International Journal of Nutrition and Physical Activity, 14*(8), 8. doi: 10.1186/1479-5868-8-18.

Gurley, K. (2016). For the health of it: How the quantified health benefits of the USDA nutrition standards justify reauthorization and increased funding for school meal reimbursement. *Harvard Journal On Legislation*, *53*(1), 387-415.Retrieved from

http://ezproxy.alfred.edu:2345/ehost/pdfviewer/pdfviewer?sid=64f893b4-205e-4291-99d4-b81a786c7492%40sessionmgr104&vid=53&hid=126

Guthrie, J., & Ralston, K. (2017). United States Department of Agriculture. *National school lunch program.* Retrieved December 12, 2017, from https://www.ers.usda.gov/topics/food-nutrition-assistance/child-nutrition-programs/national-school-lunch-program.aspx

Halfon, N., Shulman, E., Hochstein, M. (Eds.) (2001). *Brain development in early childhood.* Los Angeles, CA: UCLA Center for Healthier Children, Families and Communities. Retrieved from https://files.eric.ed.gov/fulltext/ED467320.pdf.

Hallal, P.C., Anderson, L.B., Bull, F.C., Guthold, R., Haskell, W., & Ekelund, U. (2012). Global physical activity levels: Surveillance progress, pitfalls, and prospects. *Series, 380,* 247-257. http://dx.doi.org/10.1016/ S0140-6736(12)60646-1

Hayes, D., & Dodson, L. (2018). Practice Paper of the Academy of Nutrition and Dietetics: Comprehensive Nutrition Programs and Services in Schools. *Journal Of The Academy Of Nutrition And Dietetics*, *118*(5), 920-931. doi:10.1016/j.jand.2018.02.025

Hoffman, J.A., Franko, D.L., Thompson, D.R., Power, T.J., & Stallings, V.A. (2010). Longitudinal behavioral effects of a school-based fruit and vegetable promotion program. *Journal of Pediatric Psychology, 35*(1), 61-71. doi.10.1093/jpepsy/jsp041

Horwood, L.J., & Fergusson, D.M. (1998). Breastfeeding and later cognitive and academic outcomes. *Pediatrics,101*(1). doi: 10.1542/peds.101.1.e9

Huybrechts, I., & De Henauw, S. (2007). Energy and nutrient intakes by pre-school

children in Flanders-Belgium. *British Journal of Nutrition,*98, 600-610. doi.10.1017/S000711450773458X

Jackson, D.B. (2016). The link between poor quality nutrition and childhood antisocial behavior: A genetically informative analysis. *Journal of Criminal Justice, 44*(2016), 13-20. Retrieved from http://dx.doi.org/10.1016/j.jcrimjus.2015.11.007

Jayawardene, W.P., Torabi, M.R., Lohrmann, D.K. (2015). Exercise in young adulthood with simultaneous and future changes in fruit and vegetable intake. *Journal of the American College Nutrition, 35*(1), 59-67. https://doi.org/10.1080/07315724.2015.1022268.

Jiménez Pavón, D., Ortega, F. P., Ruiz, J. R., España Romero, V., García Artero, E., Moliner Urdiales, D., & ... Castillo, M. J. (2010). Socioeconomic status influences physical fitness in European adolescents independently of body fat and physical activity: the HELENA study. *Nutricion Hospitalaria*, *25*(2), 311-316

Joo, J., Williamson, S.A., Vazquez, A.I., Fernandez, J.R., Bray, M,.S. (2018). The influence of 15-week exercise training on dietary patterns in young adults. *International Journal of Obesity,* 43, 1681-1690. https:// doi.org/10.1038/s41366-018-0299-3.

Jyoti, D.F., Frongillo, E.A., & Jones, S.J. (2005). Food insecurity affects school children's academic performance, weight gain, and social skills. *The Journal of Nutrition, 135*(12), 2831–2839. doi: 10.1093/jn/135.12.2831

Khan, T., Powell, L. M., & Wada, R. (2012). Fast Food Consumption and Food Prices: Evidence from Panel Data on 5th and 8th Grade Children. *Journal Of Obesity*, 1-8. doi:10.1155/2012/857697

Kirk, S. M., & Kirk, E. P. (2016). Sixty minutes of physical activity per day included within preschool academic lessons improve early literacy. *Journal of School Health, 86*(3),155-163. doi: 10.1111/josh.12363

Kohl, H.W., & Cook, H. D. (Eds.). (2013*). Educating the student body: Taking physical activity and physical education to school.* Washington, DC: National Academic of Sciences. Retrieved from https://www.ncbi.nlm.nih.gov/books/NBK201500/pdf/Bookshelf_NBK201500.pdf

Kurdek, L. A. & Sinclair, R.J. (2001) Predicting reading and Mathematics achievement in fourth- grade children from kindergarten readiness scores. *Journal of Educational Psychology, 93*(3), 451-455. doi.10.1037//0022-0663.93.3.451.

Let's Move. (2016). Retrieved July 01, 2020, from https://letsmove.obamawhitehouse.archives.gov/initiatives

Li, J., & O'Connell, A. A. (2012). Obesity, high-calorie food intake, and academic achievement trends among U.S. school children. *Journal Of Educational Research*, *105*(6), 391-403. doi:10.1080/00220671.2011.646359

Lynch, M. (2011). Vegetables at any cost: How the media markets children's unhealthy food preferences in North America. *Early Childhood Education Journal, 39*(5), 297-302. doi:10.1007/s10643-011-0476-7

Maslowsky, J., Jager, J., & Hemken, D. (2016). Estimating and interpreting latent variable interactions: A tutorial for applying the latent moderated structural equations method. *International Journal of Behavioral Development, 39*(1), 87-96. doi:10.1177/0165025414552301

Matthews, J. S., Ponitz, C. C., & Morrison, F. J. (2009). Early gender differences in self-regulation and academic achievement. *Journal of Educational Psychology,101*(3), 689-704. http://dx.doi.org/10.1037/a0014240

Merkiel-Pawłowska, S., & Chalcarz, W. (2017). Gender differences and typical nutrition concerns of the diets of preschool children - the results of the first stage of an intervention study. *BMC Pediatrics*, *17*(1), 207. doi:10.1186/s12887-017-0962-1

Mickelson, R. A., Bottia, M. C., & Lambert, R. (2013). Effects of school racial composition on K–12 Mathematics outcomes: A metaregression analysis. *Review of Educational Research, 83*, 121–158. http://dx.doi .org/10.3102/0034654312475322

Mitchell, T. (2020). *Demographic and economic trends in urban, suburban and rural communities*. Pew Research Center's Social & Demographic Trends Project. RetrievedMay 7, 2023, from https://www.pewresearch.org/social-trends/2018/05/22/demographic- and-economic-trends-in-urban-suburban-and-rural-communities/

Molteni, R., Barnard, R.J., Ying, Z., Roberts, C.K., & Gomez-Pinilla, F. (2002). A high-fat, refined sugar diet reduces hippocampal brain-derived neurotrophic factor, neuronal plasticity, and learning. *Neuroscience, 112*(4), pp. 803-814. https://doi.org/10.1016/S0306-4522(02)00123-9

Moreno, G., Johnson-Shelton, D., & Boles, S. (2013). Prevalence and prediction of overweight and obesity among elementary school students. *Journal Of School Health*, *83*(3), 157-163. http://ezproxy.alfred.edu:2134/10.1111/josh.12011

My School In Motion, Inc. (2018) Our program. Retrieved on July 13, 2018. Retrieved

from https://www.myschoolinmotion.org/our-program.

National School Lunch Program (NSLP). (2016, August 18). Retrieved November 30, 2016, from http://www.fns.usda.gov/nslp/national-school-lunch-program-nslp

National Standards & Grade-Level Outcomes for K-12 Physical Education. (2014). SHAPE America & Human Kinetics. Retrieved on December 11, 2017, from www.shapeamerica.org/standards/pe for more information.

NCRMUK. (2016, July 14). *Key ideas, terms & concepts in Structural Equation Modeling: Patrick Sturgis; Parts 1-6* [Video]. YouTube. https://www.youtube.com/watch?v=NOWdrfQVWAI&t=653s

O'Dea, J. A., & Mugridge, A. C. (2012). Nutritional quality of breakfast and physical activity independently predict the literacy and numeracy scores of children after adjusting for socioeconomic status. *Health Education Research*, *27*(6), 975-985. doi:10.1093/her/cys069

Ogeden, C.L., Carroll, M.D., Fryer, C.D., & Flegal, K.M. (2015). Prevalence of obesity among adults and youth: United States, 2011-2014. *NCHS Data Brief*, pp. 1-8. Hyattsville, MD: National Center for Health Statistics. Retrieved from http://ezproxy.alfred.edu:2345/ehost/detail/detail?vid=78&sid=64f893b4-205e-4291-99d4-b81a786c7492%40sessionmgr104&hid=126&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=26633046&db=mnh

Orr, A. J. (2003). Black–White differences in achievement: The importance of wealth. *Sociology of Education, 76,* 281-304. http://dx.doi.org/10.2307/1519867

Pagani, L.S., Fitzpatrick, C., Belleau, L., & Janosz, M. (2011). Predicting academic achievement in fourth grade from kindergarten cognitive, behavioral and motor skills. *Québec, Institut de la statistique du Québec, 6*(1).

Parajuli, M. & Thapa, A. (2017). Gender differences in the academic performance of students. *Research Gate.* 39-47. DOI: 10.3126/jdse.v3i1.27958

Pearce, M.S., Basterfield, L., Mann, K.D., Parkinson, K.N., Adamson, A.J., & Reilly, J.J. (2012). Early predictors of objectively measured physical activity and sedentary behavior in 8–10 year old children: The Gateshead Millennium Study. *PLoS ONE, 7*(6), 1-10. doi:10.1371/journal.pone.0037975

Potter, D. & Morris, D.S. (2016). Family and schooling experiences in racial/ethnic academic achievement gaps: A cumulative perspective. *Sage Journals, 60(1).* https://doi.org/10.1177/0731121416629989

Rampersaud, G.C., Pereira, M.A., Girard, B.L., Adams, J., Metzl, J.D. (2005). Breakfast habits, nutritional status, body weight, and academic performance in children. *Journal of the American Dietetic Association*, *105*(5), 743-760. doi: 10.1016/j.jada.2005.02.007

Reardon, S. F., Valentino, R. A., Kalogrides, D., Shores, K. A., & Greenberg, E. H. (2013). *Patterns and trends in racial academic achievement gaps among states, 1999-2011.* Retrieved from https://cepa.stanford.edu/content/patterns-and-trends-racial-academic-achievement-gaps-among-states-1999-2011

Reford, J. (2018). English language program participation among students in

kindergarten class of 2010-2011: spring 2011 to spring 2012. *National Center for Education Statistics,*1-27. Retrieved December 18, 2022 from https://nces.ed.gov/pubs2018/2018086.pdf

Rosales, F. J., Reznick, J. S., & Zeisel, S. H. (2009). Understanding the Role of Nutrition in the Brain & Behavioral Development of Toddlers and Preschool Children: Identifying and Overcoming Methodological Barriers. *Nutritional Neuroscience*, *12*(5), 190–202. http://doi.org/10.1179/147683009X423454

School Nutrition Standards. (2016). Retrieved December 14, 2016, from https://schoolnutrition.org/AboutSchoolMeals/SchoolNutritionStandards/

Schumacker, R.E. & Lomax, G. (2004). *A Beginner's Guide to Structural Equation Modeling*. (2nd Edition). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Shafer, M. & Whitehouse, E. (2017). State policies on physical activity in schools. *The Council of State Governments.* Retrieved June 25, 2020 from https://knowledgecenter.csg.org/kc/system/files/CR_activity_school.pdf

SHAPE America-Society of Health and Physical Education. (2016). Every student succeeds act: Game changer for health and physical education. Retrieved on July 25, 2018 from www.shapeamerica.org/essa!

Sigman-Grant, M., Byington, T.A., Minggen, L., Mobley, A.R., Fitzgerald, N., & Hildebrand, D. (2004). Preschoolers can distinguish between healthy and unhealthy foods: The All 4 Kids study. *Journal of Nutrition Education and Behavior, 46*(2). 121-127. https://doi.org/10.1016/j.jneb.2013.09.012

Sirin, S. R. (2005). Socioeconomic status and academic achievement: A meta-analytic

review of research. *Review of Educational Research, 75*, 417– 453. http://dx.doi.org/10.3102/00346543075003417

Skinner, J., Carruth, B., Bounds, W., Ziegler, P., & Reidy, K. (2002). Do food-related experiences in the first 2 years of life predict dietary variety in school-aged children? *Journal Of Nutrition Education & Behavior*, *34*(6), 310-315. doi: https://doi.org/10.1016/S1499-4046(06)60113-9

Sue, D.W., & Sue, D. (2016). *Counseling the Culturally Diverse: Theory and Practice.* (7th edition). Hoboken, NT: John Wiley & Sons Inc.

Telford, R. M., Telford, R. D., Olive, L. S., Cochrane, T., & Davey, R. (2016). Why are girls less physically active than boys? Findings from the LOOK longitudinal study. *Plos ONE*, *11*(3), 1-11. doi.10.1371/journal.pone.0150041

Thompson, J. L., Jago, R., Brockman, R., Cartwright, K., Page, A. S., & Fox, K. R. (2010). Physically active families – de-bunking the myth? A qualitative study of family participation in physical activity. *Child: Care, Health & Development*, *36*(2), 265-274. doi: 10.1111/j.1365-2214.2009.01051.x

Tourangeau, K., Nord, C., Lê, T., Wallner-Allen, K., Hagedorn, M.C., Leggitt, J., & Najarian, M. (2015). Early Childhood Longitudinal Study, Kindergarten Class of 2010–11 (ECLSK: 2011), User's Manual for the ECLS-K:2011 Kindergarten–First Grade Data File and Electronic Codebook, Public Version (NCES 2015-078). U.S. Department of Education. Washington, DC: National Center for Education Statistics.

Tourangeau, K., Nord, C., Lê, T., Wallner-Allen, K., Vaden-Kiernan, N., Blaker, L., & Najarian, M. (2018). Early Childhood Longitudinal Study, Kindergarten Class of

2010–11 (ECLSK: 2011), User's Manual for the ECLS-K:2011 Kindergarten–Fourth Grade Data File and Electronic Codebook, Public Version (NCES 2015-078). U.S. Department of Education. Washington, DC: National Center for Education Statistics.

Trost, S. G., & Van Der Mars, H. (2009). Why We Should Not Cut P.E. *Educational Leadership*, *67*(4), 60-65.

Trudeau, F. & Shephard, R.J. (2010). Physical education, school physical activity, school sports and academic performance. *Journal of Behavioral Nutrition and Physical Activity, 5*(10). doi:10.1186/1479-5868-5-10.

United States Department of Agriculture. (2014). National school lunch program (NSLP). Retrieved March 12, 2016, from https://www.fns.usda.gov/nslp/history_6.

U.S. Department of Education. (2017). Every student succeeds act (ESSA). Retrieved July 24, 2017, from https://www.ed.gov/essa.

U.S. Department of Health and Human Services. (2010). *The head start child development and early learning framework: Promoting positive outcomes in early childhood programs serving children 3-5 years old* (PDF File). Retrieved March 12, 2017, from http://eclkc.ohs.acf.hhs.gov/hslc/tta system/teaching/eecd/Assessment/Child%20Outcomes/HS_Revised_Child_Outcomes_Framework(rev-Sept2011).pdf.

Walton, M., Waiti, J., Signal, L., & Thomson, G. (2010). Identifying barriers to promoting healthy nutrition in New Zealand primary schools. *Health Education Journal*, *69*(1), 84-94. Retrieved from

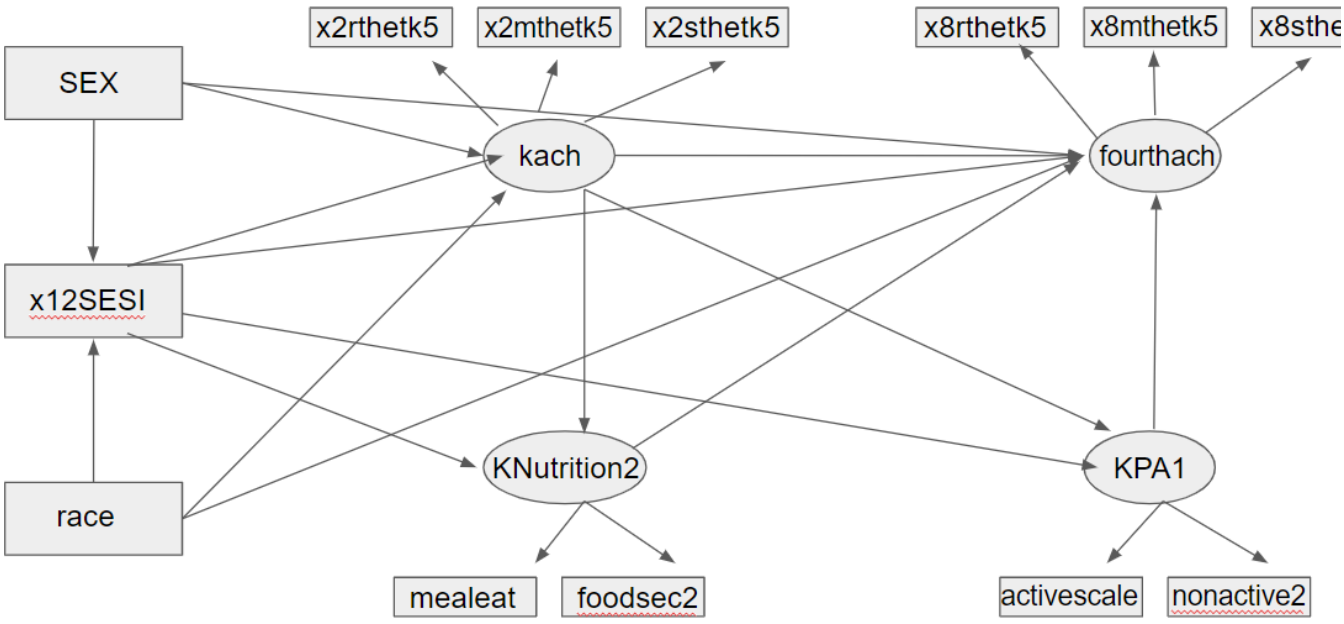
http://ezproxy.alfred.edu:2345/ehost/detail/detail?vid=112&sid=64f893b4-205e-4291-99d4-b81a786c7492%40sessionmgr104&hid=126&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=48996752&db=sph

Wang, F., & Veugelers, P. J. (2008). Self-esteem and cognitive development in the era of the childhood obesity epidemic. *Obesity Reviews*, *9*(6), 615-623. doi:10.1111/j.1467-789X.2008.00507.x

White, G. W., Stepney, C. T., Hatchimonji, D. R., Moceri, D. C., Linsky, A. V., Reyes-Portillo, J. A., & Elias, M. J. (2016). The increasing impact of socioeconomics and race on standardized academic test scores across elementary, middle, and high school. *American Journal Of Orthopsychiatry*, *86*(1), 10-23. doi:10.1037/ort0000122 *Youth Sports Facts: Participation rates*. The Aspen Institute Project Play. (2022). Retrieved May 7, 2023, from https://www.aspenprojectplay.org/youth-sports/facts/participation-rates

Figure 1

The Model

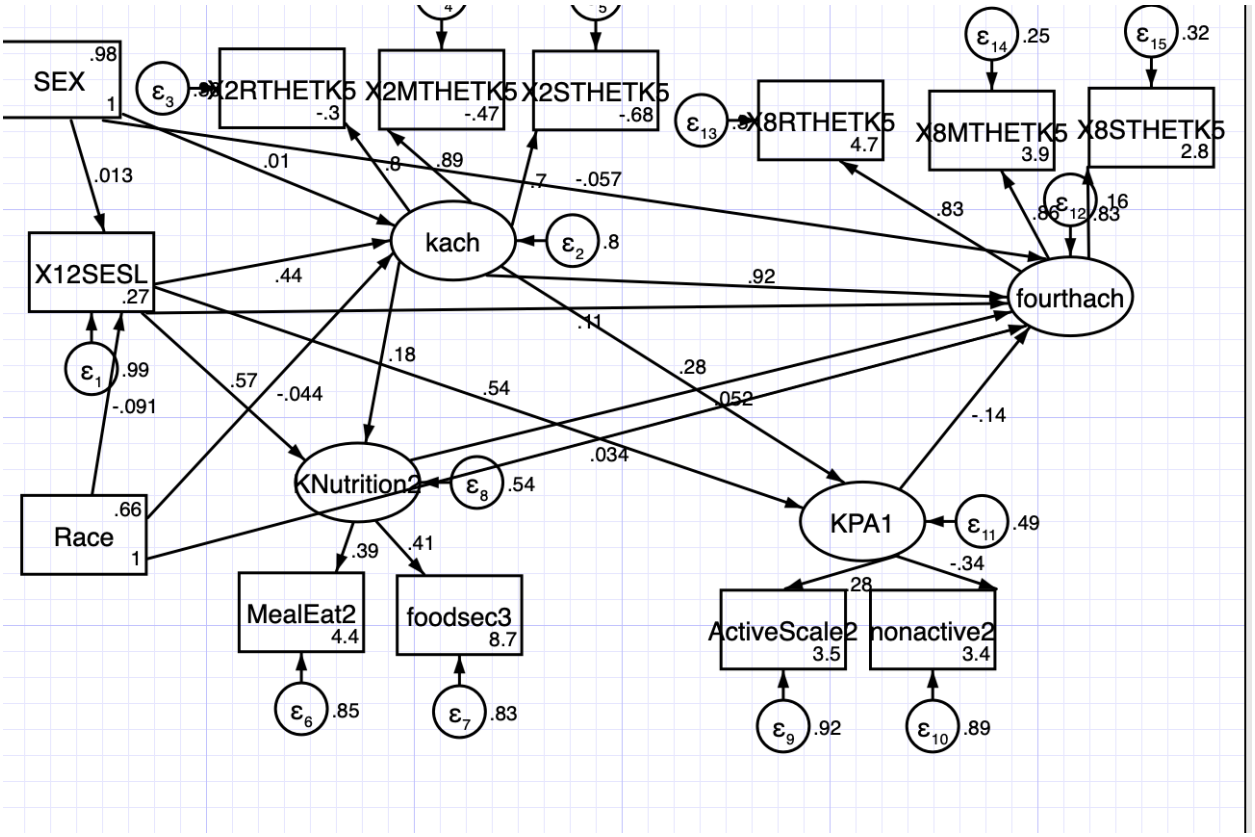


Variable Key:

Sex = Gender; **x12sesl** = SES; **Race** = Race; **kach** = overall kindergarten achievement; **KNutrition2** = kindergarten nutrition; **KPA1** = kindergarten physical activity; overall non-active scale; **fourthach** = fourth grade achievement

Figure 2

The Model with Direct Effects



Variable Key:
Sex = Gender; **x12sesl** = SES; **Race** = Race; **kach** = overall kindergarten achievement; **knutrition2** = kindergarten nutriton; **kpa1** = kindergarten physical activity; overall non-active scale; **fourthach** = fourth grade achievement

Table 1

TV Variable Created Quartiles

Variables	Percentiles		
	.25	.50	.75
1. TV watching 8A	.00	.00	.00
2. TV watching btwn 8A-6P	.00	1.00	1.00
3. TV watching after 6P	.00	1.00	1.00
4. TV watching on Sat	1.00	2.00	3.00
5. TV watching on Sun	1.00	2.00	3.00

Note: This table demonstrates the quartiles created to use as part of the creation of the Non-active Scale. A general note to this table first appears in the Methods Section.

Table 2

Path Values of Variables within the Model

Outcome	Direct Effect	Indirect Effect	Total Effect
1. SEX to X12SESL	.01	–	.01
2. Race to X12SESL	-.09***	–	-.09***
3. X12SESL to kach	.43***	_	.44***
4. kach to KNutrition2	.21***	–	.21***
5. kach to KPA1	.28***	-.07	.28***
6. SEX to kach	.01	.01	.02
7. Race to kach	-.04**	-.04***	-.08***
8. X12SESL to fourthach	.11**	.33***	.44***
9. kach to fourthach	.92***	–	.88***
10. KNutrition2 to fourthach	.05	–	.05
11. KPA1 to fourthach	-.14**	–	-.14**
12. SEX to fourthach	-.06***	.02	-.04**
13. Race to fourthach	.03***	-.06***	-.03**
14. X12SESL to KNutrition2	.57***	.08***	.65***
15. SEX to KNutrition2	–	.01	.01
16. Race to KNutrition2	–	-.07***	-.07***
17. X12SESL to KPA1	.54***	–	.66***
18. SEX to KPA1	–	.01	.01
19. Race to KPA1	–	-.06***	-.07***

Note: * to indicates which paths are significant at $p \leq .05$
** indicates which paths are significant at $p \leq .01$
*** indicates which paths are significant at $p \leq .001$
Variable Key: **SEX** = Gender; **x12sesl** = SES; **Race** = Race; **kach** = overall kindergarten achievement; **KNutrition2** = kindergarten nutrition; **KPA1** = kindergarten physical activity; overall non-active scale; **fourthach** = fourth grade achievement

Table 3

Correlation Matrix

Variables	1	2	3	4	5	6	7
1. SEX	1.00						
2. SES	-.21	1.00					
3. Race	-.29	.06***	1.00				
4. kach	.23***	.44***	.21***	1.00			
5.Knutrition2	.10	.57***	.36***	.62***	1.00		
6. KPA1	-.13***	.67	.02**	.33**	.17	1.00	
7. Fourthach	.19*	.38***	.06***	.91***	.53***	.30	1.00
8. M	.49	.17	1.21	-.80	8.64	8.64	4.72
9. SD	.50	.79	1.80	1.61	1.09	1.70	1.17

Note: * indicates which paths are significant at $p \leq .05$
** indicates which paths are significant at $p \leq .01$
*** indicates which paths are significant at $p \leq .001$
n = 6577
Variable Key: **kach** = overall kindergarten achievement; **KNutrition2** = kindergarten nutrition; **KPA1** = kindergarten physical activity; overall non-active scale; **fourthach** = fourth grade achievement

Appendix A

Active Scale

all questions show the original and recoded values

1. #CHQ060

In a typical week, on how many days does {CHILD} get exercise that causes rapid breathing, perspiration, and a rapid heartbeat for 20 continuous minutes or more?

Original Codes		Recode
0	0 Days	0
1	1 Day	.14
2	2 days	.28
3	3 days	.42
4	4 days	.57
5	5 days	.71
6	6 days	.85
7	7days	1
Refused		Missing
Don't Know		Missing

2. #CHQ070a

What types of exercise or physical activity does {child} get? How about…

Group sports?

Original Codes		Recode
1	Yes	1
2	No	0
	Refused	Missing
	Don't Know	Missing

3. #CHQ070b

[What types of exercise or physical activity does {child} get? How about…] individual sports?

Original Codes		Recode
1	Yes	1
2	No	0
	Refused	Missing
	Don't Know	Missing

4. #CHQ170c

[What types of exercise or physical activity does {child} get? How about…] dance?

Original Codes		Recode
1	Yes	1
2	No	0
	Refused	Missing
	Don't know	Missing

5. #CHQ170d
[What types of exercise or physical activity does {child} get? How about…] recreational sports or outdoor activities?

Original Codes		Recode
1	Yes	1
2	No	0
	Refused	Missing
	Don't know	Missing

6. #CHQ170e
[What types of exercise or physical activity does {child} get? How about…] martial arts?

Original Codes		Recode
1	Yes	1
2	No	0
	Refused	Missing
	Don't know	Missing

7. #CHQ170f
[What types of exercise or physical activity does {child} get? How about…] playground activities?

Original Codes		Recode
1	Yes	1
2	No	0
	Refused	Missing
	Don't know	Missing

8. #CHQ070g
[What types of exercise or physical activity does {child} get? How about…] calisthenics or general exercise?

Original Codes		Recode
1	Yes	1
2	No	0
	Refused	Missing
	Don't know	Missing

9. #CHQ109

Thinking about your {child}'s overall activity level, would you say {he/she} is …

Original Codes		Recode
1	Less active than other children {his/her} age	0
2	About as active,	.33
3	Slightly more active, or	.66
4	A lot more active than other children {his/her} age?	1
	Refused	Missing
	Don't know	Missing

Appendix B

Non-Active Scale

*scales were recoded into quartiles with scoring as follows
>/=25th = .0, 26th-50th = .33, 51st-75th = .66, and 76th-100th = 1

1. #DWQ080
On any given weekday, how many hours of television, videotapes, or DVDs on average does {CHILD} watch at home? How about…

a. Before 8:00?
b. Between 8:00 a.m. and 6 p.m.?
c. After 6 p.m.?

Refused
Don't Know

2. #DWQ082
How about on Saturday and Sunday? How many hours does {CHILD} watch television, videotapes, or DVDs at home on …

a. Saturdays?
b. Sundays?

Refused
Don't Know

Appendix C

Food Security Questions from Kindergarten Spring 2011
all questions show the recoded and original values

1. #FDQ130b
The food that {I/we} bought just didn't last, and {I/we} didn't have money to get more. Was that often true, sometimes true, or never true for {you/your household} in the last 12 months?

Original Codes		Recode
1	Often True	1
2	Sometimes True	.5
3	Never True	0
	Refused	Missing
	Don't Know	Missing

2. #FDQ130c
{I/We} couldn't afford to eat balanced meals. Was that often true, sometimes true, or never true for {you/your household} in the last 12 months?

Original Codes		Recode
1	Often True	1
2	Sometimes True	.5
3	Never True	0
	Refused	Missing
	Don't Know	Missing

3. #FDQ192a
{I/We} relied on only a few kinds of low-cost food to feed {CHILD}/the children} because {I was/we were} running out of money to buy food. Was that often true, sometimes true, or never true for {you/your household} in the last 12 months?

Original Codes		Recode
1	Often True	1
2	Sometimes True	.5
3	Never True	0
	Refused	Missing
	Don't Know	Missing

4. #FDQ192b
{I/We} couldn't feed {{CHILD}/the children} a balanced meal because {I/we} couldn't afford that. Was that often true, sometimes true, or never true for {you/your household} in the last 12 months?

Original Codes	Recode

1	Often True	1
2	Sometimes True	.5
3	Never True	0
	Refused	Missing
	Don’t Know	Missing

5. #FDQ192c
{CHILD} was/The children were} not eating enough because {I/we} just couldn't afford enough food. Was that often true, sometimes true, or never true for {you/your household} in the last 12 months?

Original Codes		Recode
1	Often True	1
2	Sometimes True	.5
3	Never True	0
	Refused	Missing
	Don’t Know	Missing

Appendix D

Breakfast and Meal-related Questions from Kindergarten Spring Survey 2011
all questions show the recoded and original values

1. #HEQ460
During the last five days {CHILD} was in school, how many breakfasts did {he/she} eat were not school breakfasts. By breakfast we mean breakfasts eaten at home, at childcare, or at school, but not part of a school breakfast program. Please count only one breakfast per day.

[____]
NUMBER OF BREAKFASTS

Range	Recode
REFUSED	Missing
DON'T KNOW	Missing
	0 days = 0
	1 day = .2
	2 days = .4
	3 days = .6
	4 days = .8
	5 days = 1

2. #HEQ500
In a typical week, please tell me the number of days at least some of the family eats breakfast together.

[____]
NUMBER OF DAYS

Range	Recode
REFUSED	Missing
DON'T KNOW	Missing
	0 days = 0
	1 day = .14
	2 days = .28
	3 days = .42
	4 days = .57
	5 days = .71
	6 days = .85
	7 days = 1

3. #HEQ510
In a typical week, please tell me the number of days {CHILD} has breakfast at a regular time.

[____]
NUMBER OF DAYS

Range	Recode
REFUSED	Missing
DON'T KNOW	Missing
	0 days = 0
	1 day = .14
	2 days = .28
	3 days = .42
	4 days = .57
	5 days = .71
	6 days = .85
	7 days = 1

4. #HEQ520
In a typical week, please tell me the number of days your family eats the evening meal together.

[____]
NUMBER OF DAYS

Range	Recode
REFUSED	Missing
DON'T KNOW	Missing
	0 days = 0
	1 day = .14
	2 days = .28
	3 days = .42
	4 days = .57
	5 days = .71
	6 days = .85
	7 days = 1

5. #HEQ530
In a typical week, please tell me the number of days the evening meal is served a regular time.

[____]
NUMBER OF DAYS

Range	Recode
REFUSED	Missing
DON'T KNOW	Missing
	0 days = 0
	1 day = .14
	2 days = .28
	3 days = .42
	4 days = .57
	5 days = .71
	6 days = .85

7 days = 1

Appendix E

Detailed Income Range Categories Used in the Parent Interview

Detailed income range	Total household income
1	$5,000 or less
2	$5,001 to $10,000
3	$10,001 to $15,000
4	$15,001 to $20,000
5	$20,001 to $25,000
6	$25,001 to $30,000
7	$30,001 to $35,000
8	$35,001 to $40,000
9	$40,001 to $45,000
10	$45,001 to $50,000
11	$50,001 to $55,000
12	$55,001 to $60,000
13	$60,001 to $65,000
14	$65,001 to $70,000
15	$70,001 to $75,000
16	$75,001 to $100,000
17	$100,001 to $200,000
18	$200,001 or more

SOURCE: U.S. Department of Education, National Center for Education, Early Childhood Longitudinal Study, Kindergarten Class of 2010-2011 (ECLS-K:2011), Spring 2015

Appendix F

Occupation Categories and Assigned Prestige Scores

Occupation category	Prestige score
1 Executive, Admin, Managerial Occupation	53.5
2 Engineers, Surveyors, & Architects	64.89
3 Natural Scientists & Mathematicians	62.87
4 Social Scientist/Workers/ Lawyers	59
5 Teachers; College, Postsecondary Counselors, Librarians;	72.1
6 Teacher, Except Postsecondary	63.43
7 Physicians, Dentists, Veterinarians	77.5
8 Registered Nurses, Pharmacists	61.56
9 Writers, Artists, Entertainers, Athletes	52.54
10 Health Technologists & Technicians	57.83
11 Technologists, Except Health	48.69
12 Marketing & Sales Occupation	35.78
13 Administrative Support, Including Clerk	38.18
14 Service Occupations	34.95
15 Agriculture, Forestry, Fishing Occupations	35.63
16 Mechanics & Repairs	39.18
17 Construction & Extractive Occupations	39.2
18 Precision Production Occupation	37.67
19 Production Working Occupation	33.42
20 Transportation, Material Moving	35.92
21 Handler, Equip, Cleaner, Helpers, Labor	29.6

22: Unemployed/Retired (If a person was on leave from a job or unemployed and actively looking for work, he or she was asked the occupation questions. Category 22 was used only if a respondent reported "unemployed "or "retired" as an answer for occupation rather than providing an actual occupation, thus it should not be used as an indication of current employment status.)	Assignment of the prestige score depended on the value of X1PAR1EMP or X1PAR2EMP for parent 1 or parent 2, respectively
-1 (No occupation)	Assignment of the prestige score depended on the value of X1PAR1EMP or X1PAR2EMP for parent 1 or parent 2, respectively

SOURCE: U.S. Department of Education, National Center for Education, Early Childhood Longitudinal Study, Kindergarten Class of 2010-2011 (ECLS-K:2011), fall 2010

Appendix G

MARY F. LEPOSA

mleposa@leroycsd.org

EDUCATION:

Alfred University – Alfred, NY
- Doctor of Psychology in School Psychology (Anticipated 2023)
- Certificate of Advanced Study (2018)
- Masters of Arts in School Psychology (2016)

SUNY Fredonia – Fredonia, NY
- Major - Bachelor of Arts in Psychology (2014)
- Minor - Sociology

PROFESSIONAL EXPERIENCE

School Psychologist (7/2018 - Present)
Le Roy Central School District

School Psychology Intern (7/2017-6/2018)
North Tonawanda City School District

Academic Consultant (8/2015-5/2017)
Center for Academic Success - Alfred University

Graduate Clinician (8/2015-5/2016)
The Child and Family Service Center - Alfred, NY

Undergraduate and Graduate professor (8/2016-5/2017)
Alfred University, Alfred

Professional Credentials and/or Affiliations

- School Psychologist, Permanent Certification in New York State
- National Association of School Psychologists (NASP)
- New York Association of School Psychologists (NYASP)