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Predictive Effects of Gender, SES, and Body Mass Index Scores on Student Achievement

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PREDICTIVE EFFECTS OF GENDER, SES, AND BODY MASS INDEX SCORES ON STUDENT ACHIEVEMENT

by

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ABSTRACT

by
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Title: Predictive Effects of Gender, SES, and Body Mass Index Scores on Student Achievement (Under the direction of Dr. David Bangs)

The purpose of this study was to determine the predictive effects of gender, SES, and BMI scores on academic achievement as measured by the ACT Aspire Exam for sixth- and eighth-grade students in rural, Delta schools in Arkansas. A quantitative, regression strategy was used to analyze the data. Predictor variables for each one of the hypotheses were gender, SES, and BMI scores. Criterion variables were ACT Aspire mathematics achievement and ACT Aspire reading achievement for Grades 6 and 8. Four Arkansas Delta schools participated in the study. The sample included 366 individual student scores from sixth-grade and 350 individual student scores from eighth grade. The results were analyzed by examining the combination of all predictor variables on the different criterion variables. Then, each predictor variable from each model was examined individually to determine how much it contributed to the overall prediction formula. The overall model significantly predicted mathematics and reading achievement for both Grade 6 and Grade 8. Results were consistent for each of the four hypotheses. Gender and SES significantly contributed to each of the prediction models and BMI did not.

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CHAPTER I

INTRODUCTION

Throughout the past few decades, weight management has become a priority for healthcare and school officials. Multiple initiatives have been implemented to combat unhealthy weight categories among children. Each initiative has done little to curb the negative effects of both underweight and overweight children. Childhood obesity has been on a significant upward trend since the early 2000s with obesity reaching 18.5% in 2015-2016 (Hales, Carroll, Fryar, & Ogden, 2017). The percentage of students categorized as obese remains above national goals of 14.5% by 2020 (U.S. Department of Health and Human Services, 2017). Furthermore, since 1980, childhood obesity has risen from 7% to 18.5% in 6- to 11-year-olds and from 5% to 20.6% in 12- to 19-year-olds (Centers for Disease Control and Prevention, 2018). Adolescent students also struggle with eating disorders, with 2.7% of 13- to 18-year-olds diagnosed. Females are twice as likely as males to develop some type of eating disorder (National Institute of Mental Health, 2017). Many states, such as Arkansas, have implemented body mass index (BMI) screening and surveillance programs to track body weight in schools. In addition, BMI percentiles have been used to study how body weight affects several academic factors in schools.

Several studies have indicated that weight status can predict health and emotional consequences among children (Davidson & Birch, 2001; French, Story, & Perry, 1995;

Hales et al., 2017; Reiff, 2001; Strauss & Pollack, 2003). Furthermore, weight status may also predict academic achievement, especially with females (Datar & Sturm, 2006). According to Wingfield, Graziano, McNamara, and Janicke (2011), individual and subgroup differences, such as gender, affect obesity and academic performance. Conversely, other studies have indicated no relationship between BMI percentile and academic achievement but have indicated a relationship between academic achievement and race (Baxter, Guinn, Tebbs, & Royer, 2013). Other factors, such as socioeconomic status (SES), have also been aligned with BMI and its effects on academic performance.

Statement of the Problem

The purposes of this study were four-fold. First, the purpose of this study was to determine the predictive effects of gender, SES, and BMI scores on mathematics achievement as measured by the ACT Aspire Exam for sixth-grade students in rural, Delta schools in Arkansas. Second, the purpose of this study was to determine the predictive effects of gender, SES, and BMI scores on reading achievement as measured by the ACT Aspire Exam for sixth-grade students in rural, Delta schools in Arkansas. Third, the purpose of this study was to determine the predictive effects of gender, SES, and BMI scores on mathematics achievement as measured by the ACT Aspire Exam for eighth-grade students in rural, Delta schools in Arkansas. Fourth, the purpose of this study was to determine the predictive effects of gender, SES, and BMI scores on reading achievement as measured by the ACT Aspire Exam for eighth-grade students in rural, Delta schools in Arkansas.

Background

Body Mass Index in Schools

BMI statistics have been used universally to analyze the relationship between obesity and academic performance. Few studies have been conducted that only link BMI percentiles to academic achievement. More research includes physical fitness along with BMI scores. High BMI scores, along with the lack of physical fitness, is negatively associated with academic performance (Castelli, Hillman, Buck, & Erwin, 2007). Specifically, Castelli et al. (2007) found that BMI is directly correlated to reading and mathematics standardized achievement scores. Further, observably high levels of physical fitness are linked to low BMI percentages. Castelli et al. found that students who maintain high physical fitness scores are more likely to achieve academically regardless of other variables such as age, sex, and poverty. However, a direct link of cognitive abilities associated with BMI and physical fitness was unable to be determined.

Fewer studies have found that BMI is not a consistent measure to predict academic achievement. Baxter et al. (2013) found no relationship between BMI and academic achievement among fourth-grade students in the Southeast. They suggested that other factors such as SES and race are better predictors of academic achievement. Kaestner and Grossman (2008) also countered previous studies that link obesity to academic achievement. Results suggested that although obesity has other adverse and lasting effects on children's lives, the academic achievement of children who are obese or overweight is the same as those who are average weight.

Weight status has also shown indications of affecting the social, cognitive, and emotional health of students. Both overweight and underweight students have shown to

have a negative relationship in psychosocial functions (Halfon, Larson, & Slusser, 2013; Tsiros et al., 2009). Obese students tend to have more behavior issues compared to their counterparts, have difficulty turning in homework, and avoid extracurricular activities (Turer, Lin, & Flores, 2013). As a result, student motivation to participate in school-related activities is lower than their optimal-weight peers. In addition, overweight students are more likely to feel anxious, sad, or unhappy because of their weight perception (Turer et al., 2013; Whetstone, Morrissey, & Cummings, 2007). Early identification is critical to avoid the negative consequences of maintaining an unhealthy weight. Educating students, teachers, and parents is also important to promote social, cognitive, and emotional health.

Socioeconomic Status and Body Mass Index

SES has been used to predict various academic outcomes. Children living in low-income households are more likely to be obese compared to children with higher income (Ogden, Lamb, Carroll, & Flegal, 2010). Students living in low-income neighborhoods are 30% to 60% more likely to be overweight than students living in higher-income neighborhoods (Singh, Siahpush, & Kogan, 2010). This association can be significant for communities in the Arkansas Delta because of recent income declines in this region. While some researchers have found that obesity rates are higher for African-American and Hispanic individuals, when family income is considered, obesity trends are consistent across races and ethnic groups (Rogers et al., 2015). The consideration of factors that contribute to differences in weight status could be valuable for schools and healthcare officials.

SES has also been a predicting factor for students developing eating disorders. Bould et al. (2016) found that adolescent females that attend schools with higher proportions of girls whose parents are highly educated, which would indicate higher annual income, are more likely to develop an eating disorder. Previous research indicates that females in households with higher incomes are more likely to develop eating disorders than students for lower-income families. Students with eating disorders are less active, more apathetic, and interact less with their environment (U.S Department of Health and Human Services, 2005). Undernourished students who have low BMI scores are tired and become ill more frequently, resulting in increased absenteeism. These results contribute to a lack of motivation and lower academic performance compared to their peers. Students in the upper-income bracket are often overlooked as having health concerns. However, eating disorders are prevalent in these demographics and other subgroups.

The benefits of maintaining a healthy weight may direct schools to provide more physical fitness and health programs for students. Increasing accountability for schools in mathematics, literacy, and science instruction has forced schools to reduce physical education programs and reduce physical fitness opportunities for students during the school day. School-based obesity prevention interventions have been beneficial for low-income students (Hollar et al., 2010). Schools that provide interventions for low-income children are more likely to see a decrease in overweight children. Also, the interventions provide indirect positive effects on academic performance and higher scores on standardized tests. Hollar et al. (2010) concluded that school-based obesity prevention interventions along with healthy school-provided meals, health education, and physical

fitness throughout the school day could improve the overall health of individual students and improve academic achievement in low-income schools. The interventions can be important because many low-income students primarily eat at public schools.

SES may also contribute to predicting academic achievement. Judge and Jahns (2007) indicated that there was an association between being overweight and academic achievement, but after considering SES and ethnicity, being overweight was no longer significant. SES and race had a stronger association with academic performance than being overweight alone. These results were consistent with the findings of Datar, Sturm, and Magnabosco (2004) who discovered that a combination of factors contributed to the lack of academic performance. Frequently, students from low-income families miss more days of school and have more discipline-related infractions compared to those of high-income homes, which contribute to academic deficiencies (Renth, Buckley, & Puchner, 2015). Schools have sought ways to counter these inconsistencies. Schools such as KIPP Delta in Arkansas have focused efforts on reasons why low-income students are not successful and have created goals to counter the effects (Maranto & Shuls, 2011). The practices implemented by KIPP Delta and others have created opportunities for low-income students and have aided in closing the achievement gap.

Grade Level and Body Mass Index

The implication that BMI influences academic achievement is somewhat inconsistent across grade levels. Primarily, researchers that attempt to associate BMI and academic achievement have conducted most of their studies at the elementary school level. Few studies have been conducted at the secondary level. One study by Shore et al. (2008) suggested that middle school students who are overweight achieve lower grades

and have an overall lower physical fitness rating compared to their non-overweight peers. These students achieved a lower overall GPA and scored approximately 11% lower on a national standardized reading test. However, Crosnoe and Muller (2004) reported that although adolescents who were at risk of obesity had lower achievement than students who were not obese, change in achievement over time was the same for both groups, which would indicate a baseline for the lack of academic achievement among overweight children in elementary school. Crosnoe and Muller stated further, "Given the differences across population subgroups in achievement and weight, exploration of how the moderating role of school context could itself be moderated by demographic factors would be an interesting approach" (p. 404). When studying middle school and high school students, they found that students' academic achievement levels and gaps had already been set and remained unchanged.

Social factors and self-concept also seem to affect adolescents' performance as they age. Self-esteem and emotional responses by adolescents tend to become more prevalent as students attend middle school and high school. In addition, lower levels of self-concept can lead to greater behavioral issues and absenteeism that can, in turn, affect academic performance (Shore et al., 2008). As adolescents' bodies begin to change, the emotional consequences due to self-awareness can be challenging for this group of students.

Gender and Body Mass Index

Changes in overweight status have had adverse effects on a wide range of school outcomes. Datar and Strurm (2006) studied the link between childhood overweight status and school outcomes. The unique aspect of their research was that they sought to find out

if changes in overweight status were linked to negative academic achievement from kindergarten through the third grade. The results of standardized mathematics and reading scores were analyzed for varying groups of students. Changing from not overweight to overweight had a significant negative relationship among girls. Boys changing from not overweight to overweight were not significantly affected. This study was contrary to Datar et al.'s (2004) previous study that found a significant association between kindergarten and first-grade students being overweight and academic achievement. When other factors such as SES were not controlled, the relationship between BMI and academic achievement became insignificant. Even with the adjustments for other factors, overweight (unadjusted) status and academic performance could be added to the negative stigma of overweight children as early as kindergarten.

Relationships in gender, BMI, and academic achievement have also been found in other studies. Consistent with Datar and Strum's (2006) findings, Wingfield et al. (2011) suggested that relationships between BMI and academic performance were more prevalent among females. They found that BMI moderately correlated with academic performance but only with certain age groups. Results indicated that only certain groups of students were vulnerable to declines in academic achievement based on weight increases. Across groups, not all students show the same results due to being overweight.

Hypotheses

The initial literature review suggested an association between BMI scores and academic achievement. Therefore, the researcher generated the following null hypothesis:

1. No significant predictive effect will exist among gender, SES, grade level, and BMI scores on mathematics achievement as measured by the ACT Aspire Exam for sixth-grade students in rural, Delta schools in Arkansas.
2. No significant predictive effect will exist among gender, SES, grade level, and BMI scores on reading achievement as measured by the ACT Aspire Exam for sixth-grade students in rural, Delta schools in Arkansas.
3. No significant predictive effect will exist among gender, SES, grade level, and BMI scores on mathematics achievement as measured by the ACT Aspire Exam for eighth-grade students in rural, Delta schools in Arkansas.
4. No significant predictive effect will exist among gender, SES, grade level, and BMI scores on reading achievement as measured by the ACT Aspire Exam for eighth-grade students in rural, Delta schools in Arkansas.

Description of Terms

Academic Achievement. Student scale scores on the ACT Aspire in each subject area were used to measure academic achievement for individual students in this study.

ACT Aspire. A summative assessment that includes a vertically aligned series of achievement tests that measure student growth in mathematics, English language arts, reading, writing, and science for Grades 3-10 (ACT Aspire, 2019). The purpose is to measure student achievement and progress toward college and career readiness.

Body Mass Index (BMI). According to the Centers for Disease Control and Prevention (2017), BMI is the ratio of weight to height squared. BMI is often used to assess weight status because it is relatively easy to measure and correlates with body fat.

Eating Disorders. Eating disorders are illnesses in which the people experience severe disturbances in their eating behaviors and related thoughts and emotions (National Institute of Mental Health, 2017). People with eating disorders typically become pre-occupied with food and their body weight. Common eating disorders include anorexia nervosa and bulimia nervosa.

Obese/Overweight. Hales et al. (2017) defined obesity in adults as a BMI of greater than or equal to 30. Obesity in youth was defined as a BMI of greater than or equal to the age- and sex-specific 95th percentile of the Centers for Disease Control and Prevention (2017) growth charts.

Socioeconomic Status (SES). Students were classified based on their free and reduced-cost lunch status according to state and federal guidelines. Children from families with incomes below 130% of the poverty level are eligible for free meals (U.S. Department of Agriculture Services, 2017). Those with incomes between 130% and 185% of the poverty level are eligible for reduced-price meals (U.S. Department of Agriculture Services, 2017).

Significance

Research Gaps

The number of students in Grades K-12 that are categorized as overweight continues to rise. In schools, BMI has been a standard measurement to categorize the weight level of students. There is an abundance of studies that analyze the relationship between physical activity, BMI, and academic achievement. However, few studies have been conducted that only attempt to link BMI to academic achievement. The studies that have been conducted that specifically consider BMI and academic achievement have

been inconsistent. Wingfield et al. (2011) found that the relationship between BMI and academic achievement was more prevalent among females and only with certain age groups. Other studies have found that overweight status affected academic achievement, but after considering SES, being overweight was less significant (Judge & Jahns, 2007). Because of the limited research and the inconsistencies of findings, further research is needed to determine how BMI, among other factors, predicts academic achievement.

Possible Implications for Practice

Physical education and health education have become less imperative in both elementary and secondary schools. An emphasis on mathematics, English language arts, and science due to accountability measures has controlled many of the limited resources. The Arkansas Department of Education (2018) has specific standards for physical education and requires a predetermined amount of time that students must engage in physical activity each week. Yet, are schools doing enough to ensure that students maintain a healthy weight and lifestyle? This study provided policymakers and leaders with data to determine if it is important to provide students with more resources to maintain a healthy weight. The research also provided educators with data to determine how BMI, along with other demographic factors, can be used to predict academic success in specific subject areas.

Process to Accomplish

Design

A quantitative, regression strategy was used to examine Hypotheses 1-4. The predictor variables for all hypotheses were gender, SES, and BMI scores. The dependent or criterion variables for Hypotheses 1-2 were mathematics and reading achievement,

respectively, as measured by the ACT Aspire for students in Grade 6. The dependent or criterion variables for Hypotheses 3-4 were mathematics and reading achievement, respectively, as measured by the ACT Aspire for students in Grade 8.

Sample

The sample for this study was scores taken from 2017-2018 sixth and eighth graders from four schools in the Delta region of Arkansas. The researcher chose the sample because the schools had similar demographics and were located in similar geographic areas. School 1 had a student population that consisted of Caucasian (78.2%), African American (12.4%), Hispanic (5.4%), American Indian (0.2%), Asian (0.2%), and two or more races (3.4%). School 2 had a population that consisted of Caucasian (43.4%), African American (45.7%), Hispanic (5.9%), American Indian (0.3%), Asian (1.4%), and two or more races (3.4%). School 3 had a population that consisted of Caucasian (21.8%), African American (64.0%), Hispanic (12.0%), American Indian (0.2%), Asian (0.6%), and two or more races (0.8%). School 4 had a population that consisted of Caucasian (70.0%), African American (18.9%), Hispanic (7.7%), American Indian (0.2%), Asian (0.1%), and two or more races (3.1%). Students qualification for free or reduced-cost lunch determined SES. Schools 1, 2, and 3 had 64-68% of their students qualify for free and reduced-cost lunches, and School 4 had 71% of its student population qualify for free and reduced-cost lunches. The four schools were also similar in size: School 1 (1,236), School 2 (1,568), School 3 (1,250), and School 4 (1,537).

Instrumentation

In the first semester of each school year, BMI scores were calculated for all students in even-numbered grades in the four schools included in this study. In this study,

2018 BMI scores for Grades 6 and 8 were used as predictor variables. Other predictor variables included in the study were gender, SES status (school lunch eligibility), and grade level, which were recorded from data accessed in eSchool.

The criterion variable for each of the hypotheses was student achievement data from the 2017 ACT Aspire assessment. Scale scores for mathematics and reading were used for this study. Mathematics scale scores ranged from 400-451 (sixth grade) and 400-456 (eighth grade). Reading scale scores ranged from 400-436 (sixth grade) and 400-440 (eighth grade). The superintendent of each school granted permission to obtain the data. All participants' scores were kept confidential, and all data were inputted into SPSS version 22.

Data Analysis

A multiple regression analysis was used to address each hypothesis. The predictor variables for all hypotheses were gender, SES, grade level, and BMI scores. The criterion variable for Hypotheses 1 and 3 was mathematics achievement as measured by the ACT Aspire assessment for Grades 6 and 8, respectively. The criterion variable for Hypotheses 2 and 4 was reading achievement as measured by the ACT Aspire assessment for Grades 6 and 8, respectively. The results were analyzed by examining the combination of all predictor variables on the different criterion variables. Then, each predictor variable from each model was examined individually to determine how much it contributed to the overall prediction formula. The null hypotheses were tested using a two-tailed test with a .05 level of significance.

Summary

Maintaining a healthy weight has proven to be critical for students to sustain a healthy lifestyle physically, mentally, and emotionally. Chapter I described how BMI relates to the academic development of students and how certain demographic factors such as socioeconomic status, grade level, and gender are related to both BMI and academic achievement. The statement of the problem, description of terms, the significance of the study, and process to accomplish were also introduced. BMI screening in Arkansas assists professionals in determining how weight status can affect numerous student outcomes, including academic performance. Chapter II will review the related literature.

CHAPTER II

REVIEW OF THE RELATED LITERATURE

The weight status of American students has become a pressing health issue. The number of students currently being identified as overweight and underweight in the United States has become a national epidemic (Gray, Byrd, Fountain, Rader, & Fruge, 2016; Phillips et al., 2010). The increase of obese students has been a concern of health officials for several years. According to the Centers of Disease Control (2017), since 1980, childhood obesity has increased from 10% to 15% among school-aged children. At the other end of the spectrum, 50% of teenage girls and 30% of teenage boys use unhealthy weight control behaviors (Neumark-Sztainer, 2005). A call for action for sustainable, healthy choices in schools has become a priority. Changes to nutritional and physical fitness requirements have been ever-changing in Arkansas and other states in the United States (Nihiser et al., 2007). The adverse health consequences of obesity are well known, but what is unclear are the effects that an unhealthy weight can have on academic and social aspects of a child's life. To solve the epidemic of childhood weight issues, officials may need to examine other factors.

BMI has traditionally been used as a universal tool to assess healthy weight levels in the United States. Furthermore, schools in Arkansas have used this tool to assess weight-related health risks of children of all age groups (Arkansas Center for Health Improvement, 2013). Numerous research studies have sought to connect weight status to

other factors that could potentially affect the academics of children (Baxter et al., 2013; Castelli et al., 2007; Crosnoe & Muller, 2004; Datar et al., 2006; Wingfield et al., 2011). Along with weight status, factors that could negatively affect a child's performance could include SES, gender, and the grade level of students. As complex as each of these factors is to measure when considered together, research has been uncertain as to their cumulative effects on children.

Further, puberty may also affect children's health and academic performance. Adolescence may be a time when weight concerns emerge. As children develop into adolescents, they are confronted with many challenges. These challenges are present during their academic school day. Throughout this development, they begin to cultivate a perception of themselves and determine areas of self-motivation (Shore et al., 2008). A student's weight status, along with other factors, could not only affect his perception of himself but also internally motivate him to achieve in certain capacities or direct his attention in a different area. This concept of development of oneself through the study of self-identification and motivation is aligned with the humanist theory (Huitt, 2001). Humanism is based on self-actualization and how a student perceives himself. Characteristics such as weight status, SES, and gender could motivate students either negatively or positively based on their perceptions. These characteristics of individual students could also have a lasting influence on academic achievement throughout their school careers.

Body Mass Index in Schools

History

As obesity became a concern in the 1980s and 1990s, federal and state healthcare officials sought ways to estimate an individual's risk of weight-related health problems. Health officials have universally endorsed the BMI measurement to estimate the prominence of obesity among students. Adolphe Quetelet originally derived the formula between 1830 and 1850 and named it the Quetelet Index (Blackburn & Jacobs, 2014). Ancel Keys later reintroduced the measurement and coined the term *body mass index* (BMI) (Blackburn & Jacobs, 2014). BMI is the ratio of an individual's weight to height squared (Centers of Disease Control, 2017). The simplistic measurements of BMI gave healthcare personnel a way to measure an individual's potential for health risk. Furthermore, the simplicity and noninvasiveness of BMI made the measurement a good option for schools. Health officials in school districts can use the BMI measurement as a tool to address weight-related health problems students face today.

Obesity in school-age children became such a concern in the early 2000s that schools began to screen students using BMI. Arkansas, in 2003, was one of the first states to pass legislation requiring school districts to screen children (Nihiser et al., 2007). Other states, such as Illinois and Florida, soon followed with specific BMI expectations. Currently, less than a quarter of the states require schools to screen their students using the BMI measure (Nihiser et al., 2007). The lack of participation among states is due to questions regarding the accuracy of BMI and the appropriateness of schools reporting the measurement to state health officials. Proponents of the measure assert that there are benefits of having an early screening tool for identifying adverse health conditions

(Morgan, Houser, Au, & Sacheck, 2012). In Arkansas, BMI reports have become the norm for providing parents with surveillance and screening data.

Collecting and reporting BMI measurements in schools have two primary goals. The first purpose is to provide surveillance data. Surveillance data can be used for describing trends among the populations of students and creating awareness for personnel to identify the extent of weight problems in particular student demographics (Nihiser et al., 2007). Results from surveillance data provide valuable information for personnel to improve policies and services to promote healthy body weights among students. Also, surveillance can be an evaluative tool for programs and policies that have been implemented. Surveillance data are beneficial for the analysis of the overall population or subgroups, but less beneficial for individuals.

BMI can be valuable for screening for potential health risks in individual students. BMI screening provides healthcare personnel and parents with beneficial information to assess weight status without invasive procedures. The goals of screening programs encourage optimal body weight, include preventing obesity in students, reducing eating disorders among students, correcting misperceptions of parents and students about their weights, and motivating students to make healthy choices. Screening can also raise awareness of potential health concerns, but BMI should not be used as a stand-alone tool to assess obesity (Nihiser et al., 2007). BMI reports should be reviewed with the acknowledgment of the two primary objectives of the measurement. BMI screening provides a simple measure for parents and students to prevent and address any weight-related health indicators that may exist.

The State of Arkansas was a pioneer for required BMI testing reporting in schools. Arkansas legislators passed Act 1220 of 2003 to Combat Childhood Obesity, which required school districts to assess and report BMI measurements of all students. This Act was designed to make changes within school districts that encouraged healthier lifestyles for students and their families (Arkansas Center for Health Improvement, 2013). The Act also required school districts to report BMI to the Arkansas Department of Education and send an individual student report to parents. The original Act was amended in 2007, which required a fewer amount of grade levels to be assessed. Following Arkansas' lead, other states soon required BMI measurements, although not identical to the standards of Act 1220 of 2003 (Nihiser et al., 2007). The initiative that Arkansas and other states have taken to encourage a healthy weight status offers students and parents educational resources to begin a potentially healthier lifestyle. Although Arkansas originally sought to address obesity in 2003, states have now begun to also address malnutrition and the lower end of BMI scores.

Physical Fitness and Body Mass Index

School health personnel use the BMI to provide awareness for parents regarding student health and wellness levels universally. Rarely do schools provide parents with information that links physical fitness levels and other critical health indicators with BMI results. Weight status and fitness have been correlated to one another, with students who are physically fit more likely to be within a normal weight than students who are unfit (Castelli et al., 2007; Morgan et al., 2012; Wingfield et al., 2011). Additionally, BMI has an influence on aerobic fitness estimates based on physical fitness tests (Saint-Maurice, Welk, Laurson, & Brown, 2014). This link could provide valuable information for

parents and educators to directly connect BMI scores to physical fitness and the health benefits of being physically fit. Providing more in-depth information such as BMI and physical fitness levels in reports could be beneficial to parents to evaluate their child's health and encourage healthy family behaviors.

In recent years, states have sought to implement a more comprehensive fitness test to assess student fitness levels. In 2007, the Texas Education Agency (2014) approved FitnessGram to assess student fitness levels. In addition to body composition results, the FitnessGram assessment is composed of cardiovascular endurance, muscular endurance, muscular strength, and flexibility assessments (Plowman & Meredith, 2013). Each student is provided a report that uses a Health Fitness Index to assess physical fitness in three categories: Healthy Fitness Zone, Needs Improvement, and Needs Improvement Health Risk (Texas Education Agency, 2014). Assessments such as FitnessGram provide school districts and parents a more detailed assessment of a student's health, rather than simply providing BMI scores. As more states introduce healthy fitness index measurements, schools will be able to adjust nutrition and physical activity standards to meet the needs of their students.

The FitnessGram assessment also provides relevant information on the spectrum of weight-associated measures. The body composition component of the reports use BMI measurements; however, body fat percentage tools, such as the skinfold test, are also used. Multiple body composition measurements can provide more accurate results and in-depth fitness information. The results reported using the Healthy Fitness Zone could address body composition issues for both underweight and overweight students. According to Saint-Maurice, Welk, and Bai (2017),

> When compared with other commonly used indicators such as the BMI score, the Healthy Fitness Zone score may provide a more sensitive and robust indicator of favorable progress with BMI over time, making it potentially useful not only for individual students but also for schools, researchers, and public health personnel. (p. 61)

The more robust results provide schools with reliable information to create and implement intervention strategies for all student populations. In addition, nutritional guidelines can be analyzed to address the needs of both underweight and overweight students.

In addition to predictive health indicators, physical fitness has been associated with academic achievement, but findings are mixed. Castelli et al. (2007) discovered that students who are more physically fit perform better on standardized tests. Specifically, reading and mathematics were both related to aerobic fitness and BMI scores. The results of the study were independent of other factors such as age, sex, school characteristics, and SES. The findings indicated more physical activity opportunities during the school day could benefit overall student health, BMI, and academic achievement. The amount of physical activity during the school day could be a factor in increasing academic achievement among all students. In Arkansas, physical activity time has been reduced due to increased academic accountability, but stricter nutritional guidelines have been implemented. However, physical activity has shown, academically and physically, to benefit students.

However, an association between physical activity, BMI, and academic achievement has not been consistent in all research findings. Kaestner and Grossman

(2008) reported that standardized test scores of obese and overweight students are about the same as average weight students. Furthermore, adolescents who were overweight or obese did not have inferior academic performance in the classroom compared to other students. These findings indicated that BMI was not a factor that predicted academic achievement. Baxter et al. (2013) found no significant association between BMI and academic achievement, but demographics such as race and SES were better predictors of academic achievement. The consideration of other predictor variables together with student weight on the prediction of achievement is essential because of the inconsistencies with BMI and achievement.

Act 1220 of 2003 focused on nutritional changes in schools but did not address educating students on changes that could be transferred to the home environment. Programs that seek to provide students with information regarding healthy nutrition and fitness options reduced BMI scores of students classified as obese (Bogart et al., 2016). Interventions and other programs can have long-term effects on student health behaviors. In contrast, limiting the number of unhealthy foods in schools has done little to change the weight status of students (Datar & Nicosia, 2012). The findings suggest that schools should spend more resources on educating students or providing physical activities and less on specialized nutrition.

Social, Cognitive, and Emotional Effects

BMI surveillance programs can aid parents and school officials in intervening with potential emotional, behavioral, and social problems associated with weight status. High BMI measurements are an indication of obesity. Obese students have tendencies to have more behavior infractions than their optimal-weight peers, have difficulty turning in

homework, and avoid extracurricular activities (Turer et al., 2013). These deficiencies could hinder overweight students' abilities to develop behaviorally and emotionally, causing future issues in these areas. BMI reports that educate parents on early behavioral and emotional intervention strategies could assist in overall student development.

Weight status can be directly linked to the emotional well-being of middle school students. Being overweight or obese has been directly associated with poorer health status, lower emotional functioning, and school-related problems (Halfon et al., 2013). Turer et al. (2013) found that overweight students were more likely to feel anxious, sad, or unhappy compared to their peers of healthy weights. These feelings can ultimately lead to depression or behavior disorders (Halfon et al., 2013). The findings in these studies suggested that obesity's link to emotional health could affect students' school-related activities, therefore requiring school districts to address the emotional issues that may be present in this particular demographic in middle school grades.

Weight status, including both being underweight and obese, can cause challenges for adolescents in social environments. Previous research has indicated that increasing weight status was likely to have a moderate to a strong relationship in psychosocial functions among students (Halfon et al., 2013; Tsiros et al., 2009). Teasing, social stigmatization, and peer rejection were among the factors that led to social issues for students (Halfon et al., 2013). These relationships marked a need for further education for parents and school personnel about the adverse effects of social barriers for overweight students. Crosnoe and Muller (2004) suggested that overweight status was not only a marker for physical health but also a social marker that influenced students' positions on status hierarchies in grade levels as low a kindergarten and first grade, further adding to

the concern of psychosocial effects in school populations. The inclusion of social ranks in early grades only adds to the challenge of weight classification in upper grades, indicating a need for social, behavioral, and emotional interventions for students in early childhood grade levels.

Perceived weight status can cause fatal consequences for adolescent students. Suicide was the second leading cause of death for middle school students, age 10 to 14 (Centers of Disease Control, 2018). Although weight perception is not the only factor that causes suicidal behavior, perception has been shown to increase suicidal thoughts. In a study conducted by Whetstone et al. (2007), both males and females were shown to have suicidal thoughts and behaviors due to weight perception. Males who were underweight were more likely to have suicidal thoughts or behaviors than normal-weight males. The suicidal behaviors could be due to the likelihood of being teased or bullied because of their underweight status. Whetstone et al. (2007) also determined that females were more likely to have suicidal thoughts due to overweight status than males. This research is consistent with findings by Judge and Jahns (2007) where overweight females were more likely to show signs of loneliness and sadness compared to non-overweight females. Overweight students exhibit signs of depression and emotional functioning, possibly linking depression and suicidal thoughts of adolescence (Halfon et al., 2013). Students also struggle with eating disorders that affect their mental and emotional health. Approximately 2.7% of 13-18-year-olds struggle with some type of eating disorder (National Institute of Mental Health, 2017). Mental and behavioral health services could be beneficial for schools to address the needs of students in both underweight and

overweight categories. The effects of weight perception have can be fatal and must be addressed in middle schools.

Socioeconomic Status and Body Mass Index

Obesity and Socioeconomic Status

Obesity and income levels have remained consistent over the past decade. Students from homes of poverty may be thought to have low BMI scores because of the lack of nutrition, but the opposite has been found in several research studies. Students living in poor neighborhoods are 30-60% more likely to be overweight or obese compared to students living in wealthier neighborhoods (Singh et al., 2010). Food stamp participation has been directly linked to higher BMI scores and waist circumference (Jilcott, Liu, Dubose, Chen, & Kranz, 2011). The association between economic status and weight status has also been consistent across demographic groups. Previous research has indicated that higher rates of obesity for African-Americans and Hispanics exist, but one study noted the relationship disappeared when considering family income (Rogers et al., 2015). The association between economic status and obesity is problematic for Arkansas considering the amount of small rural communities that deal with poverty.

Although some studies have found a relationship between obesity and low-income children, other studies suggest that other factors could contribute to overweight status. A Center of Disease Control study found that from 2011-2014, more low-income children were overweight or obese compared to high-income children (Ogden et al., 2018). However, the middle class had the highest percentage of overweight or obese students. Recent findings indicate that low-income status may be less associated with the prevalence of obesity (Smith et al., 2018). Differences in levels of parent education could

be more consistent with obesity indicators across subgroups (Ogden et al., 2010). However, a link to the level of education of the head of household and income could also be linked among populations. For example, a higher level of education typically results in higher wages. As a result, a link between economic status and weight status has been shown to be prevalent among both low-income and middle-class populations.

Many low-economic communities in the United States face environmental barriers in regards to living a healthy lifestyle. One such barrier is that many poor communities lack the resources needed to maintain a healthy lifestyle (Singh et al., 2010). These communities do not have walking trails, health clubs, swimming pools, and community centers that would promote physical fitness. The Mississippi Delta region of Arkansas is composed primarily of poor farming communities. Students in this area are more likely to play video games and watch television as opposed to exercising. Students have indicated that the availability of team sports, nearby parks, or community centers would motivate them to exercise more (McGee, Richardson, Johnson, & Johnson, 2015). Fitness resources can especially be limited in the Mississippi Delta where communities are declining in population. Consideration regarding fitness opportunities could prove to be beneficial for students.

The diet of children living in poverty is also a contributing factor to childhood obesity. Impoverished communities consume foods that have lower nutritional values, including fried foods, sugary beverages, and other foods high in refined grains, fat, and sugar (McGee et al., 2015; Rogers et al., 2015). Barriers that prohibit healthy eating habits include the neighborhood environment, media, convenience, time, and taste preference (Gray et al., 2016). Often traditions and culture can affect eating habits. For

example, fried foods have been popular in the South, further adding to the need to address healthy lifestyles in low-income communities.

The differences in diet choices between the economically disadvantaged and those who are not are a concern for government officials. The United States Department of Agriculture has explored policy options to reward participants of the food stamp program who make healthy choices (Jilcott et al., 2011). Providing incentives could encourage participants to choose healthy foods as opposed to cheaper, non-healthy options. In addition, healthcare officials are considering policies and procedures to educate low-income individuals about healthy behaviors and the benefits of a healthy lifestyle (Jilcott et al., 2011). Educating participants in these options could encourage better nutritional choices and increase physical activity. These efforts, if implemented with fidelity, could aid in closing the health gap between economic classes throughout the United States.

Obesity Interventions

To combat childhood obesity, school-based interventions have been implemented in schools across the Mississippi Delta region. Community members in the Delta have identified a lack of diet knowledge, healthy food intake, and a lack of physical activity as problems for their health (Harrington et al., 2014). The lack of education marks a need for school-based interventions to educate all students about healthy lifestyles. Students in low-income communities have specific economic and social needs that should be addressed through interventions (Ries et al., 2014). Students receive a significant portion of their nutritional intake and physical activity at school, making interventions fit within this period. With good nutrition and physical activity implemented throughout the school day, interventions can meet the needs of both underweight and overweight students.

Several factors affect the success of intervention programs. Staff members who provide interventions must be competent, and training must be ongoing (Blain et al., 2017). Some schools may not have staff members who specialize in nutrition and physical education. In addition, programs should be focused on a need for change and readiness to change behaviors (Ries et al., 2014). A focus on weight loss among overweight participants has been more successful than weight-gain prevention (Katz, O'Connell, Njike, Yeh, & Nawaz, 2007). Students must identify the health risks involved with their weight status before they will see the need to address the issues. Once these barriers are addressed, interventions can be prescribed to meet the needs of students in each demographic area.

There are several contributing components of a successful weight intervention program. Interventions have been more successful when embedded in the regular curriculum (Blaine et al., 2017). For example, merging nutrition, physical activity, concepts of a healthy body image, and screen time reduction lessons into subjects such as English language arts and science have been useful for students (Katz et al., 2007). These moments throughout the school day remind students of choices and activities that can be beneficial to their health. A combination of physical activity and dietary guidelines are embedded for success (Harrington et al., 2014). Physical activity and nutrition awareness should not only be encouraged but also added throughout the school day (Katz et al., 2007). Students spend a considerable amount of their day at school, and students should be active during this time and provided nutritious meals. Embedding these two components can help students begin a lifestyle of health and wellness that continues beyond the school day.

Weight interventions may have a positive effect on both health and academics. According to Hollar et al. (2010), "School-based interventions targeting obesity prevention can have indirect positive effects on academic performance among low-income children who are at high risk for both obesity and poor academic achievement" (p. 650). School-based interventions may affect students in more ways than previously thought, and schools should find ways to embed weight interventions into regular instruction. Interventions in poor, rural communities could be one component that has been missing that improves overall school quality in these areas.

Academic Achievement and Socioeconomic Status

School districts often use socioeconomic categories to compare different performance and behavioral outputs. Commonly, low SES is determined by participation in a school district's free and reduced-cost lunch program. Often, students from low-income families perform worse academically, miss more days of school, and have more discipline-related issues compared to students from high-income homes (Renth et al., 2015). These factors can be intertwined to result in overall lower achievement for this group of students. Comparing SES in research studies can be beneficial for researchers to discover relationships that may provide causation among economic groups. Educators are continually comparing SES groups as schools attempt to close the achievement gap between the rich and the poor.

SES is used as a demographic category, particularly relative to educational testing, to compare individuals within groups. SES has been significant in studies that measure academic achievement. Some studies that have sought to compare BMI and academic achievement have determined that SES had a stronger negative relationship

with achievement than weight status (Baxter et al., 2013; Datar & Sturm, 2006). More specifically, SES and parent's education has had a stronger negative association on reading and mathematics scores than overweight status (Judge & Jahns, 2007). The hidden effect of SES has the potential to mislead researchers about associations within a study and should be analyzed independently to determine the correlation between other variables within a study. SES is a salient factor to consider in many studies, especially when considering factors that negatively affect achievement.

Not all schools struggle with meeting the needs of low-income students. The KIPP Delta School in Helena-West Helena, Arkansas has received much attention in Arkansas for the academic achievement of their low-income population (Maranto & Shuls, 2011). Several reasons account for the successes of KIPP students. KIPP educators have high expectations, a commitment to excellence, a rigorous college-prep curriculum, and accountability of stakeholders (Brown & Holt, 2014). The KIPP staff focuses on the reasons that low-income students are not successful and addresses these with solutions. Maranto and Shuls (2011) stated, "What distinguishes KIPP is not just the hard work, [but] linking the daily processes of schooling to the goals of schooling, in their case, success in college" (p. 56). KIPP personnel do not accept the barriers that their population faces daily; they seek to change the mindset of parents and students through goal planning. Individuals at KIPP Delta have laid out a blueprint of how students from low-income schools can be successful. Other schools in Arkansas and the Delta have also begun following the KIPP plan to address their low-income population. Low-income does not necessarily equate to low achievement. The expectations and strategies that schools develop can overcome this barrier.

Weight-related issues also affect students on the opposite end of the income spectrum. Females from families with higher incomes are more likely to develop eating disorders than students from lower-income families are (Bould et al., 2016). Undernourished students who have low BMI scores are tired and become ill more frequently, resulting in increased absenteeism (U.S Department of Health and Human Services, 2005). These results contribute to a lack of motivation and lower academic performance compared to their peers. Careful examination of the socioeconomic characteristics of all children is vital to address weight-related outcomes in schools.

Grade Level and Body Mass Index

Social Factors and Self-Concept

Significant changes occur both socially and emotionally during the transition from childhood to adolescence. The transition increases the number of psychological problems, including eating disorders, that are present with students entering adolescence (Moksue & Espnes, 2012). During the onset of adolescence, these issues may not be present, but over a year or two, students may begin to have issues with social interactions and self-concept. Understanding the role of social and self-concept issues in the lives of adolescents is imperative to help them deal with the many changes and to teach them ways to deal with the changes as these occur. The transitional years, particularly the middle school grades, can be challenging for both students and teachers as the students learn to cope with the changes.

As children begin the transition into adolescence, they may have issues with their self-esteem. Adolescents' self-esteem is shaped by how they perceive themselves, and during this time, they are trying to determine where they fit into different social groups

(Moksue & Espnes, 2012). Students transition at different times in their lives. Maturation begins earlier for some students and later for others. Students may not show any signs of self-esteem issues during childhood but may develop self-concept issues as their bodies change (Moksue & Espnes, 2012). As a result, the self-perception of a sixth-grade student may change throughout middle school. Self-esteem, which in turn affects academics, can affect the social, emotional, and cognitive health of individual students and may need to be part of the educational processes for this age group.

Developmental changes among adolescents can lead to more serious emotional problems if left untreated. Self-esteem concerns are a major contributing factor of depression among adolescents, with depression being especially present as children are transitioning in pubertal stages (MacPhee & Andrews, 2006). The U.S. Department of Health and Human Services (2005) reported that students with eating disorders were less active, more apathetic, and interact less with their environment. The effects of their self-perceptions and depressive characteristics often were heightened during pubertal stages and had adverse outcomes on their school-related activities. As a result, interventions that are designed to prevent negative self-concepts are essential to counter depression, especially for students ages 12 and13 (MacPhee & Andrews, 2006). If students improve their self-concept, unfavorable outcomes become increasingly unlikely, making the development of school-based interventions necessary for school officials. Often, if treated correctly, students will not be affected by the more serious emotional effects of depression.

The timing of pubertal development could have negative consequences for adolescents. Students do not progress through adolescent changes over the same period of

time. These physical changes during puberty can lead to increased self-consciousness and concerns about how others perceive them (Oldehinkel, Verhulst, & Ormel, 2011). Students who mature earlier feel lonelier, with students who mature later having less emotional problems. This loneliness could be due to students functioning through changes alone, as their peers have physical characteristics that have not changed yet. Furthermore, obesity has also been linked to early pubertal development (Oldehinkel et al., 2011). The self-perception of being overweight and experiencing hormonal changes may compound the emotional effects of early maturing students. The combination of these factors makes interventions necessary for school officials to curb the negative effects of early pubertal development in adolescents.

The adverse effects of pubertal changes affect girls and boys differently over the course of time. Girls' perceptions decrease in body satisfaction, which results in a decrease in self-concept and self-esteem (Fu, Padilla-Walker, & Brown, 2017; Fuller-Tyszkiewicz et al., 2015). Because of lower self-esteem, girls are twice as likely compared to boys to develop some type of eating disorder (National Institute of Mental Health, 2017). These changes fluctuate over short periods among girls. Reasons for the self-esteem issues could be because the physical development of girls is more profound, and the changes are recognizable as they develop. Boys' physical development is less recognizable. Adolescent boys have little to no self-esteem issues because of pubertal changes (Fu et al., 2017). Although boys show little signs of self-esteem issues during development, late-maturing boys have shown signs of negative self-concept. The gender differences in development among adolescents and the emotional effects of physical

changes are challenging for parents and teachers to identify the educational needs of students.

Adding to the challenges of adolescence, transitions into new academic buildings can be stressful. Other factors, such as changes in the environment, add to negative self-esteem among students. Transitions into secondary schools from elementary add to the negative associations of self-concept and self-esteem (Arens, Yeung, Craven, Waterman, & Hasselhorn, 2013). Arens et al. (2013) suggested that self-esteem issues could start well before pubertal changes affecting students' academic performance. Changes in adolescent development can be complicated, making the complexity of development difficult for staff to develop plans to intervene in the negative emotional causes of transitions.

Grade Level and Achievement

The middle grades are a time of developmental changes for students physically, cognitively, and emotionally. The effects of the beginning stages of adolescence and transitions to new campuses can be troublesome for some students. The transition to middle school from elementary has been associated with decreased academic engagement among female and male students (Forrest, Bevans, Riley, Crespo, & Louis, 2013). Changes can occur within a school year that can naturally affect the academics of individual students. However, not all researchers agree that transitions from elementary to middle school or junior high cause negative associations. Seifert and Schulz (2007) found no statistically significant effects in the transition from elementary school existed. The transition may have less to do with negative associations than other factors. During

this stage in life, adolescents are experiencing multiple changes that can hinder their academic performance.

One of the changes that begins in the early stages of adolescence is pubertal development. Hormones affect the physical appearance of the body, and they affect the brain and behavior (Blakemore, Burnett, & Dahl, 2010). Furthermore, evidence has indicated that the early stages of puberty play a fundamental role in brain development. A study such as this confirms the value of better understanding the relationship between the brain, cognition, behavior, and puberty. The timing of maturation has also shown to affect achievement. Late pubertal boys score lower on cognitive tests and have lower levels of educational attainment (Koerselman & Pekkarinen, 2018). Puberty alone may not influence cognition, but factors such as timing could contribute to other causal factors and warrant inquiry. Results can be beneficial to aid students in the early stages of adolescence.

Adolescence, along with puberty, can change student behavior and development. Students who are in the pubertal stage typically have lower motivation and students who have developed further along in the pubertal stage have even lower motivation (Martin & Steinbeck, 2017). Motivation has been linked to achievement. Students who had lower motivation had lower assessment scores, and students who had higher motivation had higher scores. Puberty has been directly associated with motivation, which in turn was associated with lower achievement. Specifically, Dreber, Essen, and Ranehill (2011) determined that girls who matured early had lower educational aspirations compared to girls who matured later. The timing of puberty and adolescent changes can influence achievement, causing academic differences among students in elementary and middle

schools. These changes in behavior and motivation can be a challenge for teachers of adolescents.

The challenges students face with transitions into middle school and adolescence can be minimized with appropriate strategies. Good health may shield the effects of pubertal development (Forrest et al., 2012). Students who have a nutritionally sound diet and participate in physical activity seem to have better school outcomes. In addition, students who have less stress also have performed better (Forrest et al., 2012). These findings indicate that concentrating on the physical, cognitive, and emotional well-being of adolescent students may minimize the effects of puberty.

During adolescence, children's bodies begin to change as they begin to deal with the social effects of their weight status. Although limited studies exist concerning adolescents, BMI, and achievement, Shore et al. (2008) reported that non-overweight middle school students had better grades, reading scores, attendance, and discipline than overweight middle school students. These findings are consistent with other studies that concluded that students who are overweight perform worse academically than other students. Additionally, a change in weight status may be an indicator for poor academic performance (Datar & Sturm, 2006). The correlation between weight status and academic performance can be especially strong for adolescents who are going through so many changes emotionally. However, academic performance may already be predictable for middle school students regardless of weight changes during adolescence. Crosnoe and Muller (2004) found that adolescents who were obese had lower scores and the achievement gaps were consistent over time. Although changes in weight status may have consequential effects, students who have been obese during preadolescence may

already be behind academically, but the academic gap remains the same when compared to non-overweight students. The development of adolescents is complex and have multiple factors that contribute to adverse performance indicators.

Once students enter adolescence, they begin to reflect on how they perceive themselves, which can affect their academic performance. Characteristics such as being overweight or underweight become a social status marker as young as elementary age (Datar & Sturm, 2006). Furthermore, negative influences on academic achievement can result from the lack of self-efficacy and personal resiliency among adolescents, who are typically middle school students (Shore et al., 2008). These influences indicate that the academic achievement of middle school students may go beyond pedagogy and curriculum. The self-perception of students and social influences are among the items taken into account when educating adolescents.

Gender and Body Mass Index

The prevalence of obesity in youth ages 2 to 19 has been on the increase for several years. However, no difference in the increase in obesity between boys and girls has been noted. Specifically, for girls ages 2 to 19, 17.8% were classified as obese (Hales et al., 2017). Only 13.5% of 2 to 5-year-olds were classified as obese compared to 20.9% of 12- to 19-year-old females. Statistics indicate that as female children age, the prevalence of obesity increases. The increases among female youth have been consistent since the early 21st century, indicating an upward trend.

The trends in boys ages 2 to 19 have been similar to that of girls. In 2015-2016, 19.1% of boys ages 2 to 19 were classified as obese (Hales et al., 2017). Among boys, 14.3% of boys ages 2 to 5 were obese compared to 20.4% of 6- to 11-year-olds. In

addition, 20.2% of 12- to 19-year-old adolescent males were overweight. The data indicated that older boys have a larger risk of being obese than younger boys. Overall, the prevalence of obesity is not only more prevalent for school-aged boys and girls but is also on an upward increase.

Gender Differences in Body Mass Index

The association between academic achievement and BMI has been inconsistent in prior research studies. However, previous research has indicated somewhat more consistency in associations among females. Wingfield et al. (2011) suggested that physical fitness and academic performance was significantly associated with fifth-grade girls. Furthermore, higher BMI levels in fifth-grade girls predicted lower academic outcomes. Similarly, moving from an optimal weight to overweight can have a negative association with academic achievement (Datar & Sturm, 2006). The combination of becoming overweight and the social stigma that is connected can add to the negative academic performance for female students. Although researchers have found a correlation between weight status and achievement, caution is warranted because of the overall inconsistencies of findings.

No relationship was found between academic achievement and BMI among early childhood females. No significant differences were found between overweight and non-overweight girls in prior research (Datar et al., 2004; Kaestner & Grossman, 2009; Saint-Maurice et al., 2014). Datar et al. (2004) determined that a mother's education was a more significant factor when predicting the academic performance of girls. The academic achievement gap could be more profound for middle school aged females. Conversely, underweight students were found to have negative differences in achievement compared

to both normal and overweight children (Kaestner & Grossman, 2009). Weight status can have numerous effects on academic performance; however, with an abundance of factors associated with achievement among girls, educational outcomes are difficult to predict consistently using weight status alone.

The prevalence of obesity is consistent among school-age males and females. Yet, males may be less likely to experience adverse academic effects due to being overweight or obese. Numerous studies have found that BMI levels are not negatively associated with academic performance among boys (Datar & Sturm, 2006; Singh et al., 2010; Wingfield et al., 2011). Although the indication may be that boys are unaffected academically, consideration of negative associations between unhealthy weight and other factors that could affect performance is imperative. The statistical similarities between school-age males and females could also indicate parallels in academic performance among students with weight issues.

Gender and Academic Achievement

Gender has long been associated with specific academic content. In the 1980s and 1990s, females were viewed as underachievers (Wiens, 2006). However, after the turn of the century, perceptions began to change, and boys became the ones who are perceived as academic underachievers (Jones & Myhill, 2004). In either case, distinct differences between the academic performance of female and male students are present. Motivation was identified as an issue for boys (Jones & Myhill, 2004; Wiens, 2006). The lack of motivation could result from masculinity perceptions among boys. For example, some do not want to be perceived as concerned about grades, and others are simply bored. Recently, educators have placed an emphasis on literacy strategies among boys and

STEM participation among girls (Hansen, Mann, Valant, & Quintero, 2018; O'Dea, Lagisz, Jennions, & Nakagawa, 2018). The interventions are a result of underperformance and non-participation by each gender. The goal is to narrow the gender gap.

Various subject areas were identified as better suited for each gender. Recent data indicated that females possess skills, such has commitment and persistence, that aid them in attaining better grades than males across all subject areas (Voyer & Voyer, 2014). In contrast, males have scored better on standardized tests, indicating skills in problem-solving techniques (Lindberg, Hyde, Peterson, & Linn, 2010; Voyer & Voyer, 2014). Recently, the gender gap does seem to be narrowing, although minute. Other factors such as SES and parent's education have been better predictors of academic achievement (Lindberg et al., 2010). Previous research indicates that males and females learn somewhat differently, and teachers must be cognizant of the differences for all students to reach their full potential.

Historically, girls were identified as better readers compared to boys. They enjoy reading more and are overall better readers (Logan & Johnston, 2009). Although a gap in reading proficiency is present, boys' reading levels have improved, indicating the deficiency is not due to biological differences (Hansen et al., 2018). Improving the frequency of reading can be beneficial for developing good readers. Frequent readers have better vocabulary, comprehension, fluency, and general knowledge (Logan & Johnston, 2009). Developing proficient readers may have less to do with gender and more to do with developing good reading habits. If encouraged with the proper intervention strategies, boys can read on proficiency levels like girls.

Summary

Specific consideration of physiological, psychosocial, and emotional effects of BMI status as factors of a child's education is essential. A student's BMI, along with other characteristics, could help educators identify student risks that may not be recognizable through normal school-day activities. Not only does a student's weight status affect him physically, but weight could also be a predictor of social and emotional health and academic achievement. Although a review of previous research has identified several key contributions to the academic field, several inconsistencies are present. This study contributed more evidence regarding the effects of BMI in predicting academic achievement.

CHAPTER III

METHODOLOGY

The review of literature indicated several benefits of maintaining a healthy weight. Students with a normal BMI are more likely to be physically fit and are more likely to exhibit other health-related benefits (Castelli et al., 2007; Morgan et al., 2012; Wingfield et al., 2011). Further, a healthy weight can increase the social and emotional health of students (Whetstone et al., 2007). However, research results have been less consistent regarding the effect of a normal BMI on academic achievement. On the one hand, some researchers have found that BMI and academic achievement are directly correlated (Datar & Sturm, 2006; Wingfield et al., 2011). Conversely, other researchers suggest that factors such as SES are better indicators of academic achievement (Baxter et al., 2013; Kaestner & Grossman, 2008). The purpose of this study was to determine the predictive effects of gender, SES, and BMI on academic achievement in rural, Delta schools in Arkansas. As a result, the following hypotheses were generated:

1. No significant predictive effect will exist among gender, SES, and BMI scores on mathematics achievement as measured by the ACT Aspire Exam for sixth-grade students in rural, Delta schools in Arkansas.
2. No significant predictive effect will exist among gender, SES, and BMI scores on reading achievement as measured by the ACT Aspire Exam for sixth-grade students in rural, Delta schools in Arkansas.

3. No significant predictive effect will exist among gender, SES, and BMI scores on mathematics achievement as measured by the ACT Aspire Exam for eighth-grade students in rural, Delta schools in Arkansas.
4. No significant predictive effect will exist among gender, SES, and BMI scores on reading achievement as measured by the ACT Aspire Exam for eighth-grade students in rural, Delta schools in Arkansas.

The purpose of this chapter was to describe the research design, the sample, the instruments used to measure each of the variables, the data collection procedures, and the limitations present in this study.

Research Design

A quantitative, multiple regression was used in this study. The predictor variables for Hypotheses 1-4 were gender, SES, and BMI scores. The dependent or criterion variables for Hypotheses 1 and 2 were mathematics achievement and reading achievement, respectively, as measured by the ACT Aspire Exam for sixth-grade students in rural Delta schools in Arkansas. The criterion variables for Hypotheses 3 and 4 were mathematics achievement and reading achievement, respectively, as measured by the ACT Aspire Exam for eighth-grade students in rural, Delta schools in Arkansas.

Sample

The sample of this study consisted of ACT Aspire scores taken from 2018-2019 sixth and eighth-graders from four schools in the Delta region of Arkansas. The sample was chosen with consideration of location and other demographical characteristics of the school districts. School 1 had a student population that consisted of Caucasian (79.3%), African American (11.6%), Hispanic (4.5%), American Indian (0.2%), Asian (0.2%), and

those declaring two or more races (4.0%). School 2 had a population that consisted of Caucasian (43.1%), African American (44.8%), Hispanic (6.8%), American Indian (0.3%), Asian (1.0%), and those declaring two or more races (3.9%). School 3 had a population that consisted of Caucasian (20.4%), African American (66.4%), Hispanic (11.4%), American Indian (0.2%), Asian (0.5%), and those declaring two or more races (1.1%). School 4 had a population that consisted of Caucasian (69.8%), African American (18.5%), Hispanic (8.1%), American Indian (0.2%), Asian (0.4%), and those declaring two or more races (3.0%). Student qualification for free or reduced-cost lunch determined the school's level of SES. Schools 1, 2, and 4 had 60-64% of their students qualify for free and reduced-cost lunches, and School 3 had 80% of its student population qualify for free and reduced-cost lunches. All four schools were similar in size and were classified as 4A in accordance with the Arkansas Activities Association's (2019) classification system. The four school populations were the following for the 2018-2019 school year: School 1 (1,219), School 2 (1,553), School 3 (1,215), and School 4 (1,488).

Instrumentation

Arkansas Department of Education rules require schools to assess student weight status by determining BMI for all students in even-numbered grades. For this study, I obtained BMI scores for students in Grades 6 and 8 for each school district. I also confidentially obtained BMI scores from the Arkansas Center for Health Improvement database via individual school district personnel. The raw BMI score for each individual student was used for this study. The Arkansas Center for Health Improvement (2014) also classifies each student as being either underweight, healthy weight, overweight, or obese. A higher BMI indicates a greater risk of having or developing obesity-related health

problems. Other predictor variables included gender and SES, which were both categorical.

The ACT Aspire Summative exam is a formative assessment that is administered each year to students in Grades 3-10. Total testing time is between 4 to 5 hours and is administered over 3 to 5 days (ACT Aspire, 2019). The assessment is a combination of both multiple-choice and open-response questions covering mathematics, reading, English language arts, and science. Although the Arkansas Department of Education has curriculum standards for each of the tested subject areas, the primary purpose of the ACT Aspire summative exam is to determine progress towards ACT College and Career Readiness Standards and Benchmarks (ACT Aspire, 2019). Many of the state standards and ACT College and Career Readiness Standards have common achievement goals. The 2019 ACT Aspire Exam for sixth-grade students contained 23 to 25 multiple-choice questions, 5 to 7 technology-enhanced questions, and 4 constructed-response exercises for mathematics. The reading exam for sixth-grade students contained 18 to 20 multiple-choice questions, 1 to 3 technology-enhanced questions, and 3 constructed-response exercises. The 2019 ACT Aspire Exam for eighth-grade students contained 29 to 30 multiple-choice questions, 3 to 4 technology-enhanced questions, and 5 constructed-response exercises for mathematics. The reading exam for eighth-grade students contained 20 to 21 multiple-choice questions, 0 to 1 technology-enhanced questions, and 3 constructed-response exercises. Scale scores for mathematics and reading were used for this study. Mathematics scale score ranges included 400-451 for the sixth grade and 400-456 for the eighth grade. Reading scale score ranges included 400-436 for the sixth grade and 400-440 for the eighth grade.

Data Collection Procedure

The 2019 ACT Aspire was administered by personnel within each individual public school district in Arkansas. The assessment was taken and submitted electronically by each individual student. ACT Aspire then assigned a scale score for each student assessment in mathematics, reading, English language arts, and science that was reported to the Arkansas Department of Education. Performance scoring for the ACT Aspire was conducted by professional scorers that have specialized educational and professional experience, including professional experience with performance scoring (ACT Aspire, 2019). Student assessment scores were made available to school districts in July of 2019 on the ACT Aspire Data Portal. The researcher contacted each school superintendent who gave permission to use the school district data for the four schools. In the school district where the researcher was employed, data use was approved by the School Board President. At each district, an authorized user downloaded a data file from the ACT Aspire Portal that included individual scale scores for sixth- and eighth-grade students in both mathematics and reading. Also, the data included each student's gender, SES, and grade level.

BMI data were entered into the Arkansas Center for Health database by authorized school district personnel each school year. BMI scores for each sixth- and eighth-grade student were requested and added to the spreadsheet that included student achievement data and demographic information. All identifiable student information was removed and replaced with a specific research number. Data from all four schools were combined into one spreadsheet, and students with missing values were excluded from the sample. The data were then exported to SPSS for analysis.

Analytical Methods

SPSS *Version 25* was used for data analysis to determine if any predictive effects occurred. The predictor variables for this study were gender, SES, grade level, and BMI scores. The criterion variable for Hypotheses 1 and 3 was mathematics achievement, and the criterion variable for Hypotheses 2 and 4 was reading achievement as measured by the ACT Aspire assessment. A multiple regression analysis was used to analyze the predictor variables. The results were analyzed by examining the combination of all predictor variables on the different criterion variables. Then, each predictor variable from each model was examined individually to determine how much it contributed to the overall prediction formula.

Before conducting a regression analysis, the data were examined to determine if the assumptions for multiple regression were met. A scatter plot was generated to determine if a linear relationship between the variables existed. Residual plots were analyzed to determine linearity, normality, and homoscedasticity. Outliers were also identified and deleted as necessary. Collinearity statistics were used to determine if variables met the necessary requirements for tolerance and variance inflation factor of less than .1 or greater than 10 (Mertler & Vannatta, 2010).

Limitations

Several limitations were noted in this study. The limitations did not severely limit the quality of the study. However, the communication of the limitations was important to understand the data analyses and to establish a context for the generalizability of the results. The following limitations were present in this study.

First, the study only used student data from four school districts in the Arkansas Delta Region. Additional data from other school districts and from a broader range of ages would allow for a wider range of generalizations. Furthermore, comparable instructional practices and professional development may not be present in all schools. Second, in two of the districts, the sixth-grade students who provided the scores for the study were enrolled at a different campus than eighth-grade students. This presented an issue regarding instructional time and instructional practices. Students in the sixth-grade received more core instructional time than students in eighth-grade. The additional time could improve student achievement for some. Also, the building's procedures for Response to Intervention and enrichment were different than those at other buildings.

Third, the SES composition of each school was different. In particular, one school district's low-income percentage was 80%. This could be problematic because a school district where the poverty level is greater than 70% receives increased National School Lunch Act funds that are used to increase student achievement. Finally, the researcher was an administrator for one of the school districts in which the study was conducted. Procedures were put into place to avoid bias. Individual classrooms and student scores were assigned research numbers to keep individuals from being identifiable. In addition, the researcher did not work directly with students in daily classroom activities and did not administer the ACT Aspire tests to students whose scores were used in the study.

Summary

Previous research findings have been inconsistent on the extent to which BMI has a predictive effect on academic achievement. The inclusion of other demographical data, such as gender, socioeconomic status, and grade level, could provide possible insights as

to why these inconsistencies exist. Examining each predictor variable individually to determine how much it contributed to the overall model could also provide valuable information for school leaders. In Chapter IV I provide an overview of the analytical methods and an analysis of the results for Hypotheses 1-4.

CHAPTER IV

RESULTS

The purpose of this study was to determine the predictive effects of gender, SES, and BMI scores on mathematics achievement and reading achievement as measured by the ACT Aspire Exam in rural, Delta schools in Arkansas. Mathematics and reading achievement were measured using scores obtained from students in Grades 6 and 8 in four Arkansas Delta schools. The predictor variables for Hypotheses 1-4 were gender, SES, and BMI scores. The criterion variable for Hypotheses 1 and 3 was mathematics achievement scores as measured by the ACT Aspire Exam for sixth-grade students and eighth-grade students, respectively. The criterion variable for Hypotheses 2 and 4 was reading achievement scores as measured by the ACT Aspire Exam for sixth-grade students and eighth-grade students, respectively.

Analytical Methods

The four hypotheses were analyzed using IBM Statistical Packages for Social Sciences Version 25 (Morgan et al., 2012). The data for each of the hypotheses were coded according to gender (0 = Female, 1 = Male) and SES (0 = participation in free and reduced lunch program, 1 = no participation). Raw BMI scores and scaled ACT Aspire scores were also used for the analyses. A multiple regression analysis was used to address each of the hypotheses. The results were analyzed by examining the combination of all predictor variables and then examining each predictor variable individually to determine

how much it contributed to the overall prediction formula. The null hypotheses were tested using a two-tailed test with a .05 level of significance. Before running each analysis, data were examined to determine that assumptions for multiple regression were met. Linear relationships between variables, normal distribution, and homoscedasticity were checked using residual plots. In addition, model fit diagnostics were assessed by conducting casewise diagnostics and tests for influential cases.

Hypothesis 1

Hypothesis 1 stated that no significant predictive effect will exist among gender, SES, and BMI scores on mathematics achievement as measured by the ACT Aspire Exam for sixth-grade students in rural, Delta schools in Arkansas. Before conducting a regression analysis, the data were examined to determine if assumptions for multiple regression were met. Scatter plots of the correlation between the predictor variables and the outcome variable showed an acceptable degree of linear relationship. An examination of the intercorrelation table indicated that all the variables had a low degree of correlation, and all had a tolerance greater than .946 ($1 - r^2$). Therefore, multicollinearity was not considered a problem. See Table 1 for the intercorrelation among the variables.

Table 1

Means, Standard Deviations, and Intercorrelations for Mathematics Achievement and Predictor Variables (N = 377)

Variable	*M*	*SD*	Gender	SES	BMI
Math Scale Score	418.48	5.48	-.117*	.223*	-.034
Predictor variable					
Gender	0.53	0.50	1.000	-.031	-.036
SES	0.18	0.39		1.000	.147*
BMI	22.81	6.36			1.000

Note. SES = Socioeconomic Status; BMI = Body Mass Index.
*$p < .05$.

To test the assumptions of normally distributed residuals, as well as homoscedasticity of residuals, a residual plot was generated. An examination of this plot revealed no obvious violations of either assumption. To examine the fit of the regression model for predicting mathematics achievement, casewise diagnostics as well as tests for influential cases were conducted. These diagnostics revealed no significant outliers or cases identified as exerting significant influence in the model. After testing all the relevant assumptions and model fit diagnostics, a standard multiple regression analysis was then conducted to determine the degree to which gender, SES, and BMI predicted mathematics achievement. See Table 2 for the regression results.

Table 2

Simultaneous Multiple Regression Analysis for Predicting Mathematics Achievement

Model	Sum of Squares	*df*	Mean Square	*F*	*p*
Regression	697.60	3	232.53	8.20	.000
Residual	10574.50	373	28.35		
Total	11272.10	376			

Regression results indicated that the overall model significantly predicted mathematics achievement, $F(3, 373) = 8.20$, $p < .001$. The results indicated that the model was a better predictor of mathematics achievement than the mean; therefore, the null hypothesis was rejected. However, the model only accounted for approximately 5.40% of the variance in mathematics achievement ($R^2 = .062$ $R^2_{adj} = .054$). According to Cohen (1988), this result was a medium effect size. A summary of the unstandardized and standardized regression coefficients for this model is presented in Table 3.

Table 3

Unstandardized and Standardized Coefficients for Predictors of Mathematics Achievement

Model	*B*	*SE*	*β*	*t*	*p*	Collinearity Statistics	
1(Constant)	418.67	1.11		376.85	.000	Tolerance	VIF
Gender	-1.21	0.55	.110	-2.19	.029	.997	1.003
SES	3.10	0.72	.219	4.31	.000	.977	1.023
BMI	-0.01	0.04	-.006	-0.12	.906	.977	1.024

Results from the coefficient table revealed that two variables of the three variables were significant. Therefore, gender and SES were the only predictor variables that significantly contributed to the model. BMI did not significantly contribute to the model. According to the results, the following prediction model could be used to predict each individual case for mathematics achievement for sixth-grade students: mathematics achievement (predicted) = 418.67 + -1.21 (gender) + 3.10 (SES) + -0.01 (BMI).

Hypothesis 2

Hypothesis 2 stated that no significant predictive effect will exist among gender, SES, and BMI scores on reading achievement as measured by the ACT Aspire Exam for sixth-grade students in rural, Delta schools in Arkansas. Before conducting a regression analysis, the data were examined to determine if assumptions for multiple regression were met. Scatterplots of the correlation between the predictor variables and the outcome variable showed an acceptable degree of linear relationship. An examination of the intercorrelation table indicated that all of the variables had a low degree of correlation, and all had a tolerance greater than .941 ($1 - r^2$). Therefore, multicollinearity was not considered a problem. See Table 4 for the intercorrelation among the variables.

Table 4

Means, Standard Deviations, and Intercorrelations for Reading Achievement and Predictor Variables (N = 377)

Variable	*M*	*SD*	Gender	SES	BMI
Reading Scale Score	417.63	6.67	-.127*	.227*	-.048
Predictor variable					
Gender	0.53	0.50	1.000	-.031	-.036
SES	0.18	0.39		1.000	-.147*
BMI	22.81	6.36			1.000

Note. SES = Socioeconomic Status; BMI = Body Mass Index.
*$p < .05$.

To test the assumptions of normally distributed residuals as well as homoscedasticity of residuals, a residual plot was generated. An examination of this plot revealed no obvious violations of either assumption. To examine the fit of the regression model for predicting reading achievement, casewise diagnostics as well as tests for influential cases were conducted. These diagnostics revealed no significant outliers or cases identified as exerting significant influence in the model. After testing all the relevant assumptions and model fit diagnostics, a standard multiple regression analysis was then conducted to determine the degree to which gender, SES, and BMI predicted reading achievement. See Table 5 for the regression results.

Table 5

Simultaneous Multiple Regression Analysis for Predicting Reading Achievement

Model	Sum of Squares	*df*	Mean Square	*F*	*p*
Regression	1109.04	3	369.68	8.84	.000
Residual	15598.71	373	41.82		
Total	16707.75	376			

Regression results indicated that the overall model significantly predicted reading achievement, $F(3, 373) = 8.84$, $p < .001$. The results indicated that the model was a better predictor of reading achievement than the mean; therefore, the null hypothesis was rejected. However, the model only accounted for approximately 5.90% of the variance in reading achievement ($R^2 = .066$ $R^2_{adj} = .059$). According to Cohen (1988), this result was a medium effect size. A summary of the unstandardized and standardized regression coefficients for this model is presented in Table 6.

Table 6

Unstandardized and Standardized Coefficients for Predictors of Reading Achievement

Model	*B*	*SE*	*β*	*t*	*p*	Collinearity Statistics	
1(Constant)	418.27	1.35		309.99	.000	Tolerance	VIF
Gender	-1.61	0.67	-.121	-2.41	.016	.997	1.003
SES	3.80	0.87	.220	4.36	.000	.977	1.023
BMI	-0.02	0.05	-.020	-0.34	.690	.977	1.024

Results from the coefficient table revealed that two f the three variables were significant. Therefore, gender and SES were the only predictor variables that significantly contributed to the model. BMI did not significantly contribute to the model. According to the results, the following prediction model could be used to predict each individual case for reading achievement for sixth-grade students: reading achievement (predicted) = 418.27 + -1.61 (gender) + 3.76 (SES) + -0.02 (BMI).

Hypothesis 3

Hypothesis 3 stated that no significant predictive effect will exist among gender, SES, and BMI scores on mathematics achievement as measured by the ACT Aspire Exam for eighth-grade students in rural, Delta schools in Arkansas. Before conducting a regression analysis, the data were examined to determine if assumptions for multiple regression were met. Scatterplots of the correlation between the predictor variables and the outcome variable showed an acceptable degree of linear relationship. An examination of the intercorrelation table indicated that all the variables had a low degree of correlation, and all had a tolerance greater than .957 ($1 - r^2$). Therefore, multicollinearity was not considered a problem. See Table 7 for the intercorrelation among the variables.

Table 7

Means, Standard Deviations, and Intercorrelations for Mathematics Achievement and Predictor Variables (N = 350)

Variable	*M*	*SD*	Gender	SES	BMI
Math Scale Score	424.77	7.86	-.085	.180*	-.075
Predictor variable					
Gender	0.56	0.50	1.000	.110*	-.097*
SES	0.24	0.43		1.000	.003
BMI	24.46	6.16			1.000

Note. SES = Socioeconomic Status; BMI = Body Mass Index.
*$p < .05$.

To test the assumptions of normally distributed residuals as well as homoscedasticity of residuals, a residual plot was generated. An examination of this plot revealed no obvious violations of either assumption. To examine the fit of the regression model for predicting mathematics achievement, casewise diagnostics as well as tests for influential cases were conducted. These diagnostics revealed no significant outliers or cases identified as exerting significant influence in the model. After testing all the relevant assumptions and model fit diagnostics, a standard multiple regression analysis was then conducted to determine the degree to which gender, SES, and BMI predicted mathematics achievement. See Table 8 for the regression results.

Table 8

Simultaneous Multiple Regression Analysis for Predicting Mathematics Achievement

Model	Sum of Squares	*df*	Mean Square	*F*	*p*
Regression	1101.13	3	367.04	6.21	.000
Residual	20442.58	346	59.08		
Total	21543.71	349			

Regression results indicated that the overall model significantly predicted mathematics achievement, $F(3, 346) = 6.21$, $p < .001$. Therefore, the results indicated that the model was a better predictor of mathematics achievement than the mean; therefore, the null hypothesis was rejected. However, the model only accounted for approximately 4.30% of the variance in mathematics achievement ($R^2 = .051$ $R^2_{adj} = .043$). According to Cohen (1988), this result was a small effect size. A summary of the unstandardized and standardized regression coefficients for this model is presented in Table 9.

Table 9

Unstandardized and Standardized Coefficients for Predictors of Mathematics Achievement

Model	*B*	*SE*	*β*	*t*	*p*	Collinearity Statistics	
1(Constant)	427.64	1.81		236.79	.000	Tolerance	VIF
Gender	-1.81	0.84	.115	-2.17	.031	.979	1.022
SES	3.54	0.96	.193	3.67	.000	.988	1.012
BMI	-0.11	0.07	-.087	-1.65	.101	.990	1.010

Results from the coefficient table revealed that two variables of the three variables were significant. Therefore, gender and SES were the only predictor variables that significantly contributed to the model. BMI did not significantly contribute to the model. According to the results, the following prediction model could be used to predict each individual case for mathematics achievement for eighth-grade students: mathematics achievement (predicted) = 427.64 + -1.81 (gender) + 3.54 (SES) + -0.11 (BMI).

Hypothesis 4

Hypothesis 4 stated that no significant predictive effect will exist among gender, SES, and BMI scores on reading achievement as measured by the ACT Aspire Exam for eighth-grade students in rural, Delta schools in Arkansas. Before conducting a regression analysis, the data were examined to determine if assumptions for multiple regression were met. Scatterplots of the correlation between the predictor variables and the outcome variable showed an acceptable degree of linear relationship. An examination of the intercorrelation table indicated that all the variables had a low degree of correlation, and

all had a tolerance greater than .928 (1 - r^2). Therefore, multicollinearity was not considered a problem. See Table 10 for the intercorrelation among the variables.

Table 10

Means, Standard Deviations, and Intercorrelations for Reading Achievement and Predictor Variables (N = 350)

Variable	*M*	*SD*	Gender	SES	BMI
Reading Scale Score	421.84	7.74	-.192*	.185*	.011
Predictor variable					
Gender	0.56	0.50	1.000	.110*	-.097*
SES	0.24	0.43		1.000	.003
BMI	24.46	6.16			1.000

Note. SES = Socioeconomic Status; BMI = Body Mass Index.
*$p < .05$.

To test the assumptions of normally distributed residuals as well as homoscedasticity of residuals, a residual plot was generated. An examination of this plot revealed no obvious violations of either assumption. To examine the fit of the regression model for predicting mathematics achievement, casewise diagnostics as well as tests for influential cases were conducted. These diagnostics revealed no significant outliers or cases identified as exerting significant influence in the model. After testing all the relevant assumptions and model fit diagnostics, a standard multiple regression analysis was then conducted to determine the degree to which gender, SES, and BMI predicted reading achievement. See Table 11 for the regression results.

Table 11

Simultaneous Multiple Regression Analysis for Predicting Reading Achievement

Model	Sum of Squares	*df*	Mean Square	*F*	*p*
Regression	1670.44	3	556.81	10.03	.000
Residual	19214.60	346	55.53		
Total	20885.04	349			

Regression results indicated that the overall model significantly predicted mathematics achievement, $F(3, 346) = 10.03$, $p < .001$. The results indicated that the model was a better predictor of mathematics achievement than the mean; therefore, the null hypothesis was rejected. However, the model only accounted for approximately 7.20% of the variance in reading achievement ($R^2 = .080$ $R^2_{adj} = .072$). According to Cohen (1988), this result was a medium effect size. A summary of the unstandardized and standardized regression coefficients for this model is presented in Table 12.

Table 12

Unstandardized and Standardized Coefficients for Predictors of Reading Achievement

Model	*B*	*SE*	*β*	*t*	*p*	Collinearity Statistics	
1(Constant)	423.15	1.75		241.67	.000	Tolerance	VIF
Gender	-3.36	0.81	-.216	-4.14	.000	.999	1.022
SES	3.76	0.94	.209	4.02	.000	.988	1.012
BMI	-0.01	0.07	-.011	-0.21	.838	.990	1.010

Results from the coefficient table revealed that two variables of the three variables were significant. Therefore, gender and SES were the only predictor variables that significantly contributed to the model. BMI did not significantly contribute to the model. According to the results, the following prediction model could be used to predict each individual case for reading achievement for eighth-grade students: reading achievement (predicted) = 423.15 + -3.36 (gender) + 3.76 (SES) + -0.01 (BMI).

Summary

The purpose of this study was to determine the predictive effects of gender, SES, and BMI scores on mathematics achievement and reading achievement as measured by the ACT Aspire Exam in rural, Delta schools in Arkansas. The predictor variables for all hypotheses were gender, SES, and BMI scores. The criterion variables for Hypotheses 1 and 3 was mathematics achievement scores as measured by the ACT Aspire Exam for sixth-grade students and eighth-grade students, respectively. The criterion variable for Hypotheses 2 and 4 was reading achievement scores as measured by the ACT Aspire Exam for sixth-grade students and eighth-grade students, respectively. Table 13 summarizes the results of the overall model and each predictor variable for each of the hypotheses.

Table 13

Summary of p Values for the Overall Model, Gender, SES, & BMI on Mathematics and Reading Achievement by Hypothesis

Variables by H_o	H1	H2	H3	H4
Overall Model	.000	.000	.000	.000
Gender	.029	.016	.031	.000
SES	.000	.000	.000	.000
BMI	.906	.690	.101	.838

Note. SES = Socioeconomic Status; BMI = Body Mass Index.

Regression results indicated that the overall model for each of the four hypotheses significantly predicted mathematics and reading achievement. Of the three predictors, BMI was the only variable that did not significantly contribute to the overall model for Hypotheses 1-4. Gender and SES significantly contributed to the model for each of the Hypotheses 1-4.

CHAPTER V

DISCUSSION

Physical education and school-based health services have long been a part of K-12 education. The physical and mental benefits of school-based health services are well documented. In addition, the identification of at-risk health factors, such as BMI, has been used in academics. Since the turn of the century, an increased emphasis has been placed on academic achievement, and school leaders are always seeking to identify factors that affect academics. Categorical data such as race, gender, SES, and grade level are often used and compared in research studies. Identifying individual demographical factors that predict outcomes can be advantageous for school leaders and teachers. This study focused on identifying such factors to determine their predictive effects on academic achievement.

The purpose of this study was to determine the predictive effects of gender, SES, and BMI scores on academic achievement as measured by the ACT Aspire Exam for sixth- and eighth-grade students in rural, Delta schools in Arkansas. This chapter summarizes the results from the data collections and analysis of each hypothesis. Also, this chapter describes the possible implications of this study within the broader context of previous research. Finally, recommendations for potential changes in practices and policies are discussed, along with future research considerations.

Findings

A quantitative, regression strategy was used in this study. The predictor variables for all hypotheses were gender, SES, and BMI scores. The dependent or criterion variables for Hypotheses 1-2 were mathematics and reading achievement, respectively, as measured by the ACT Aspire Summative Tests for students in Grade 6. The dependent or criterion variables for Hypotheses 3-4 were mathematics and reading achievement, respectively, as measured by the ACT Aspire Summative Tests for students in Grade 8. The results were analyzed by examining the combination of all predictor variables on the different criterion variables. Then, each predictor variable from each model was examined individually to determine how much it contributed to the overall prediction formula.

Hypothesis 1

Hypothesis 1 stated that no significant predictive effect will exist among gender, SES, and BMI scores on mathematics achievement as measured by the ACT Aspire Exam for sixth-grade students in rural, Delta schools in Arkansas. Before conducting the regression analysis, the data were checked to ensure assumptions were met. A multiple regression was then conducted to determine if the combination of the predictors statistically predicted mathematics achievement for sixth-grade students. The results indicated that the overall model significantly predicted mathematics achievement, and two of the three predictors, gender and SES, significantly contributed to the model. However, the model only accounted for approximately 5% of the variance in mathematics achievement. Since the variance was low, it was determined that the combined model prediction was limited, but due to the overall statistical significance of

the model, the null hypothesis was rejected. BMI did not significantly contribute to the model.

Hypothesis 2

Hypothesis 2 stated that no significant predictive effect will exist among gender, SES, and BMI scores on reading achievement as measured by the ACT Aspire Exam for sixth-grade students in rural, Delta schools in Arkansas. Prior to conducting the regression analysis, the data were checked to ensure assumptions were met. A multiple regression was then conducted to determine if the combination of the predictors statistically predicted reading achievement for sixth-grade students. The results indicated that the overall model significantly predicted reading achievement, and two of the three predictors, gender and SES, significantly contributed to the model. However, the model only accounted for approximately 6% of the variance in reading achievement. Since the variance percentage was low, it was determined that the combined model prediction was limited, but due to the overall statistical significance of the model, the null hypothesis was rejected. BMI did not significantly contribute to the model.

Hypothesis 3

Hypothesis 3 stated that no significant predictive effect will exist among gender, SES, and BMI scores on mathematics achievement as measured by the ACT Aspire Exam for eighth-grade students in rural, Delta schools in Arkansas. Before conducting the regression analysis, the data were checked to ensure assumptions were met. A multiple regression was then conducted to determine if the combination of the predictors statistically predicted mathematics achievement for eighth-grade students. The results indicated that the overall model significantly predicted mathematics achievement, and

two of the three predictors, gender and SES, significantly contributed to the model. However, the model only accounted for approximately 4% of the variance in mathematics achievement. Since the variance percentage was low, it was determined that the combined model prediction was limited, but due to the overall statistical significance of the model, the null hypothesis was rejected. BMI did not significantly contribute to the model.

Hypothesis 4

Hypothesis 4 stated that no significant predictive effect will exist among gender, SES, and BMI scores on reading achievement as measured by the ACT Aspire Exam for eighth-grade students in rural, Delta schools in Arkansas. Prior to conducting the regression analysis, the data were checked to ensure assumptions were met. A multiple regression was then conducted to determine if the combination of the predictor statistically predicted reading achievement for eighth-grade students. The results indicated that the overall model significantly predicted reading achievement, and two of the three predictors, gender and SES, significantly contributed to the model. However, the model only accounted for approximately 7% of the variance in reading achievement. Since the variance percentage was low, it was determined that the combined model prediction was limited, but due to the overall statistical significance of the model, the null hypothesis was rejected. BMI did not significantly contribute to the model.

Implications

The results of this study helped to explain if certain student characteristics could predict academic achievement. The analyses produced four items to be considered for implications. How the overall model predicted student achievement and how each

predictor variable contributed to the model were contemplated. Along with previous literature, the findings of this study could be used by educators and policymakers who are continuously striving to increase student achievement. Each of the predictor variables is discussed in relation to the results of this research and prior studies.

First, the overall model indicated a predictive effect for sixth- and eighth-grade students in both mathematics and reading achievement. This finding is similar to other research studies that found BMI, along with other demographical factors, was a predictor of academic achievement (Crosnoe & Miller, 2004; Datar & Sturm, 2006; Datar et al., 2004; Judge & Jahns, 2007; Shore et al., 2008; Wingfield et al., 2011). As noted in these previous studies, BMI was only one component of their models, and some factors could have contributed to the models more than others. Baxter et al. (2013) conversely found no significant association between BMI and academic achievement but determined that demographics such as race and SES were better predictors of academic achievement. Before drawing predictive conclusions, an examination of individual contributions should be considered.

Second, BMI did not significantly contribute to the models predicting mathematics and reading achievement for students in both Grades 6 and 8. The findings in this study indicated that BMI alone was not a significant predictor of academic achievement. Kaestner and Grossman (2009) similarly found that weight status alone was not a predictor of academic achievement on standardized tests. Maintaining a healthy weight could have lasting benefits for mental and physical health (Crosnoe & Muller, 2009; Halfon et al., 2013; Tsiros et al., 2009). However, a link between weight status and academic achievement was limited as referenced by the contribution of BMI to the

predictive model. In the Delta region of Arkansas, weight status should not be ignored, particularly as a health benefit because of its possible effects on other school-based factors such as attendance and participation in activity-related events. However, weight status alone should not be used to predict which students may need academic interventions.

The third implication of this study concerned SES and how it predicted academic achievement. SES significantly contributed to the overall predictor model in each of the four hypotheses. Impoverished students statistically performed lower academically in reading and math, in both grade levels, compared to other students. Renth et al. (2015) noted that students of low-income families performed worse academically, missed more days of school, and had more discipline-related issues compared to students from high-income homes. Additionally, low SES and low levels of parent education had a negative association between mathematics and reading scores (Judge & Jahns, 2007). The results of this study were consistent with these findings. SES remains to be a prominent factor when predicting academic achievement. Students who live in poor neighborhoods were also more likely to be overweight and directly linked to a higher BMI (Jilcott et al., 2011; Singh et al., 2010). Although associating SES and BMI was not a direct purpose of this study, the results were consistent with other research studies in which SES had a stronger association with academic achievement than weight status (Baxter et al., 2013; Datar & Sturm, 2004). The significant contribution of SES to the overall predictor model has the potential to mislead research results and was present in this study.

Fourth, gender differences were present in this study. Gender significantly contributed to the overall predictor formula in each of the four hypotheses. An analysis of

which gender performed better or worse was not the primary focus of this study. However, differences were present. This finding was consistent with previous research that determined that certain academic and gender differences existed among students (Brown et al., 2014; Jones & Myhill, 2004; Lindberg et al., 2010; Logan & Johnston, 2009; O'Dea et al., 2018; Voyer & Voyer, 2014; Wiens, 2006). The goal in recent years has been to narrow the gap among genders, but the finding in this study suggested that a gap still exists in this region. More work is needed in this area to determine what academic differences exist between males and females.

In summary, the overall model was found to be a significant predictor of mathematics and reading achievement among students in Grades 6 and 8. Differences in grade levels was not studied in this study, but BMI was not found to be a significant factor. In all the hypotheses, gender and SES each contributed significantly to the models. Consequently, administrators and policymakers should focus on how to address each factor in their attempts to improve student achievement.

Recommendations

Potential for Practice/Policy

This study sought to evaluate the predictive effects of gender, SES, and BMI scores on academic achievement as measured by the ACT Aspire Exam for sixth- and eighth-grade students in rural, Delta schools in Arkansas. Two of the three predictor variables, SES and gender, significantly contributed to the model. The results suggested that potential changes in practice are needed to address these two areas. BMI did not significantly contribute to the overall model. Even so, the study suggested areas that should be addressed concerning the weight and physical fitness of students.

The results indicate that an examination by administrators and other school leaders is needed to address the socioeconomic achievement gap. The state of Arkansas provides additional funding for schools that have a high number of students that are living in poverty. However, the extra funding alone does not seem to be closing the gap fast enough. Administrators and teachers should provide interventions to meet the needs of students from this demographic. Lessons can be learned from schools such as KIPP Delta in Arkansas where low income is not used as an excuse, but rather embraced. KIPP Delta maintains high expectations, a commitment to excellence, a rigorous college-prep curriculum, and accountability of stakeholders (Brown & Holt, 2014). Many of the strategies that are used in successful schools do not require extra funding. School leaders and teachers must be focused on changing the culture of these schools and make expectations of success the norm.

Second, the gender gap should be addressed in schools. The results of this study did not provide specifics about where the gender gap exists. However, other research studies have provided answers for school leaders. Males have been identified as strong in areas of STEM and females in English Language Arts and reading (Hansen et al., 2018; O'Dea, 2018). School leaders and policymakers should continue to identify ways to increase STEM participation among females and provide reading interventions for males. Logan and Johnson (2009) advised that developing good reading habits produces improved vocabulary, comprehension, fluency, and general knowledge. Administrators and leaders should be conscious of gender differences and continue to seek strategies that address deficiencies in identified areas.

Schools systems are charged with educating and meeting the needs of the "whole child". Although BMI did not significantly contribute to academic achievement in this study, adolescent weight issues remain an issue in the United States. Adolescent obesity has risen to 20.6%, an increase of 15% since 1980 (Centers for Disease Control and Prevention, 2017). Additionally, 50% of adolescent girls and 30% of adolescent boys use unhealthy weight control behaviors (Neumark-Sztainer, 2005). Therefore, school leaders many need to provide interventions in areas other than academic achievement. Schools must continue to educate students on healthy eating behaviors and maintaining an active lifestyle. The physical benefits of healthy choices are well documented. This is even more necessary in poor communities of the Arkansas Delta region. Low-income students are more likely to be obese than higher-income students (Ogden et al., 2010). The mission of schools is to educate well-rounded students and includes how to live a healthy lifestyle. Schools would be disserving students by not providing them with proper health and physical education programs.

Moreover, discussions about mental health and behavioral issues have become prominent among administrators and policymakers. Discussions need to include a recognition of how weight-related issues affect students socially, emotionally, and cognitively. Overweight students are more likely to feel anxious, sad, or unhappy, and these feelings can lead to depression or behavior disorders (Halfon et al., 2013; Turer et al., 2013). Also, weight-perception among adolescents can cause suicidal thoughts and behaviors (Whetstone et al., 2007). A call to action is needed to address the emotional and cognitive issues that exist in schools. School leaders have a responsibility, along with

parents, to address the causes of mental illness and trauma to provide students with the help they need.

Future Research Considerations

The findings of this study were consistent with related research findings in which a combination of factors predicted academic achievement, though the contribution of BMI in predicting academic achievement was limited. This research contributed to previous literature that sought to discover factors, including weight status, that predicted achievement. To further expand research in this area, recommendations for future studies included the following:

1. Additional research on how SES predicts academic success among students would be beneficial. The State of Arkansas allocates additional funding for schools that have a large low-SES population. The additional funding does not seem to be making a difference in narrowing the gap within the region from which the data were gathered. Additional research could possibly give some insight into what areas need to be addressed.
2. Researchers could investigate how gender differences are associated with academic differences on standardized tests. The results in this study indicated a significant contribution to the prediction formula. Research explaining the extent to which gender predicts academic achievement or relative associations could be useful for educators.
3. Previous research indicated that gender differences exist regarding weight perception. A study that focuses on male and female weight differences and

how the possible association affects academic achievement would add to the literature in this area.

4. A study that includes race as a predictor variable could add insight into how the diversity of student populations contribute to academic achievement and how race interacts with other demographical factors, including BMI.
5. A replication of this study that includes physical fitness as a predictor variable could be of benefit. A form of fitness test like FitnessGram would be beneficial to compare weight status and fitness levels.
6. A replication of this study with a larger sample size that includes different regions of the State and has more diverse income levels could also be instructive.

Conclusion

This study attempted to determine if gender, SES, and BMI were significant predictors of academic achievement. This chapter focused on how the results of this study contributed to the field. The study was based on the Humanist theory in which an individual's concept of development of oneself through the study of self-identification and motivation can affect student outcomes. Self-perception of oneself can have a long-term influence on academic achievement, and characteristics such as weight status, SES, and gender could motivate students. This research complemented existing literature and should be continued to better understand how existing characteristics predict academic achievement.

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