Who Is Riding the Bus and How Does It Impact Student Sleep, Attendance, Discipline, Mental Health, and Achievement?

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Who Is Riding the Bus and How Does It Impact Student Sleep, Attendance, Discipline, Mental Health, and Achievement?

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Education in Educational Leadership

by

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ABSTRACT

The purpose of this research study was to determine the relationship between morning transportation mode choice, sleep, and factors that impact achievement for students in grades 9-12 at Sleepy Valley High School. The study also examined the relationship between race and/or socioeconomic status and morning transportation mode choice to determine to what extent, if any, students from low socioeconomic backgrounds and minority populations are disproportionally affected by the district’s pupil transportation system.

Data related to morning transportation mode choice, factors that impact mode choice, student sleep, and mental health were collected through a 12 question Student Transportation Survey. Each survey respondent’s demographic information, attendance, suspensions, achievement, and socioeconomic data were downloaded from the division’s student information management system.

The results of this research study established a clear and significant relationship between morning transportation mode choice and student sleep. The study also indicated that a variety of factors prevent some families from having a choice with regard to transportation to school, resulting in disproportionality of participation for historically marginalized populations. Finally, the study established a relationship between student achievement data and transportation mode choice, likely the result of the impact of mode choice on wake time and sleep.

While this study did not intend to specifically examine the relationship between parent-set bedtimes and student sleep, the results of data analysis associated with this research study were consistent with existing research and indicated that parent-set bedtimes have a significant positive impact on student sleep.
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CHAPTER ONE: INTRODUCTION

Introduction

The purpose of this research study is to determine the effect of a student’s morning transportation mode choice on sleep and other factors that impact student achievement. More specifically, does a sleep disparity exist for students in grades 9-12 who participate in the Sleepy Valley School Division’s transportation program when compared to students who arrive at school by some other method? The study also examines the relationship between race and/or socioeconomic status and preferred morning transportation mode to determine if the division’s transportation practices disproportionately disadvantage specific groups of students. Finally, the study examines the relationship between the independent variables, nightly/weekly sleep, and the dependent variables of student mental health, attendance, discipline, and academic achievement. In an attempt to control for factors that might also influence the dependent variables, the study includes a comparison between students who ride the bus and an equated sample of the car-rider population demographically similar to the bus-rider population. Characteristics, including grade level, gender, race, socioeconomic status, and eligibility for special education services are considered to ensure that the bus-rider group is demographically similar to the equated sample of car riders to control for the impact of these factors on student mental health, attendance, discipline, and academic achievement.

This research further supports existing research that suggested that students will adjust their sleep cycles to address environmental conditions (Bryant & Gomez, 2015) and that sleep affects students’ mental and physical health, academic achievement, and a variety of additional factors that affect academic achievement (Wahlstrom, 2016). In addition to supporting existing research, this study highlights the effect of transportation routines on student sleep. This
information will inform and encourage school divisions to examine a variety of practices and procedures that may limit students’ opportunity to acquire the recommended amount of sleep. Finally, this study examines differences in sleep and the factors that support healthy sleep habits in minority and economically disadvantaged populations, informing research that suggested that Black and Hispanic students are less likely to acquire the recommended hours of sleep when compared to their peers (Winsler, Deutsch, Verona, Payne, & Szklo-Coxe, 2014). Research that demonstrates a correlation between sleep loss and historically disadvantaged student populations frame student sleep as an equity issue. This should encourage school divisions to shift start times and transportation routines so they are more congruent with recommendations from the American Academy of Pediatrics (AAP) and the Centers for Disease Control (CDC) and ensure that all children have access to a fair, equitable, and high-quality education (Elementary and Secondary Education Act, 1965).

Problem Statement

Sleepy Valley High School has what would be described by most as an early start time, 7:50 a.m. In addition, the division employs transportation routines that result in students who ride the bus arriving at school significantly earlier than their peers who drive, ride with a parent or friend, walk, or utilize some other form of transportation. Based on existing research, it would appear that this combination of factors could impact student sleep and may result in a sleep disparity for students who ride the bus. If a sleep disparity exists, it could have detrimental effects on physical and mental health, school attendance, behavior, and academic achievement. If specific student groups are disproportionally represented in the bus-rider population, this problem could negatively affect some students more than it does others and prevent the division
from providing equitable access to, and success in, the division’s academic and extracurricular programs.

**Focus on a Systemic Issue**

In the early 1990s, research began to indicate that the sleep phase of teenagers is shifted later into the evening because of changes in the mechanisms that control sleep (Bryant & Gomez, 2015). As a result, in the late 1990s and early 2000s, hundreds of schools across the country adjusted school start times to allow middle and high school students to sleep later into the morning to provide students with access to the recommended hours of sleep (9 hours) for adolescents (Wahlstrom, 2016). Longitudinal studies assessing the impact of later school start times have shown improvements in enrollment and attendance, in addition to several other student health indicators. In 2010, a study on the effects of later school start times conducted by the CDC confirmed improvements in attendance and reductions in depression and mood disorders but added to evidence that suggested that later school start times also result in statistically significant improvements in academics (Wahlstrom, 2016).

In 2014, with mounting evidence, the AAP issued a policy statement identifying insufficient sleep in adolescents as a public health issue affecting the health, safety, and academic success of middle and high school students and recommended that middle and high schools start no earlier than 8:30 a.m. (American Academy of Pediatrics [AAP], 2014). Despite the overwhelming evidence, the average start time for an estimated 39,700 U.S. public middle, high, and combined schools, with an estimated enrollment of 26.3 million students, was 8:03 a.m. (Wheaton, Ferro, & Croft, 2015). Barnes, Davis, Mancini, Ruffin, Simpson, and Casazza (2016) stated, “According to the American Academy of Pediatrics, 85% of high schools in the US start before 8:30 a.m., half of which start before 8:00 a.m.” (p. 553). As a result, only 7.6%
of U.S. teens report achieving the recommended 9 or more hours of sleep on school nights; in fact, 69% indicate that they receive insufficient sleep consisting of less than 7 hours (Winsler et al., 2014).

**Observability**

Sleepy Valley High School operates on a traditional seven-period day. The first bell rings at 7:50 a.m., and students are expected to be in class by 7:55 a.m. The division’s transportation system consists of three transportation tiers, one for high-school students, one for middle-school students, and one for elementary-school students. Because of a similar start time for elementary schools (7:45 a.m.) and the high school (7:50 a.m.), high school bus routes start considerably earlier than necessary. In fact, some high-school bus routes start as early as 6:15 a.m. and arrive at Sleepy Valley High School as early as 7:00 a.m., a full 55 minutes before students are required to be in class. Based on existing research, it would appear that this combination of factors could impact student sleep and may result in a sleep disparity for students who ride the bus. If a sleep disparity exists, it could have detrimental effects on physical and mental health, school attendance, behavior, and academic achievement. This is more likely to impact disadvantaged and minority students at a higher rate based on research that suggested that students from these populations are less likely to have support for healthy sleep habits in the home because of a lack of routine and structure (Marco, Wolfson, Sparling, & Azuaje, 2012).

**Is Actionable**

School start times and transportation schedules are actionable and can be changed to provide more high-school students with the opportunity to acquire the recommended 8 to 9 hours of sleep (Wheaton, Chapman, & Croft, 2016). Research from the longitudinal study in Minneapolis indicated that students tend to go to bed at approximately the same time regardless
of the school start time, resulting in more nightly and weekly sleep than peers with earlier school start times, likely the result of biological factors that influence teen sleep (Wahlstrom, 2002). Another study of middle-and-high-school students showed that students gained 12 to 30 additional minutes of sleep per night when their school start time was changed from 7:30 a.m. to 8:30 a.m., “and the percentage of students who reported ≥8 hours of sleep increased from 37% to 50%” (AAP, 2014, p. 644). In a similar study, researchers reported that student bedtimes shifted earlier, student-reported sleep duration increased by 45 minutes per night, and the percentage of students who were getting less than 7 hours of sleep per night decreased by 79% as the result of a 30-minute delay in their school start time (AAP, 2014).

However, despite the fact that the research to support that teenagers have biologically different sleep patterns from children and adults has been available since the early 1990s, making the decision to alter school start times is still considered risky behavior (Wahlstrom, 2002). Concerns over transportation costs, student participation in after-school activities, opportunities for students to work after school, and the mere notion of change, in general, are frequently cited as deterrents to change (Wahlstrom, 2002). In fact, a quick Google search reveals the difficulty school divisions have had addressing this issue. Wahlstrom (2002) pointed out that, without a clear picture of the research behind this problem, any discussion about shifting school start times is likely to be met with disapproval.

**Connects to a Broader Strategy of Improvement**

The goal of Title I of the Elementary and Secondary Education Act of 1965 as amended by the Every Student Succeeds Act (ESSA) signed into law by President Barack Obama on December 10, 2015, is to improve the academic achievement of the disadvantaged by “providing all children the opportunity to receive a fair, equitable, and high-quality education and to close
educational achievement gaps” (Elementary and Secondary Education Act [ESSA], 1965, p. 8).

In addition, while current school wellness policies primarily address student access to nutrition and physical activity, the heart of the school wellness policy requirement is to establish a school environment that promotes student health, well-being, and ability to learn (Healthy and Hunger-Free Kids Act, 2010).

While the Sleepy Valley School Division does not have a specific goal related to addressing early start times, it does have goals in its Six-Year Comprehensive Plan and in its Annual Division Goals and Objectives related to increasing cultural proficiency to ensure equity throughout the division for all children in all aspects of its educational program. In addition, the division’s overall mission is to provide an environment that helps every child reach his or her full potential. As a component of this belief and the realization that equity issues exist in its organization, the division has recently initiated a Deep Equity Professional Development Program. This program is designed to raise cultural awareness and shine a light on equity issues that exist for children within the division’s schools.

In addition, the division strives for excellence through a program of continuous improvement that embraces change. It appears that the division has a systemic problem that is negatively affecting students in grades 9-12 and their families and could be disproportionally affecting students and families from historically disadvantaged populations. This should resonate with the superintendent and the school board and increase their willingness to tackle this issue to be consistent with the division’s mission, vision, goals, and objectives and to ensure that the division meets federal requirements outlined in the Elementary and Secondary Education Act of 1965, as amended and signed into law in 2015, and the goals and objectives of school wellness.
Is High Leverage

If the Sleepy Valley School Division’s start times and transportation routines are creating a sleep disparity, the research would suggest that it has a negative impact on student mental and physical health, school attendance, discipline, and student achievement: “Insufficient sleep represents one of the most common, important, and potentially remediable health risks in children” (AAP, 2014, p. 642). Research from the American Academy of Pediatrics (2014) also suggested that adjusting school start times and transportation routines could significantly increase the amount of sleep for all 1,291 students in grades 9-12 at Sleepy Valley High School and could further inform school divisions across the commonwealth and the nation about the impact of school start times and the role transportation schedules play in student sleep.

Research Questions

This study proposed to answer the following three research questions:

1. How does morning transportation mode choice impact student sleep?

2. What are the factors that impact transportation mode choice, and are these factors disproportionately impacting students according to their race/ethnicity and/or socioeconomic status?

3. What is the relationship between student sleep and students’ mental health, academic achievement, discipline, and attendance?

By answering these questions, the researcher endeavored to gain a better understanding of the relationship between school start times, student transportation, and student sleep. Additionally, the researcher sought a further understanding of the relationship between student sleep and academic achievement, discipline, attendance, and mental well-being in this research setting. This study adds to the current body of research by examining how a variety of factors,
such as transportation routines, race, and socioeconomic status, in addition to school start times, impact student sleep.

**Overview of Methodology**

According to Creswell (2014), “Quantitative research is an approach for testing objective theories by examining the relationship among variables. These variables, in turn, can be measured, typically on instruments, so that numbered data can be analyzed using statistical procedures” (p. 4). This research study employed a post-facto comparative design approach (Abbot, 2011) to examine the relationship between morning transportation methods and student sleep. In addition, a correlational-design approach (Creswell, 2014) was used to test the established theory that sleep deficits impact students’ mental health, student achievement, discipline, and attendance (Winsler et al., 2014) by examining the relationship between student sleep and student archival data.

This research approach is based on the postpositivist worldview that causes influence outcomes (Creswell, 2014). When applied to this research study, a postpositive worldview assumes that in this research setting, transportation mode affects student sleep and that sleep impacts student achievement, discipline, attendance, and mental health. This approach also assumes that quantitative research methods can measure and analyze student sleep by transportation method to determine the impact of transportation method on sleep, and sleep on student archival data such as achievement (grades), discipline (referrals/suspensions), attendance (absences/tardies), and survey data that measures students’ mental health and well-being.

At Sleepy Valley High School, all students in grades 9-12 with parental consent to participate in this research study completed a 12 question student survey delivered online using Google Forms. The survey link was delivered to each student using his or her Sleepy Valley
Schools email address. The students were directed to access the email on their school-issued Chromebook and complete the survey on a designated date at a specific time to ensure a high response rate.

Question one asked students to identify their primary mode of transportation to school in the morning. Questions two through four were used to calculate each student’s nightly and weekly sleep by asking students to report their bedtime (2), estimate how long it typically takes them to fall asleep (3), and what time they rise on school days (4). Questions five through eight were used to determine the level of support at home for sleep by asking students to indicate a parent-set bedtime (5), the availability of a parent to support night routines (6), the availability of a parent to support morning routines (7), and the method the student uses to wake up on school mornings (8). Questions 9-11 further informed the factors that impact transportation mode choice. Question nine asked students to list the factors that impact their morning transportation mode choice according to the mode (bus or car) they selected on question one. Questions 10 and 11 asked students to indicate the transportation mode they would choose if given the option and collected information regarding the factors that influenced their choice. Question 12 was taken directly from the Centers for Disease Control (CDC) Youth Risk Behavior Survey (YRBS) and asked students if they had felt sad or hopeless every day for at least two weeks during the previous six months to the point that they had stopped participating in their usual activities. The results of this question allowed for an analysis of the impact of sleep on students’ mental health.

In addition to the administration of the student survey, student and parent focus groups were conducted to add contextual information to the survey results (see Appendices D-G for a list of focus group questions). A series of four focus group sessions were conducted. The four focus groups consisted of five students who ride the bus to school (group one), five students who
ride in a privately owned vehicle (group two), five parents whose children ride the bus (group three), and five parents whose children ride in a privately owned vehicle (group four). The results of the focus groups were used to further inform and add context to the survey data related to the impact of transportation mode choice on student sleep and the factors that impact transportation mode choice.

The calculated sleep time for students who ride the bus was compared to that of students who arrive at school by car using a $t$-test to determine the impact of participating in the division’s transportation program on student sleep.

Using the survey results, each student who completed the survey was identified as an AM BUS RIDER or AM CAR RIDER. Once all students were classified, each student’s age, race, ethnicity, socioeconomic status, grade level, absences, suspensions, referrals, and grade point average were imported into an Excel spreadsheet from the PowerSchool Student Information Management System for statistical analysis. The demographic and socioeconomic profiles of the AM-BUS-RIDER group and the AM-CAR-RIDER group was analyzed using a chi-Square analysis to determine if there is a relationship between race, socioeconomic status, and AM transportation method. $T$-tests were conducted to analyze the impact of student-selected AM transportation methods on absences, suspensions, discipline referrals, and grade point average. According to Creswell (2014), $t$-tests are appropriate inferential statistical tests to examine hypotheses when continuous data are being compared between two groups or categories. Finally, these same statistical tests were completed comparing the data between the AM-BUS-RIDER group and an equated sample from the AM-CAR-RIDER group to attempt to control for other factors such as race and/or socioeconomic status that have been shown to impact student achievement (Turner, Rubie-Davies, & Webber, 2015).
Positionality

According to Ravitch and Carl (2016), “Positionality refers to the researcher’s role and social location/identity in relationship to the context and setting of the research” (p. 537). As it relates to this research proposal, positionality refers to how my professional position within the Sleepy Valley School Division, my personal position in the community as an educator and parent, and my position in society as a White upper-middle-class man impact my views of the problem of practice and associated research.

Researcher’s Role

I am currently the Assistant Superintendent in the Sleepy Valley School Division where I have served as a central office administrator for twelve years. As the Assistant Superintendent, I am directly responsible for ensuring the success of the division, its students, staff, and families. As such, identifying and investigating problems of practice within every aspect of services provided by the division is a significant component of my job. I am also a parent of three children who have attended or are attending Sleepy Valley High School, a member of the community with numerous friends who also have children who attend our schools, and a coach who has grown to know and love numerous Sleepy Valley families and their children. As the researcher in this proposal, I initially identified the problem of practice when I began to see its impact on children in my neighborhood and my own children. As the Assistant Superintendent and trusted member of the Sleepy Valley community, I believe it is my responsibility to provide a thorough investigation of this problem, to communicate the problem and its effects to all stakeholders, and to work to develop solutions that ensure equity of opportunity for all students.
Assumptions

As the researcher, I have two primary assumptions that affect the way I view this problem of practice. First, I assume that students who utilize the division’s transportation wake up significantly earlier than their peers who arrive at school by other means and that those students do not adjust their bedtimes to account for the fact that they must wake up earlier, resulting in a sleep disparity that negatively affects their mental health, attendance, discipline, and academic achievement. Second, I assume that this problem disproportionately affects students from historically marginalized populations because of a lack of transportation alternatives. I will need to be aware of these assumptions as I move forward with my research to ensure that these assumptions or biases do not impact how I interpret the research findings.

Definition of Key Terms

*Eveningness Chronotype:* A sleep pattern common in adolescents where changes to the biological mechanisms that control sleep result in difficulty falling asleep before 11:00 p.m. and waking before 9:00 a.m.

*First Bell:* The first bell in the morning which notifies students that they have 5 minutes to get to their first-period class.

*Seven Period Day:* The schedule configuration for Sleepy Valley High School, seven 50-minute class periods between 7:55 a.m. and 2:50 p.m.

*Sleep Phase:* This refers to the time of day that the biological mechanisms controlling sleep begin to induce sleep.

*Transportation Mode:* This refers to the method students use to travel between school and home.

*Transportation Routines:* The procedures and practices school divisions use to transport students between home and school.
**Transportation Tier**: A series of bus routes that serve a school or schools. School divisions with multiple *transportation tiers* use the same buses to conduct multiple, staggered bus routes. This typically results in different start times for the schools served by each *transportation tier*.

**Organization of the Dissertation**

The next chapter (Chapter Two) reviews the literature associated with the impact of sleep on student achievement and the factors that affect student achievement. This review also includes literature related to the impact of race and socioeconomic status on sleep, the effects of changing school start times, and trends in pupil transportation.

Chapter Three (Inquiry Methods) provides the reader with a more detailed description of the research design and the problem setting. Chapter Three also includes a detailed description of participant demographics and data collection and analysis methods. Finally, Chapter Three includes information related to the trustworthiness of the research study, the study’s limitations, and the study’s delimitations.

Chapter Four (Results) provides information related to the survey response rate and a demographic profile of survey respondents. This chapter reviews the survey responses and the results of an analysis of the data collected by the Student Transportation Survey and information retrieved from the Sleepy Valley School Division’s Student Information Management System. Chapter Four also provides an overview of the results of the data analysis by research question and includes qualitative information from focus group sessions to add context and depth to the data.

Finally, in Chapter Five (Conclusions), the reader is presented with the research findings for each research question and its connections to the research. Chapter Five also includes a discussion of additional findings of the research study, the significance of the research findings,
and their implications for schools and further research. Chapter Five concludes with the researcher’s recommendations and a conclusion statement.
CHAPTER TWO: LITERATURE REVIEW

Introduction

The purpose of this problem of practice is to determine the impact of the Sleepy Valley School Division’s morning transportation system on student sleep. More specifically, does a sleep disparity exist for students in grades 9-12 who participate in the Sleepy Valley School Division’s school bus transportation program when compared to students who arrive at school by some other method? The study also examines the relationship between race and/or socioeconomic status and preferred morning transportation method to determine if the division’s transportation practices disproportionately affect specific groups of students. Finally, the study examines the relationship between the independent variables, nightly/weekly sleep, and the dependent variables of student mental health, attendance, discipline, and academic achievement. In an attempt to control for factors that might also influence the dependent variables, the study includes a comparison between students who ride the bus and an equated sample of the car-rider population that is demographically similar to the bus-rider population.

In an effort to answer these questions, I reviewed literature related to the biological and societal factors that impact adolescent sleep cycles, which included recommendations for adolescent sleep, the current state of adolescent sleep, and the impact of sleep deficiency on physical and mental health, academic achievement, and a variety of factors that impact academic achievement. I also researched the impact of school start times and transportation times as limiting factors of students’ sleep and the impact of changing start times and transportation routines on the aforementioned student outcomes. Finally, I researched associations between race and socioeconomic status, sleep, and transportation mode preference. I used the University of Arkansas library’s advanced search feature to search for terms including but not limited to
adolescent sleep, school start time, student sleep deficiency, teen sleep habits, student transportation mode, travel time, wake time, bedtime, sleep disparity, socioeconomic factors, mode choice, and race. The results included information from a variety of multidisciplinary sources, including peer-reviewed articles, books, government reports, and dissertations.

**Review of the Literature**

The following sections represent research topics that were reviewed to develop a deeper understanding of adolescent sleep, the impacts of sleep deprivation on student health, achievement, and factors that affect achievement, and the current state of teen sleep. The following review also includes research on the relationship between sleep, school start times, and school transportation mode and how changes in school start time impact students. Finally, this review explores connections between sleep habits, preferred transportation mode, socioeconomic status, and race.

The research which indicated that teens are biologically conditioned to go to sleep later and sleep later into the morning because of changes in the mechanisms that control sleep (Barnes et al., 2016; Bryant & Gomez, 2015) and that school start times and transportation times affect students’ ability to acquire adequate sleep was compelling (Carrell, Maghakian, & West, 2011; Thacher & Onyper, 2016; Wahlstrom, 2014). There was also abundant evidence that changes geared toward later start times increased the likelihood that students will acquire the recommended sleep leading to better physical and mental health outcomes and positively impacting a variety of factors that affect student achievement (Barnes et al., 2016; Beebe, Rose, & Amin, 2010; Bryant & Gomez, 2015; Eaton, McKnight-Eily, Lowery, Perry, Presley-Cantrell, & Croft, 2009; Marco et al., 2012; Wahlstrom, 2016; Wheaton et al., 2016; Wheaton et al., 2015; Winsler et al., 2014). However, despite this evidence, data from the CDC indicated that “the
average start time for middle and high schools in the United States is 8:03 a.m., with fewer than 18% of schools starting at or after 8:30 a.m.” (Hale & Troxel, 2018, p. 600).

While the impact of selected morning transportation mode on student sleep and the factors that impact mode choice were not as clear, parents indicated that they will choose the most efficient mode of transportation to school in an effort to save time (Ewing, Schroeer, & Greene, 2004; Faulkner, Richichi, Buliung, Fusco, & Moola, 2010; McDonald, 2007; McDonald & Aalborg, 2009; Westman, Friman, & Olsson, 2017). In addition, a variety of socioeconomic and racial factors may impact transportation mode choice, thereby creating a disparity for students from historically marginalized populations (Ewing et al., 2004; McDonald, 2007; McDonald & Aalborg, 2009; Westman et al., 2017). For example, Ewing et al. (2004) reported that the number of licensed drivers, automobile ownership, and parental employment status are “significant determinants” of school mode choice (p. 56). Similarly, Westman et al. (2017) reported that “the children of well-educated parents, from households with higher income, higher levels of car ownership, and more than one child are more likely to travel to school by car” (p. 2). In another study that looked at equity and travel mode choice between car riders and walkers, McDonald and Aalborg (2009) added “that minority and low-income youth walk to school at rates two to three times those of white students” (p. 2).

**Biological and Social Factors That Impact Adolescent Sleep**

In the early 1990s, research began to reveal that teenagers have different sleep patterns from children and adults (Wahlstrom, 2002). Research indicated that adolescents experience a sleep-wake phase delay of almost 2 hours relative to their sleep cycles in middle childhood as a result of a delay in nocturnal melatonin secretion and a shift to an evening preference which result in difficulty falling asleep earlier (AAP, 2014). Similarly, the secretion of melatonin
persists later into the morning, making it more difficult for teens to wake up early (Barnes et al., 2016; Bryant & Gomez, 2015). This delay is caused by developmental changes to two sleep-wake mechanisms in adolescents: homeostatic sleep drive and circadian rhythm (Bryant & Gomez, 2015). In fact, the research suggested that teens have difficulty falling asleep before 10:45 p.m. and are biologically conditioned to stay asleep until 8 a.m. (Wahlstrom, 2016). It was also reported that “for around 40% of teens, this natural tendency toward an eveningness chronotype is so severe that it is practically impossible for them to fall asleep much before midnight” (Winsler et al., 2014, p. 364). This research was further supported by longitudinal surveys which indicated that student bedtimes shift approximately 3 hours from 9:00-9:30 p.m. to 11:00 p.m.- midnight when 10-year-olds are compared to high school seniors (Carskadon, 1990). The research also suggested that the need for sleep does not change during adolescence; in fact, “older adolescents sleep more than younger adolescents when given the opportunity in laboratory settings or on weekends, summers, and vacations” (Wolfson & Carskadon, 2005, p. 47). These phenomena are not limited to students in the United States. According to Wahlstrom (2002):

Similar studies on students have recently been completed in Brazil, Italy, and Israel. Those studies have revealed that the sleep-wake cycle for students in those countries is nearly identical to that found among students in the United States. In other words, the sleep phase shift occurring in adolescents’ neurological systems is not culturally based; it is, instead, a phenomenon of human development. (p. 19)

While the research clearly indicated biological factors related to the shift in adolescent sleep patterns, there are also a number of socio-behavioral factors that influence teen sleep. Teens begin to experience greater autonomy with regard to sleep behaviors which, when
combined with changes to their natural sleep-wake cycle, lead to later bedtimes. Other socio-behavioral factors include increased social and academic commitments, work outside the home, and increased connectivity to peers facilitated by technology (Bryant & Gomez, 2015). More simply stated, teens are increasingly connected and overcommitted, leading to less time for sleep.

One area that was less evident in the research is the impact of race and socioeconomic factors on student sleep. While limited, research has established an association between Socioeconomic Status (SES) and sleep. Children from low SES are more likely to experience issues such as parents who work at night and in the evening, shared sleeping arrangements, and concerns over personal safety, resulting in shorter and more interrupted sleep (Marco et al., 2012). These same students are less likely to have structure and routine (parent-set bedtimes) and watch more television, both of which contribute to poor sleep habits and overall reductions in sleep (Marco et al., 2012). In a study of 155 seventh-graders, Marco et al. (2012) reported that economically disadvantaged students’ sleep is more delayed, shorter in duration, and less consistent, a growing concern because of the fact that an estimated 38% of adolescents live in low-income families.

Also, while limited, studies have identified a relationship between race and sleep, reporting that Black, Hispanic/Latino, and Asian students sleep less than their White peers (Eaton et al., 2010; Winsler et al., 2014). While some may attempt to attribute differences to socioeconomic factors, “even when SES is controlled, Black children are still found to sleep less and be more at risk for cognitive/academic deficits as a result of sleep deprivation” (Winsler et al., 2014, p. 364). Adam, Snell, and Pendry (2007) also reported that African-American children averaged .42 hours less sleep per night than White children, primarily because of later bedtimes and earlier wake times.
The Impact of Insufficient Sleep on Adolescents

Much like the body of research related to adolescent sleep, the research related to the negative effects of insufficient sleep in adolescents was significant and convincing. It is important to also note that there was significant agreement between researchers and scholars regarding these impacts. The research clearly indicated that adolescents who experience insufficient sleep are more likely to have difficulty regulating their emotions (Adam et al., 2007; Barnes et al., 2016; Gangwisch, Babiss, Malaspina, Turner, Zammit, & Posner, 2009), express a depressed mood or symptoms of depression (Adam et al., 2007; Carskadon, 1990; Eaton et al., 2009; Gangwisch et al., 2009; Marco et al., 2012; Wahlstrom, 2016; Wheaton et al., 2016; Wheaton et al., 2015; Winsler et al., 2014), and report suicidal ideation (Gangwisch et al., 2009; Winsler et al., 2014). The research also suggested insufficient sleep causes problems with cognition (Adam et al., 2007; Barnes et al., 2016; Bryant & Gomez, 2015; Wahlstrom, 2016), academic performance (Barnes et al., 2016; Beebe et al., 2010; Bryant & Gomez, 2015; Eaton et al., 2009; Marco et al., 2012; Wahlstrom, 2016; Wheaton et al., 2016; Wahlstrom, 2016). Finally, the research indicated that students who do not acquire sufficient sleep are more likely to be overweight (Adam et al., 2007; Barnes et al., 2016; Wheaton et al., 2016), more likely to use substances (Marco et al., 2012; Wheaton et al., 2016; Wheaton et al., 2015; Winsler et al., 2014), and more likely to be involved in accidents (Adam et al., 2007; Bryant & Gomez, 2015; Eaton et al., 2009; Hansen, Janssen, Schiff, Zee, & Dubocovich, 2005; Wahlstrom, 2016).
The Impact of Changes to School Start Times

While teens clearly face numerous biological and social obstacles to achieving the 8.5 to 9.5 hours of sleep recommended by the American Academy of Pediatrics (Barnes et al., 2016), school start times, and more specifically their imposition of earlier wake times, are a key factor preventing teens from acquiring optimal sleep (Carrell et al., 2011; Thacher & Onyper, 2016; Wahlstrom, 2014). In fact, only about 20% of teens acquire the recommended amount of sleep on school nights (Winsler et al., 2014). In one large research study conducted in Fairfax County, Virginia (N=27,939), only 7.6% of teens reported that they acquired optimal sleep on weeknights (≥9 h), 69% reported insufficient sleep (≤7 h), and 44% indicated that they struggle to stay awake at school (Winsler et al. 2014).

With mounting evidence that teens are biologically conditioned to go to bed later and sleep later into the morning (Barnes et al., 2016; Bryant & Gomez, 2015) and that they face a number of socio-behavioral factors such as increased social and academic commitments, work outside the home, and increased connectivity to peers facilitated by technology (Bryant & Gomez, 2015), seven high school districts in Minneapolis, Minnesota, shifted their start times from 7:15 a.m. to 8:40 a.m., almost 1.5 hours later (Wahlstrom, 2002). A longitudinal study assessing the impact of this change showed improvements in enrollment and attendance, in addition to several qualitative indicators (Wahlstrom, 2002). Wahlstrom (2017) found that students were now awake the first hour of class, the principal reported fewer disciplinary incidents in the halls and the lunchroom, and students reported less depression and feelings of greater efficacy. Over 92% of the parents said their kids were “easier to live with.” (p.10)
Studies also showed that later school start times had a direct positive impact on student sleep duration. For example, in a study of 1,187 students between the ages of 12 and 19, Adam et al. (2007) reported that students gained an average of just over 17 minutes of sleep for every 30-minute increase in school start time. Similarly, studies indicated that student wake times shifted later in conjunction with later start times (Paksarian, Rudolph, He, & Merikangas, 2015).

Growing evidence on the biological factors associated with teen sleep and the impact of school start times would eventually lead to greater interest in adjusting school start times to address growing concerns over teen sleep. Hundreds of school divisions were investigating the issues related to school start times, and by 2005, more than 250 high schools across the country had shifted to a later start in response to the research (Wahlstrom, 2016). This created an opportunity for extensive research to determine the results of students having the opportunity for more sleep.

In 2010, faced with mounting evidence of the role of sleep in teens, the CDC called for a larger study on the effects of later school start times. This study confirmed improvements in attendance and reductions in depression and mood disorders but added to evidence that suggested that later school start times also result in statistically significant improvements in academics (Wahlstrom, 2016). In fact, the study highlighted statistically significant increases in the 1st period grade point average in one or more core courses of English, math, social studies, and science in three districts with start times from 8:00-8:35 a.m. and in all 1st period core courses for all semesters in all grades in Jackson Hole High School in Wyoming, with a start time of 8:55 a.m. (p.11)

This study also reported that students who achieve 8 or more hours of sleep per night were less likely to use substances and less likely to engage in sexual activity. In fact, Winsler, et al. (2014)
reported that the odds of students using alcohol, tobacco, or marijuana increased by 23% and the odds of students using illicit drugs increased by 37% for each hour of lost sleep. As a result of this growing body of research, Wahlstrom (2016) stated:

The body of evidence concerning the academic benefits of a later start time for high school students is compelling. Also, the medical research into the function of the brain in memory, learning, and cognition is robust, while the link between sleep and mental health is unequivocal. (p. 13)

In another widely cited study on the topic of sleep and academic performance, students receiving Cs, Ds, and Fs slept 25 fewer minutes per night than students receiving As and Bs (Bryant & Gomez, 2015). Similarly, one study of high school students found that later bedtimes predicted lower grade point averages, greater incidents of behavior problems, and depressive mood (Wolfson & Carskadon, 1998). In addition, students age 13-17 retained less educational content and had more attentional lapses when their sleep was restricted to 6.5 hours per night for five nights (Beebe et al., 2010). While the factors that affect academic performance are many and varied, the connection between sleep and school functioning appears to be well supported (Bryant & Gomez, 2015).

Finally, as a result of the growing body of research, in 2014 the AAP issued a policy statement identifying insufficient sleep in adolescents as a public health issue affecting the health, safety, and academic success of middle and high school students and recommended that middle and high schools start at 8:30 a.m. or later (AAP, 2014).

While the research has clearly identified the biological and socio-behavioral factors affecting teen sleep patterns, some stakeholders might still believe that parents just need to make their children go to bed earlier. The research suggested that adolescents with parent-set bedtimes
do tend to get more sleep. A study published in *SLEEP* in January 2011 reported that teens with a parent-set bedtime went to bed 23 minutes earlier on average and slept 19 minutes longer each night, reported less daytime fatigue, greater wakefulness, and better daytime functioning (Short, Gradisar, Wright, Lack, Dohnt, & Carskadon, 2011). A similar study by Gangwisch et al. (2009) reported that teens with a parent-set bedtime slept 40 additional minutes per night and were at a reduced risk of depression and suicidal ideation. This research clearly illustrated that implementing set bedtimes provides children with more sleep and may even prevent or mitigate the biological shift that occurs in adolescents (Bryant & Gomez, 2015).

However, the issue with these findings is the fact that as children enter their teen years, they are less likely to have a parent-set bedtime. The research suggested that parents tend to over-report that they have a set bedtime for their teen (75%) compared to 17.5% and 5% reported by the teens themselves in similar studies (Short et al., 2011). Short et al. (2011) also noted that students who reported a parent-set bedtime were generally younger and that there was a “steady decline in the percentage of adolescents whose parents set their bedtime from age 13 to 18 years” (p. 798). In other words, teens would benefit from a parent-set bedtime, but it is unlikely that parents will implement and support an effective bedtime as students age. In addition, parent-set bedtimes, structures, and routines to support sufficient sleep were even less likely for disadvantaged teens (Adam et al., 2007; Eaton et al., 2009; Marco et al., 2012; Winsler et al., 2014).

Some parents might assert that they have a set bedtime for their children, but their teens will not go to bed on time. Gangwisch et al.’s (2010) research indicated that students with parent-set bedtimes went to sleep within 5 minutes of their established bedtime regardless of economic standing, family structure or educational attainment (Bryant & Gomez, 2015). Short et
al. (2011) confirmed this research and further indicated that parent-set bedtimes are an effective means of ensuring that teens get enough sleep regardless of a variety of social factors.

Parents might also assume that teens will just use later school start times as an excuse to stay up even later, mitigating any positive benefit that might be gleaned from a later start time. However, research from the longitudinal study in Minneapolis indicated that students tend to go to bed at approximately the same time, regardless of the school start time, resulting in more nightly and weekly sleep than peers with earlier school start times, likely the result of biological factors that influence teen sleep (Wahlstrom, 2002). Another study of middle and high school students showed that students gained 12 to 30 additional minutes of sleep per night when their school start time was changed from 7:30 a.m. to 8:30 a.m., “and the percentage of students who reported ≥8 hours of sleep increased from 37% to 50%” (AAP, 2014, p. 644). In a similar study, researchers reported that student bedtimes actually shifted earlier, student-reported sleep duration increased by 45 minutes per night, and the percentage of students who were getting less than 7 hours of sleep per night decreased by 79% as the result of a 30-minute delay in their school start time (AAP, 2014). To further support their policy statement, the AAP also highlighted a three-year study of eight public schools in Colorado, Wyoming, and Minnesota where the research indicated that “the percentage of students sleeping ≥8 hours per night was dramatically higher in those schools that had a later start time” (AAP, 2014, p. 644).

An additional area of research that also needs to be explored deals with the barriers to change. While change, in and of itself, is difficult, especially changes that affect large groups of people, there are specific forces at play when the changes occur in schools and affect children and families. Wahlstrom (2016) reported that stakeholders expressed concern about the potential for negative consequences in every community that adjusted school start times or any that were
even considering a change. She indicated that these concerns can derail changes designed to address sleep loss, suggesting that some need to be addressed head-on, from the outset of any discussion to change school start times. Wahlstrom (2016) provided the following list of issues that need attention prior to implementing any changes that affect the daily routine of students and families:

1. Athletic schedules that may result in a student-athlete missing part of a class at the end of the day.
2. Because of a rearranged bus schedule, younger children may have to take an earlier bus to school when it may still be dark.
3. Arranging childcare for younger children before and after school may be more difficult.
4. Parents’ work schedules may not easily align with new start times.
5. The later start time may coincide with local rush-hour traffic, creating the need to discuss with local traffic safety officials how traffic flow can be improved. (p. 13)

In addition to the issues listed above that Wahlstrom considered legitimate concerns, she provided another list of concerns that never materialized in her research, but are likely to be expressed by stakeholders:

1. The later start time may result in less participation in sports and fewer games won.
2. Because they get up later in the morning, teens may choose to stay up later in the night.
3. Participation in after-school activities may decline.
4. Students may have difficulty arriving on time to after-school employment.
5. Transportation costs may increase. (p.13)

The Connection to Wake Time

While the association of school start times as a limiting factor for student sleep was clear, a more specific connection to school start time as a determinant of student wake time was less evident in the literature. Wahlstrom et al. (2014) alluded to this connection by stating, “It has repeatedly been shown that when middle or high school start times are pushed later, students still tend to go to bed at about the same time, but, due to waking up later, increase their sleep” (p.4). Adam et al. (2015) also supported this connection by indicating that on average, students reported a 25-minute later wake time for each hour increase in school start time. In another study that analyzed the sleep patterns of 14-year-olds in Raipur, India, the researchers reported that the wake time for students who attended school in the morning hours (7:30 a.m. start) was significantly earlier (5:23 a.m.±31) compared to their peers (6:59 a.m.±1:05) who attended school during the day shift (11:00 a.m. start) (Pradhan & Sinha, 2017).

The Influence of Pupil Transportation on Sleep

Another area of research less evident in the literature was the impact of student transportation to school on wake time and its associated influence on student sleep. Those studies that have researched the connection between student transportation and student sleep have established a clear connection between a student’s morning commute and wake time (Adam et al., 2007; Paksarian et al., 2015; Pereira, Moreno, & Louzada, 2012; Pradhan & Sinha, 2017; Wolfson & Carskadon, 2005; Wahlstrom et al., 2015). Adam et al. (2007) reported that students experienced sleep gains from changes in transportation times similar to those experienced by students because of later school start times. In fact, Adam et al. (2007) reported that “for every additional hour younger children spend getting to school their weekday sleep decreased by .69
hr., and for older children, sleep time decreases by a notable 1.42 hr., because of earlier wake times” (p.10). In their study of Indian teens, Pradhan and Sinha (2017) reported that wake time was a function of commute time and found a “significant negative correlation between wake time and commuting distance” (p.155). In another study of 1,126 high school students in Brazil, researchers reported a significant inverse association between commuting time and time in bed, further indicating that longer transportation times were associated with earlier wake times (Pereira et al., 2012). In fact, Pereira et al. (2012) determined that shorter commuting times to school were associated with changes in student sleep similar to those observed as a result of later school start times. It should also be noted that the research indicated that longer school travel times appear to disproportionately affect Black students, contributing to a racial/ethnic sleep disparity (Adam et al., 2007).

While not a significant body of research, it would appear that, in addition to school start time, student sleep was also a function of travel time to school in the morning because of its influence on wake time. More specifically, the time a student is required to wake in order to make it to school on time appears to be the key factor in determining the likelihood that he or she will acquire sufficient sleep. As a result, researchers have suggested that, in addition to school start times, policymakers should consider travel time, and its associated impact on wake time, as an important factor contributing to insufficient sleep for adolescents (Adam et al., 2007; Pradhan & Sinha, 2017).

Factors that Impact Transportation Mode Choice

Similar to the impact of transportation time on student sleep, an additional consideration for this study was research related to how students get to school, or more specifically how parents and students choose their mode of morning transportation. Most of the research
associated with preferred travel modes is related to the growing interest in students resuming active modes of transportation like biking and walking. However, this research offered some insight into the factors that influence mode choice and suggested that one of the key factors affecting mode choice is time, or more specifically the influence transportation mode choice has on wake time (Ewing et al., 2004; Faulkner et al., 2010; McDonald, 2007; McDonald & Aalborg, 2009; Westman et al., 2017). When parents were asked about their choice for students to walk or to drive or ride with a parent, they repeatedly reported that they tend to choose the most efficient mode of travel to school if they have a choice. More specifically, parents cited the impact of travel choice on their morning routine and wake time, explaining that a choice that would take longer, such as walking, would just require getting up earlier (Faulkner et al., 2010). McDonald (2007) reported that travel time has the strongest influence on the decision to walk to school and that, as travel time increases, students are less likely to walk to school. In fact, 75% of parents who drove their children less than two miles to school cited the savings of 5-10 minutes in the morning as their primary reason for choosing to drive, explaining that their children could use the time savings for additional sleep (McDonald & Aalborg, 2009).

While the research would suggest that parents and students consider transportation time when deciding transportation mode, are there other factors that impact the opportunity for families to choose the most time-efficient transportation option? More specifically, are there socioeconomic or racial barriers that prevent families from making the most time-efficient choice for their children? The research suggested that there are. In fact, the research indicated that the children of well-educated parents with higher income levels are more likely to travel to school by car (Ewing et al., 2004; McDonald, 2007; McDonald & Aalborg, 2009; Westman et al., 2017). McDonald (2007) reported that increases in income lead to declines in walking and increases
students being driven to school. Other factors include car ownership and the number of licensed drivers in the home, both of which are directly related to socioeconomic factors (Ewing et al., 2004; McDonald, 2007; McDonald & Aalborg, 2009; Westman et al., 2017). While connections to race were not as clear in the research, it was reported that “minority and low-income youth walk to school at rates two to three times those of White students” (McDonald & Aalborg, 2009, p. 340). The researchers added that racial variation in mode choice “is mostly explained by factors such as household income, density, and neighborhood composition” (McDonald, 2007, p. 29).

**School Start Time as a Social Justice Issue**

Social justice initiatives strive to improve the health of the overall population and ensure fair treatment of historically disadvantaged populations. Gorski (2007) explained that students from low SES backgrounds are more likely to attend overcrowded, underfunded schools with high teacher turnover and inadequate funding. He went on to explain that poor children do not have access to adequate healthcare or health insurance, that they live in unsafe neighborhoods, and that they lack access to basic necessities such as food, uncontaminated water, and healthy living spaces, impacting their access to equitable education services (Gorski, 2007). Gorski (2007) stated, “in almost every conceivable way, the structure of the U.S. education system denies students in poverty opportunities and access it affords most other students” and “that students and parents from poverty simply do not have the same access to material resources that their economically advantaged peers -- and many of us -- take for granted” (p. 32). As a result, economically disadvantaged children are more likely to underachieve, more likely to have behavior problems, and are at a greater risk of dropping out of school (Buckhalt, 2011).
When school officials are armed with the knowledge of teen sleep cycles, the impact of school start time on adolescents’ ability to acquire the recommended amount of sleep, and the impact of insufficient sleep on physical and mental health, it is clear that efforts to adjust school start times and/or transportation routines to increase teen sleep addresses the social justice goal of improving the health for the population. When combined, the evidence that students from minority populations and low SES backgrounds are less likely to acquire sufficient sleep and the research that has shown improvements in academic results associated with later school start times, later school start times and their impact on the achievement gap and academic outcomes address the social justice goal of ensuring the fair treatment of historically disadvantaged populations (Hale & Troxel, 2018).

**Conceptual Framework**

The Sleepy Valley School Division utilizes a three-tiered transportation system to provide transportation to students at the elementary, middle, and high school levels. Research indicated that the number of bus tiers in a school division has an effect on school start times and that schools in districts with two or three transportation tiers typically have significantly earlier start times than schools with one tier or schools that do not provide buses (Wolfson & Carskadon, 2005). It is easy to see why the number of transportation tiers impacts school start times. School divisions that provide multiple transportation tiers must stagger school start times to allow for the buses to complete each transportation tier. For example, the minimum amount of time between the start time for the schools served by the earliest transportation tier and the next is the maximum amount of time it takes any bus serving the second tier to complete its route and arrive at the next school. In most multi-tier systems, each transportation tier coincides with the start time for the schools it serves; for example, the schools served by the first transportation
tier would typically have the earliest start time followed by schools served by the second transportation tier. However, in Sleepy Valley, the school served by the first bus tier (Sleepy Valley High School) actually starts ten minutes later than schools served by the second tier (elementary schools). This results in an inefficient transportation routine that requires the first tier to begin significantly earlier than necessary and results in students arriving at school as much as 55 minutes before their first class.

As the Assistant Superintendent, I have been aware of this transportation configuration for several years, but I began to have a better understanding of its impact on students when my oldest child started high school. I realized that my son would need to wake up at approximately 5:55 a.m. each day in order to catch the bus at 6:25 a.m. However, if I drove him to school, he could wake up at approximately 7:15 a.m., 1.33 hours later. From my perspective as a parent, I understood that because of homework, activities, and biological factors, my son had difficulty getting to bed before 11:00 p.m., so I made the decision to drive him to school, so he could sleep later in the morning. While this was a minor inconvenience for me, I felt it was important for his overall health.

Eventually, my son would get his license and could drive to school on his own, but I continued to have concerns about the impact this problem of practice was having on students who have no alternative to riding the bus to school. I also could not help but speculate that the students who were being impacted most were those from historically disadvantaged populations, making this an issue of social justice.

The existing research that teens are biologically conditioned to go to sleep later and sleep later into the morning because of changes in the mechanisms that control sleep is compelling (Barnes, Davis, Mancini, Ruffin, Simpson, & Casazza, 2016; Bryant & Gomez,
2015). It is also clear that school start times and transportation times affect students’ ability to acquire adequate sleep (Carrell et al., 2011; Thacher & Onyper, 2016; Wahlstrom 2014) and that changes geared toward later start times increase the likelihood that students will acquire the recommended sleep leading to better physical and mental health outcomes and positively impacting a variety of factors that affect student achievement (Barnes et al., 2016; Beebe et al., 2010; Bryant & Gomez, 2015; Eaton et al., 2009; Marco et al., 2012; Wahlstrom, 2016; Wheaton et al., 2016; Wheaton et al., 2015; Winsler et al., 2014). However, despite this research and recommendations from the AAP, data from the CDC indicated that “the average start time for middle and high schools in the United States is 8:03 a.m., with fewer than 18% of schools starting at or after 8:30 a.m.” (Hale & Troxel, 2018, p. 600). Furthermore, data indicated that only 7.6% of high school students sleep ≥ 9 hours per night, and 69% sleep less than seven hours per night on school nights (Winsler et al., 2014).

When considering transportation mode, parents indicated that they will choose the most efficient mode of transportation to school in an effort to save time (Ewing et al., 2004; Faulkner et al., 2010; McDonald, 2007; McDonald & Aalborg, 2009; Westman et al., 2017). Socioeconomic and racial barriers may impact transportation mode choice thereby creating a sleep disparity for students from historically marginalized populations (Ewing et al., 2004; McDonald, 2007; McDonald & Aalborg, 2009; Westman et al., 2017). As a result, parents, students, educators, and policymakers should consider the impact of long and/or inefficient transportation routines and their potential impacts on disadvantaged populations and enact procedures that ensure sleep equity across all transportation modes (Adam et al., 2007; Pereira et al., 2012; Pradhan & Sinha, 2017).
Summary

This chapter reviewed the literature related to the biological and societal factors that impact adolescent sleep and the impact of sleep on physical health, mental health, academic achievement, and other factors that impact academic achievement in adolescents. It also provided a research-based recommendation for adolescent sleep and identified school start times, and more specifically, factors that impact wake time such as transportation mode, as the primary factor limiting adolescent sleep. Finally, this chapter further explained the impact of an inefficient transportation system in the Sleepy Valley School Division on adolescent sleep and hypothesized that this phenomenon is disproportionately impacting students from historically disadvantaged populations, putting these students at further risk and increasing the disparity between these groups and their affluent peers.

The following chapter identifies and explains the inquiry methods and the rationale for the chosen research approach. The chapter also more clearly describes the problem of practice, the problem setting, and the characteristics of the study participants. Finally, Chapter Three provides a thorough description of the data collection and analysis methods, the trustworthiness of this study, and an explanation of any limitations or delimitations of this research.
CHAPTER THREE: METHODOLOGY

Introduction

The purpose of this research study was to determine the relationship between student sleep and morning transportation mode choice for students in grades 9-12 at Sleepy Valley High School. The study also examined the relationship between race and/or socioeconomic status and selected morning transportation method to determine to what extent, if any, students from low socioeconomic backgrounds and minority populations are disproportionally affected by the district’s pupil transportation system. Additionally, the study attempted to control for factors that might also influence the dependent variables by comparing data between students who ride the bus and an equated sample of the car-rider population that is demographically similar to the bus-rider population. Characteristics such as grade level, gender, race, socioeconomic status, and eligibility for special education services were considered to ensure that the treatment group (bus riders) closely resembled the control group (car riders) to control for the impact of these factors on student mental health, attendance, discipline, and academic achievement.

The existing research that teens are biologically conditioned to go to sleep later and sleep later into the morning because of changes in the mechanisms that control sleep was compelling (Barnes et al., 2016; Bryant & Gomez, 2015). There was also evidence that school start times and transportation times affect students’ ability to acquire adequate sleep (Carrell et al., 2011; Thacher & Onyper, 2016; Wahlstrom, 2016) and that changes geared toward later start times increase the likelihood that students will acquire the recommended sleep, leading to better physical and mental health outcomes and positively impacting a variety of factors that affect student achievement (Barnes et al., 2016; Beebe et al., 2010; Bryant & Gomez, 2015; Eaton et al., 2010; Marco et al., 2012; Wahlstrom, 2016; Wheaton et al., 2016; Wheaton et al., 2015;
Winsler et al., 2014). This study highlights the impact of transportation routines (route start time) on wake time and its impact on student sleep, an area of study that was less evident in the research literature. While the literature review revealed abundant research on the impact of school start times on student sleep, the literature connecting student sleep to morning transportation method was scant. Including this information should inform and encourage school divisions to consider a variety of practices and procedures, in addition to school start times, that may limit students’ opportunity to acquire the recommended amount of sleep.

This study also examined the factors that impact morning transportation mode choice to determine the relationship between mode choice and socioeconomic status and/or race. While most of the research associated with preferred transportation mode was related to interest in students resuming active modes of transportation like biking and walking, this research did offer some insight into the factors that influence mode choice and suggested that one of the key factors affecting mode choice is time, or more specifically, the influence transportation mode choice has on wake time (Ewing et al., 2004; Faulkner et al., 2010; McDonald, 2007; McDonald & Aalborg, 2009; Westman et al., 2017).

When asked about their choice for their children to walk or to ride in a private vehicle or drive, parents repeatedly reported that they tend to choose the most efficient mode of travel to school if they have a choice. More specifically, parents cited the impact of travel choice on their morning routine and wake time, further explaining that a choice that would take longer, such as walking, would just require getting up earlier (Faulkner et al., 2010). McDonald (2007) reported that travel time has the strongest influence on the decision to walk to school and that, as travel time increases, students are less likely to walk. In fact, 75% of parents who drove their children less than two miles to school cited the savings of 5-10 minutes in the morning as their primary
reason for choosing to drive, explaining that they could use the time savings for additional sleep (McDonald & Aalborg, 2009).

While the research suggested that parents and students consider transportation time when deciding transportation mode, are there other factors that impact the opportunity for families to choose the most time-efficient transportation option? More specifically, are there factors that prevent some families from making the most time-efficient choice for their children and are those factors related to socioeconomic status? The research suggested that there are factors that limit choice and that there is a relationship between these factors and socioeconomic status. In fact, the research indicated that the children of well-educated parents with higher income levels are more likely to travel to school by car (Ewing et al., 2004; McDonald, 2007; McDonald & Aalborg, 2009; Westman et al., 2017). McDonald (2007) reported that increases in income lead to declines in walking and increases students being driven to school. Factors that influence mode choice include car ownership and the number of licensed drivers in the home, both of which are directly related to socioeconomic factors (Ewing et al., 2004; McDonald, 2007; McDonald & Aalborg, 2009; Westman et al., 2017). While connections to race were not as clear in the research, in studies that examined morning transportation mode choice, it was reported “that minority and low-income youth walk to school at rates two to three times those of White students” (McDonald & Aalborg, 2009, p. 340). However, this research further indicated that racial variation in mode choice “is mostly explained by factors such as household income, density, and neighborhood composition” (McDonald, 2007, p. 29).

Finally, there is limited research that suggested that African-American, Latino, and students from low-socioeconomic backgrounds are less likely to acquire the recommended hours of sleep when compared to their peers (Buckhalt, 2011; Winsler et al., 2014). If this problem of
practice demonstrates that division transportation routines create a sleep disparity for participants, and if students from African-American, Latino, and economically disadvantaged populations are overrepresented in the AM-BUS-RIDER group, it could shed light on division practices and procedures that impact achievement for these populations. This could encourage school divisions to shift start times and transportation routines to be more congruent with recommendations from the AAP and the CDC and ensure that all children have access to a fair, equitable, and high-quality education (ESSA, 1965).

**Research Questions**

This study proposed to answer the following three research questions:

1. How does morning transportation mode choice impact student sleep?
2. What are the factors that impact transportation mode choice, and are these factors disproportionally impacting students according to their race/ethnicity and/or socioeconomic status?
3. What is the relationship between student sleep and students’ mental health, academic achievement, discipline, and attendance?

By answering these three questions, the researcher endeavored to gain a better understanding of the relationship between student transportation mode choice and student sleep to assess the impact of factors, in addition to school start time, that impact student sleep. Additionally, this study sought to identify the factors that impact mode choice and to determine to what degree, if any, specific groups of students are disproportionally impacted by inefficient transportation routines at Sleepy Valley High School. Finally, this research further investigated the relationship between student sleep and academic achievement, discipline, attendance, and mental well-being.
Rationale

According to Creswell (2014), “Quantitative research is an approach for testing objective theories by examining the relationship among variables. These variables, in turn, can be measured, typically on instruments, so that numbered data can be analyzed using statistical procedures” (p. 4). This research study used a post-facto comparative design approach (Abbot, 2011) to examine the relationship between morning transportation mode choice and student sleep. While this study collected data that did not already exist through a student survey, the survey merely captured and stores existing data related to behaviors that had occurred in the past. In this case, the students report behaviors they had previously exhibited in the recent past on the student survey. In addition, the archival data collected from the Sleepy Valley Student Information Management System was data that already existed. As such, the primary focus of this study was to compare differences in existing groups of students, AM BUS RIDERS and AM CAR RIDERS, using data that already existed or survey data on behaviors that had already occurred (Abbott, 2011).

Additionally, a causal-comparative quantitative research approach was used to examine the relationship between students’ transportation mode choice and their race, socioeconomic status, and ethnicity. According to Creswell (2014), causal-comparative research is a type of nonexperimental research that “compares two or more groups in terms of a cause that has already occurred” (p. 12). As it applies to this problem of practice, a causal-comparative research approach examined the relationship between a student’s race, socioeconomic status, and ethnicity and his or her AM transportation mode choice.

Finally, a correlational-design approach (Creswell, 2014) was used to test the established theory that sleep deficits impact students’ mental health, academic achievement, discipline, and
attendance (Winsler et al., 2014). According to Creswell (2014), researchers use a correlational design to describe the relationship between variables. As it applies to this study, a correlational-design approach examined the relationship between students’ AM transportation mode choice and absences, suspensions, grades, depressed mood, and suicidal ideation.

These research approaches are based on the postpositivist worldview that causes influence outcomes (Creswell, 2014). When applied to this problem of practice, a postpositive worldview assumes that, in this setting, race and socioeconomic status impact transportation mode choice, that transportation mode choice impacts student sleep, and that sleep impacts student achievement, discipline, attendance, and mental health. This approach assumed that quantitative research methods could measure and analyze student sleep by transportation mode choice, the relationship between race, socioeconomic status, and ethnicity and transportation mode choice, and the impact of student sleep on student achievement (grades), discipline (referrals/suspensions), attendance (absences/tardies), and mental health and well-being.

Problem Setting/Context

The Sleepy Valley School Division is an urban/suburban public school division that serves approximately 4,000 students in grades K-12 who reside in the City of Sleepy Valley. The City of Sleepy Valley is an independent city of approximately 25,000 residents located on the southern border of Random City (100,000), the principal municipality of the Random Metropolitan Statistical Area, which includes four counties with an estimated total population of 309,000. The school division consists of six schools, four elementary schools (grades K-5), one middle school (grades 6-8), and one high school (grades 9-12). According to information available through the Sleepy Valley Schools’ Student Information Management System on March 25, 2019, 74% of Sleepy Valley School Division students are Caucasian, 17%
are African American, 5% are Hispanic, 3% are Asian, and <1% are American Indian or Pacific Islander. Approximately 35% are classified as disadvantaged as indicated by receiving free or reduced meals.

The Sleepy Valley Schools transportation system consists of three bus schedules, one for high-school students, one for middle-school students, and one for elementary-school students. Because of a similar start time for elementary schools (7:45 a.m.) and the high school (7:50 a.m.), and a finite number of buses and drivers, high-school bus routes start considerably earlier than routes that serve the elementary schools and middle school in order to complete their routes in time to return to start the elementary routes. In fact, some high-school bus routes start as early as 6:20 a.m. and arrive at Sleepy Valley High School as early as 7:00 a.m., approximately 55 minutes before students are required to begin their day. It is likely that this results in a significant difference in the wake time for students who ride the school bus when compared to students who arrive at school by private transportation. It is also likely that an inefficient transportation program impacts disadvantaged students at a higher rate based on the assumption that disadvantaged students may be less likely to have options with regard to transportation to school and could be overrepresented in the bus-rider population.

In the early 1990s, research began to indicate that teenagers have different sleep patterns from those of children and adults (Wahlstrom, 2002). In fact, research indicated that adolescents experience a sleep-wake phase delay of almost 2 hr relative to their sleep cycles in middle childhood as a result of a delay in nocturnal melatonin secretion and a shift to an evening preference which result in difficulty falling asleep earlier (AAP, 2014). This delay is caused by developmental changes to two sleep-wake mechanisms in adolescents: homeostatic sleep drive and circadian rhythm (Bryant & Gomez, 2015). Research indicated that changes to these sleep
mechanisms cause teens to stay up later and experience difficulty falling asleep (Bryant & Gomez, 2015). When combined with early wake times, the sleep phase delay may result in a significant sleep deficit for students who ride the bus. Research also supported that disadvantaged students and students from minority populations are less likely to have support for healthy sleep habits in the home because of a lack of routine and structure (Marco et al., 2012), increasing the likelihood that students from these populations are sleep deprived.

This setting provided the unique opportunity to measure the impact of transportation mode on student sleep and to identify the factors that impact mode choice for students (1,273) at Sleepy Valley High School.

**Research Sample and Data Sources**

This problem of practice included the entire student population in grades 9-12 at Sleepy Valley High School consisting of 1,273 students. Sleepy Valley High School is the only high school in the Sleepy Valley School Division where the problem setting outlined above exists. In my role as the Assistant Superintendent, I have access to the entire student population and regularly administer student and parent surveys via Google Forms. The descriptive statistics for the student population is provided in Table 3.1.
Table 3.1
*Descriptive Statistics for Students at Sleepy Valley High School*

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>641</td>
<td>50</td>
</tr>
<tr>
<td>Female</td>
<td>632</td>
<td>50</td>
</tr>
<tr>
<td><strong>Grade</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>350</td>
<td>27</td>
</tr>
<tr>
<td>10</td>
<td>311</td>
<td>24</td>
</tr>
<tr>
<td>11</td>
<td>320</td>
<td>25</td>
</tr>
<tr>
<td>12</td>
<td>292</td>
<td>23</td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>987</td>
<td>78</td>
</tr>
<tr>
<td>Black</td>
<td>189</td>
<td>15</td>
</tr>
<tr>
<td>Hispanic</td>
<td>52</td>
<td>4</td>
</tr>
<tr>
<td>Asian</td>
<td>39</td>
<td>3</td>
</tr>
<tr>
<td>Other</td>
<td>6</td>
<td>&lt;1</td>
</tr>
<tr>
<td><strong>Socio-Economic Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disadvantaged</td>
<td>389</td>
<td>31</td>
</tr>
<tr>
<td>Non-Disadvantaged</td>
<td>884</td>
<td>69</td>
</tr>
</tbody>
</table>

Note. Total of percentages may not equal 100 due to rounding. Socioeconomic status is determined by eligibility for free/reduced-priced meals.

In addition to data that was collected directly from the student population through a student survey, demographic, socioeconomic, achievement, attendance, and discipline (suspensions) data were collected from the Sleepy Valley Student Information Management System.
Data Collection Methods

All students in grades 9-12 at Sleepy Valley High School were invited to participate in the research study. The researcher provided an overview to students through a brief presentation in their English classes at Sleepy Valley High School using the Classroom Script (Appendix A) and provided each student with the School Transportation Survey Parental Informed Consent Form. Parents and students also received the same information and the informed consent form (Appendix B) via email on the day that the information was provided to students in class. Students received numerous reminders from their English teachers, by announcement at school, and by email to return their completed consent forms. Students and parents who did not return a signed consent form received a second invitation to participate on the Monday following the initial due date of the consent forms. A third and final invitation to participate was provided approximately one week after the original due date.

All completed consent forms (504) were collected and logged into an Excel spreadsheet which included the students’ Sleepy Valley school-issued email address. Students who returned a completed consent form were invited to complete a 12 question student survey (Appendix C) delivered online using Google Forms. The use of special-purpose surveys is an established research method frequently used to collect, quantify, and analyze information about a population that does not already exist (Fowler, 2014). The survey link was delivered to each student using his or her Sleepy Valley Schools email address. The students were directed to access the email on their school-issued Chromebook and complete the survey on a designated date at a specific time to ensure a high response rate. Students who did not complete the survey received a second email reminder approximately one week later and their third and final reminder fourteen days later. The survey collected the students’ school-division issued email account address. This
allowed for the collection of student-specific demographic, socioeconomic, attendance, discipline, and achievement data from the division’s student information management system.

Question one identified the student’s primary mode of transportation to school in the morning. Questions two through four were used to calculate each student’s nightly and weekly sleep by asking students to report their bedtime (2), estimate how long it typically takes them to fall asleep (3), and what time they wake on school days (4). Questions five through eight were used to determine the level of support at home for sleep by asking students to indicate a parent-set bedtime (5), the availability of a parent to support night routines (6), the availability of a parent to support morning routines (7), and the method the student uses to wake up on school mornings (8). Questions 9-11 further informed the factors that impact transportation mode choice. Question nine asked students to list the factors that impact their morning transportation mode choice according to the mode (bus/car) they selected on question one. Questions 10 and 11 asked students to indicate the transportation mode they would choose if given the option and collected information regarding the factors that influenced their choice. Question 12 was taken directly from the Centers for Disease Control (CDC) Youth Risk Behavior Survey (YRBS) and asked students if they felt sad or hopeless every day for at least two weeks during the previous six months to the point that they had stopped participating in their usual activities. The results of this question allowed for an analysis of the impact of transportation mode choice on students’ mental health.

Survey questions one through four provided sleep totals for each student according to his or her transportation mode choice, providing the data necessary to answer research question number one. Survey questions one, and 9-11 provided information related to the factors that impact transportation mode choice and when combined with each student’s race and
socioeconomic status collected from the division’s student information management system, provided information for analysis to answer research question number two. Finally, each student’s calculated sleep time was associated with his or her attendance (absences/tardies), discipline data (suspensions), achievement data (grades), and self-reported mental health (survey question 12) to provide data to answer research question number three. The survey also provided information related to parent-set bedtimes and support for sleep based on these same demographic categories, providing additional information related to research questions one and three.

In addition to the administration of the student survey and data collected from the Sleepy Valley Student Information Management System, student and parent focus groups were conducted to add contextual information to the survey results (see Appendicies D-G for a list of focus group questions). A series of four focus group sessions were conducted. The four focus groups consisted of five students who ride the bus to school (group one), five students who ride in a privately owned vehicle (group two), five parents whose children ride the bus (group three), and five parents whose children ride in a privately owned vehicle (group four). The results of the focus groups were used to further inform and add context to the survey data related to the impact of transportation mode choice on student sleep (research question one) and the factors that impact transportation mode choice (research question two).

Data Analysis Methods

After completing the survey, students were labeled as AM BUS RIDERS or as AM CAR RIDERS. The survey results for students who indicated that they use some other modes of transportation were eliminated. Once all survey respondents were classified or eliminated, each remaining student’s race, ethnicity, socioeconomic status (free/reduced lunch status), attendance
data (absences), discipline data (suspensions), and academic achievement data (grades) was imported into an Excel spreadsheet from the Sleepy Valley High School Student Information Management System and associated with his or her survey response for statistical analysis. A t-test was used to compare the calculated sleep time for the AM-BUS-RIDER group to the AM-CAR-RIDER group to determine the impact of participating in the division’s transportation program on student sleep (research question one). Similarly, a series of t-tests were conducted to compare absence, suspensions, grades, and mental health data between the AM-BUS-RIDER group and the AM-CAR-RIDER group to assess the impact of student-selected AM transportation method, and any associated sleep disparity, on attendance, discipline, achievement, and mental health. A second series of t-tests were conducted comparing the absences, suspensions, grades, and mental health data between the AM-BUS-RIDER group and an equated sample from the AM-CAR-RIDER group in an attempt to control for other factors such as race and/or socioeconomic status that have been shown to affect student achievement and factors that impact achievement (Turner, Rubie-Davies, & Webber, 2015).

In addition, chi-square analyses were conducted to determine if there is a relationship between race, socioeconomic status, ethnicity, and AM transportation mode. Chi-square is a statistical analysis frequently used in post-facto research designs to examine nominal or categorical data to determine if frequency patterns suggest a relationship between variables (Abbott, 2011). In this research study, one 3x2 chi-square analysis was conducted to determine if a statistically significant relationship exists between race and AM transportation mode choice, and two 2X2 chi-square analyses were conducted to determine if a statistically significant relationship exists between ethnicity or socioeconomic status and AM transportation mode.
choice, informing research question two. Table 3.2 provides an overview of the data that was collected, the source of the data, and the statistical analysis that was used to analyze the data.

Table 3.2
*Data Elements and Statistical Analysis*

<table>
<thead>
<tr>
<th>Variables</th>
<th>Groups</th>
<th>Source</th>
<th>Statistical Analysis Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleep Time</td>
<td>CAR RIDER/BUS RIDER</td>
<td>Survey</td>
<td><em>t</em>-test</td>
</tr>
<tr>
<td>Attendance</td>
<td>CAR RIDER/BUS RIDER</td>
<td>SVS SIMS</td>
<td><em>t</em>-test</td>
</tr>
<tr>
<td>Suspensions</td>
<td>CAR RIDER/BUS RIDER</td>
<td>SVS SIMS</td>
<td><em>t</em>-test</td>
</tr>
<tr>
<td>GPA</td>
<td>CAR RIDER/BUS RIDER</td>
<td>SVS SIMS</td>
<td><em>t</em>-test</td>
</tr>
<tr>
<td>Mental Health</td>
<td>CAR RIDER/BUS RIDER</td>
<td>Survey</td>
<td><em>t</em>-test</td>
</tr>
<tr>
<td>Sleep Time</td>
<td>EQ CAR RIDER/BUS RIDER</td>
<td>Survey</td>
<td><em>t</em>-test</td>
</tr>
<tr>
<td>Attendance</td>
<td>EQ CAR RIDER/BUS RIDER</td>
<td>SVS SIMS</td>
<td><em>t</em>-test</td>
</tr>
<tr>
<td>Suspensions</td>
<td>EQ CAR RIDER/BUS RIDER</td>
<td>SVS SIMS</td>
<td><em>t</em>-test</td>
</tr>
<tr>
<td>Grades</td>
<td>EQ CAR RIDER/BUS RIDER</td>
<td>SVS SIMS</td>
<td><em>t</em>-test</td>
</tr>
<tr>
<td>Mental Health</td>
<td>EQ CAR RIDER/BUS RIDER</td>
<td>Survey</td>
<td><em>t</em>-test</td>
</tr>
<tr>
<td>Race/TMC</td>
<td>CAR RIDER/BUS RIDER</td>
<td>Survey/ SVS SIMS</td>
<td>chi-square</td>
</tr>
<tr>
<td>Ethnicity/TMC</td>
<td>CAR RIDER/BUS RIDER</td>
<td>Survey/ SVS SIMS</td>
<td>chi-square</td>
</tr>
<tr>
<td>SES/TMC</td>
<td>CAR RIDER/BUS RIDER</td>
<td>Survey/ SVS SIMS</td>
<td>chi-square</td>
</tr>
</tbody>
</table>

EQ CAR RIDER= Equated Sample from the AM CAR RIDER group, SVS SIMS= Sleepy Valley Schools Student Information Management System, TMC= Transportation Mode Choice, SES= Socioeconomic status as defined by eligibility for free or reduced-price meals
Ethical Issues and Safeguards

Ethical regulation in research is the result of medical and experimental research that imposed on, intruded in, and in some cases even abused historically marginalized and vulnerable populations (Ravitch & Carl, 2016). As a result, universities and research institutions created institutional review boards, ethics committees, and codes of ethics to ensure that researchers protect the welfare of their participants. While some researchers might look at these entities and the regulations they represent as barriers to be overcome, I believe that these organizations are important resources to inexperienced researchers. As such, I worked closely with my Dissertation Committee Chair and the University of Arkansas’ Institutional Review Board (IRB) to identify any ethical issues with my research proposal and implement the necessary safeguards to protect my study participants.

The first consideration with regard to ethical considerations for my study was communication. I made every effort to ensure that I informed participants and, in the case of minors, their parents, accurate information related to internal transparency such as, what they were being asked to do as a result of their participation, how much time it would take, and any potential risks associated with their participation. I also identified anyone who would have access to data, how it will be collected, analyzed, stored, and reported. Finally, I clearly communicated the purpose of the research, the research methods, and who would have access to research documents (Ravitch & Carl, 2016). I believe that thorough and accurate communication creates the transparency of research that leads to truly informed consent, and assent, in the case of minors. I did not anticipate any issues with participant safety.

Ravitch and Carl (2016) pointed out that IRBs have identified specific populations as vulnerable. These populations include children and can be expanded to include historically
marginalized populations such as minorities and the economically disadvantaged. One of the concerns Ravitch and Carl (2016) posited with regard to researching these populations is the potential for projecting stereotypes and/or deficits on these individuals or groups. This has the potential to have detrimental emotional or physiological impacts on study participants.

In order to prevent this research from impacting study participants, I was careful not to generalize research findings to entire populations of students or marginalized student groups. Instead, I attempted to focus on the data as they applied to the study and the study participants. For example, instead of generalizing results to all economically-disadvantaged students or Black students, I simply reported the findings and compared findings between demographic groups. As an example, instead of reporting that Black students lack support at home for good sleep habits, I report that --% of Black students reported that there is support at home for good sleep habits compared to --% reported by White students and --% reported by Hispanic students.

Two additional ethical considerations for this research were confidentiality and anonymity. Ravitch and Carl (2016) defined confidentiality as “how and what data related to participants will be disseminated,” while “anonymity means that there would be no way for anyone to identify an individual within a sample of participants because data and resulting reports are aggregated and not individually contextualized or displayed” (p. 363). For the purposes of my study, I was careful not to use any personally identifiable information. This is very important because of the fact that I was examining the impact of socioeconomic status on sleep and transportation mode. Socioeconomic information is available as it relates to federal free and reduced lunch qualifications and is restricted to very few individuals within the division.

To ensure confidentiality and anonymity, once I identified the students who participate in the division’s transportation program and students who arrive at school by car, and I downloaded
demographic, socioeconomic, attendance, discipline, and achievement data from the Sleepy Valley Student Information Management System (SVSIMS), and associated it with each student’s survey response, I removed the student identification numbers prior to saving the data to any device. From that point forward, all data was compared and reported by group and did not contain any personally identifiable information. To ensure that a reader cannot deduce the identity of any participant, I removed any demographic categories with fewer than 10 participants.

**Validity and Reliability**

Quantitative researchers attempt to use control groups, random sampling, explicit hypotheses, and statistical analysis to address threats of validity in their research (Maxwell, 2013). Typically, researchers use a variety of sources and instruments to collect data. The accuracy of their sources and the validity of their instruments are critical because the analysis of the data will ultimately inform their research conclusions (Zohrabi, 2013). Most of the data for my research was collected from the Sleepy Valley Student Information Management System (SVSIMS). Our division employs a data manager who maintains, verifies, and reports this information to the Virginia Department of Education three times per year. As such, this information is considered valid and reliable.

In addition to the information available to me in the SVSIMS, I conducted an online survey to quantify student nightly and weekly sleep for bus riders and non-bus-riders. I also collected the participants’ age, race, grade, gender, ethnicity, and information related to sleep hygiene and parental support for sleep. The specific consideration for validity and reliability as it relates to this survey are, if the items measure what they are intended to measure (content validity) and if repeat administrations of the survey lead to similar results (reliability) (Creswell,
To ensure validity and reliability, I piloted the survey with a random sample of students to ensure that the questions were clear, that they measured what they were intended to measure, and that the results were reliable over multiple administrations.

Creswell (2014) also identified the selection of the population as a potential threat to trustworthiness. While Creswell recommended random sampling, I intended to sample the entire Sleepy Valley High School population through an online administration of the survey instrument using a Google Form. All students who had reached the age of 18 and agree to participate and minors whose parents provided informed consent received an email with a link to the survey. Students who did not complete the survey received a second email reminder approximately one week later and their third reminder fourteen days later. This method could have potentially lead to response bias “based on the assumption that those who return surveys in the final weeks of the response period are nearly all nonrespondents” (Creswell, 2014, p. 162). I used wave analysis to examine the survey responses by submission date to see if there was any change in the average response, and I used respondent-nonrespondent checks to see if nonrespondent results were substantially different from those of respondents (Creswell, 2014).

Additional validity concerns for this study were the variety of factors that could contribute to statistically significant results between the car-rider and bus-rider groups related to attendance, discipline, and achievement. My initial assumption was that disadvantaged and minority students are over-represented in the bus-rider population. If that was the case, it would be natural to assume that any differences in attendance, suspensions, and achievement are also the result of the academic, behavioral, and attendance characteristics of these populations (Turner et al., 2015). This could lead readers to ask the question, “how do I know that sleep had anything to do with the results?” Creswell (2014) suggested that researchers use equating to
control for these variables. I used equating to create a demographically similar group of students from the non-bus-rider student group to compare to the bus-rider group to look for statistically significant differences in grades, attendance, and suspensions.

**Limitations**

There are a few limitations that might have impacted my research study. Because I was working with minors, I was required to provide informed consent and to secure consent from parents for anyone under the age of 18. While it is natural to expect some students not to participate in the study, that number is likely to increase significantly if receipt of a signed consent form from a parent is required. While this research attempted to include all 1,289 students at Sleepy Valley High School, only 504 (40%) students returned a signed consent form. The response rate could have been an indication that students and/or parents did not want to participate and did not complete the form, but was most likely the result of no response at all.

An additional limitation of my study was related to positionality and bias. I feel that there is clear evidence that adolescents shift to an evening sleep preference as a result of a delay in the biological mechanisms that control sleep (Bryant & Gomez, 2015). While I intended to be transparent in representing this research and the goals of my study, I fear that, when combined with my position and existing research readily available on this topic, this could have led students to provide answers that tell me what they might think I wanted to hear. To address this issue, I included a statement at the beginning of the survey explaining the importance of accurate information in research, imploring students to answer the survey as accurately and honestly as possible.

While quantitative research generally lends itself to broader application because of the nature of statistical analysis available to quantitative researchers, I feel that the application of my
research may be a limitation. The circumstances surrounding my problem of practice are very specific to my school division. In fact, the only school in the division affected by this problem is the high school and students who ride the bus to school in grades 9-12. Therefore, while I believe the research has the potential to inform the public on the impact of riding the bus to school in Sleepy Valley as it relates to sleep, the broader impact may be limited.

**Summary**

This quantitative study used a post-facto comparative design approach (Abbot, 2011) to examine the relationship between morning transportation mode choice and student sleep. In addition, a causal-comparative quantitative research approach was used to examine the relationship between students’ transportation mode choice and race, socioeconomic status, and ethnicity. Finally, a correlational-design approach (Creswell, 2014) was used to test the established theory that sleep deficits impact students’ mental health, academic achievement, discipline, and attendance (Winsler et al., 2014).

Data were collected through the administration of a 12 question student survey and from the Sleepy Valley School Division student information management system. A series of focus group interviews were conducted to confirm survey data and add depth and context to the survey responses. A series of \( t \)-tests were conducted to compare data from the AM-CAR-RIDER group and the AM-BUS-RIDER group. In addition, a second series of \( t \)-tests were conducted between the AM-BUS-RIDER group and an equated sample from the AM-CAR-RIDER group to control for other factors that could contribute to academic differences between these groups. Finally, chi-square analyses were conducted to determine if there was a relationship between race, socioeconomic status, ethnicity, and AM transportation mode.
The results of this study provided data to describe the impact of the Sleepy Valley School Division’s transportation program on student sleep for students in grades 9-12 at Sleepy Valley High School. The study examined the impact of a sleep disparity on attendance, discipline, academic achievement, and student mental health. Finally, the study highlighted any disproportionality in the AM-BUS-RIDER population to determine the impact of race, socioeconomic status, and ethnicity on AM transportation mode choice.

The following chapter restates the purpose of the study, provides a demographic breakdown of the survey participants, summarizes the survey results, reports the quantitative results of the study, and provides context and depth by reporting qualitative information collected through focus group interviews. Chapter Four is organized into three sections. The first section describes the problem of practice and provides a summary of the purpose of the research and the research design approach. The second section provides a description of the survey participants, summarizes the survey responses, and provides the results of the data analysis. The third and final section of this chapter reports how the results of the study provide answers to each of the research questions with added context by including qualitative data collected through focus group interviews.
CHAPTER FOUR: RESULTS

Background Information

Sleepy Valley High School operates on a traditional seven-period day. The first bell rings at 7:50 a.m., and students are expected to be in class by 7:55 a.m. The division’s transportation system consists of three transportation tiers, one for high school students, one for middle school students, and one for elementary students. Because of a similar start time for elementary schools (7:45 a.m.) and the high school (7:50 a.m.), high school bus routes start considerably earlier than necessary. In fact, some high school bus routes start as early as 6:15 a.m. and arrive at Sleepy Valley High School as early as 7:00 a.m., a full 55 minutes before students are required to be in class. Based on existing research, it would appear that this combination of factors could impact student sleep and may result in a sleep disparity for students who ride the bus. If a sleep disparity exists, it could have detrimental effects on physical and mental health, school attendance, behavior, and academic achievement. This is more likely to impact disadvantaged and minority students at a higher rate based on research that suggested that students from these populations are less likely to have support for healthy sleep habits in the home because of a lack of routine and structure (Marco, Wolfson, Sparling, & Azuaje, 2012).

Purpose

The purpose of this research study was to determine the relationship between student sleep and morning transportation mode choice for students in grades 9-12 at Sleepy Valley High School and the relationship between sleep and factors that impact student achievement. The study also examined the relationship between race, socioeconomic status, ethnicity, and selected morning transportation method to determine to what extent, if any, students from low
socioeconomic backgrounds and minority populations are disproportionately affected by the
district’s pupil transportation system.

This study proposed to answer the following research questions:

1. How does morning transportation mode choice impact student sleep?
2. What are the factors that impact transportation mode choice, and are these factors
disproportionally impacting students according to their race/ethnicity and/or socioeconomic
status?
3. What is the relationship between student sleep and students’ mental health, academic
achievement, discipline, and attendance?

Additionally, the study attempted to control for factors that might also influence the
dependent variables by comparing data between students who ride the bus and an equated sample
of the car-rider population that is demographically similar to the bus-rider population.
Characteristics such as grade level, gender, race, and socioeconomic status were considered to
ensure that the treatment group (bus-riders) closely resembled the control group (car-riders) to
control for the impact of these factors on student mental health, attendance, discipline, and
academic achievement.

**Research Design**

This research study used a post-facto comparative design approach (Abbot, 2011) to
examine the relationship between morning transportation mode choice and student sleep.
Additionally, a causal-comparative quantitative research approach was used to examine the
relationship between students’ transportation mode choice and their race, socioeconomic status,
and ethnicity. Finally, a correlational-design approach (Creswell, 2014) was used to test the
established theory that sleep deficits impact students’ mental health, academic achievement, discipline, and attendance (Winsler et al., 2014).

Data related to morning transportation mode choice, factors that impact mode choice, student sleep, and mental health were collected through a 12 question Student Transportation Survey (Appendix C). Demographic information and attendance, suspension, and achievement data were downloaded from the division’s student information management system. Finally, qualitative information was collected through four focus group interviews to further inform survey responses.

Survey Response Rate

All 1,273 students in grades 9-12 at Sleepy Valley High School were invited to participate in the research study. The researcher provided an overview to students through a brief presentation in their English classes at Sleepy Valley High School using the Classroom Script (Appendix A) and provided each student with the School Transportation Survey Parental Informed Consent Form. Parents and students also received the same information and the informed consent form (Appendix B) via email on the day that the information was provided to students in class. Students received numerous reminders from their English teachers, by announcement at school, and by email to return their completed consent forms. Students and parents who did not return a signed consent form received a second invitation to participate on the Monday following the initial due date of the consent forms. A third and final invitation to participate was provided approximately one week after the original due date. As a result of these efforts, 504 students (40%) returned signed consent forms.

Completed consent forms (504) were collected and logged into an Excel spreadsheet which included the students’ Sleepy Valley school-issued email address. Students who returned
a completed consent form were invited to complete a 12 question student survey (Appendix C) delivered online using Google Forms by email. The students were directed to access the email on their school-issued Chromebook and complete the survey on a designated date at a specific time to ensure a high response rate. Students who did not complete the survey received a second email reminder approximately one week later and their third and final reminder fourteen days later. As a result, 443 of the 504 students who returned consent forms (88%) completed the student transportation survey. The survey collected the students’ school-division issued email account address. This allowed for the collection of student-specific demographic, socioeconomic, attendance, discipline, and achievement data from the division’s student information management system.

Based on a population size of 1,273 students, using the survey sample size calculation of sample size = (Distribution of 50%) / ((Margin of Error% / Confidence Level Score)Squared) (Gibson, 2016), a survey response rate of 296 students provides a confidence level of 95% with a margin of error of 5%. From the total population of 1,273 students in grades 9-12, 504 students returned a consent form, and 443 students completed the online survey. Eleven survey responses were removed because they were incomplete, four surveys were removed because the respondents selected a morning mode of transportation other than the bus or a private vehicle, and three surveys were removed because the respondents indicated that their morning mode of transportation varied by week. After eliminating these surveys, there were 425 completed surveys available for analysis representing approximately 33% of the overall student population and 84% of the population of students who returned a signed consent form. The descriptive statistics for the survey respondents are provided in Table 4.1.
## Table 4.1
### Descriptive Statistics for Survey Respondents

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grade</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>129</td>
<td>30</td>
</tr>
<tr>
<td>10</td>
<td>109</td>
<td>26</td>
</tr>
<tr>
<td>11</td>
<td>92</td>
<td>22</td>
</tr>
<tr>
<td>12</td>
<td>95</td>
<td>22</td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>353</td>
<td>83</td>
</tr>
<tr>
<td>Black</td>
<td>50</td>
<td>12</td>
</tr>
<tr>
<td>Asian</td>
<td>17</td>
<td>4</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td><strong>Socio-Economic Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disadvantaged</td>
<td>98</td>
<td>23</td>
</tr>
<tr>
<td>Non-Disadvantaged</td>
<td>327</td>
<td>77</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>26</td>
<td>6</td>
</tr>
<tr>
<td>Non-Hispanic</td>
<td>399</td>
<td>94</td>
</tr>
</tbody>
</table>

*Note. Total of percentages may not equal 100 due to rounding. Socioeconomic status is determined by eligibility for free/reduced-priced meals.*

When compared to the overall demographic profile attributed to the total student population in Table 3.1, survey respondents appeared to be younger (56% freshmen and sophomores vs. 51%), less diverse (83% white vs. 78%), and less socioeconomically disadvantaged (23% disadvantaged vs. 31%).
Survey Data and Analysis

Question one of the Student Transportation Survey asked students to choose the transportation method they use to arrive at school in the morning from a list of possible choices that included the bus, a privately owned vehicle, walking, cycling, and other. The question instructed the students to select the method they use most often and to answer all the remaining questions based on their answer to the question. The survey data indicate that 130 (30.6%) student respondents ride the bus, and 295 (69.4%) arrive at school in a privately owned vehicle. Table 4.2 outlines the descriptive statistics by morning transportation mode choice.

Table 4.2

<table>
<thead>
<tr>
<th>Demographic Category</th>
<th>Bus</th>
<th>%</th>
<th>Car</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Race</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>91</td>
<td>25.7%</td>
<td>262</td>
<td>74.2%</td>
</tr>
<tr>
<td>Black</td>
<td>25</td>
<td>50%</td>
<td>25</td>
<td>50%</td>
</tr>
<tr>
<td>Asian</td>
<td>10</td>
<td>59%</td>
<td>7</td>
<td>41%</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
<td>60%</td>
<td>2</td>
<td>40%</td>
</tr>
<tr>
<td><strong>Socio-Economic Status</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disadvantaged</td>
<td>59</td>
<td>60%</td>
<td>39</td>
<td>40%</td>
</tr>
<tr>
<td>Non-Disadvantaged</td>
<td>70</td>
<td>21.4%</td>
<td>257</td>
<td>79%</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>15</td>
<td>62.5%</td>
<td>9</td>
<td>37.5%</td>
</tr>
<tr>
<td>Non-Hispanic</td>
<td>114</td>
<td>28.4%</td>
<td>287</td>
<td>72%</td>
</tr>
</tbody>
</table>

Note. Total of percentages may not equal 100 due to rounding. Socioeconomic status is determined by eligibility for free/reduced-price meals.

Using each respondent’s school-division-assigned email address, race, socioeconomic status (eligibility of free or reduced-price meals), and ethnicity were collected from the Sleepy
Valley Student Information System for analysis to determine if a relationship existed between race, socio-economic status, ethnicity, and morning transportation mode choice (research question two).

A 3x2 chi-square test of independence was performed to examine the relation between race and morning transportation mode choice. The relation between these variables was significant, $X^2 (2, N = 420) = 19.24, p = .000066$. Non-white students are more likely to ride the bus. A 2x2 chi-square test of independence was also performed to examine the relationship between socioeconomic status and morning transportation mode choice. The relation between these variables was significant, $X^2 (1, N = 425) = 53.69, p = .00001$. Students who are economically disadvantaged are more likely to ride the bus. Finally, an additional 2x2 chi-square test of independence was also performed to examine the relationship between ethnicity and morning transportation mode choice. The relation between these variables was also significant, $X^2 (1, N = 425) = 12.43, p = .00042$. Hispanic students are more likely to ride the bus than their non-Hispanic peers.

Question two asked students to record their bedtime on school nights. The question further instructed students to enter a time that best represents the time that they go to bed most often, and asked students not to list a range of times. A $t$-test was used to determine if there was a difference in bedtimes between car riders and bus riders. Based on a $t$-critical two-tail of 1.97 the results indicated that the mean bedtime of car riders ($M=10:57$ PM, $SD=1:16:28$) was not significantly different from the mean bedtime of bus riders ($M=10:47$ PM, $SD=1:01:33$), $t=.10, p >.05, \alpha=.05$.

Question three asked students to report the number of minutes it typically takes them to fall asleep. The question further instructed students to enter a specific number of minutes that
they believe best represents how long it typically takes them to fall asleep and asked the students not to enter a range of minutes. A *t*-test was used to determine if there was a difference in the number of minutes it takes to fall asleep when comparing car riders and bus riders. Based on a *t-critical two-tail* of 1.97 the results indicated that the mean number of minutes required to fall asleep for car riders ($M=25.87, SD=26.63$) was not significantly different from the mean number of minutes required to fall asleep for bus riders ($M=10:47 \text{ PM}, SD=30.56$), $t=.19, p>.05, \alpha=.05$.

Question four asked students to record their wake time on school nights. The question further instructed students to enter a time that best represents the time that they typically wake, and asked students not to list a range of times. A *t*-test was used to determine if there was a difference in wake times between car riders and bus riders. Based on a *t-critical two-tail* of 1.97 the results indicated that the mean wake time of car riders ($M=6:32:36 \text{ AM}, SD=0:30:04$) was significantly different from the mean wake time of bus riders ($M=5:55:20 \text{ AM}, SD=0:23:34$), $t=9.62E-31, p<.05, \alpha=.05$.

Questions two through four were used to calculate survey respondents, sleep opportunity based on their reported bedtime and their wake time, and their perceived sleep based on their bedtime and wake time minus the number of minutes they reported they typically need to fall asleep. *T*-tests were used to determine if there were differences in sleep opportunity and perceived sleep between car riders and bus riders. Based on a *t-critical two-tail* of 1.97 the results indicated that the mean sleep opportunity for car riders ($M=7:33:26, SD=1:02:28$) was significantly different from the mean sleep opportunity for bus riders ($M=7:08:21, SD=1:17:29$), $t=.0004, p<.05, \alpha=.05$. Similarly, the mean hours of perceived sleep (sleep hours minus minutes until sleep) acquired by car riders ($M=7:07:44, SD=1:08:05$) was significantly different from the
mean hours of perceived sleep acquired by bus riders \((M=6:39:44, SD=1:24:48), t=.0003, p < .05, \alpha=.05\).

Questions five, six, and seven asked students to report qualitative information related to support for sleep in the home. Question five asked students if they have a parent-set bedtime (yes/no), question six asked students if they have an adult at home on school nights to make sure they go to bed (yes/no), and question seven asked students if there is an adult at home in the morning to support their morning routine (yes/no). Table 4.3 provides a demographic breakdown of survey responses to question 5-7.

<table>
<thead>
<tr>
<th>Table 4.3</th>
<th>Percentage of Students Who Reported Support for Sleep by Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographic Categories</td>
<td>Parent-Set Bedtime</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Disadvantaged</td>
<td>33%</td>
</tr>
<tr>
<td>Non-Disadvantaged</td>
<td>26%</td>
</tr>
<tr>
<td>White</td>
<td>28%</td>
</tr>
<tr>
<td>Black</td>
<td>26%</td>
</tr>
<tr>
<td>Asian</td>
<td>41%</td>
</tr>
<tr>
<td>Bus-Riders</td>
<td>35%</td>
</tr>
<tr>
<td>Car-Riders</td>
<td>24%</td>
</tr>
</tbody>
</table>

Asking students to indicate if they had a parent-set bedtime also provided the opportunity to analyze the impact of parent-set bedtimes on bedtimes and on student sleep. One hundred-seventeen students (27.5%) reported that they have a parent-set bedtime, and 308 students (72.5%) reported that they did not. A \(t\)-test was used to determine if there was a difference in bedtimes between students who reported a parent-set bedtime and students who did not. Based
on a *t-critical two-tail* of 1.97 the results indicated that the mean bedtime of students who reported a parent-set bedtime ($M=10:20$ PM, $SD=0:51:04$) was significantly different from the mean bedtime of students who reported that they did not have a parent-set bedtime ($M=11:08$ PM, $SD=1:07:01$), $t=.000000000009$, $p<.05$, $\alpha=.05$.

*T*-tests were also used to determine if there was a difference in sleep opportunity and perceived sleep between students who reported a parent-set bedtime and students who reported that they did not have a parent-set bedtime. Based on a *t-critical two-tail* of 1.97 the results indicated that the mean sleep opportunity for students who reported a parent-set bedtime ($M=7:54:27$, $SD=0:50:39$) was significantly different from the mean sleep opportunity for students who reported that they did not have a parent-set bedtime ($M=7:15:40$, $SD=1:10:49$), $t=.0000001$, $p<.05$, $\alpha=.05$. Similarly, the mean hours of perceived sleep acquired by students who reported a parent-set bedtime ($M=7:28:55$, $SD=0:56:26$) was significantly different from the mean hours of perceived sleep for students who reported that they did not have a parent-set bedtime ($M=6:48:40$, $SD=1:17:30$), $t=.0000004$, $p<.05$, $\alpha=.05$.

Question eight asked students to report the method they used to wake up each morning. Seventy percent of students (299) indicated that they used an alarm clock, and 26% (111) indicated that a parent, guardian, or other responsible adult woke them up in the morning to get ready for school.

Question nine asked students to report the main reason they use the morning transportation method they selected in question number one. The main reasons reported by students who ride the bus were that they had no other option (29%), their parent works and cannot drive them to school (26%), and that it was the most convenient mode of transportation
available (17%). Approximately 10% of bus riders indicated that they rode the bus for financial reasons which included not having a car or only having one car in the family.

Car riders reported that their choice was primarily because of the early wake time associated with riding the bus (34%) and the mere fact that they had access to a vehicle and could drive (17%). Approximately 12% indicated that it was the most convenient method, and 8% enjoyed the independence/flexibility provided by this transportation method.

Question 10 asked students to select their preferred morning transportation method if they had complete control over their choice, and question 11 asked students to explain why they would choose the method they selected. Students could select from walking, biking, a car (I would drive or ride in a privately owned vehicle), or the bus. Eighty-eight percent (110) of bus riders indicated that they would choose some other method to arrive at school. Sixty-eight percent of current bus riders who selected a different method reported that the main reason given for selecting a different mode of transportation to school was related to sleeping later or longer. Only 4% of car riders (12) indicated that they would choose some other method of transportation to school.

The final question asked students, “During the past six months, did you ever feel so sad or hopeless almost every day for at least two weeks or more in a row that you stopped doing some usual activities?” Students responded by selecting yes or no. Fifty-five students (42%) who rode the bus to school indicated that they had felt so sad or hopeless almost every day for at least two weeks or more in a row that they had stopped doing some usual activities in the past six months. Ninety-four students (32%) who ride to school in a privately owned vehicle indicated that they had felt so sad or hopeless almost every day for at least two weeks or more in a row that they had stopped doing some usual activities in the past six months.
Achievement Data and Analysis

After completing the survey, each student was labeled as an AM BUS RIDER or an AM CAR RIDER. Once all survey respondents were classified or eliminated, each student’s race, ethnicity, socioeconomic status (free/reduced lunch status), attendance data (absences), discipline data (suspensions), and academic achievement data (grades) were imported into an Excel spreadsheet from the Sleepy Valley Student Information Management System and associated with his or her survey response for statistical analysis. A series of \( t \)-tests were conducted to compare absences, suspensions, and grades (term GPA) data between the AM-BUS-RIDER group and the AM-CAR-RIDER group to assess the impact of student-selected AM transportation method, and any associated sleep disparity, on attendance, discipline, and achievement.

\( T \)-tests were used to determine if there was a difference in term GPA, suspension days, and absences when these data for car riders were compared to bus riders. Based on a \( t \)-critical two-tail of 1.97 the results indicated that the mean term GPA scores for car riders (\( M=3.60, SD=.81 \)) was significantly different from the mean term GPA scores for bus riders (\( M=3.18, SD=.98 \)), \( t=.00004, p < .05, \alpha=.05 \). However, the mean number of annual absences for car riders (\( M=7.02, SD=6.47 \)) was not significantly different from the mean number of annual absences for bus riders (\( M=6.51, SD=6.63 \)), \( t=.46, p > .05, \alpha=.05 \), and the mean number of suspension days for car riders (\( M=.20, SD=.71 \)) was not significantly different from the mean number of suspension days for bus riders (\( M=.32, SD=.99 \)), \( t=.15, p > .05, \alpha=.05 \).

In an attempt to control for other factors that might contribute to significant differences in achievement data between the car-rider group and the bus-rider group, an equated sample of students from the car-rider group that matched the demographic profile of the bus-rider group
was created at random to reassess differences in term GPA. Both samples contained the same
number of students from each racial category (Hispanic, Asian, White, Black) and the same
number of students who qualified for free and/or reduced-price school meals (38). Based on a *t-
critical two-tail* of 1.97 the results indicated that the mean term GPA scores for an equated
sample of car riders (*M*=3.49, *SD*=.85) continued to be significantly different from the mean
term GPA scores for bus riders (*M*=3.18, *SD*=.98), *t*=.02, *p* <.05, *α*=.05.

**Focus Group Data**

In addition to the administration of the student survey and data collected from the Sleepy
Valley Student Information Management System, student and parent focus groups were
conducted to add contextual information to the survey results (see Appendices D-G for a list of
focus group questions). A series of four focus group sessions were conducted. The four focus
groups consisted of five students who ride the bus to school (group one), five students who ride
in a privately owned vehicle (group two), five parents whose children ride the bus (group three),
and five parents whose children ride in a privately owned vehicle (group four). The results of the
focus groups were used to further inform and add context to the survey data related to the impact
of transportation mode choice on student sleep (research question one) and the factors that
impact transportation mode choice (research question two).

**The Impact of AM Transportation Mode on Student Sleep**

Research question one sought to determine the impact of a student’s preferred method of
transportation to school each morning on his or her acquisition of sleep. Survey questions two
(What time do you go to bed on school nights?), three (How long does it take you to fall
asleep?), and four (What time do you wake up on school days?) were used to calculate sleep
opportunity and perceived sleep acquisition for survey respondents by their morning transportation mode choice.

*T*-tests were used to determine if there was a difference in bedtimes, minutes to sleep, wake time, perceived sleep, and sleep opportunity between car riders and bus riders. As reported above, the data indicated that there is no significant difference in bedtimes and minutes to sleep between car riders and bus riders. However, the data indicated that there is a significant difference in wake times, sleep opportunity and perceived sleep between these groups of students. The mean wake time of car riders (*M*=6:32:36 AM, *SD*=0:30:04) was significantly different from the mean wake time of bus riders (*M*=5:55:20 AM, *SD*=0:23:34), *t*=9.62E-31, *p* <.05, *α*=.05. Also, the mean sleep opportunity for car riders (*M*=7:33:26, *SD*=1:02:28) was significantly different from the mean sleep opportunity for bus riders (*M*=7:08:21, *SD*=1:17:29), *t*=.0004, *p* <.05, *α*=.05. Similarly, the mean hours of perceived sleep (sleep hours minus minutes until sleep) acquired by car riders (*M*=7:07:44, *SD*=1:08:05) was significantly different from the mean hours of perceived sleep acquired by bus riders (*M*=6:39:44, *SD*=1:24:48), *t*=.0003, *p* <.05, *α*=.05. On average, car riders had approximately 25 more minutes per night available for sleep and acquire approximately 28 minutes of additional sleep per night when compared to students who ride the bus to school.

Qualitative information collected on the Student Transportation Survey and through focus group interviews appears to support the relationship between riding the bus, earlier wake times, and less sleep. Car riders reported that their AM transportation mode choice was primarily because of the early wake time associated with riding the bus (34%). In addition, 68% percent of current bus riders who indicated that they would select a different transportation method if given the choice (75), reported that the main reason for selecting a different mode of transportation to
school was related to sleeping later or longer. Similarly, car riders and the parents of car riders indicated that the opportunity to sleep later is one of the primary reasons that they ride/drive to school in a car. One parent explained, “My daughter started out riding the bus, but the bus runs so early I decided to start taking her to school. Now she gets up around 6:30 AM when before she was getting up at 5:45 AM.” Another parent added “When I realized my daughter was going to have to get up at like 5:50 (AM) to catch the bus we decided we would figure out a way to get her to school. Now she gets more sleep and has time to eat. As it was she was getting up almost an hour before anyone else in the house.” A student also added, “I rode the bus the first day of school and I was like I am not waking up that early again.”

When asked about the drawbacks to riding the bus, bus riders and their parents also cited wake time and sleep as issues. One student said, “The main drawback is sleep. The buses run way too early. My house is only like five minutes from school. There is no reason for the bus to pick me up at 6:30 AM and drop me off at school at 7:00 AM when school doesn’t start until 7:55 AM, but I don’t have any other choice.” A parent of a student who rides the bus added, “The bus routes start too early, most kids I know have to get up almost an hour earlier to ride the bus.”

Who Is Being Impacted

The goal of research question two was to examine the factors that impact transportation mode choice and determine if these factors were disproportionally impacting students according to their race/ethnicity and/or socioeconomic status. Question nine on the Student Transportation Survey asked students to report the main reason they use the morning transportation method they selected in question number one. The main reasons reported by students who ride the bus were that they had no other option (29%), their parent works and cannot drive them to school (26%),
and that it was the most convenient mode of transportation available (17%). Approximately 10% of bus riders indicated that they rode the bus for financial reasons which included not having a car or only having one car in the family. Car riders reported that their choice was primarily because of the early wake time associated with riding the bus (34%) and the mere fact that they had access to a vehicle and could drive (17%). Approximately 12% indicated that it was the most convenient method, and 8% enjoyed the independence and flexibility provided by this transportation method.

When the bus riders and their parents were asked to identify the factors that influence their choice to ride the bus to school, their responses appeared to indicate that the choice is the result of limited options. For example, one parent said, “We really just don’t have any other option. She can’t drive and there isn’t anyone who can take her.” Another parent added, “Same here, we don’t have any other option.” They also referenced conflicting work schedules. One student said, “My mom currently works three jobs so she can’t get me to school. She gets home in the morning and has to sleep.” A student added, “My mom works nights and she isn’t home when I get up in the morning to get ready for school,” a third student said, “She has to go to work at a certain time so (she can’t take me),” and another student added, “My mom is busy in the mornings so she can’t take me.”

Parents cited similar issues. One parent said, “My daughter is a sophomore and doesn’t have her license yet and there isn’t anyone who can take her to school,” another added, “I can’t drop off because of my work schedule. I work nights and don’t get home until after she leaves for school.”

As opposed to the responses of bus riders and their parents, the responses of car riders and their parents indicated that their choice was the result of having alternatives. Student
responses included, “My mom doesn’t have to be at work as early as she used to so now she can drive me”, “My brother drives so I have someone to take me,” “We have an extra car that someone can use to drive us to school,” and “My mom doesn’t work so she can take me to school.” Parents added, “I don’t work so I am home in the morning and don’t mind taking them to school, I certainly wouldn’t want them getting up that early to catch the bus,” “Our oldest has her license so she just takes her brother to school with her in the morning,” “I don’t have to be at work until about 8:30 AM, so I have time to drop them off at school and still get to work on time,” “Our daughter has her license and we have an extra car so she can drive to school.”

In addition to identifying the factors that impact transportation mode choice, research question two also sought to determine if these factors were disproportionally impacting students according to their race/ethnicity and/or socioeconomic status. A 3x2 chi-square test of independence was performed to examine the relation between race and morning transportation mode choice. The relation between these variables was significant, $X^2 (2, N = 420) = 19.24, p = .000066$. Non-white students are more likely to ride the bus. A 2x2 chi-square test of independence was also performed to examine the relationship between socioeconomic status and morning transportation mode choice. The relation between these variables was significant, $X^2 (1, N = 425) = 53.69, p = .00001$. Students who are economically disadvantaged are more likely to ride the bus. Finally, an additional 2x2 chi-square test of independence was also performed to examine the relationship between ethnicity and morning transportation mode choice. The relation between these variables was also significant, $X^2 (1, N = 425) = 12.43, p = .00042$. Hispanic students are more likely to ride the bus than their non-Hispanic peers. These results indicated that non-white, economically disadvantaged, and Hispanic students are overrepresented in the bus rider population.
What Are the Impacts on Students

Research question three sought to determine the relationship between student sleep and students’ academic achievement, discipline, and attendance. After completing the survey, each student was labeled as an AM BUS RIDER or an AM CAR RIDER. Once all survey respondents were classified or eliminated, each student’s race, ethnicity, socioeconomic status (free/reduced lunch status), attendance data (absences), discipline data (suspensions), and academic achievement data (grades) were imported into a spreadsheet from the Sleepy Valley Student Information Management System and associated with his or her survey response for statistical analysis. A series of $t$-tests were conducted to compare absences, suspensions, and grades (term GPA) data between the AM-BUS-RIDER group and the AM-CAR-RIDER group to assess the impact of student-selected AM transportation method, and any associated sleep disparity, on attendance, discipline, and achievement.

$T$-tests were used to determine if there was a difference in term GPA, suspension days, and absences when these data for car riders were compared to bus riders. Based on a $t$-critical two-tail of 1.97 the results indicated that the mean term GPA scores for car-riders ($M=3.60$, $SD=.81$) was significantly different from the mean term GPA scores for bus riders ($M=3.18$, $SD=.98$), $t=.00004$, $p < .05$, $\alpha=.05$. However, the mean number of annual absences for car riders ($M=7.02$, $SD=6.47$) was not significantly different from the mean number of annual absences for bus riders ($M=6.51$, $SD=6.63$), $t=.46$, $p > .05$, $\alpha=.05$, and the mean number of suspension days for car riders ($M=.20$, $SD=.71$) was not significantly different from the mean number of suspension days for bus riders ($M=.32$, $SD=.99$), $t=.15$, $p > .05$, $\alpha=.05$.

In an attempt to control for other factors that may contribute to significant differences in achievement data between the car-riper group and the bus-riper group, an equated sample of
students from the car-ride group that closely matched the demographic profile of the bus rider group was created at random to reassess differences in term GPA. Both samples contained the same number of students from each racial category (Asian, Hispanic, White, Black) and the same number of students who qualified for free and/or reduced-price school meals (38). Based on a $t$-critical two-tail of 1.97 the results indicated that the mean term GPA scores for an equated sample of car riders ($M=3.49$, $SD=.85$) continued to be significantly different from the mean term GPA scores for bus riders ($M=3.18$, $SD=.98$), $t=.02$, $p < .05$, $\alpha = .05$.

An additional goal of research question three was to determine the impact of student sleep on students’ mental health. The final question on the Student Transportation Survey asked students, “During the past six months, did you ever feel so sad or hopeless almost every day for at least two weeks or more in a row that you stopped doing some usual activities?” Students responded by selecting yes or no. Fifty-five students (42%) who rode the bus to school indicated that they had felt so sad or hopeless almost every day for at least two weeks or more in a row that they had stopped doing some usual activities in the past six months. Ninety-four students (32%) who rode to school in a privately owned vehicle indicated that they had felt so sad or hopeless almost every day for at least two weeks or more in a row that they had stopped doing some usual activities in the past six months, a difference of 10%.

The following chapter restates the purpose of the research study and the connection to existing research. The chapter provides the research findings by research question and additional findings of the research study. Chapter 5 includes a discussion of the significance of the findings and their implications for schools and further research and provides recommendations for practitioners.
CHAPTER FIVE: CONCLUSION

Introduction

The purpose of this research study was to determine the relationship between student sleep and morning transportation mode choice for students in grades 9-12 at Sleepy Valley High School. The study also examined the relationship between race and/or socioeconomic status and selected morning transportation method to determine to what extent, if any, students from low socioeconomic backgrounds and minority populations are disproportionally affected by the district’s pupil transportation system. Finally, the study examined student achievement data to determine to what degree, if any, a student’s transportation mode choice was related to student factors that impact student achievement. The study attempted to control for factors that might also influence student achievement by comparing data between students who ride the bus and an equated sample of the car-rider population that is demographically similar to the bus-rider population. Characteristics such as grade level, gender, race, socioeconomic status, and eligibility for special education services were considered to ensure that the treatment group (bus riders) closely resembles the control group (car riders) to control for the impact of these factors on student mental health, attendance, discipline, and academic achievement.

The existing research that teens are biologically conditioned to go to sleep later and sleep later into the morning because of changes in the mechanisms that control sleep was compelling (Barnes et al., 2016; Bryant & Gomez, 2015). There was also evidence that school start times and transportation times affect students’ ability to acquire adequate sleep (Carrell et al., 2011; Thacher & Onyper, 2016; Wahlstrom, 2016) and that changes geared toward later start times increased the likelihood that students will acquire the recommended sleep leading to better physical and mental health outcomes and positively impacting a variety of factors that affect
student achievement (Barnes et al., 2016; Beebe et al., 2010; Bryant & Gomez, 2015; Eaton et al., 2010; Marco et al., 2012; Wahlstrom, 2016; Wheaton et al., 2016; Wheaton et al., 2015; Winsler et al., 2014). This study highlighted the impact of transportation routines (route start time) on wake time and its impact on student sleep, an area of study that was less evident in the research literature.

This study proposed to answer the following research questions:

1. How does morning transportation mode choice impact student sleep?
2. What are the factors that impact transportation mode choice, and are these factors disproportionately impacting students according to their race/ethnicity and/or socioeconomic status?
3. What is the relationship between student sleep and students’ mental health, academic achievement, discipline, and attendance?

This research study used a post-facto comparative design approach (Abbot, 2011) to examine the relationship between morning transportation mode choice and student sleep. Additionally, a causal-comparative quantitative research approach was used to examine the relationship between students’ transportation mode choice and their race, socioeconomic status, and ethnicity. Finally, a correlational-design approach (Creswell, 2014) was used to test the established theory that sleep deficits impact students’ mental health, academic achievement, discipline, and attendance (Winsler et al., 2014).

Data related to morning transportation mode choice, factors that impact mode choice, student sleep, and mental health were collected through a 12 question Student Transportation Survey (Appendix C). Demographic information and attendance, suspension, and achievement data were downloaded from the division’s student information management system. Finally,
qualitative information was collected through four focus group interviews to further inform survey responses.

**The Impact of AM Transportation Mode on Student Sleep**

Research question one sought to determine the impact of students’ preferred method of transportation to school each morning on their acquisition of sleep. Survey questions two (What time do you go to bed on school nights?), three (How long does it take you to fall asleep?), and four (What time do you wake up on school days?) were used to calculate sleep opportunity and perceived sleep acquisition for survey respondents by their morning transportation mode choice (Survey Question one).

*T*-tests were used to determine if there was a difference in bedtimes, minutes to sleep, wake time, perceived sleep, and sleep opportunity between car riders and bus riders. The data indicated that there is no significant difference in bedtimes and minutes to sleep between car riders and bus riders. However, the data did indicate that there is a significant difference in wake times, sleep opportunity, and perceived sleep. The mean wake time of car riders ($M=6:32:36$ AM, $SD=0:30:04$) was significantly different from the mean wake time of bus riders ($M=5:55:20$ AM, $SD=0:23:34$), $t=9.62E-31$, $p < .05$, $\alpha=.05$. Also, the mean sleep opportunity for car riders ($M=7:33:26$, $SD=1:02:28$) was significantly different from the mean sleep opportunity for bus riders ($M=7:08:21$, $SD=1:17:29$), $t=.0004$, $p < .05$, $\alpha=.05$. Similarly, the mean hours of perceived sleep (sleep hours minus minutes until sleep) acquired by car riders ($M=7:07:44$, $SD=1:08:05$) was significantly different from the mean hours of perceived sleep acquired by bus riders ($M=6:39:44$, $SD=1:24:48$), $t=.0003$, $p < .05$, $\alpha=.05$. On average, car riders had approximately 25 more minutes per night available for sleep and acquire approximately 28 minutes of additional sleep per night when compared to students who ride the bus to school. More importantly, this
nightly deficit results in 140 fewer minutes of sleep per week (2.3 hours) for students who ride the bus to school.

Qualitative information collected on the transportation survey and through focus group interviews appeared to support the relationship between riding the bus, earlier wake times, and less sleep. Car riders reported that their AM transportation mode choice was primarily because of the early wake time associated with riding the bus (34%). In addition, 68% percent of current bus riders who indicated that they would select a different transportation method if given the choice (75), reported that the main reason for selecting a different mode of transportation to school was related to sleeping later or longer. Similarly, car riders and the parents of car riders indicated that the opportunity to sleep later is one of the primary reasons that they ride/drive to school in a car. One parent explained, “My daughter started out riding the bus, but the bus runs so early I decided to start taking her to school. Now she gets up around 6:30 AM when before she was getting up at 5:45 AM.” Another parent added, “When I realized my daughter was going to have to get up at like 5:50 to catch the bus we decided we would figure out a way to get her to school. Now she gets more sleep and has time to eat. As it was she was getting up almost an hour before anyone else in the house.” A student also added, “I rode the bus the first day of school and I was like, I am not waking up that early again.”

When asked about the drawbacks to riding the bus, bus riders and their parents also cited wake time and sleep as issues. One student said, “The main drawback is sleep. The buses run way too early. My house is only like five minutes from school. There is no reason for the bus to pick me up at 6:30 AM and drop me off at school at 7:00 AM when school doesn’t start until 7:55 AM, but I don’t have any other choice.” A parent of a student who rides the bus added,
“The bus routes start too early, most kids I know have to get up almost an hour earlier to ride the bus.”

This is important because the research clearly indicated that adolescents who experience insufficient sleep are more likely to have difficulty regulating their emotions (Adam et al., 2007; Barnes, et al., 2016; Gangwisch, Babiss, Malaspina, Turner, Zammit, & Posner, 2009), expressed a depressed mood or symptoms of depression (Adam et al., 2007; Carskadon, 1990; Eaton et al., 2009; Gangwisch et al., 2009; Marco et al., 2012; Wahlstrom, 2016; Wheaton et al., 2016; Wahlstrom et al., 2015; Winsler et al., 2014), and reported suicidal ideation (Gangwisch et al., 2009; Winsler et al., 2014). The research also suggested insufficient sleep causes problems with cognition (Adam et al., 2007; Barnes et al., 2016; Bryant & Gomez, 2015; Wahlstrom, 2016), academic performance (Barnes et al., 2016; Beebe et al., 2010; Bryant & Gomez, 2015; Eaton et al., 2009; Marco et al., 2012; Wahlstrom, 2016; Wheaton et al., 2016; Wahlstrom, 2016), and behavior problems at school (Adam et al., 2007; Eaton et al., 2009; Wahlstrom, 2016).

**Who Is Being Impacted?**

The goal of research question two was to examine the factors that impact transportation mode choice and determine if these factors were disproportionally impacting students according to their race/ethnicity and/or socioeconomic status. Question nine on the Student Transportation Survey asked students to report the main reason they use their preferred method of transportation to school. The main reasons reported by students who ride the bus were that they had no other option (29%), their parent works and cannot drive them to school (26%) and that it was the most convenient mode of transportation available (17%). Approximately 10% of bus riders indicated
that they rode the bus for financial reasons which included not having a car or only having one car in the family.

When the bus riders and their parents were asked to identify the factors that influence their choice to ride the bus to school, their responses appeared to indicate that the choice is the result of limited options. For example, one parent said, “We really just don’t have any other option. She can’t drive and there isn’t anyone who can take her.” Another parent added, “Same here, we don’t have any other option.” They also referenced conflicting work schedules. One student said, “My mom currently works three jobs so she can’t get me to school. She gets home in the morning and has to sleep.” A student added, “My mom works nights and she isn’t home when I get up in the morning to get ready for school,” a third student said, “She has to go to work at a certain time so (she can’t take me),” and another student added, “My mom is busy in the mornings so she can’t take me.”

Parents cited similar conflicts with their work schedules. One parent said, “My daughter is a sophomore and doesn’t have her license yet and there isn’t anyone who can take her to school.” Another added, “I can’t drop off because of my work schedule. I work nights and don’t get home until after she leaves for school.”

As opposed to the responses of bus riders and their parents, the responses of car riders and their parents indicated that their choice was the result of having alternatives. Student responses included, “My mom doesn’t have to be at work as early as she used to so now she can drive me,” “My brother drives so I have someone to take me,” “We have an extra car that someone can use to drive us to school,” and “My mom doesn’t work so she can take me to school.” Parents added, “I don’t work so I am home in the morning and don’t mind taking them to school, I certainly wouldn’t want them getting up that early to catch the bus,” “Our oldest has
her license so she just takes her brother to school with her in the morning,” “I don’t have to be at work until about 8:30 AM, so I have time to drop them off at school and still get to work on time,” “Our daughter has her license and we have an extra car so she can drive to school.”

The qualitative data suggested that, while parents and students consider transportation time when deciding how they will get to school, there are other factors that impact the opportunity for families to choose the most time-efficient transportation option. More specifically, socioeconomic barriers prevent some families from making the most time-efficient choice for their children. This is consistent with the research which indicated that the children of well-educated parents with higher income levels are more likely to travel to school by car (Ewing et al., 2004; McDonald, 2007; McDonald & Aalborg, 2009; Westman et al., 2017) and that increases in income lead to declines in walking and increases students being driven to school (McDonald, 2007). Other factors impacting transportation mode choice include car ownership and the number of licensed drivers in the home, both of which are directly related to socioeconomic factors (Ewing et al., 2004; McDonald, 2007; McDonald & Aalborg, 2009; Westman et al., 2017). While connections to race were not as clear in the research, it was reported that “minority and low-income youth walk to school at rates two to three times those of White students” (McDonald & Aalborg, 2009, p. 340), and that racial variation in mode choice “is mostly explained by factors such as household income, density, and neighborhood composition” (McDonald, 2007, p. 29).

In addition to identifying the factors that impact transportation mode choice, research question two also sought to determine if these factors were disproportionally impacting students according to their race/ethnicity and/or socioeconomic status. A 3x2 chi-square test of independence was performed to examine the relation between race and morning transportation
mode choice. The relation between these variables was significant, \( X^2 (2, N = 420) = 19.24, p = .000066 \). Non-white students are more likely to ride the bus. A 2x2 chi-square test of independence was also performed to examine the relationship between socioeconomic status and morning transportation mode choice. The relation between these variables was significant, \( X^2 (1, N = 425) = 53.69, p = .00001 \). Students who are economically disadvantaged are more likely to ride the bus. Finally, an additional 2x2 chi-square test of independence was also performed to examine the relationship between ethnicity and morning transportation mode choice. The relationship between these variables was also significant, \( X^2 (1, N = 425) = 12.43, p = .00042 \). Hispanic students are more likely to ride the bus than their non-Hispanic peers. These results indicated that non-white, economically disadvantaged, and Hispanic students are overrepresented in the bus rider population and identify this problem of practice as a potential social justice issue for schools.

Social justice initiatives strive to improve the health of the overall population and ensure fair treatment of historically disadvantaged populations. Gorski (2007) explained that students from low SES backgrounds are more likely to attend overcrowded, underfunded schools with high teacher turnover and inadequate funding. He went on to explain that poor children do not have access to adequate healthcare or health insurance, that they live in unsafe neighborhoods, and that they lack access to basic necessities such as food, uncontaminated water, and healthy living spaces, impacting their access to equitable education services. Gorski (2007) stated, “in almost every conceivable way, the structure of the U.S. education system denies students in poverty opportunities and access it affords most other students” and “that students and parents from poverty simply do not have the same access to material resources that their economically advantaged peers --and many of us-- take for granted” (p. 32). As a result, economically
disadvantaged children are more likely to underachieve, more likely to have behavior problems, and are at a greater risk of dropping out of school (Buckhalt, 2011).

Armed with the knowledge of teen sleep cycles, the impact of school start time on adolescents’ ability to acquire the recommended amount of sleep, and the impact of insufficient sleep on physical and mental health, it is clear that efforts to adjust school start times and/or transportation routines to increase teen sleep addresses the social justice goal of improving the health for the population. When combined, the evidence that students from minority populations and low SES backgrounds are less likely to acquire sufficient sleep and the research that has shown improvements in academic results associated with later school start times, addressing inefficient transportation routines that impact wake times and their impact on the achievement gap and academic outcomes address the social justice goal of ensuring the fair treatment of historically disadvantaged populations (Hale & Troxel, 2018).

What are the Impacts on Students?

Research question three sought to determine the relationship between student sleep and students’ academic achievement, discipline, attendance, and mental health. After completing the survey, each student was labeled as an AM BUS RIDER or an AM CAR RIDER. Once all survey respondents were classified or eliminated, each student’s race, ethnicity, socioeconomic status (free/reduced lunch status), attendance data (absences), discipline data (suspensions), and academic achievement data (grades) were imported into an Excel spreadsheet from the PowerSchool Student Information Management System and associated with his or her survey response for statistical analysis. A series of t-tests were conducted to compare absences, suspensions, and grades (term GPA) data between the AM-BUS-RIDER group and the AM-
CAR-RIDER group to assess the impact of student-selected AM transportation method, and any associated sleep disparity, on attendance, discipline, and achievement.

* T-tests were used to determine if there was a difference in term GPA, suspension days, and absences when these data for car riders were compared to bus riders. Based on a *t-critical two-tail* of 1.97 the results indicated that the mean term GPA scores for car riders (*M*=3.60, *SD*=.81) was significantly different from the mean term GPA scores for bus riders (*M*=3.18, *SD*=.98), *t*=.00004, *p* <.05, *α*=.05. However, the mean number of annual absences for car riders (*M*=7.02, *SD*=6.47) was not significantly different from the mean number of annual absences for bus riders (*M*=6.51, *SD*=6.63), *t*=.46, *p* >.05, *α*=.05, and the mean number of suspension days for car riders (*M*=.20, *SD*=.71) was not significantly different from the mean number of suspension days for bus riders (*M*=.32, *SD*=.99), *t*=.15, *p* >.05, *α*=.05.

In an attempt to control for other factors that may contribute to significant differences in achievement data between the car-rider group and the bus-rider group, an equated sample of students from the car-rider group that closely matched the demographic profile of the bus-rider group was created at random to reassess differences in term GPA. Both samples contained the same number of students from each racial category (Asian, White, Hispanic, Black) and the same number of students who qualified for free and/or reduced-price school meals (38). Based on a *t-critical two-tail* of 1.97 the results indicated that the mean term GPA scores for an equated sample of car riders (*M*=3.49, *SD*=.85) continued to be significantly different from the mean term GPA scores for bus riders (*M*=3.18, *SD*=.98), *t*=.02, *p* <.05, *α*=.05.

This relationship between transportation mode choice, sleep, and GPA supports existing research which suggested insufficient sleep causes problems with cognition (Adam et al., 2007; Barnes et al., 2016; Bryant & Gomez, 2015; Wahlstrom, 2016), and academic performance...
An additional goal of research question three was to determine the impact of student sleep on students’ mental health. The final question on the Student Transportation Survey asked students, “During the past six months, did you ever feel so sad or hopeless almost every day for at least two weeks or more in a row that you stopped doing some usual activities?” Students responded by selecting yes or no. Fifty-five students (42%) who rode the bus to school indicated that they had felt so sad or hopeless almost every day for at least two weeks or more in a row that they had stopped doing some usual activities in the past six months. Ninety-four students (32%) who ride to school in a privately owned vehicle indicated that they had felt so sad or hopeless almost every day for at least two weeks or more in a row that they had stopped doing some usual activities in the past six months, a difference of 10%.

While the survey data related to mental health did not allow for analysis to determine statistical significance, it did appear to support research indicating that adolescents who experience insufficient sleep are more likely to have difficulty regulating their emotions (Adam et al., 2007; Barnes et al., 2016; Gangwisch, Babiss, Malaspina, Turner, Zammit, & Posner, 2009), express a depressed mood or symptoms of depression (Adam et al., 2007; Carskadon, 1990; Eaton et al., 2009; Gangwisch et al., 2009; Marco et al., 2012; Wahlstrom, 2016; Wheaton et al., 2016; Wheaton et al., 2015; Winsler et al., 2014), and report suicidal ideation (Gangwisch et al., 2009; Winsler et al., 2014). Regardless of any connection to morning transportation mode choice or student sleep, the percentage of students who indicated that they had experienced symptoms related to depression is concerning and may warrant further investigation by the school division.
Additional Research Findings

Question five of the Student Transportation Survey asked students if they had a parent-set bedtime. This question provided the opportunity to analyze the influence of parent-set bedtimes on bedtimes and the acquisition of sleep. One hundred-seventeen students (27.5%) reported that they have a parent-set bedtime and 308 students (72.5%) reported that they did not. A t-test was used to determine if there was a difference in bedtimes between students who reported a parent-set bedtime and students who did not. Based on a t-critical two-tail of 1.97, the results indicated that the mean bedtime of students who reported a parent-set bedtime ($M=10:20$ PM, $SD=0:51:04$) was significantly different from the mean bedtime of students who reported that they did not have a parent-set bedtime ($M=11:08$ PM, $SD=1:07:01$), $t=.000000000009$, $p<.05$, $\alpha=.05$.

T-tests were also used to determine if there was a difference in sleep opportunity and perceived sleep between students who reported a parent-set bedtime and students who reported that they did not have a parent-set bedtime. Based on a t-critical two-tail of 1.97, the results indicated that the mean sleep opportunity for students who reported a parent-set bedtime ($M=7:54:27$, $SD=0:50:39$) was significantly different from the mean sleep opportunity for students who reported that they did not have a parent-set bedtime ($M=7:15:40$, $SD=1:10:49$), $t=.0000001$, $p<.05$, $\alpha=.05$. Similarly, the mean hours of perceived sleep acquired by students who reported a parent-set bedtime ($M=7:28:55$, $SD=0:56:26$) was significantly different from the mean hours of perceived sleep for students who reported that they did not have a parent-set bedtime ($M=6:48:40$, $SD=1:17:30$), $t=.0000004$, $p<.05$, $\alpha=.05$. On average, students who reported a parent-set bedtime went to bed 48 minutes earlier than their peers who do not have a parent-set bedtime. This results in 39 additional minutes of sleep opportunity and 40 minutes
more sleep per night on average, or 3.3 hours of additional sleep per week for students with a parent-set bedtime.

The data supported existing research that suggests that adolescents with parent-set bedtimes tend to get more sleep. A study published in *SLEEP* in January 2011 reported that teens with a parent-set bedtime went to bed 23 minutes earlier on average and slept 19 minutes longer each night (Short, Gradisar, Wright, Lack, Dohnt, & Carskadon, 2011). A similar study by Gangwisch et al. (2009) reported that teens with a parent-set bedtime slept 40 additional minutes per night. This research clearly illustrated that implementing set bedtimes is a significant factor in adolescent sleep and provides children with more sleep (Bryant & Gomez, 2015), but teens are less likely to have a parent-set bedtime (Short et al., 2011).

Some parents might assert that they have a set bedtime for their children, but their teens will not go to bed on time. Gangwisch et al.’s (2010) research indicated that students with parent-set bedtimes went to sleep within 5 minutes of their established bedtime regardless of economic standing, family structure, or educational attainment (Bryant & Gomez, 2015). Short et al. (2011) confirmed this research and further indicated that parent-set bedtimes are an effective means of ensuring that teens get enough sleep regardless of a variety of social factors.

**Significance of the Findings**

The research which indicated that teens are biologically conditioned to go to sleep later and sleep later into the morning because of changes in the mechanisms that control sleep (Barnes et al., 2016; Bryant & Gomez, 2015) and that school start times and transportation times affect students’ ability to acquire adequate sleep is compelling (Carrell, Maghakian, & West, 2011; Thacher & Onyper, 2016; Wahlstrom, 2014). There is also abundant evidence that changes that increase the likelihood that students will acquire the recommended sleep lead to better physical
and mental health outcomes and positively impact a variety of factors that affect student
achievement (Barnes et al., 2016; Beebe, Rose, & Amin, 2010; Bryant & Gomez, 2015; Eaton,
McKnight-Eily, Lowery, Perry, Presley-Cantrell, & Croft, 2009; Marco et al., 2012; Wahlstrom,
2016; Wheaton et al., 2016; Wheaton et al., 2015; Winsler et al., 2014).

While the impact of selected morning transportation mode on student sleep and the
factors that impact mode choice are not as clear, parents indicate that, when they have the option,
they will choose the most efficient mode of transportation to school in an effort to save time
(Ewing, Schroeer, & Greene, 2004; Faulkner, Richichi, Buliung, Fusco, & Moola, 2010;
McDonald, 2007; McDonald & Aalborg, 2009; Westman, Friman, & Olsson, 2017). In addition,
a variety of socio-economic and racial factors may impact transportation mode choice, thereby
creating a disparity for students from historically marginalized populations (Ewing et al., 2004;
McDonald, 2007; McDonald & Aalborg, 2009; Westman et al., 2017).

The results of this research study clearly indicated that students who ride the bus to
school in grades 9-12 in the Sleepy Valley School Division have significantly less opportunity
for sleep and acquire significantly fewer minutes of sleep per night (28) than their peers who
arrive at school by car. The research indicated that, when given the opportunity, parents will
choose the most efficient transportation mode choice with regard to time. However, the majority
of students who ride the bus to school (65%) expressed a lack of options with regard to their
transportation to school. They either indicated that riding the bus was their only option (29%),
that their parent’s schedules prevented them from driving them to school (26%), or that for
financial reasons, which included not having a car or only having one car in the family, riding
the bus was their only option (10%).
The results of this research also indicated that these limiting factors are impacting historically marginalized populations of students to a greater degree than their predominantly white, more affluent peers. The data indicated that non-white students, economically disadvantaged students, and Hispanic students are more likely to ride the bus to school and are, thereby, more likely to suffer the consequences with regard to sleep created by the Sleepy Valley School Division’s inefficient morning transportation system in grades 9-12.

While the findings did not suggest a relationship between morning transportation mode choice and attendance or suspensions, the data did indicate a significant difference in mean GPA for students who ride the bus (3.18) when compared to their peers who arrive at school by car (3.60). Even when an equated sample of students from the car-rider group that matched the demographic profile of the bus-rider group was examined, the mean term GPA scores of car riders (3.49) continued to be significantly different than the mean term GPA scores for bus riders (3.18). While this relationship does not establish causation, at the very least, students who ride the bus to school represent a population of students who are at greater academic risk than their peers who arrive at school by car.

In addition, a higher percentage of students who ride the bus to school (42%) reported that they had felt so sad or hopeless almost every day for at least two weeks or more in a row that they had stopped doing some usual activities in the past six months compared their peers who arrive at school by car (32%). While this data did not allow for analysis to determine statistical significance, the percentage of students who indicate feelings of depression is a concern and may warrant additional investigation.
Implications and Recommendations for Professional Practice

While the association of school start times as a limiting factor for student sleep is clear, a more specific connection to school start time as a determinant of student wake time was less evident in the literature. Wahlstrom et al. (2014) alluded to this connection by stating, “It has repeatedly been shown that when middle or high school start times are pushed later, students still tend to go to bed at about the same time, but, due to waking up later, increase their sleep” (p.4). Adam et al. (2015) also supported this connection by indicating that on average, students reported a 25-minute later wake time for each hour increase in school start time. In another study that analyzed the sleep patterns of 14-year-olds in Raipur, India, the researchers reported that the wake time for students who attended school in the morning hours (7:30 a.m. start) was significantly earlier (5:23 a.m.±31) compared to their peers (6:59 a.m.±1:05) who attended school during the day shift (11:00 a.m. start) (Pradhan & Sinha, 2017).

Another area of research less evident in the literature was the impact of student transportation to school on wake time and its associated influence on student sleep. Those studies that have researched the connection between student transportation and student sleep have established a clear connection between a student’s morning commute and wake time (Adam et al., 2007; Paksarian et al., 2015; Pereira, Moreno, & Louzada, 2012; Pradhan & Sinha, 2017; Wolfson & Carskadon, 2005; Wahlstrom et al., 2015). Adam et al. (2007) reported that students experienced sleep gains from changes in transportation times similar to those experienced by students because of later school start times. In fact, Adam et al. (2007) reported that “for every additional hour younger children spend getting to school their weekday sleep decreased by .69 hr., and for older children, sleep time decreases by a notable 1.42 hr., because of earlier wake times” (p.10). In a study of 1,126 high school students in Brazil, researchers reported a
significant inverse association between commuting time and time in bed, further indicating that longer transportation times were associated with earlier wake times (Pereira et al., 2012). In fact, Pereira et al. (2012) determined that shorter commuting times to school were associated with changes in student sleep similar to those observed as a result of later school start times. Thus, it would appear that, in addition to school start time, student sleep is also a function of travel time to school in the morning because of its influence on wake time. More specifically, the time a student is required to wake in order to make it to school on time appears to be the key factor in determining the likelihood that he or she will acquire sufficient sleep. As a result, in addition to school start times, policymakers should consider travel time, and its associated impact on wake time, as an important factor contributing to insufficient sleep for adolescents (Adam et al., 2007; Pradhan & Sinha, 2017).

This study clearly demonstrated that students who ride the bus to school acquire less sleep than their peers. While the relationship between transportation mode choice and sleep in the Sleepy Valley School Division is likely not the result of longer commute times, it is more likely the result of earlier wake times caused by the school district’s transportation schedule. The study also revealed that students from historically marginalized populations are more likely to ride the bus since they are less likely to have alternative transportation options for a variety of factors, many of which are directly related to their socioeconomic status, creating a social justice issue for the district. The research was also clear and compelling that there is a positive statistical relationship between the sleep deficit experienced by student bus-riders and their academic performance. This relationship was evident even when an equated sample of students from the car-rider group that matched the demographic profile of the bus-rider group was examined to control for other factors that might impact academic performance.
The primary implications of this particular research are that, when developing transportation routines and establishing school start times, school divisions should consider the impact on wake time for students who ride the bus to school. In addition, school divisions should carefully consider the factors that allow families to make choices with regard to participation in a variety of school programs and should take steps necessary to ensure that students from historically marginalized populations have equal opportunity to participate. School divisions should also consider a systematic approach to monitoring student participation in all manner of school functions to ensure that students from historically marginalized populations are experiencing equity of access to school services and programs and that students from these populations are not overrepresented in data associated with negative outcomes.

While this study specifically examined the relationship between morning transportation mode choice and student sleep, it is likely that any changes to the Sleepy Valley School Division’s transportation system will impact school start times. While change, in and of itself, is difficult, changes that affect the daily routines of children and families are specifically problematic. Wahlstrom (2016) reported that stakeholders expressed concern about the potential for negative consequences in every community that adjusted school start times or any that were even considering a change. She indicated that these concerns can derail changes designed to address sleep loss, suggesting that some need to be addressed head-on, from the outset of any discussion about changes that affect the daily routine of students and families.

For example, on October 19, 2019, *The Virginian-Pilot* reported that the Virginia Beach School Board is facing strong opposition to its plan to adjust school start times for more than 21,000 high schoolers (Harper & Adhikusuma, 2019). Based on its research of the issue, and armed with broad community support, the school board asked the school administration to
develop a schedule that would provide a later start time for high school students. The proposed plan adjusted school start times for high schools two hours later, from 7:20 AM to 9:20 AM (Harper & Adhikusuma, 2019). Administrators explained that this was the only option that would not require an excessively early start for elementary schools or additional buses and drivers (Harper & Adhikusuma, 2019).

However, stakeholders expressed concerns about how the proposed dismissal time (4:10 PM) will affect students and families. Parents and students expressed concerns about the dismissal time’s impact on participation in school sports, clubs and activities and students’ opportunities to supervise siblings and work after school (Harper & Adhikusuma, 2019). These concerns are consistent with the barriers to change outlined by Wahlstrom (2016). As a result, the board was presented with a petition with over 12,000 signatures asking its members to reconsider (Harper & Adhikusuma, 2019).

**Conclusion**

The purpose of this quantitative research study was to determine the statistical relationship between student sleep and morning transportation mode choice for students in grades 9-12 at Sleepy Valley High School. The study also examined the factors that impact transportation mode choice and the relationship between race and/or socioeconomic status and selected morning transportation method to determine to what extent, if any, students from low socioeconomic backgrounds and minority populations are disproportionally affected by the district’s pupil transportation system. Finally, the study examined the relationship between transportation mode choice and attendance, suspensions, and GPAs to determine the relationship between these student outcomes and transportation mode choice.
The existing research that teens are biologically conditioned to go to sleep later and sleep later into the morning because of changes in the mechanisms that control sleep is compelling (Barnes et al., 2016; Bryant & Gomez, 2015). There is also evidence that school start times and transportation times affect students’ ability to acquire adequate sleep (Carrell et al., 2011; Thacher & Onyper, 2016; Wahlstrom, 2016) and that changes geared toward later start times increase the likelihood that students will acquire the recommended sleep leading to better physical and mental health outcomes and positively impact a variety of factors that affect student achievement (Barnes et al., 2016; Beebe et al., 2010; Bryant & Gomez, 2015; Eaton et al., 2010; Marco et al., 2012; Wahlstrom, 2016; Wheaton et al., 2016; Wheaton et al., 2015; Winsler et al., 2014).

While the impact of selected morning transportation mode on student sleep and the factors that impact mode choice are not as clear, Adam et al. (2007) reported that students experienced sleep gains from changes in transportation times similar to those experienced by students because of later school start times, and parents indicate that, when they have the option, they will choose the most efficient mode of transportation to school in an effort to save time (Ewing, Schroer, & Greene, 2004; Faulkner, Richichi, Buliung, Fusco, & Moola, 2010; McDonald, 2007; McDonald & Aalborg, 2009; Westman, Friman, & Olsson, 2017). In addition, a variety of socio-economic and racial factors may impact transportation mode choice, thereby creating a disparity for students from historically marginalized populations (Ewing et al., 2004; McDonald, 2007; McDonald & Aalborg, 2009; Westman et al., 2017).

The results of this research study established a clear and significant relationship between morning transportation mode choice and student sleep as a result of mode choice on wake time. The study also supported research that indicated that, when they have the choice, parents will
select the most efficient mode of transportation to school with regard to time, but a variety of factors prevent some families from having a choice, resulting in disproportionality of participation for historically marginalized populations. Finally, the study established a relationship between student achievement data and transportation mode choice. While it is not possible to determine the exact cause of the differences in academic achievement for bus riders when compared to car riders, research would suggest that transportation mode choice and its impact on student sleep is likely a factor.

While this study did not intend to specifically examine the relationship between parent-set bedtimes and student sleep, the results of the data associated with this research study are consistent with existing research and indicated that parent-set bedtimes have a significant positive impact on student sleep.

Change is hard. Especially changes that impact schools as well as the families they serve. The research makes it clear that changes to a student’s transportation routines, and possibly school start times, in an effort to ensure that all students have an equitable opportunity to acquire recommended amounts of sleep are likely to face opposition but are warranted.

The first step to facilitate change is to develop a clear and compelling reason for the proposed change. The Sleepy Valley School Division should develop a thorough understanding of this problem of practice and communicate the problem and how it is impacting students. More specifically, the division needs to understand and communicate how the problem is impacting specific groups of students. This will allow the division to advocate for change as an issue of equity despite any perceived negative impacts.

The division will also need to have a clear understanding of the changes necessary to address the problem. If changes to transportation routines and school start times can address this
problem, what are the impacts of those changes on families? If addressing the problem makes it necessary to increase the number of bus routes, what is the financial impact to the school division? If changes to transportation routines necessitate combining bus routes for some students, how many students are affected? The school division needs to have a clear understanding of the impacts of changes necessary to address this problem and develop a plan that minimizes these impacts. This process will take time and should be highly participatory. Students, parents, staff, and stakeholders should have multiple opportunities to receive information and provide feedback about the problem and the impact of potential changes prior to implementation.
REFERENCES


My name is Curtis Hicks, and I am the Assistant Superintendent of Schools in the Salem City School Division. I am also a Doctoral student in the Educational Leadership Program at the University of Arkansas, and I am conducting research for the Salem City School Division that I will use to complete my Doctoral Dissertation to fulfill my degree requirements.

I am studying the impact of students’ morning transportation mode choice on student sleep, grades, attendance, suspensions, and mental health. I am trying to determine to what degree how you arrive at school each morning affects the amount of sleep you acquire each night and how that might also affect your performance at school. I am also conducting an analysis of the bus rider population to determine to what degree if any, specific groups of students might be disproportionately represented in the bus rider population.

I would like you to participate in a short Google survey to collect data to inform my research. I have included the survey questions below for your full review. The survey will also collect your email address. Your email address will be used to connect your individual survey response to your academic, attendance, discipline, disadvantaged status, and demographic data in the division’s student information management system. Your email address and any other personally identifiable information will be removed by the PowerSchool Administrator prior to returning the data to the researcher. Therefore, the researcher will not have the ability to link the academic, attendance, discipline, disadvantaged status, and demographic data to individual students.

Please take the consent form home today and review this information with your parent/guardian. If you and your parents agree to participate in this research study, please complete the consent form and return it to your English teacher by the end of the week.
Appendix B School Transportation Survey
Parental Informed Consent Form

This informed consent form is for parents of students in grades 9-12 at Salem High School participating in the research titled, “Who Is Riding the Bus and How Does It Impact Student Sleep, Attendance, Discipline, Mental Health, and Achievement.”

Principal Investigator: Curtis Hicks
Organization: University of Arkansas/Salem City Schools
Sponsor: Kevin Brady
Project: Who Is Riding the Bus and How Does It Impact Student Sleep, Attendance, Discipline, Mental Health, and Achievement?

This Informed Consent Form has two parts:
• Information Sheet (to share information about the study with you)
• Certificate of Consent (for signatures if you agree that your child may participate)

Part I: Information Sheet

Introduction:
My name is Curtis Hicks, and I am the Assistant Superintendent of Schools in the Salem City School Division. I am also a Doctoral student in the Educational Leadership Program at the University of Arkansas and the Principal Investigator conducting research for the Salem City School Division that I will use to complete my Doctoral Dissertation to fulfill my degree requirements. Whenever researchers study children, we communicate with parents and ask them for their permission.

Purpose
I am studying the impact of students’ morning transportation mode choice on student sleep, grades, attendance, suspensions, and mental health. I am trying to determine how students’ transportation mode choice each morning affects the amount of sleep they acquire each night and how that might also affect their performance at school. I am also conducting an analysis of the bus rider population to determine if specific groups of students might be disproportionally impacted by the division’s transportation schedule.

Procedure
In order to collect data for my research study, I will administer a short Student Transportation Survey to all students in grades 9-12 at Salem High School. The survey will be administered online during the school day at Salem High School. Student participants will receive an email delivered to their Salem City Schools email address with a link to the Google Form survey questionnaire. Students will be prompted to complete the survey by their teacher. It is expected that students will take approximately five minutes to complete the survey.

The goals of the survey are to determine how each student travels to school each morning, and how his or her transportation mode choice impacts his or her sleep and mental health. The survey will also collect information related to the factors that impact his or her transportation mode choice, other factors that impact his or her nightly sleep, and his or her preferred
transportation mode choice. The survey questions have been included on the back of this form for your review.

**Risks, Benefits, and Discomforts**
Participation is voluntary and will not affect your child’s grade nor will there be any disciplinary, academic, or social consequences for failing to complete the survey. There are no perceived risks or benefits associated with the completion of the transportation survey. Students will not be provided any compensation for their participation, nor will there be any academic or social consequences for students who do not complete the survey.

**Confidentiality**
All information will be kept confidential to the extent allowed by law and University policy. The survey will collect each student’s SCS provided email address. The sole purpose of collecting this data is to connect each student’s survey response to his or her grades, suspensions, attendance, demographic information and disadvantaged status available in the PowerSchool Student Information Management System. The students' email address and any other personally identifiable information will be removed from the data set prior to it being provided to the researcher. At that point, the researcher will not have the ability to connect individual students to his or her survey response or his or her academic data.

**Sharing the Research Findings**
At the conclusion of this research study, the findings will be shared with the Salem City School Board and the Salem Community at a School Board meeting. A written report will also be available to the public. The report will not contain any personally identifiable information for students.

**Right to refuse or withdraw**
You may choose not to have your child participate in this study, and your child does not have to take part in this research if she or he does not wish to do so. Your child may decide not to complete the survey at any time even if you have provided your consent. This will not impact his or her grades or student record in any way.

**Contact Information**
If you have any questions you may contact the principal investigator, Curtis Hicks, or the University Faculty Sponsor, Kevin Brady using the contact information provided below.

Curtis Hicks
Assistant Superintendent
Salem City Public Schools
510 South College Ave.
Salem VA. 24153
chicks@salem.k12.va.us

Kevin Brady
Associate Professor of Educational Leadership
University of Arkansas
105 Peabody Hall
Fayetteville, AR 72701
kpbrady@uark.edu
This proposal has been reviewed and approved by the University of Arkansas IRB, which is a committee whose task is to make sure that research participants are protected from harm. If you wish to find out more about the IRB or if you have questions or concerns about your child’s rights as a participant, the details of his or her participation, the potential risks or benefits of participating, or confidentiality, please contact:

Douglas Adams
IRB Chair
University of Arkansas
109 MLKG
1424 W. Martin Luther King, Jr.
Fayetteville, AR 72701
djadams@uark.edu
Appendix C IRB Approval Letter

To: Curtis Neil Hicks
From: Douglas James Adams, Chair
IRB Committee
Date: 05/08/2019
Action: Expedited Approval
Action Date: 05/08/2019
Protocol #: 1903180797
Study Title: Who's Riding the Bus and How Does It Impact Student Sleep, Attendance, Discipline, Mental Health, and Achievement?
Expiration Date: 04/15/2020
Last Approval Date:

The above-referenced protocol has been approved following expedited review by the IRB Committee that oversees research with human subjects.

If the research involves collaboration with another institution then the research cannot commence until the Committee receives written notification of approval from the collaborating institution's IRB.

It is the Principal Investigator's responsibility to obtain review and continued approval before the expiration date.

Protocols are approved for a maximum period of one year. You may not continue any research activity beyond the expiration date without Committee approval. Please submit continuation requests early enough to allow sufficient time for review. Failure to receive approval for continuation before the expiration date will result in the automatic suspension of the approval of this protocol. Information collected following suspension is unapproved research and cannot be reported or published as research data. If you do not wish continued approval, please notify the Committee of the study closure.

Adverse Events: Any serious or unexpected adverse event must be reported to the IRB Committee within 48 hours. All other adverse events should be reported within 10 working days.

Amendments: If you wish to change any aspect of this study, such as the procedures, the consent forms, study personnel, or number of participants, please submit an amendment to the IRB. All changes must be approved by the IRB Committee before they can be initiated.

You must maintain a research file for at least 3 years after completion of the study. This file should include all correspondence with the IRB Committee, original signed consent forms, and study data.

cc: Kevin P Brady, Investigator
Appendix D Student Transportation Survey

1. How do you arrive at school in the morning?
   a. I ride a school bus.
   b. I ride in a car driven by a parent or family member.
   c. I ride in a car driven by someone other than a parent or family member.
   d. I drive to school.
   e. I walk to school.
   f. I ride a bicycle to school.
   g. I use some other form of transportation not listed.

2. What time do you go to bed on school nights?
   _______________________

3. How long would you estimate in minutes does it take you to fall asleep?
   _______________________

4. What time do you wake up in the morning to get ready for school?
   _______________________

5. Do you have a parent-set bedtime?
   a. Yes
   b. No

6. Is there an adult at home at night to help make sure you go to bed on time?
   a. Yes
   b. No

7. Is there an adult at home in the morning to support your morning routine?
   a. Yes
   b. No

8. How do you wake up in the morning on school days?
   a. An alarm wakes me in the morning.
   b. A parent or guardian or grandparent wakes me up in the morning.
   c. A sibling (brother or sister) wakes me up in the morning.
   d. I use some other method to wake up in the morning.

9. List the reasons you use the transportation method you selected in question #1.

10. If you had complete control over your transportation mode choice and could choose
    between riding the bus and driving/riding to school in a private vehicle which would you
    choose?
    a. Car
    b. Bus
11. Please list the reasons or perceived benefits from your choice to question 11.

12. During the past 6 months, did you ever feel so sad or hopeless almost every day for two weeks or more in a row that you stopped doing some usual activities?
   a. Yes
   b. No
Appendix E Focus Group Questions

AM Car Riders (Students)

1. Why do you choose to ride in a personal vehicle with a parent, family member, or friend to arrive at school?

2. In your opinion, what are the benefits of taking a car to school compared to the school bus?

3. In your opinion, what are the drawbacks or disadvantages of taking a car to school compared to the school bus?

4. What factors allow you to have the choice of arriving at school by car?

5. What circumstances might cause you to have to ride the bus to school?

6. What would you consider to be the advantages of riding to school on the bus?

7. What would you consider to be drawbacks or disadvantages to riding the bus?

8. If you had the choice, would you choose a different transportation option to arrive at school in the morning? If so, please explain why you would prefer an alternative transportation option?

9. Do you feel that a student’s socioeconomic status impacts their morning transportation mode choice?

10. If so, how?
Appendix F Focus Group Questions

AM Bus Riders (Students)

1. Why do you choose to ride the bus to school?

2. In your opinion, what are the benefits of riding the bus to school compared to riding in a car?

3. In your opinion, what are the drawbacks or disadvantages of taking the bus to school compared to taking a car?

4. What factors influence your choice of arriving at school by bus?

5. What circumstances might cause you to have to ride to school in a car?

6. What would be some of the advantages of riding to school in a car?

7. What would you consider to be the drawbacks or disadvantages of riding in a car?

8. If you had the choice, would you choose a different transportation option to arrive at school in the morning? If so, please explain why you would prefer an alternative transportation option?

9. Do you feel that a student’s socioeconomic status impacts their morning transportation mode choice?

10. If so, how?
Appendix G Focus Group Questions

AM Bus Riders (Parents)

1. Why does your child ride the bus to school?

2. In your opinion, what are the benefits of riding the bus to school compared to riding in a car?

3. In your opinion, what are the drawbacks or disadvantages of taking the bus to school compared to taking a car?

4. What factors influence the decision to ride the bus to school?

5. What circumstances might cause you to have to use a car to arrive at school?

6. What would be some of the advantages of your child riding to school in a car?

7. What would you consider to be the drawbacks or disadvantages of your child riding to school in a car?

8. If you had the choice, would you choose a different transportation option for your child to arrive at school in the morning? If so, please explain why you would choose an alternative transportation option?

9. Do you feel that a student’s socioeconomic status impacts their morning transportation mode choice?

10. If so, how?
Appendix H Focus Group Questions

AM Car Riders (Parents)

1. Why does your child ride to school in a personal vehicle with a parent, family member, or friend?

2. In your opinion, what are the benefits of your child taking a car to school compared to the school bus?

3. In your opinion, what are the drawbacks or disadvantages of your child taking a car to school compared to the school bus?

4. What factors allow your child the choice of taking a car to school?

5. What circumstances might cause your child to have to ride the bus to school?

6. What would you consider to be the advantages of your child riding to school on the bus?

7. What would you consider to be drawbacks or disadvantages to your child riding the bus?

8. If you could, would you choose a different transportation option for your child to arrive at school in the morning? If so, please explain why you would prefer an alternative transportation option for your child?

9. Do you feel that a student’s socioeconomic status impacts their morning transportation mode choice?

10. If so, how?