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The Association Between Parent Educational Attainment and Adolescent Sleep Health

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The Association Between Parent Educational Attainment and Adolescent Sleep Health

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Bachelor of Arts

New College of Florida

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An abstract of a thesis submitted to the

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Abstract

The Association Between Parent Educational Attainment and Adolescent Sleep Health

By Lillian Walker

Introduction: Sleep deprivation is a public health epidemic among America's teenagers, and can lead to a wide range of physical, behavioral, mental, and academic concerns. Parent educational attainment has been found to impact adolescent sleep health outcomes, although most research has focused only on sleep duration and not other measures of sleep.

Objective: The purpose of this study was to examine the association between the highest level of parent educational attainment and adolescent sleep duration, timing, and sufficiency, to better understand potential sleep health disparities and identify at-risk populations.

Methods: This cross-sectional study used data from a study of 9th grade students from two racially and economically diverse high schools in Barrow County, a semi-rural area in north-central Georgia, collected during the spring semester of 2020. The primary outcomes of interest were student self-reported sleep duration (hours per night), timing (school day and weekend bedtimes before midnight), and sufficiency (feeling like they receive enough sleep). Linear and logistic regressions were conducted for each of these outcomes, adjusted for race/ethnicity, sex, free/reduced lunch status, and whether the student's parents work traditional hours (9am-5pm).

Results: A total of 405 responses were included in this study. Overall, there was an association between parent educational attainment and all measured adolescent sleep health outcomes in both unadjusted and adjusted models. Students whose parents had lower educational attainment reported shorter sleep durations, less sleep sufficiency, and had later sleep timing on the weekends. The strongest associations were found between parent educational attainment and later sleep timing on weekends, with p-values of less than 0.05.

Conclusions: The association between parent educational attainment and adolescent sleep health outcomes demonstrates a potential area to identify at-risk students and reduce sleep health disparities. Including measures on sleep timing and sufficiency fills a key knowledge gap, but further work is needed to better understand the mechanisms of the relationships found in order to inform the development of equitable and effective sleep health interventions.

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Table of Contents

Introduction

Adolescent sleep deprivation is a public health epidemic, with more than 87 percent of high school students in the United States getting far less than the recommended eight to ten hours of sleep a night, and an estimated 26 percent of high school students averaging just six and a half hours of sleep or less on school nights[1,2]. A wide variety of factors prime adolescents for sleep difficulties, including screen time and social media use, academic pressures, early school start times, bedtime autonomy, and a shift in circadian rhythm during puberty[1].

Inadequate sleep has been associated with a variety of behavioral and mental health concerns, such as drowsy driving, risky sexual activities, increased suicide risk, substance abuse, and reduced physical activity[1,2]. Mental health consequences of sleep deprivation among adolescents include irritability, depression, anxiety, and diminished quality of life and social relationships[3]. Sleep deprivation in teenagers can also have consequences on academic performance and achievement, causing impaired cognitive functioning, decreased alertness, attention span, creativity, and working memory[2,4]. This results in greater difficulties in attendance and academic achievement among sleep-starved students than well-rested students[2,4]. Sleep deficiency can also impede academic performance by interfering with brain growth and repair, learning and memory consolidation, and restoration[4].

Research among adolescents has also linked sleep deprivation with several adverse health outcomes, including obesity, cardiovascular disease, metabolic and endocrine dysfunction, and reduced glucose tolerance[2,5]. Adolescents with poor sleep have worse perceived health, as well as reported symptoms such as headaches, stomach aches, and backaches[3]. There is a growing body of work connecting low socioeconomic and racial minority status to higher levels of sleep deficiency among adolescents, however it remains unclear which pathways and factors are

involved in these disparities. Identifying and understanding these disparities in adolescents is essential to creating effective and equitable interventions to prevent adverse physical health, psychological health, daytime functioning, and academic performance outcomes associated with shorter and poorer quality sleep. While there are individual-level choices that may impact sleep health, such as social and digital media use, nutrition behaviors, and physical activity levels, there is little known about how contextual mechanisms and parent demographics, such as parental education level, may affect outcomes.

To begin addressing this research gap, this analysis investigated the relationship between parent educational attainment and adolescent sleep health and related demographic differences. Building on evidence that socioeconomic factors shape health behaviors and outcomes, this study hypothesizes that lower levels of parental education will be associated with shorter sleep duration, poorer sleep sufficiency, and greater inconsistencies in sleep timing among adolescents[6,7]. A literature review was conducted as well as a secondary analysis of qualitative and quantitative data. This data comes from a previously conducted study of 9th grade students from two racially and economically diverse high schools in Barrow County, a semi-rural area in north-central Georgia, collected during the spring semester of 2020. The questions used a multifaceted approach and collected information on sleep duration, timing, and sufficiency to gain a more complete understanding of adolescent sleep health.

Literature Review

The Association Between Parent Educational Attainment and Adolescent Sleep Health

Research to date examining the influence of parental education on sleep health has focused on sleep duration and not other measures of sleep such as sufficiency and timing. This thesis aims to explore a wider variety of factors associated with adolescent sleep health, focusing not only on duration, but also timing and sufficiency.

A 2022 systematic review and meta-analysis investigated the influence of parental education on childhood sleep health and included all relevant, peer-reviewed articles from database inception to December 2019. Studies were included if an association between an indicator of parental socioeconomic status, such as educational attainment, and a measure of child sleep health (i.e. duration, quality, and problems) was reported. They found that higher parental education was associated with longer childhood sleep duration (OR=1.3, 95% CI [1.1, 1.5]) and better sleep quality (OR=1.3, 95% CI [1.0, 1.8]), however this association seemed to be stronger in samples with a higher proportion of White children[8]. This meta-analysis did not find a relationship between parental education and any specific child sleep problems, such as reported difficulties initiating sleep, maintaining sleep, and experiencing early morning awakenings[9]. It is important to note that while this meta-analysis included 14 articles on childhood sleep duration and 11 on sleep problems, there were just 2 which addressed sleep quality. Their results highlight the importance of investigating the association between parental education and adolescent sleep health, with a particular need to further research on the relationship with sleep quality.

A 2012 study examined a sample of 5,781 children aged 11-13 years old from the Bergen Child Study, a population-based study of children in all public and private schools in the municipality of Bergen, Norway[10]. They used a parent and self-reported “time in bed” variable as

a proxy for sleep duration, a parent-report question on whether their child had “difficulties initiating and/or maintaining sleep”, and defined parental education as elementary (elementary school), high school (high school vocational and high school general), and college/university. Using Pearson chi-square tests and ANOVAs to analyze their data, they found a significant association between maternal education level and time in bed. Paternal education did not have a significant effect on time in bed, and neither parent’s educational attainment was found to play a significant role in children's difficulties initiating and/or maintaining sleep. Although the study lacked racial diversity, the results align with similar work conducted in the United States[11,12].

In 2009, researchers used parent-report data on a diverse sample of 3,217 three-year-old children from the Fragile Families and Child Wellbeing Study[11]. This analysis aimed to investigate whether family characteristics, such as maternal education level, was associated with the presence, time, and consistency of bedtime routines in preschoolers. Data was collected from interviews, questionnaires, and in-home visits. Mother’s education level was defined as less than high school, high school, and more than high school, and bedtime information was assessed by the following variables: (1) whether a child has a regular bedtime and, if so (2) the hour of bedtime and (3) whether the family enforced this bedtime at least four of the last five weeknights (i.e., Monday through Friday); (4) whether the family has one or more bedtime routines and, if so (5) whether the family engaged in these routines at least four of the last five weeknights[11]. Logistic and ordinary least squares regressions were used to analyze the data.

Results indicated that children whose mothers had less than a high school education were 27% less likely to have a bedtime than those who had a mother with more than a high school education, and also less likely to have any sort of bedtime routine[11]. This may be explained by the fact that the mothers with lower levels of education are more likely to be less advantaged,

which can cause increased stress in their households, lower levels of structure and routines, or they may not be aware of the benefits of bedtime routines[11]. Results also found that having a biological father present in the household was associated with decreased likelihood of having a regular bedtime[11].

While the association between low maternal education levels and shorter adolescent sleep duration has been established in previous research, including the studies cited above, the role of paternal education levels is less well-known. A 2020 study used data from a nationally representative study of Korean children and youths to investigate the impact of demographic and socioeconomic factors on weekend and weekday sleep patterns among adolescent students by sex[13]. This study focused on junior high school students (n = 2,351) who were followed from their first year of junior high school to the last year of high school. Their sleep patterns were measured using three indicators of bedtime, wake-up time, and sleep duration on weekdays and weekend days. Education levels of mothers and fathers were defined by the attainment of a college degree, and mixed effect regression analysis techniques were used to analyze the data[13].

Results showed that parent attainment of a college degree was associated with an adolescent having a later bedtime and a shorter sleep duration. The researchers found that on weekends, parent attainment of a college degree was associated with shorter adolescent sleep durations due to earlier wake-up times. This was true for male and female children, and held for both maternal and paternal education levels. Researchers hypothesized that these results may be due to a strong emphasis on educational achievement in Korea, that adolescents with better-educated parents may spend more time studying, and that maintenance of weekday routines may be a reason for early weekend wake-up times.

Overall, existing research consistently indicates an association between parent educational achievement and adolescent sleep health. Adolescents whose parents received less education tended to have shorter sleep durations, spent less time in bed, had worse sleep quality, and were less likely to have a bedtime or bedtime routine. Only one study reported that students whose parents had received at least a college degree had worse sleep health outcomes, including later bedtimes and shorter sleep durations[13]. This observation may be due to cultural differences, as the study was conducted in Korea where there is great emphasis on educational achievement. The relationship between parental education and adolescent sleep health outcomes seemed to be strongest when maternal education was the focus, however, this may be due to a lack of studies that investigate the role of paternal education. Additionally, these studies lacked racial diversity, and adolescent sleep health outcomes often just focused on duration, and did not include measures of timing or quality.

This thesis will address these gaps in knowledge by examining the association between highest parental educational attainment and sleep duration (measured in average number of hours per night), timing (whether students report falling asleep before or after midnight on school nights and weekends), and sufficiency (if a student reports feeling like they get enough sleep) in a diverse cohort of adolescents in Georgia. Investigating the relationship between the highest level of parent educational attainment and adolescent sleep duration, timing, and sufficiency, will allow a better understanding of potential sleep health disparities in teenagers and identify at-risk populations for future research. This will open the door to creating targeted and effective future interventions to improve sleep health among adolescents.

Demographic Differences in Adolescent Sleep Health

As stated above, several large studies conducted on adolescent sleep health outcomes have had majoritively White study samples, with little to no racial or ethnic diversity. Although there is a large body of research focusing on racial and ethnic differences in sleep health among adults, there is less known about adolescents[14]. Not only is there a smaller body of literature surrounding this topic, but a majority of studies utilize parent-report questionnaires, which may be less accurate in older children and teenagers who require less parental oversight and oftentimes have no strict bedtime requirements[15]. The following studies aimed to address the issues of limited data availability and parent-reported measures while furthering the understanding of demographic differences in adolescent sleep health.

A 2015 study conducted in middle schoolers (mean age, 12.3 years) in Texas found significant associations between race, ethnicity, sex, and sleep health[15]. Using a large (n = 1,543) and diverse sample of adolescents aged 11-14 years old, researchers used 2-way analysis of variance tests to investigate effects on sleep duration, which was student-reported using the Pittsburgh Sleep Quality Index[15]. Race, ethnicity, and sex information was provided by the school district. Overall, the sleep duration of the sample was 8.3 hours per night, however, there was significant variation by demographic characteristics[15].

White and Asian students reported an average sleep duration of 8.4 hours nightly, while African American and Hispanic adolescents both reported 8.1 hours[15]. Girls also tended to sleep less than boys, with 8.2 hours a night compared to 8.3[15]. It was found that sex interacted with race and ethnicity status, with significantly lower sleep durations in Hispanic males (8.0 hours) than in Asian (8.5 hours) and White males (8.4 hours)[15]. There was no difference found between African American males and other races/ethnicities, whereas African American females had

significantly lower sleep durations (7.8 hours) than White females (8.3 hours)[15]. There were no differences among Asian or Hispanic (8.2 hours) females[15]. Overall, the research revealed significant differences between African American males (8.4 hours) and females (7.8 hours), as well as in White males (8.4 hours) and females (8.3 hours)[15]. However, there were no significant sex differences found among Asian or Hispanic students.

Sex differences in sleep duration may be explained by puberty onset, with girls typically beginning puberty earlier, which could result in sleep period phase delays[15]. Girls may also use social networking sites more often than boys, disrupting or delaying their sleep[15]. The effects of race and ethnicity may be explained by several factors, including bedtime differences, socioeconomic status, and stress[15]. Little is known about the mechanisms behind the relationships found between race, ethnicity, sex, and sleep duration, and the self-reported single estimate used in this study may not represent general trends in sleep behavior. Additionally, the data was collected from adolescents in one town in Texas, and may not be entirely generalizable to the general population.

A 2020 study using data from adolescents in the Fragile Families and Child Wellbeing Study, a population-based birth cohort study of children born 1998–2000 in large American cities, aimed to address several of these concerns[16]. Using the same sample as the 2009 study cited previously, sleep information was measured using actigraphy collected from 738 adolescents at approximately age 15[16]. In cross-sectional analyses, the researchers used linear and logistic regression models to assess sex and ethnoracial disparities in weekday sleep duration, timing, and quality[16]. This study measured sleep objectively, and was able to collect multiple days of actigraphic sleep data, meaning they investigated variables such as how sleep timing changed from one day to the next and sleep outside of normal hours (i.e. napping).

The results found that on weeknights, adolescents slept for an average of 7 hours and 42 minutes, and roughly 37% of adolescents sampled did not sleep within the recommended range for their age group[16]. After accounting for naps, which approximately one third of adolescents reported taking, the weekday sleep average went up to 7 hours and 59 minutes daily[16]. On weekends, the average was 8 hours and 17 minutes at night, and 8 hours and 38 minutes after accounting for naps[16]. Typically, they found that adolescents fell asleep at 12:12am and woke at 8am on weekdays, while on weekends they slept at 12:54am and woke at 9:30am[16].

Unlike the 2015 study cited above, which found that girls slept less than boys on average, this research found that male adolescents had 60% lower odds of sleeping within the recommended guidelines than females[16]. Males slept 27 minutes less than female adolescents on weeknights, and 28 minutes less than females after accounting for naps[16]. They did not identify any sex differences in sleep timing or quality on weekday or weekend nights[16]. Some explanations for differences in sleep duration by sex may include worse sleep hygiene behaviors, such as males consuming more caffeine or spending more time on screens, or taking shorter naps, which the actigraphy tracker would not have been able to identify.

When considering ethnoracial backgrounds, it was found that on both weekdays and weekends, non-Hispanic Black adolescents had shorter nightly sleep durations than non-Hispanic White adolescents. However, there was no difference in sleep duration across the 24-hour period, suggesting that naps may play a role in mitigating the difference in durations. On weekday nights, non-Hispanic Black adolescents slept for roughly 33 minutes less than non-Hispanic White adolescents, yet there was no statistically significant difference in the total 24-hour sleep duration between the groups[16]. On weekend nights, non-Hispanic Black adolescents slept for approximately 41 minutes less than non-Hispanic White adolescents on average, however they

also had almost four times the odds of napping on weekends[16]. As a result, there was no statistically significant difference in sleep duration over the full 24-hour period between these groups. They also did not identify any ethnoracial disparities in adolescent sleep timing and quality on weekday or weekend nights.

While the findings that non-Hispanic Black adolescents slept less on average than non-Hispanic Whites aligned with the previous study conducted in Texas, the finding that naps may play a role in offsetting ethnoracial differences in sleep duration was new and notable. Although the study used an objective measure to better understand several aspects of sleep health, actigraphy is often unable to distinguish periods of low activity from nap periods and does not capture perceived sleep quality. The sample also largely included adolescents from urban areas only, which may limit generalizability.

The findings from both studies underscore the importance of research involving sex and ethnoracial differences across a variety of factors in adolescent sleep health. They mirror the findings of several reviews, which have demonstrated that White adolescents typically get longer and better quality sleep than racial and ethnic minorities[14,17]. Future research must investigate the underlying mechanisms through which these disparities come about to better create effective and equitable public health interventions. While some research focuses heavily on behavioral mechanisms which may drive disparities, such as physical activity levels, screen time, and diet, this thesis aims to better understand the contextual mechanism behind the association between parent educational attainment and sleep health outcomes, and how this relationship may be influenced by adolescent demographic characteristics.

Methods

Theoretical Framework

The Fundamental Cause Theory (FCT) is important to the field of social epidemiology, as it provides a framework for how social factors can have a large impact on health outcomes, and how focusing solely on individual risk factors may limit the ability to improve population health and promote health equity. It will be used here to explain any observed differences in adolescent sleep health outcomes after adjusting for individual risk factors such as sex, race/ethnicity, free or reduced school lunch eligibility, and parents working non-traditional hours. FCT, originally created by sociologists Link and Phelan in 1995, aims to explain the persistence of health inequalities even when individual risk factors change or there are advancements in technology, knowledge, and resources[18]. In the present study, the FCT framework guides the hypothesis that there will be differences in adolescent sleep health outcome measures regardless of if individual risk factors are adjusted for, and will be caused directly by the level of parent educational attainment.

Study Design and Population

This cross-sectional study investigates the association between parent educational attainment and adolescent sleep duration, timing, and sufficiency. The data comes from a study of 9th grade students from two racially and economically diverse high schools in Barrow County, a semi-rural area in north-central Georgia, collected during the spring semester of 2020, prior to the COVID-19 lockdown. All 9th grade students who attended school during February 2020 were eligible to participate (n = 1,133).

Data Collection

Parental consent and student assent was obtained prior to data collection, with the opportunity to opt-out. Previously validated/established survey instruments were used to develop a student survey to measure desired constructs, including sleep duration and quality, stress, self-rated health, and other covariates. Surveys were administered online via the Qualtrics survey platform on school laptops during students' advisory period or health class. Demographic information was provided by the school district.

Study Measures

Exposure: Parent Educational Attainment

Parents' highest education level was taken from the student survey. Options included Some high school or less, Finished high school, Some college or special school after high school, Finished college, and Graduate school beyond college (like doctor, lawyer, professor, social worker, scientist). Parents were identified by "Parent 1" or "Parent 2". Both parents' data was considered and the highest educational level attained between the two was used for analysis. For example, if Parent 1 received a graduate degree and Parent 2 received a high school diploma, only Parent 1's information was included in the analysis.

Outcomes: Sleep Duration, Timing, and Sufficiency

Outcomes include three sleep health constructs, including measures of sleep duration, timing, and sufficiency. Sleep duration, the average number of hours of sleep per night, was calculated using two continuous sleep duration outcomes, including school night sleep duration and habitual sleep duration. School night sleep duration was calculated based on school night bedtimes and wake times. Habitual sleep duration was calculated as the weekly weighted average

of school night and weekend sleep duration, weighted 5/7 and 2/7 respectively. The data came from student-reported bed and wake times on weekdays and weekends in response to items from the Student Sleep Habits Survey[19].

Sleep timing was assessed using two continuous sleep timing measures, including school night bedtime and weekend bedtime. Students reported bedtimes in response to the following survey questions: (1) “On school nights, what time do you usually fall asleep?” and (2) “On weekends, what time do you usually fall asleep?” These measures were then adjusted to make two separate binary variables indicating whether or not respondents went to sleep before midnight or after midnight on school nights and weekends. Sleep sufficiency was assessed using student’s answers from the following survey question: “In general, do you feel you usually get... (1) too much sleep (2) enough sleep (3) too little sleep?” This analysis focused on students who reported getting enough sleep.

Covariates: Demographic variables include race/ethnicity, sex, whether a student is eligible for free or reduced school lunch (FRL), and whether a parent works traditional hours, defined as working shifts from 9am-5pm.

Demographic information was collected by either the student survey or the school district’s Office of Student and Data Services. Race/ethnicity was categorized as non-Hispanic Asian, non-Hispanic Black, Hispanic, non-Hispanic multiracial, or non-Hispanic White and was taken from school district data. Sex was recorded as either female or male in the school district data. Students’ free or reduced lunch eligibility was recorded as “yes” or “no”, and was taken from school district data. Whether a parent worked traditional hours (i.e. 9am-5pm) was recorded as “yes” or “no” in the student survey.

Statistical Analysis

The dataset contained 615 survey responses. After cleaning the data to include only surveys with complete responses for variables of interest, 405 responses were used in the statistical analysis. Descriptive statistics are provided for the sample's demographic characteristics, as well as sleep duration, timing, and sufficiency. Unadjusted and adjusted linear and logistic regression models were used to examine the association between parental education and adolescent sleep health outcomes separately, to account for confounders . All testing assessed statistical significance for each predictor at the alpha 0.05 level. All linear regression models met assumptions of normality and displayed no heteroskedasticity. None of the predictors were found to be collinear, which was assessed using variance inflation factors and correlation matrices. All data was analyzed using SAS statistical software, version 9.4[20].

Results

Demographics

Characteristics of the study population are presented in Table 1. The majority of adolescents in this sample (56.8%) are White, followed by 18.5% Hispanic, 14.6% Black, 5.2% Multiracial, and 4.9% Asian. Exactly a third (33.3%) of the sample reported having at least one parent with a college degree, and roughly a fifth (19.6%) had parents whose highest educational attainment was some college. The sample data showed that 11.9% reported having parents whose highest education was less than high school, 26.4% received a high school diploma, and only 8.6% reported a parent with a graduate degree. 55.3% of adolescents reported having at least one parent who worked traditional hours, 50.6% were female, and 47.2% were FRL eligible.

Sleep duration and sufficiency results by demographic characteristic are presented in Table 2. Overall, respondents reported receiving an average of 7.2 hours of sleep each night (SD = 1.6), with 46.9% reporting getting enough sleep. Black respondents reported the lowest amount of sleep each night, with an average of 6.9 hours (SD = 1.5), while Asian respondents reported the highest, with 7.4 hours each night on average (SD = 1.9). Females reported 7.2 hours nightly (SD = 1.6), while males reported 7.1 (SD = 1.7), although a higher percentage of students who reported being sleep sufficient were male (55.8%). Sleep-sufficient students were also more likely to be those who had at least one parent working traditional hours (56.8%) and who were not FRL eligible (52.1%). Students with at least one parent who obtained a graduate degree reported the highest sleep duration, with an average of 7.4 hours nightly (SD = 1.8).

Interestingly, students with at least one parent with a college degree reported the lowest sleep durations, averaging 7.0 hours each night (SD = 1.5). Students with parents whose highest educational attainment was a high school diploma reported the second-highest average sleep duration, averaging 7.2 hours nightly (SD = 1.9). None of the differences between groups were found to be statistically significant, with the exception of the difference in sleep sufficiency between females and males (44.2% vs 55.8% respectively, p-value < 0.05).

Demographic characteristics for sleep timing are presented in Table 3. Overall, 76.3% of students reported going to sleep before midnight on school nights, while only 22.7% reported going to bed before midnight on weekends. Students who reported a bedtime before midnight on weekends were more likely to be females (55.4%), not be FRL eligible (55.4%), and have parents who do not work traditional hours (51.1%). These findings were not statistically significant, however, the difference in the number of students reporting a weekend bedtime before midnight between those whose parents had a high school diploma and those who had a

graduate degree was found to be (15.2% vs 16.3% respectively, p-value < 0.05). Although there are only 35 students in the sample whose parents obtained a graduate degree, 15 of them (42.9%) reported going to bed before midnight on weekends. Out of 107 students whose parents are high school graduates, only 14 (13.1%) reported weekend bedtimes before midnight.

On school days, there was less variation within groups. 52.1% of students who reported a bedtime before midnight on school days were not FRL eligible, 50.8% were female, and 57.3% had parents who worked traditional hours. None of these findings, including those among racial/ethnic groups and educational attainment levels, were found to be statistically significant.

Sleep Duration and Sufficiency

Linear regression models (presented in Table 4) examining the relationship between parent educational attainment and sleep duration found that when compared to students with at least one parent who obtained a graduate degree, students slept less hours a night on average, in both unadjusted and adjusted models. The models also indicated that Black and Multiracial respondents were found to sleep less than White respondents on average, students who were FRL eligible slept less than those who were, females slept longer than males, and those who had parents working non-traditional hours slept slightly less than students whose parents worked traditional hours. However, none of these findings were statistically significant.

Logistic regression models were used to explore the relationship between parent educational attainment and sleep sufficiency, and results are presented in Table 5. After adjusting for race/ethnicity, sex, FRL eligibility, and traditional working hours, the odds of reporting enough sleep were highest among students whose parents received a college degree (OR = 1.0, 95% CI [0.5, 2.1]) and lowest among students whose parents did not complete high school (OR =

0.7, 95% CI [0.3, 1.8]) when compared to students whose parents held a graduate degree. When compared to White students, Multiracial respondents had lower odds of feeling like they get enough sleep (OR = 1.0, 95% CI [0.4, 2.4]), while all other races had higher odds. Students whose parents worked non-traditional hours had lower odds of being sleep-sufficient (OR = 0.9, 95% CI [0.6, 1.3]) when compared to students whose parents worked traditional work hours, while those who were FRL eligible had the same odds as those who were not (OR = 1.0, 95% CI [0.7, 1.5]). None of these results were statistically significant, aside from sex. The odds that females reported feeling like they get enough sleep was only 0.6 times the odds of males (95% CI [0.4, 0.9]).

Sleep Timing

Logistic regression models were used to explore the relationship between parent educational attainment and the likelihood of students going to sleep before and after midnight on school days and weekends. Results are presented in Tables 6 and 7. Overall, it was found that students whose parents received less than a graduate degree had higher odds of going to bed before midnight on school days and that students who were not White had lower odds of going to bed before midnight. Students who were FRL eligible had 0.8 times the odds of going to bed before midnight on school days (95% CI [0.5, 1.3]), while those whose parents did not work traditional hours had 0.7 times the odds (95% CI [0.4, 1.1]). Females had slightly higher odds (OR = 1.1, 95% CI [0.7, 1.7]) of reporting school day bedtimes before midnight than males. None of these findings were statistically significant.

In both adjusted and unadjusted models, it was found that the association between parental education and going to bed before midnight on weekends was statistically significant

(p-value < 0.05). The odds of reporting a bedtime before midnight on weekends was significantly lower among students whose parents obtained an education less than a graduate degree. Odds ratios ranged from 0.2 for students whose parents received a high school diploma (95% CI [0.1, 0.4]) to 0.4 for students whose parents completed some college (95% CI [0.2, 1.0]). Students whose parents received less than a high school diploma had 0.2 times the odds of going to sleep before midnight than students whose parents received a graduate degree (95% CI [0.1, 0.6]), and students whose parents completed college had 0.4 times the odds (95% CI [0.2, 0.8]).

All other races were found to have higher odds of reporting a bedtime before midnight on weekends, except for Black students. When compared to their White counterparts, Black students had 0.9 times the odds of going to sleep before midnight (95% CI [0.4, 1.9]). Students who were not FRL eligible had higher odds of going to sleep before midnight (OR = 1.3, 95% CI [0.8, 2.3]), as well as students whose parents worked traditional hours (OR = 1.5, 95% CI [0.9, 2.5]) and students who were female (OR = 1.2, 95% CI [0.7, 2.0]). Overall, none of the demographic characteristics were found to have a statistically significant association with weekend sleep timing.

Discussion

This present study investigated the association between parent educational attainment and adolescent sleep health outcomes, including sleep duration, timing, and sufficiency, while considering the roles of race/ethnicity, sex, free/reduced lunch eligibility, and whether the student's parents worked traditional hours (9am-5pm). The results of this cross-sectional analysis of 9th grade students in a semi-rural county of north-central Georgia suggest that after adjustment for demographic characteristics, students with parents who have lower educational

attainments had shorter average sleep durations, were less likely to report getting enough sleep, and were more likely to go to bed after midnight on weekends.

A large body of research has found an association between parental education and adolescent sleep health, however it has been limited by only investigating sleep duration and having a lack of racial diversity in study samples. Although some of these results were not found to be statistically significant, this study contributes to research supporting the importance of exploring the relationship between parent educational attainment and adolescent sleep health in a unique population, and provides additional evidence on the less studied topics of sleep timing and sufficiency. Results also showed that there may be additional sex differences in reported sleep sufficiency and that parental education does have a statistically significant association with weekend sleep timing. Future work should focus on these variables to better address sex and social differences in adolescent sleep health outcomes.

The association between parental education and sleep duration in our analysis aligns with existing literature. While typically used as an indicator of socioeconomic status, parental education has been found to be significantly associated with sleep duration, timing, and sufficiency[8,12,13,21–25]. A large (n = 36,167) meta-analysis found that, on average, adolescents whose parents had higher education attainment had 1.3 (95% CI [1.1, 1.5]) times the odds of reporting longer sleep durations compared to those whose parents had lower educational attainment[8]. One prospective cohort study conducted in Britain (n = 1,702) found that lower maternal education significantly increased the odds of shorter sleep (OR = 1.6, 95% CI [1.2–2.2])[25]. However, it is important to note that this study relied on parent-reported outcomes, which may not be as accurate as student-reported data, and the sample was overwhelmingly White, with little to no racial diversity (n = 1,615 White participants, n = 87 non-White)[25].

Additionally, they only investigated the role of maternal education. Alternatively, this current study sample utilized student surveys, considered the highest educational attainment of both parents, and was 43.2% non-White.

A handful of studies reported contrary results of the association between parent educational attainment and adolescent sleep duration[13,21]. These studies found that, on average, students with parents who obtained a college degree or higher had lower sleep durations and were more likely to report having sleep problems. Possible explanations for these contradictory observations could be different cultural emphasis on educational achievement, maintenance of weekday routines on weekends, and variability in sleep measurements, reporting styles, and covariate adjustments. These hypotheses may also explain why students in this sample whose parents obtained a graduate degree had lower odds of going to sleep before midnight on school days. There may be a stronger emphasis on grades and academic achievement in families where the parents received higher education, and therefore students are more likely to stay up late studying or completing assignments on school nights.

The associations between parent educational attainment and sleep sufficiency and timing are less clear, as there is far less literature surrounding these topics. A cross-sectional study conducted in Montréal, Québec found that there was a relationship between parental education and adolescent sleep duration and quality, which was measured similarly to this study's sleep sufficiency measure: perception about feeling rested upon awakening[23]. The British cohort study mentioned previously also found an association between lower maternal education and a later bedtime in adolescents[25]. There were just two articles included in the large meta-analysis that investigated the relationship between parental education and child sleep quality (n = 1,332)[8]. Overall, they found that as the highest level of parent educational attainment increased, so did

adolescent sleep quality (OR = 1.3, 95% CI [1.0, 1.8])[8]. These results do align with the current study, but again are limited by a lack of racial diversity in the study samples, are understudied, and have a wide range of sleep measurement methods, reporting styles, and covariate adjustments.

The finding that female students are significantly more likely to feel like they are not getting enough sleep compared to males also aligns with existing literature. Several studies have shown that adolescent and young adult females report poorer sleep quality and are more likely to feel negative impacts from short sleep durations, daytime sleepiness, and sleep difficulties[26,27]. These results remained significant even after adjusting for sociodemographic, psychological, and lifestyle factors, suggesting that there may be biological mechanisms explaining the difference in sleep sufficiency between female and male students, perhaps linked to hormones[26,27]. Further research is needed to elucidate the exact pathways and fully understand the sex disparities in adolescent sleep sufficiency.

This study has at least three strengths. First, it includes a racially and economically diverse study sample from a semi-rural area in Georgia, representing an understudied and underserved population. Second, several aspects of sleep health were considered, including measurements on sleep duration, sufficiency, and timing. Finally, the main exposure of interest, parent educational attainment, was measured as the highest education of both parents, and was not limited to just maternal or just paternal data. This study's limitations include the fact that sleep data were self-reported, and may be influenced by bias. This study does not infer causality, and may have unmeasured confounders such as technology use, physical activity, or caffeine consumption, which could not be included in the analysis due to insufficient data. Finally, this

analysis was cross-sectional, and therefore there are no possible measured longitudinal changes in sleep health outcomes.

This study aimed to fill a literature gap by further examining the association between parent educational attainment and adolescent sleep duration, timing, and sufficiency. Although not all findings were statistically significant, this work highlights a potential mechanism behind differences in student sleep health outcomes. As sleep health continues to be a major concern for U.S. adolescents, negatively impacting students' well-being and success, understanding the role of parental education with the potential to identify at-risk adolescents and reduce disparities in sleep health outcomes is important. This work supports the need for larger-scale longitudinal and intervention studies focusing on multiple aspects of sleep health to better identify appropriate methods to improve sleep health outcomes among adolescents.

Conclusion

This study demonstrates that parent educational attainment does have an association with adolescent sleep health outcomes, and that students whose parents received less education often report shorter sleep durations, later sleep times, and are less likely to feel like they are getting enough sleep. While prior studies have investigated the relationship between parental education and sleep duration, this work fills a critical knowledge gap by including timing and sufficiency measures in the analysis. The results suggest that weekend sleep timing is significantly associated with parent educational attainment, and that there may be additional sex differences in reported sleep sufficiency. Future research is needed to assess how parent educational attainment affects other adolescent sleep health outcomes. The findings presented in this study are

particularly relevant when creating future sleep health interventions and identifying key at-risk groups, in order to reduce disparities and improve the sleep of adolescents.

Declarations

Informed consent: Informed consent was obtained from parent and/or legal guardian for study participation, and student assent was obtained prior to data collection. The study protocol was approved by IRB (IRB00111438).

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

Data Availability Statement: The datasets used and/or analyzed during the current study available from the corresponding author on reasonable request.

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Tables

Table 1. Demographic characteristics, *The Association Between Parent Educational Attainment and Adolescent Sleep Health*, 9th grade students, 2019 – 2020 school year (n = 405)

	n	%
Race/ethnicity [a]		
Asian	20	4.9
Black	59	14.6
Hispanic	75	18.5
Multiracial	21	5.2
White	230	56.8
FRL Eligible [b]		
No	214	52.8
Yes	191	47.2
Sex		
Female	205	50.6
Male	200	49.4
Traditional Working Hours		
No	181	44.7
Yes	224	55.3
Parental Education		
< High school	48	11.9
High school graduate	107	26.4
Some college	80	19.8
College	135	33.3
Graduate school	35	8.6

[a] School-reported race/ethnicity
[b] Free/reduced lunch eligible

Table 2. Sleep duration and sufficiency by demographic characteristics, *The Association Between Parent Educational Attainment and Adolescent Sleep Health,* 9th grade students, 2019 – 2020 school year (n = 405)

	Sleep Duration[a]		Sleep Sufficiency[b]	
	Mean	**SD**	**n**	**%**
Total	7.2	1.6	190	46.9
Race/ethnicity [c]				
Asian	7.4	1.9	10	5.3
Black	6.9	1.5	32	16.8
Hispanic	7.2	1.3	39	20.5
Multiracial	7.1	2.1	9	4.7
White	7.2	1.7	100	52.6
FRL Eligible [d]				
No	7.1	1.4	99	52.1
Yes	7.2	1.8	91	47.9
Sex				
Female	7.2	1.6	84*	44.2*
Male	7.1	1.7	106*	55.8*
Traditional Working Hours				
Yes	7.2	1.4	108	56.8
No	7.1	1.8	82	43.2
Parental Education				
< High school	7.1	1.2	21	11.1
High school graduate	7.2	1.9	48	25.6
Some college	7.2	1.5	34	17.9
College	7.0	1.5	69	36.3
Graduate school	7.4	1.8	18	9.5

[a] Hours per night
[b] Measured as students reporting getting enough sleep
[c] School-reported race/ethnicity
[d] Free/reduced lunch eligible

Table 3. Sleep timing measurements by demographic characteristics, *The Association Between Parent Educational Attainment and Adolescent Sleep Health,* 9th grade students, 2019 – 2020 school year (n = 405)

	Weekend Bedtime Before Midnight		School Day Bedtime Before Midnight	
	n	**%**	**n**	**%**
Total	92	22.7	309	76.3
Race/ethnicity [a]				
Asian	7	7.6	14	4.5
Black	12	13.0	42	13.6
Hispanic	24	26.1	58	18.8
Multiracial	5	5.4	14	4.5
White	44	47.8	181	58.6
FRL Eligible [b]				
No	51	55.4	161	52.1
Yes	41	44.6	141	47.9
Sex				
Female	51	55.4	157	50.8
Male	41	44.6	152	49.2
Traditional Working Hours				
Yes	45	48.9	177	57.3
No	47	51.1	132	42.7
Parental Education				
< High school	10	10.9	37	12.0
High school graduate	14*	15.2*	83	26.9
Some college	22	23.9	65	21.0
College	31	33.7	99	32.0
Graduate school	15*	16.3*	25	8.1

[a] School-reported race/ethnicity
[b] Free/reduced lunch eligible
*Difference results in p-value < 0.05

Table 4. Linear regression models examining parental education and sleep duration, *The Association Between Parent Educational Attainment and Adolescent Sleep Health,* 9th grade students, 2019 – 2020 school year (n = 405)

	Unadjusted		Adjusted[a]	
	β	**95% CI**	**β**	**95% CI**
Intercept	7.4	(6.9, 8.0)	7.5	(6.9, 8.2)
Parental Education				
< High school	-0.3	(-1.1, 0.4)	-0.5	(-1.3, 0.2)
High school graduate	-0.2	(-0.8, 0.4)	-0.3	(-0.9, 0.4)
Some college	-0.3	(-0.9, 0.4)	-0.3	(-1.0, 0.3)
College	-0.4	(-1.0, 0.2)	-0.5	(-1.1, 0.1)
Graduate school	Ref	--	Ref	--
Race/ethnicity [b]				
Asian			0.2	(-0.6, 0.9)
Black			-0.4	(-0.9, 0.1)
Hispanic			0.1	(-0.4, 0.5)
Multiracial			-0.1	(-0.8, 0.7)
White			Ref	--
FRL Eligible [c]				
No			-0.1	(-0.5, 0.2)
Yes			Ref	--
Sex				
Female			0.2	(-0.2, 0.5)
Male			Ref	--
Traditional Working Hours				
No			-0.0	(-0.4, 0.3)
Yes			Ref	--

[a] adjusted for race/ethnicity, free/reduced lunch, sex, parental education, and traditional working hours

[b] school-reported race/ethnicity

[c] Free/reduced lunch eligible

Table 5. Logistic regression models examining parental education and sleep sufficiency, *The Association Between Parent Educational Attainment and Adolescent Sleep Health,* 9th grade students, 2019 – 2020 school year (n = 405)

	Unadjusted		Adjusted[a]	
	Odds Ratio	**95% CI**	**Odds Ratio**	**95% CI**
Parental Education				
< High school	0.7	(0.3, 1.8)	0.7	(0.3, 1.8)
High school graduate	0.8	(0.4, 1.7)	0.7	(0.3, 1.6)
Some college	0.7	(0.3, 1.6)	0.7	(0.3, 1.6)
College	1.0	(0.5, 2.1)	1.0	(0.5, 2.1)
Graduate school	Ref	--	Ref	--
Race/ethnicity [b]				
Asian			1.4	(0.6, 3.6)
Black			1.6	(0.9, 3.0)
Hispanic			1.6	(0.9, 2.9)
Multiracial			1.0	(0.4, 2.4)
White			Ref	--
FRL Eligible [c]				
No			1.0	(0.7, 1.5)
Yes			Ref	--
Sex				
Female			0.6	(0.4, 0.9)*
Male			Ref	--
Traditional Working Hours				
No			0.9	(0.6, 1.3)
Yes			Ref	--

[a] adjusted for race/ethnicity, free/reduced lunch, sex, parental education, and traditional working hours

[b] school-reported race/ethnicity

[c] Free/reduced lunch eligible

*p-value < 0.05

Table 6. Logistic regression models examining parental education and school day sleep timing, *The Association Between Parent Educational Attainment and Adolescent Sleep Health,* 9th grade students, 2019 – 2020 school year (n = 405)

	Unadjusted		Adjusted[a]	
	Odds Ratio	**95% CI**	**Odds Ratio**	**95% CI**
Parental Education				
< High school	1.4	(0.5, 3.6)	1.3	(0.4, 3.8)
High school graduate	1.4	(0.6, 3.3)	1.4	(0.6, 3.4)
Some college	1.7	(0.7, 4.4)	1.8	(0.7, 4.5)
College	1.1	(0.5, 2.5)	1.1	(0.5, 2.5)
Graduate school	Ref	--	Ref	--
Race/ethnicity [b]				
Asian			0.6	(0.2, 1.8)
Black			0.7	(0.3, 1.3)
Hispanic			0.9	(0.4, 1.7)
Multiracial			0.5	(0.2, 1.4)
White			Ref	--
FRL Eligible [c]				
No			0.8	(0.5, 1.3)
Yes			Ref	--
Sex				
Female			1.1	(0.7, 1.7)
Male			Ref	--
Traditional Working Hours				
No			0.7	(0.4, 1.1)
Yes			Ref	--

[a] adjusted for race/ethnicity, free/reduced lunch, sex, parental education, and traditional working hours

[b] school-reported race/ethnicity

[c] Free/reduced lunch eligible

Table 7. Logistic regression models examining parental education and weekend sleep timing, *The Association Between Parent Educational Attainment and Adolescent Sleep Health,* 9th grade students, 2019 – 2020 school year (n = 405)

	Unadjusted		Adjusted[a]	
	Odds Ratio	**95% CI**	**Odds Ratio**	**95% CI**
Parental Education				
< High school	0.4	(0.1, 0.9)*	0.2	(0.1, 0.6)*
High school graduate	0.2	(0.1, 0.5)*	0.2	(0.1, 0.4)*
Some college	0.5	(0.2, 1.2)	0.4	(0.2, 1.0)*
College	0.4	(0.2, 0.8)*	0.4	(0.2, 0.8)*
Graduate school	Ref	--	Ref	--
Race/ethnicity [b]				
Asian			2.5	(0.9, 6.9)
Black			0.9	(0.4, 1.9)
Hispanic			2.7	(1.4, 5.3)
Multiracial			1.3	(0.4, 3.8)
White			Ref	--
FRL Eligible [c]				
No			1.3	(0.8, 2.3)
Yes			Ref	--
Sex				
Female			1.2	(0.7, 2.0)
Male			Ref	--
Traditional Working Hours				
No			1.5	(0.9, 2.5)
Yes			Ref	--

[a] adjusted for race/ethnicity, free/reduced lunch, sex, parental education, and traditional working hours

[b] school-reported race/ethnicity

[c] Free/reduced lunch eligible

*p-value < 0.05