ABSTRACT

Insufficient Sleep Across Racial/Ethnic Groups Over Time

Leah Bullinger

Director: Wade C. Rowatt, Ph.D.

Insufficient sleep can negatively impact individuals on social, academic, medical, and societal levels. However, there are gaps in the literature regarding the relationship between sleep averages and racial/ethnic groups across time. This study assessed the longitudinal relationships between racial/ethnic groups and reported sleep scores in a national sample. Data (n = 2,427) was collected from five waves of The National Longitudinal Study of Adolescent to Adult Health (Add Health). Data analysis showed that reported sleep averages decreased across all five waves for almost every racial/ethnic group (from 7.92 hours to 6.73 hours). Furthermore, the data showed that Whites tended to report higher sleep score averages than Hispanics, while Hispanics tended to report higher sleep score averages than 'Other' race/ethnicity members and Blacks. In the end, over two thousand participants' responses were considered, and bivariate correlations revealed small but significant effects. These results suggest that the connections between sleep insufficiency, race/ethnicity, and age groups are deserving of further investigation.

APPROVED BY DIRECTOR OF HONORS THESIS:

_____

Dr. Wade Rowatt, Department of Psychology

APPROVED BY THE HONORS PROGRAM:

_____

Dr. Elizabeth Corey, Director

DATE: _____

INSUFFICIENT SLEEP ACROSS RACIAL/ETHNIC GROUPS OVER TIME

A Thesis Submitted to the Faculty of

Baylor University

In Partial Fulfillment of the Requirements for the

Honors Program

By

Leah Bullinger

Waco, Texas

December 2022

TABLE OF CONTENTS

Preface iii

Chapter One: Introduction 1

Chapter Two: Methods 11

Chapter Three: Results. 16

Chapter Four: Discussion 18

Appendices 22

Appendix A 23

Appendix B 24

References 25

ACKNOWLEDGMENTS

I would like to express my gratitude for Dr. Wade Rowatt and his thoughtful leadership. Through every twist and turn in this journey, Dr. Rowatt was there. Furthermore, I would also like to extend my thanks to Dr. Meredith Palm for her enthusiasm, advice, and involvement. I am especially thankful for her openness to my office visits, zoom calls, and emails. Lastly, I also would not have been able to finish this project without Monica Weedman. Her patience, generosity, and statistical smarts helped me so much.

I am also very grateful for Baylor University's amazing staff and students within the Psychology and Neuroscience Department. We are all just so blessed to be a part of the "Baylor Family".

***

This research uses data from Add Health, a program project directed by Kathleen Mullan Harris and designed by J. Richard Udry, Peter S. Bearman, and Kathleen Mullan Harris at the University of North Carolina at Chapel Hill and funded by grant P01-HD31921 from the Eunice Kennedy Shriver National Institute of Child Health and Human Development, with cooperative funding from 23 other federal agencies and foundations. Special acknowledgment is due to Ronald R. Rindfuss and Barbara Entwisle for assistance in the original design. Information on how to obtain the Add Health data files is available on the Add Health website (http://www.cpc.unc.edu/addhealth).

DEDICATION

To my mom, my best friend.

CHAPTER ONE

Introduction

Insufficient sleep has deleterious effects for both adolescents and adults. In a recent report by the Centers for Disease Control (CDC), an estimated 35% of all American adults and 69% of all adolescents do not get enough sleep, which translates to nearly 100 million individuals in the U.S. alone (CDC, 2017b). Currently, the National Sleep Foundation recommends 7-9 hours of sleep per night for adults and 8-10 hours for adolescents (Hirshkowitz et al., 2015). Low amounts of sleep can be caused by voluntary choices, uncontrollable conditions, or a combination of the two. When adults and adolescents consistently do not get sufficient sleep, this creates negative social impacts, learning impacts, medical impacts, and societal impacts (Medic et al., 2017). For instance, in the social realm, low amounts of sleep can harm relationships through decreased self-control, increased aggression, and decreased focus. Meanwhile, in the medical realm, insufficient sleep can lead to a wide variety of health problems. Next, in the learning realm, sleep loss negatively affects memory and recall. Lastly, in the societal realm, poor sleep has been correlated with an increase in criminal behavior and accidents, as well as a decrease in productivity and general economic wellbeing. Collectively, these issues have begun to garner serious academic attention, as shown by the recent rise in sleep-related literature. At worst, insufficient sleep can shorten individuals' lifespans

through health issues, accidental deaths, and more. But in many cases, sleep loss is preventable, and therefore, more scientific investigation is needed to understand the causal factors of insufficient sleep.

Today's scientific community still does not fully understand the biological underpinnings of sleep, but studies across the years have demonstrated that sufficient sleep plays a key role in overall wellbeing and survival as a species. Without proper sleep, critical thinking, watchfulness, and overall focus can be seriously hindered. Similarly, insufficient sleep can also harm memory consolidation and emotional upkeep. Therefore, an emphasis on prevention over treatment is important when addressing the costs of insufficient sleep. In the right circumstances, effective prevention could put an end to "injuries, chronic diseases, mental illnesses, poor quality of life and well-being, increased health care costs, and lost work productivity" caused by sleep insufficiency (CDC, 2017a).

Social Impacts of Sleep Insufficiency

Evolutionarily speaking, human sleep patterns evolved to synchronize with our social networks. For early people groups, this sleep synchronization provided enhanced safety. But today, this synchronization is better known for its relationship with increased group harmonization and wellbeing. This can especially be seen in adolescent groups, as adolescents with strong social support tend to sleep better than adolescents with weak social support (Dahl, 2002). This trend applies to adults also, as people of all ages tend to report worsened relationships (with friends, family, etc.) when sleep insufficiency arises.

According to a 2014 study, insufficient sleep can put romantic relationships at risk (Gordon & Chen, 2014). In the study, participants reliably reported more relationship issues after experiencing poor sleep. Participants also struggled to resolve conflicts with their significant others unless both partners were well rested. Poor sleep adversely impacted participant affect, empathy for others, and conflict frequency. Similarly, researchers found that sleep deprivation worsened couple conflict and raised participant cortisol levels (Cernadas Curotto et al., 2022). The researchers randomly assigned couples to either a sleep-deprived condition or a non-sleep deprived condition and then examined the effects the next day. For the sleep-deprived couples, conflict and stress levels rose while overall satisfaction ratings fell. But for the non-sleep-deprived couples, conflict, stress, and satisfaction levels did not change much. Thus, sleep appears to play an important role in the mediation of relational conflict.

A lack of sleep can also promote anger and violence in aggression-prone individuals by impairing the self-control function of the prefrontal cortex. In a 2013 study, researchers examined a sample of 425 college students and found that those with unhealthy sleep habits were more verbally and bodily aggressive than those with healthy sleep habits (Randler & Vollmer, 2013). Similarly, researchers have found that teenagers who do not get enough sleep at night tend to have trouble controlling their emotions in relationships and may suffer from "mood disturbances… behavior problems… lack of motivation, [and] depressed mood" (Carskadon, 2011).

Learning Impacts of Sleep Insufficiency

The literature suggests that a lack of sleep can also inhibit learning. As aforementioned, sleep lack can seriously affect one's ability to concentrate and slow their reaction time (Himashree et al., 2002). Therefore, when students do not get enough sleep, they cannot easily attend to important schoolwork. This is especially true for schoolwork that features step-by-step requirements (Stepan et al., 2020). Furthermore, sleep insufficiency hinders memory consolidation, which can prevent sleep-deprived students from effectively storing or recalling learned information. Creative ability is also negatively affected since sleep lack hinders the "inventive" regions of the brain.

Sleep-deprived students also tend to have more behavioral problems in school. These problems stem from sleep deprivation's harmful impacts on decision making, risk taking, and aggression. When students don't get enough sleep, their mood and overall sense of wellbeing suffer, which can cause them to lash out at others. Sleep-deprived students may also accidentally fall asleep in class. Behavior like this can result in students receiving disciplinary action such as detention or suspension, which can then cause students to become even more detached from their teachers and peers. Furthermore, if students already have disorders that interfere with learning, such as attention-deficit/hyperactivity disorder (ADHD), a lack of sleep can make learning interference worse (Suni, 2022b). Similarly, depression and anxiety can also inhibit learning, and sleep deprivation creates a higher risk of both. Lastly, sleep loss can also increase the likelihood of tardiness and skipping school, which can negatively impact students' academic success.

In short, students that suffer from poor sleep quality and quantity tend to jointly suffer from poor learning outcomes. This holds true for students of all levels, from youth into old age. In multiple human studies, the prefrontal cortex's neural systems have proven to be especially susceptible to the harms of sleep deprivation (Curcio, 2006). Because of this, functions that connect to "divergent thinking, language, decision-making, memory and response inhibition, and serial subtraction" tend to be negatively impacted (Curcio, 2006). Similarly, University of Michigan researchers demonstrated that sleep plays a critical role in the consolidation of learning and memory (Hershner, 2014). In the study, subjects were asked to participate in a visual discrimination task in which they identified the orientation of three bars and the appearance of a 'T' or 'L' on a screen. On average, sleep-deprived subjects performed worse than well-rested subjects, even after receiving two nights of sleep recovery. Furthermore, while the performance of the well-rested subjects improved over time, the performance of the originally sleep-deprived subjects did not (Hershner, 2014). Within the same study, participants were later asked to learn and remember a certain motor task. After twelve hours, participants that were able to sleep improved by 18%, while participants that did not sleep did not improve at all. Together, these studies suggest that rest is essential for learning retention.

Medical Impacts of Sleep Insufficiency

Not surprisingly, sleep lack also negatively impacts mental and physical wellbeing. When sleep is lost, immune system weakening can ensue and increase the risk for diseases and chronic conditions, including "type 2 diabetes, cardiovascular disease, obesity, and depression" (CDC, 2018). The literature has shown that insufficient sleep is

connected to hypertension, coronary heart disease, and diabetes through increased sympathetic nervous system activity (Nagai et al., 2010). But sleep lack, depression, and obesity are believed to be connected through hormonal alterations, biochemical pathways, and cellular inflammation (Araghi et al., 2013; Fang et al., 2019).

Research has also revealed that people who get less than recommended amounts of sleep per night also have an increased risk of experiencing asthma attacks, being diagnosed with certain cancers, and dying prematurely (Luyster et al., 2020; Suni, 2022a). According to a 2020 report from the Annals of Allergy, Asthma, and Immunology, inflammation caused by sleep loss is especially harmful, as it can cause asthma symptoms to worsen and raise asthmatic patients' odds of experiencing an attack (Luyster et al., 2020). But for cancer risk, certain cancer types are more sensitive to sleep loss than others. For instance, most colon cancers start as colon polyps, and insufficient sleep can increase the likelihood of developing such polyps (Suni, 2022a). Furthermore, reduced sleep duration can also increase the risk of developing stomach cancer, lymphoma, thyroid cancer, bladder cancer, and neck cancer. Animal studies have shown that sleep loss may increase cancer risks through expedited cell damage and destruction of DNA. This same connection has not been conclusively established in human studies yet, but some believe that it will soon.

As shown, sleep loss has many negative impacts on mental and physical wellbeing. These negative impacts can also increase the risk of disease and all-cause mortality, as evidenced by a 2010 meta-analysis. In the analysis, researchers reviewed findings from 16 studies with a total of 1,382,999 male and female participants (Cappuccio et al., 2010). In the review, short sleep duration was definitively associated

with a "greater risk of death [from any cause] … with no evidence of publication bias" (Cappuccio et al., 2010).

Societal Impacts of Sleep Insufficiency

Sleep insufficiency can also negatively affect communities through increased rates of crime, injuries, and economic loss. When insufficient sleep impairs self-control functions, it can affect more than just relationships. In short, self-control loss over time can affect individuals' likelihood of committing criminal acts. A 2017 study from The Journal of Child Psychology and Psychiatry found that fifteen-year-old males who reported sleep insufficiency were more than four times more likely to commit crimes before the age of thirty than their well-rested peers (Raine & Venables, 2017). Furthermore, a 2017 report from the American Academy of Sleep Medicine suggests that sleep loss may especially impact individuals' likelihood of committing sexual assault (Celmer, 2017). Put simply, sleep loss can cause men to overestimate women's interest in sexual advances. This can then lead sleep-deprived men to make decisions that could lead to nonconsensual sex and issues like sexual harassment, sexually transmitted diseases, and unplanned pregnancy. Without adequate amounts of sleep, individuals can lose their normal feelings of self-control, care, and patience.

Insufficient sleep can also cause dangerous accidents. From 2005 to 2009 alone, the National Highway Traffic Safety Administration (NHTSA) found drowsy driving to be responsible for an average of 886 American fatalities per year; 37,000 injury crashes per year; and 83,000 overall crashes per year. (NHTSA, 2011). However, since accident causes are not always accurately recorded, it is likely that these totals underestimate the

actual impact of drowsy driving. Studies have also shown that drowsy driving is akin to drunk driving, since sleep lack can reduce alertness, impair coordination, and affect driving judgment (CDC, 2017c). Furthermore, although the legal limit for blood alcohol content is 0.08%, staying awake for 24 hours or more creates bodily effects equivalent to those induced by a blood alcohol content of 0.10% (CDC, 2017c). Drowsiness can also magnify the impact of total alcohol consumption, which can then increase accident risk even more (CDC, 2017c). Lastly, according to a 2015 report by the AAA Foundation, even though nearly 80% of Americans believe that drowsy driving is unacceptable, nearly one third have driven while drowsy in the past month (AAA, 2015).

Like drowsy driving, drowsy working can also lead to accidents. In the workplace, sleepy employees are 70% more likely than non-sleepy employees to become accident victims (Swaen, 2003). Accidents can then cost workers and businesses directly and indirectly, through costs in human capital and financial capital. At best, accidents can simply end as minor failures, which can temporarily decrease company efficiency and worker morale. But at worst, accidents can end in fatalities that drastically affect workers' loved ones and work teams in the long term. In the wake of an accident, businesses usually face significant losses of capital, lowered staff morale, and difficulty making up for spoiled production and lost work time.

Each year, sleep loss issues cost the U.S. economy an estimated 2.28 percent of the national GDP, or $411 billion in total (Hafner et al., 2016). This annual loss is greater than that estimated by Japan (about $138 billion), Germany (about $60 billion), the UK (about $50 billion), or Canada (about $21.4 billion) (Hafner et al., 2016). Furthermore, the U.S. also ranks first in lost working days, with almost 1.2 million working days lost

due to sleep issues (Hafner et al., 2016). Therefore, if sleep-deprived Americans could improve their sleeping habits, the U.S. economy would benefit substantially.

Racial/Ethnic Disparities in Sleep Insufficiency

As shown, sleep insufficiency can generate a wide variety of adverse social harms, learning issues, medical risks, and societal impacts. These problems can affect adolescents and adults alike, but sleep health disparities are especially common in minoritized groups. According to the National Community Reinvestment Coalition, this may be because low-income individuals in minority racial/ethnic groups tend to have more demanding work schedules, more exposure to pollution, more food insecurity, and more cramped living arrangements than wealthier non-minorities (Orminski, 2021). Minorities and low-income earners are also more likely to face discrimination and financial stress, which can weaken sleep health, physical health, and mental health (Orminski, 2021). This can especially be seen in the social realm, as sleep difficulties in Black adults are positively associated with stress from racism-related vigilance (Heckin et al., 2013). Additionally, in the learning realm, comparison studies have revealed that poor sleep quality among college students mediates the relationship between grade point average (GPA) and race/ethnicity (Nickel & Scullin, 2022). Likewise, in the medical realm and societal realm, researchers have found that sleep-disrupting night shifts significantly increase the risk of Black workers developing dangerous hypertension (but not White workers) (see Lieu et al., 2012). Furthermore, these disparities seem to arise early in life, as Hispanic parents more often report that their children have sleep disorder symptoms than White parents (Goodwin et al., 2003). Similarly, an actigraphy-monitored

study found that White young adults average one more hour of sleep per night than Black young adults (Lauderdale et al., 2006).

Present Study

As shown by the literature above, studying insufficient sleep is both timely and relevant. Current research has identified many important insufficient sleep correlations, but few studies have addressed the relationship between average sleep and racial/ethnic group influence over time. Therefore, the present study aims to investigate this relationship in a national longitudinal sample of Americans. This relationship will be examined via self-reported sleep measures and self-reported race/ethnicity. Furthermore, key demographics and other important variables will also be analyzed. It is hypothesized that:

1. For all races/ethnicities, sleep averages per age group will decrease across the study's five waves.
2. Whites will report the highest sleep averages, Hispanics will report the second highest sleep averages, 'Other' race/ethncity members will report the third highest sleep averages, and Blacks will report the lowest sleep averages.

CHAPTER TWO

Methods

Sample

The National Longitudinal Study of Adolescent to Adult Health (Add Health) began as a study of over 90,000 American adolescents from grades 7-12 in the school year 1994-1995 (Harris et al., 2009). The sample was nationally representative and followed longitudinally over five waves. In the initial study, participants were selected from 145 middle schools and high schools in America. Furthermore, 20,745 of the original 90,000 participants were chosen to participate in an in-home interview. This Wave-1 interview group was then asked to complete a Wave-2 interview in 1996 (N = 14,738). This was then followed by a Wave-3 interview in 2001–2002 (N = 15,197), a Wave-4 interview in 2008–2009 (Wave 4, N = 15,701), and a Wave-5 interview in 2016–2018 (N = 12,300). Through these waves, the Add Health researchers have been able to gather rich survey data on various demographics, social behaviors, family ties, socioeconomic status, behaviors, health patterns, and more from participants and family members. Add Health researchers also have collected contextual data from participants' homes, neighborhoods, schools, physical information, and biological tests. These biological tests include genetic markers, blood tests, anthropometric measurements, and drug checks. Furthermore, supporting

studies have added to the initial study over time. The project data is available online and physically and has been used in thousands of academic entries. UNC at Chapel Hill's Institutional Review Board (IRB) approved the Add Health study. For more research information, see Harris et al. (2009).

Out of the original 20,745 adolescents that completed the Wave-1 interview, 6,504 individuals' data were made available for the public after deidentification. Out of the publicly available sample, only 2,427 participants completed the sleep sections across all five waves. Therefore, due to the proportion of missing data, we decided to use data removal rather than imputation, and ended with 2,427 participants in total.

Measures

Sleep

Sleep averages were assessed through all five waves. In waves one, two, and five, participants were simply asked to provide how many hours of sleep they had in a typical night. The responses ranged from 1 to 20 hours. However, in waves three and four, participants were asked to share their average bedtimes and waketimes for the week. Therefore, to calculate average sleep, we subtracted participants' bedtimes from their waketimes. In keeping with the National Sleep Foundation's recommendations for teenaged sleep time, we classified the averages for waves one and two as either "insufficient sleep" for fewer than eight hours, "sufficient sleep" for eight to ten hours, or "overly sufficient sleep" for ten or more hours (Hirshkowitz et al., 2015). However, for waves three through five, we modified the classifications to fit with the National Sleep Foundation's recommendations for adult sleep by classifying "insufficient sleep" as

fewer than seven hours, “sufficient sleep” as seven to nine hours, and “overly sufficient” sleep as nine or more hours (Hirshkowitz et al., 2015).

Age

In this study, the cohort’s range in age varied by about ten years. For wave one, the youngest participant was 12, while the oldest was 20. Then, in wave two, the youngest participant was 12, while the oldest was 21. Next, in wave three, the youngest participant was 18 and the oldest was 26. In wave four, the youngest participant was 25 while the oldest was 33. Lastly, in wave five, the youngest participant was 33 and the oldest was 42.

Race/Ethnicity

Race/ethnicity was categorized into four separate groups, those being 1 = White, non-Hispanic, 2 = Hispanic, 3 = Black, non-Hispanic, and 4 = other race/ethnicity. This ‘other race/ethnicity’ category was comprised of American Indian/Native American participants, Asian/Pacific Islander participants, and self-identified ‘other race/ethnicity’ participants. In total, White participants accounted for 67.3% of the sample, Black participants for 17.1%, Hispanic participants for 8.4%, and ‘other race/ethnicity’ participants for 7.3% (see Table 1).

Birth-Assigned Sex

At Wave I, participants' birth-assigned sex was dummy coded (male = 0). Out of the total sample, each participant provided their birth-assigned sex. In all, there were 1294 female respondents and 891 male respondents (see Table 1).

Income

Income was categorized via an index across the five survey waves. In our index, we converted self-reported income into Z scores, which reflect a value's relationship to the its group average. Then, we converted each wave's Z scores into just one Z score average for exploratory analysis use. For the Z scores in waves 5 and 4, we averaged 1) reported household income and 2) reported personal income. But in wave 3, participants reported "total income", "household income", and "personal income", so we used three Z scores to create the wave average. In wave two, we averaged the available income responses that provided allowance amounts per week, summer job pay per week, and non-summer job pay per week. Lastly, for wave one, we used just one Z score variable, which was parent-reported "total income." About 1,902 participants chose to provide income data for all five waves, while 525 did not.

Education

To classify participant education levels, we created an index to measure participants' highest level of education to date. We created fifteen categories for education levels ranging from "8th grade or less" to "completed a doctoral degree". Most participants (93.7%) fell somewhere in between the above extremes, with most (21.8%) obtaining a bachelor's degree at their educational peak.

Analytic Plan

All analyses were completed via various tests within SPSS version 28. To test hypothesis one, we utilized a means difference test to compare the pooled participants' sleep averages across time. We also used bivariate correlation tests to compare sleep average correlations between waves. Then, to test hypothesis two, we utilized a one-way ANOVA sample t-test to compare sleep differences among racial/ethnic groups.

CHAPTER THREE

Results

We firstly used a mean difference test to check the hypothesis that there would be decreases in pooled sleep averages across the study's five waves. This test revealed that our first hypothesis was supported, as the sleep average trend for the pooled respondents followed a downward slope across the waves. The average was 7.92 hours in wave 1, followed by 7.61 hours in wave 2, 7.54 hours in wave 3, 7.48 hours in wave 4, and 6.73 hours in wave 5 (see Figure 1). For waves 1, 2, and 5, the averages reflected insufficient sleep, but in waves 3 and 4, the average reflected sufficient sleep (see Hirshkowitz et al., 2015).

Next, through bivariate Pearson Correlation tests, we found statistically significant correlations between all five sleep waves. Reported sleep averages in wave 5 showed small but significantly positive correlations to the sleep averages in wave 4 ($r = .26$, $p < .001$), wave 3 ($r = .15$, $p < .001$), wave 2 ($r = .15$, $p < .001$), and wave 1 ($r = .09$, $p < .001$) (See Table 2).

We then used a one-way ANOVA to test the hypothesis that there would be racial/ethnic differences in average sleep across waves ($F(3, 2423)=10.581$, $p<.001$). Our test revealed that our second hypothesis was also supported, with White participants reporting more sleep, on average, than other racial/ethnic groups (see Table 3).

Specifically, we found significant differences in sleep across racial/ethnic groups in Wave 1, Wave 4, and Wave 5. In Wave 1, White participants (Mean = 7.97, SD = 1.27) and Hispanic participants (Mean = 8.08, SD = 1.52) reported more sleep on average than Black participants (Mean = 7.71, SD = 1.62) ($F(3, 2423)=6.190$, $p<.001$). In Wave 4, White participants (Mean = 7.54, SD = 1.29) reported more sleep on average than Black participants (Mean = 7.27, SD = 1.61) ($F(3, 2423)=4.895$, $p<.01$). For Wave 5, White participants (Mean = 6.81, SD = 1.11) reported more sleep on average than Black participants (Mean = 6.50, SD = 1.30) ($F(3, 2423)=8.516$, $p<.001$).

Additionally, pooled female participants (M = 7.5 hours, SD = .79) reported getting more sleep on average than pooled male participants (M = 7.38 hours, SD = .75) ($T=-4.0$, $p<.001$, $d=.775$). We also considered income and education interactions and found that both variables did not significantly impact the connection between race/ethnicity and sleep. Moderation was used to test the total effect of race/ethnicity on sleep and was non-significant when including education or income as a predictor.

CHAPTER FOUR

Discussion

In the present study, we assessed the connections between average sleep time, race/ethnicity, and age group. The first hypothesis about pooled sleep averages decreasing across the study's five waves was supported by the results. The second hypothesis about Whites reporting more sleep on average than racial/ethnic minorities was also supported. These findings have important implications for American adults, especially those in minority race/ethnicity groups.

To date, research on insufficient sleep has garnered considerable interest, but researchers have yet to reach a consensus on sleep insufficiency's connection to the passage of time. According to a 2013 Gallup report, Americans average about 6.8 hours of sleep per night, which is significantly lower than the 1942 average of about eight hours of sleep per night (Jones, 2021). Data from the National Health Interview Survey (NHIS) supports this downward trend with evidence that adult sleep has fallen by 10–15 minutes total from 1985 to 2012 (Ford et al., 2015). However, data from the American Time Use Survey (ATUS) suggests otherwise, with evidence that from 2003 to 2016, sleep averages increased in many areas of the U.S. (Basner and Dinges, 2018). Furthermore, although sleep needs decrease to an extent from childhood to adulthood, experts say that both

young and old adults alike should get at least seven hours per night (Hirshkowitz et al., 2015). Meeting this standard can be difficult, especially for those who have busy work or school schedules, child-rearing responsibilities, too much screen time, poor sleep habits, or medical problems that prevent sleep. Smoking, overeating, and drinking caffeine or alcohol before bed can also disrupt sleep. However, on an individual level, behavior modifications, environmental improvements, situational changes, and prescribed medication can often positively enhance sleep quality. Moreover, on the societal level, program leaders, policy makers, and involved communities can also fight for positive sleep health change – especially for underserved groups that need it most.

Limitations

While this study revealed an interesting downward trend in sleep by age group and a number of significant sleep correlations, there are several limitations that must be addressed. First, since this study only included participants that chose to respond to the sleep measures for all five waves, it is likely that the final sample does not adequately reflect the general population. Moreover, the use of a racial/ethnic 'Other' category prevented us from fully examining and appreciating minority differences. Second, social-desirability bias may have led Add Health questionnaire respondents to give untruthful answers for the sleep and socioeconomic status questions in order to seem more 'socially desirable'. However, the Add Health researchers attempted to overcome this bias by asking close-ended questions and letting participants self-administer certain sections of the interview (Harris et al., 2009). Furthermore, the researchers promised the participants that all information would be kept confidential and mixed into a large pool of responses

from other participants (Harris et al., 2009). Third, it is important to note that sleep quality does not always align with sleep quantity, and some respondents may have inadvertently overestimated their average sleep hours per night (see Lauderdale et al., 2008). Fourth, in waves 3 and 4, the Add Health researchers changed their sleep measure slightly to reflect average sleep and wake times for school, work, and activity days (instead of just average hours of sleep). Therefore, for waves 3 and 4, we had to manually calculate respondents' average hours of sleep by finding the difference between their bedtime and wake time. This methodology change, though slight, may have impacted our findings for waves 3 and 4. Last, the Add Health study questionnaire was designed to address many variables of interest, and its sleep questions did not come from a clear subscale. Therefore, the reliability of our sleep findings is somewhat difficult to ascertain.

Directions for Future Research

The results of our study suggest that the relationship between race/ethnicity and sleep duration over time is deserving of further research. In addition, the role of nighttime work hours, family needs, and perceived discrimination should be considered more in the future. Multiple studies have suggested that these three variables are positively related to poor sleep health in minoritized groups (Jehan et al., 2017; Meltzer & Montgomery-Downs, 2011; Slopen et al., 2016). These impacts can be especially harmful for adults above age 30, which seems to fit with this study's findings (as wave 5 sleep hours were the lowest overall). Additional studies on sleep homeostasis and circadian rhythms, which impact sleep through gene-driven biological clocks, may also be helpful (see Egan et al., 2017).

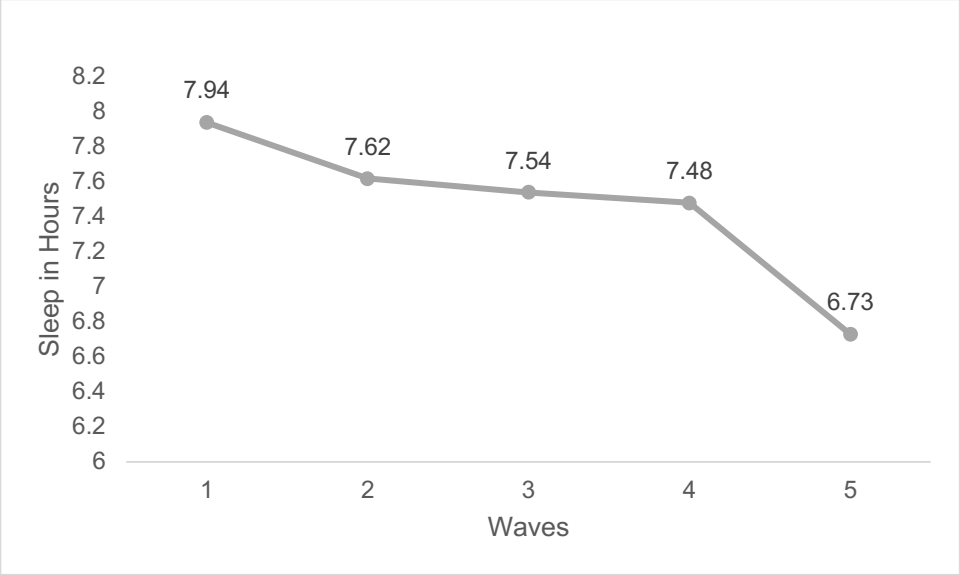
Conclusion

In conclusion, this study showed that sleep averages from wave 1 to wave 5 decreased for Whites, Hispanics, 'Other' races/ethnicities, and Blacks. Furthermore, our data showed that on average, Whites reported more sleep than Hispanics, 'Other' race/ethnicities members, and Blacks. The data also showed significant correlations between sleep averages across time. We also discussed the negative effects of insufficient sleep on four different levels and presented personal and societal solutions. Lastly, this study added to the current literature through its revelation of the downward sleep average trend across age and race/ethnicity groups. Future research should seek to explore these connections in depth and explore solutions for closing the sleep health gap for minority groups.

APPENDICES

APPENDIX A

Figure 1. Average Sleep Hours Over Time



Note. This figure shows the average in self-reported sleep hours for the pooled sample of 2,427 participants. The self-reports were recorded across five waves, with Wave 1 representing 1994-1995, when the average participant was fifteen years of age. This was followed by Wave in 1996, when the average participant was sixteen years of age. Next was Wave 3 in 2001–2002, when the average participant was twenty-one years of age. Wave 4 followed in 2008–2009, when the average participant was twenty-eight years of age. Lastly, Wave 5 represents 2016–2018, when the average participant was thirty-seven years of age.

APPENDIX B

Table 1. Participant Demographics Information

Demographic Information

Factor	n=2427	Total
Gender		
	%Females	57.1
	%Males	42.9
Race/Ethnicity		
	%White	65.1
	%Black	18.4
	%Hispanic	9.4
	%Other	7.2

Table 2. Correlations with Average Sleep Across Waves

	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5
Wave 1	1				
Wave 2	.36**	1			
Wave 3	.08**	.11**	1		
Wave 4	.12**	.10**	.22**	1	
Wave 5	.09**	.15**	.15**	.26**	1

Note. ** Correlation is significant at the 0.01 level (2-tailed). Each wave represents average sleep for that wave.

Table 3. Descriptive Statistics for Sleep by Race/Ethnicity and Wave

	Race/Ethnicity	N	Mean	SD
Wave 1	Hispanic	227	8.08	1.52
	White	1579	7.97	1.27
	Black	447	7.71	1.62
	Other	174	7.75	1.42
	Total	2427	7.92	1.38
Wave 2	Hispanic	227	7.62	1.43
	White	1579	7.66	1.29
	Black	447	7.48	1.45
	Other	174	7.48	1.39
	Total	2427	7.61	1.35
Wave 3	Hispanic	227	7.42	1.35
	White	1579	7.57	1.44
	Black	447	7.5	1.69
	Other	174	7.47	1.53
	Total	2427	7.54	1.49
Wave 4	Hispanic	227	7.55	1.34
	White	1579	7.54	1.29
	Black	447	7.27	1.61
	Other	174	7.39	1.39
	Total	2427	7.48	1.37
Wave 5	Hispanic	227	6.73	1.28
	White	1579	6.81	1.11
	Black	447	6.5	1.3
	Other	174	6.61	1.25
	Total	2427	6.73	1.18

Note. Sleep is measured by hours per night.

REFERENCES

AAA Foundation for Traffic Safety. (2015). 2014 Traffic Safety Culture Index (Technical Report). https://aaafoundation.org/2014-traffic-safety-culture-index/.

Araghi, M. H., Jagielski, A., Neira, I., Brown, A., Higgs, S., Thomas, G. N., & Taheri, S. (2013). The Complex Associations Among Sleep Quality, Anxiety-Depression, and Quality of Life in Patients with Extreme Obesity. Sleep, 36(12), 1859–1865. https://doi.org/10.5665/sleep.3216

Basner, M. and Dinges, D.F. (2018) Sleep duration in the United States 2003–2016: first signs of success in the fight against sleep deficiency?, Sleep, Volume 41, Issue 4, https://doi.org/10.1093/sleep/zsy012

Cappuccio, F. P., D'Elia, L., Strazzullo, P., & Miller, M. A. (2010). Sleep duration and all-cause mortality: A systematic review and meta-analysis of prospective studies. Sleep, 33(5), 585–592. https://doi.org/10.1093/sleep/33.5.585

Carskadon, M. A. (2011). Sleep in Adolescents: The Perfect Storm. Pediatric Clinics of North America, 58(3), 637–647. https://doi.org/10.1016/j.pcl.2011.03.003

Celmer, L. (2017, August 24). Sleep deprived men over perceive women's sexual interest and intent. American Academy of Sleep Medicine – Association for Sleep Clinicians and Researchers. https://aasm.org/sleep-deprived-men-over-perceive-womens-sexual-interest-and-intent/

Centers for Disease Control and Prevention. (2017, June 5). CDC - About our Program – Sleep and Sleep Disorders. Centers for Disease Control and Prevention. https://www.cdc.gov/sleep/about_us.html#:~:text=Lack%20of%20sleep%20is%20associated,costs%2C%20and%20lost%20work%20productivity.

Centers for Disease Control and Prevention. (2017, May 2). CDC - Data and Statistics – Sleep and Sleep Disorders. Centers for Disease Control and Prevention. https://www.cdc.gov/sleep/data_statistics.html

Centers for Disease Control and Prevention. (2017, March 21). CDC - Drowsy Driving-Sleep and Sleep Disorders. Centers for Disease Control and Prevention. https://www.cdc.gov/sleep/about_sleep/drowsy_driving.html

Centers for Disease Control and Prevention. (2018, August 8). CDC - Sleep and Chronic Disease - Sleep and Sleep Disorders. Centers for Disease Control and Prevention. https://www.cdc.gov/sleep/about_sleep/chronic_disease.html

Cernadas Curotto, P., Sterpenich, V., Sander, D., Favez, N., Rimmele, U., & Klimecki, O. (2022). Quarreling After a Sleepless Night: Preliminary Evidence of the Impact of Sleep Deprivation on Interpersonal Conflict. Affective Science, 3(2), 341–352. https://doi.org/10.1007/s42761-021-00076-4

Curcio, G., Ferrara, M., & De Gennaro, L. (2006). Sleep loss, learning capacity and academic performance. Sleep Medicine Reviews, 10(5), 323–337. https://doi.org/10.1016/j.smrv.2005.11.001

Dahl, Ronald E. (2002). "The Regulation of Sleep-Arousal, Affect, and Attention in Adolescence: Some Questions and Speculations." Adolescent Sleep Patterns: Biological, Social, and Psychological Influences, 269–84.

Egan, K. J., Knutson, K. L., Pereira, A. C., & von Schantz, M. (2017). The role of race and ethnicity in sleep, circadian rhythms and cardiovascular health. Sleep medicine reviews, 33, 70–78. https://doi.org/10.1016/j.smrv.2016.05.004

Fang, H., Tu, S., Sheng, J., & Shao, A. (2019). Depression in sleep disturbance: A review on a bidirectional relationship, mechanisms and treatment. Journal of Cellular and Molecular Medicine, 23(4), 2324–2332. https://doi.org/10.1111/jcmm.14170

Ford, E. S., Cunningham, T. J., & Croft, J. B. (2015). Trends in Self-Reported Sleep

Duration among US Adults from 1985 to 2012. Sleep, 38(5), 829–832. https://doi.org/10.5665/sleep.4684

Gordon, A. M., & Chen, S. (2014). The role of sleep in interpersonal conflict: Do sleepless nights mean worse fights? Social Psychological and Personality Science, 5(2), 168–175. https://doi.org/10.1177/1948550613488952

Hafner, Marco, Martin Stepanek, Jirka Taylor, Wendy M. Troxel, and Christian Van Stolk, (2016). Why sleep matters — the economic costs of insufficient sleep: A cross-country comparative analysis. https://www.rand.org/pubs/research_reports/RR1791.html.

Harris, K. M., Halpern, C. T., Whitsel, E., Hussey, J., Tabor, J., Entzel, P., & Udry, J. R. (2009). The National Longitudinal Study of Adolescent Health: Research Design. http://www.cpc.unc.edu/projects/addhealth/design

Hicken, M. T., Lee, H., Ailshire, J., Burgard, S. A., & Williams, D. R. (2013). "Every shut eye, ain't sleep": The role of racism-related vigilance in racial/ethnic disparities in sleep difficulty. Race and social problems, 5(2), 100–112. https://doi.org/10.1007/s12552-013-9095-9

Hershner, S. D., & Chervin, R. D. (2014). Causes and consequences of sleepiness among college students. Nature and Science of Sleep, 6, 73–84. https://doi.org/10.2147/NSS.S62907

Himashree G, Banerjee PK, Selvamurthy W. Sleep and performance--recent trends. Indian J Physiol Pharmacol. 2002 Jan;46(1):6-24. PMID: 12024958.

Hirshkowitz, M., Whiton, K., Albert, S. M., Alessi, C., Bruni, O., DonCarlos, L., Hazen, N., Herman, J., Katz, E. S., Kheirandish-Gozal, L., Neubauer, D. N., O'Donnell, A. E., Ohayon, M., Peever, J., Rawding, R., Sachdeva, R. C., Setters, B., Vitiello, M. V., Ware, J. C., & Adams Hillard, P. J. (2015). National Sleep Foundation's sleep time duration recommendations: Methodology and results summary. Sleep Health, 1(1), 40–43. https://doi.org/10.1016/j.sleh.2014.12.010

Goodwin, J. L., Babar, S. I., Kaemingk, K. L., Rosen, G. M., Morgan, W. J., Sherrill, D.

L., & Quan, S. F. (2003). Symptoms Related to Sleep-Disordered Breathing in White and Hispanic Children: The Tucson Children's Assessment of Sleep Apnea Study. CHEST, 124(1), 196–203. https://doi.org/10.1378/chest.124.1.196

Jehan, S., Zizi, F., Pandi-Perumal, S. R., Myers, A. K., Auguste, E., Jean-Louis, G., & McFarlane, S. I. (2017). Shift Work and Sleep: Medical Implications and Management. Sleep medicine and disorders: international journal, 1(2), 00008.

Jones, J. M. (2021, June 4). In U.S., 40% get less than recommended amount of sleep. Gallup.com. https://news.gallup.com/poll/166553/less-recommended-amount-sleep.aspx

Lauderdale, D. S., Knutson, K. L., Yan, L. L., Liu, K., & Rathouz, P. J. (2008). Self-reported and measured sleep duration: how similar are they?. *Epidemiology (Cambridge, Mass.)*, *19*(6), 838–845.

Lieu, S. J., Curhan, G. C., Schernhammer, E. S., & Forman, J. P. (2012). Rotating night shift work and disparate hypertension risk in African–Americans. *Journal of Hypertension*, *30*(1), 61–66. https://doi.org/10.1097/HJH.0b013e32834e1ea3

Lauderdale, D. S., Knutson, K. L., Yan, L. L., Rathouz, P. J., Hulley, S. B., Sidney, S., & Liu, K. (2006). Objectively measured sleep characteristics among early-middle-aged adults: the CARDIA study. American journal of epidemiology, 164(1), 5–16. https://doi.org/10.1093/aje/kwj199

Luyster, F. S., Shi, X., Baniak, L. M., Morris, J. L., & Chasens, E. R. (2020). Associations of sleep duration with patient-reported outcomes and health care use in US adults with asthma. Annals of Allergy, Asthma & Immunology, 125(3), 319–324. https://doi.org/10.1016/j.anai.2020.04.035

Medic, G., Wille, M., & Hemels, M. E. (2017). Short- and long-term health consequences of sleep disruption. Nature and science of sleep, 9, 151–161. https://doi.org/10.2147/NSS.S134864

Meltzer, L. J., & Montgomery-Downs, H. E. (2011). Sleep in the family. Pediatric clinics of North America, 58(3), 765–774. https://doi.org/10.1016/j.pcl.2011.03.010

Nagai, M., Hoshide, S., & Kario, K. (2010). Sleep Duration as a Risk Factor for Cardiovascular Disease- a Review of the Recent Literature. Current Cardiology Reviews, 6(1), 54–61. https://doi.org/10.2174/157340310790231635

National Highway Traffic Safety Administration. (2011). *Traffic Safety Facts: Drowsy Driving*. www-nrd.nhtsa.dot.gov/pubs/811449.pdf

Nickel, A., & Scullin, M. (2022). 0067 Sleep Disparities and the Academic Achievement Gap in 1.9 Million College Students. *Sleep*, *45*(Supplement_1), A31. https://doi.org/10.1093/sleep/zsac079.065

Orminski, E. (2021, October 4). Sleep is a Cyclical Inequity for Those in Poverty. NCRC. https://ncrc.org.

Raine, A., & Venables, P. H. (2017). Adolescent daytime sleepiness as a risk factor for adult crime. *Journal of Child Psychology and Psychiatry*, *58*(6), 728–735. https://doi.org/10.1111/jcpp.12693

Randler, C., & Vollmer, C. (2013). Aggression in young adults–A matter of short sleep and social jetlag? Psychological Reports: Disability and Trauma, 113, 754–765.

Slopen, N., Lewis, T. T., & Williams, D. R. (2016). Discrimination and sleep: a systematic review. *Sleep medicine*, *18*, 88–95.

Stepan ME, Altmann EM, Fenn KM. Effects of total sleep deprivation on procedural placekeeping: More than just lapses of attention. J Exp Psychol Gen. 2020 Apr;149(4):800-806. doi: 10.1037/xge0000717. Epub 2019 Nov 21. PMID: 31750712.

Suni, E. (2022, April 18). Cancer and Sleep: Connections, Disturbances, & Sleep Tips. Sleep Foundation. www.sleepfoundation.org/physical-health/cancer-and-sleep

Suni, E. (2022, April 29). Can school performance be improved with good sleep? Sleep Foundation. https://www.sleepfoundation.org/children-and-sleep/sleep-and-school-performance

Swaen, G., van Amelsvoort, L. G. P. M., Bultmann, U., & Kant, I. (2003). Fatigue as a risk factor for being injured in an occupational accident: Results from the Maastricht Cohort Study. *Occupational and Environmental Medicine*, *60* (Suppl 1), i88–i92. https://doi.org/10.1136/oem.60.suppl_1.i88