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Treatment Disparities in Black and Hispanic Children with Attention-Deficit Hyperactivity Disorders

Charlotte Seiji Frey
Walden University

Walden University

College of Health Sciences

This is to certify that the doctoral study by

Charlotte Frey

has been found to be complete and satisfactory in all respects,
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Review Committee
Dr. Hebatullah Tawfik, Committee Chairperson, Public Health Faculty
Dr. Jirina Foltysova, Committee Member, Public Health Faculty
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Chief Academic Officer and Provost
Sue Subocz, Ph.D.

Walden University
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Abstract

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Charlotte S. Frey

MSPAS, University of Texas at Edinburg, 2012

MS, Framingham State College, 2000

BS, University of Hawaii, 1985

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Public Health

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Abstract

Disparity in diagnosis and treatment of attention deficit hyperactivity disorder (ADHD) among children has been studied; however, no known studies examining disparities based on severity of symptoms have been investigated. The purpose of this study was to assess the racial disparities in diagnosis and treatment that exist among children based on severity of symptoms. This cross-sectional quantitative analysis used data from the 2016 National Survey of Children's Health and the theoretical foundation was guided by the behavioral model of healthcare utilization and help-seeking behavior for ADHD. Binomial logistic regression analysis showed an overall association between race and the diagnosis and treatment of ADHD. The greatest disparities were observed among Hispanic children who were less likely to be diagnosed with ADHD (*OR*=0.718 [0.616, 0.838], $p<.001$) and less likely to receive medication (*OR*=0.638 [0.520, 0.784], $p<.001$) compared to non-Hispanic White children. While non-Hispanic Black children were also less likely to be diagnosed with ADHD (*OR*=0.932 [0.770, 1.130], $p=.474$) and less likely to receive medication (*OR*=0.899 [0.698, 1.158], $p=.409$) compared to non-Hispanic White children, these results were not statistically significant. When severity of symptoms was considered, non-Hispanic Black children with mild or moderate symptoms were less likely to receive medication compared to non-Hispanic Whites. However, the association was only statistically significant among Hispanic children. No difference was observed when symptoms were severe. Implications for positive social change include implementing targeted public health policies and effective programs to improve ADHD management among Hispanic and non-Hispanic Black children.

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Dedication

I would like to dedicate my doctoral research to all children with special needs and neurodevelopmental disorders. I feel privileged to work with these children every day and hope that my research will help bring their plight to the forefront.

Acknowledgments

I would like to thank my husband, Michael, for his support throughout our marriage and during my long doctoral journey. He encouraged me when I was down, exhausted after a long day at work with deadlines for my doctoral classes still demanding my attention. He calmed me during all my meltdowns particularly while working on my statistical analysis and when trying to meet classwork requirements. I am grateful to my beautiful grandchildren who were much younger when I started, who inspired me to work harder and understood that once I complete “my school time” I would be able to spend time and play with them once again. Finally, I would like to give my sincere appreciation and thanks to my doctoral chair, Dr. Hebatullah Tawfik and committee member, Dr. Jirina Renger whom both provided me with support, guidance, and most of all encouragement whenever I needed it and throughout my doctoral research.

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Section 1: Foundation of the Study and Literature Review

Introduction

Attention-deficit hyperactivity disorder (ADHD) is a growing epidemic among children. In the United States, one in 10 children are diagnosed with ADHD, with a 42% increase in diagnosis by health care providers between 2003 and 2011 (Visser et al., 2015). In this study, I looked at the disparity that may exist in the diagnosis and treatment of ADHD among African American and Hispanic children compared to non-Hispanic White children based on symptom severity. It is important to note that ADHD may result in social and emotional impairment (Bunford, Evans, & Langberg, 2014) and greatly impacts a child's functional ability (Efron et al., 2014; Matza, Margolis, Deal, Farrand, & Erder, 2017) affecting a child's ability to learn and lowering academic achievements (Colomer, Berenguer, Rosello, Baixauli, & Miranda, 2017).

This study has added to the current body of scholarly research on the treatment and care of children with ADHD. The implications for positive social change are substantial in providing knowledge of the disparity that may exist in the treatment and care of non-Hispanic Blacks and Hispanic children with ADHD and improving the health and development of these children. Knowing that non-Hispanic Black and Hispanic children may be treated and cared for differently from non-Hispanic White children, public health officials can implement policy and hopefully improve the effectiveness of programs that focus on ADHD treatment and treatment modalities to this population. Ultimately, by improving the effectiveness in the management of ADHD in these children by diagnosing and applying appropriate treatment and treatment modality their

quality of life and outcomes may improve and the disease burden of ADHD in the community and society may decrease.

Problem Statement

In the United States, ADHD is the most commonly diagnosed mental health disorder in children (Collins & Cleary, 2016). Due to underdiagnoses of ADHD among both non-Hispanic Black and Hispanic children they are less likely to be treated for ADHD than non-Hispanic White children (Coker et al., 2016; Morgan Hillemeier, Farkas, & Maczuga, 2016). Untreated children with ADHD are more likely attributed to parent's psychological distress and poor family functioning (Moen, Hedelin, & Hall-Lord, 2016). More significantly, untreated children whose symptoms persist and remain untreated as adults are associated with higher risk of criminal behavior than those treated for their ADHD (Hamed, Kauer, & Stevens, 2015; Holthe & Lanvik, 2017). There are studies showing a disparity in diagnosis and treatment of ADHD among non-Hispanic Blacks and Hispanic children (see Alvarado & Modesto-Lowe, 2017; Coker et al., 2016; Cummings, Ji, Allen, Lally, & Druss, 2017; Morgan et al., 2016; Walls, Allen, Cabral, Kazis, & Bair-Merrit, 2017). However, none of the studies have identified whether this disparity varies by the severity of ADHD symptoms. In children with ADHD, academic underachievement is predictable based on severity of symptoms with more severe behavioral symptoms negatively impacting school performance (Owens & Jackson, 2017). Although most children may benefit in both their behavior and academic achievement from treatment of their ADHD, children with more severe symptoms of ADHD benefit more than those with less severe symptoms (Owens & Jackson, 2017).

Non-Hispanic Blacks are disproportionally incarcerated in the juvenile system with girls being the fastest growing population experiencing a higher ADHD prevalence compared to female nonoffenders (Behnken, 2014). Addressing and treating children with ADHD, particularly in non-Hispanic Blacks and Hispanics with more significant ADHD symptomology, may help close the gap in adverse behavior and academic achievement.

Purpose of the Study

The purpose of this study was to assess the relationship in the care and treatment of non-Hispanic Black and Hispanic children compared to non-Hispanic White children based on the severity of symptoms of their ADHD. The study was intended to examine unequal treatment and care of non-Hispanic Blacks and Hispanic children with ADHD particularly based on their severity of symptoms. The goal was to increase awareness of such a disparity if it exists in order to be able to create appropriate prevention and management programs.

Research Questions and Hypotheses

RQ1: Is there an association between race and diagnosis of ADHD after adjusting for age, gender, attributes of the child and socioeconomic status?

$H_0$1: There is no association between diagnosis of ADHD and race.

H_a1: There is an association between diagnosis of ADHD and race.

RQ2: Is there an association between race and receiving medication to treat ADHD after adjusting for age, gender, attributes of the child and socioeconomic status?

$H_0$2: There is no association between receiving medication to treat ADHD and race.

H_a2: There is an association between receiving medication to treat ADHD and race.

RQ3: Is there an association between race and receiving behavioral treatment for ADHD after adjusting for age, gender, attributes of the child and socioeconomic status?

$H_0 3$: There is no association between receiving behavioral treatment for ADHD and race.

$H_a 3$: There is an association between receiving behavioral treatment for ADHD and race.

RQ4: Is there an association between race and receiving alternative health care or treatment for ADHD after adjusting for age, gender, attributes of the child and socioeconomic status?

$H_0 4$: There is no association between receiving alternative health care or treatment for ADHD and race.

$H_a 4$: There is an association between receiving alternative health care or treatment for ADHD and race.

RQ5: Is there an association between race and receiving combined treatment for ADHD after adjusting for age, gender, attributes of the child and socioeconomic status?

$H_0 5$: There is no association between receiving combined treatment for ADHD and race.

$H_a 5$: There is an association between receiving combined treatment for ADHD and race.

RQ6: Is there an association between race and receiving medication treatment based on ADHD severity after adjusting for age, gender, attributes of the child and socioeconomic status?

$H_0$6: There is no association between receiving medication to treat ADHD and race based on ADHD severity.

H_a6: There is an association between receiving medication to treat ADHD and race based on ADHD severity.

RQ7: Is there an association between race and receiving behavior treatment based on ADHD severity after adjusting for age, gender, attributes of the child and socioeconomic status?

$H_0$7: There is no association between receiving behavioral treatment for ADHD and race based on ADHD severity.

H_a7: There is an association between receiving behavioral treatment for ADHD and race based on ADHD severity.

RQ8: Is there an association between race and receiving alternative health care or treatment based on ADHD severity after adjusting for age, gender, attributes of the child and socioeconomic status?

$H_0$8: There is no association between receiving alternative health care or treatment for ADHD and race based on ADHD severity.

H_a8: There is an association between receiving alternative health care or treatment for ADHD and race based on ADHD severity.

RQ9: Is there an association between race and receiving combined treatment for ADHD severity after adjusting for age, gender, attributes of the child and socioeconomic status?

$H_0$9: There is no association between receiving combined treatment for ADHD and race based on ADHD severity.

H_a9: There is an association between receiving combined treatment for ADHD and race based on ADHD severity.

Theoretical Foundation and Conceptual Framework for the Study

Theoretical Foundation

The theoretical foundation for this study was based on the behavioral model of healthcare utilization and an emerging model of help-seeking behavior for ADHD. The behavioral model of healthcare utilization was first developed in 1968 in order to understand families use and equitable access of healthcare services (Hirshfield, Downing, & Horvath, 2016). The behavioral model included five major categories: predisposing factors, enabling factors, need factors, and health services systems (Kim & Lee, 2016; Li, Nong, Wei, Feng, & Luo, 2016). Predisposing factors for children with ADHD would include their demographics (e.g., gender, age, race/ethnicity), social structure of their family, and the child's and family's attitudes and beliefs about ADHD. Some of the reasons a child does not receive treatment may be due to their predisposing factors such as their race/ethnicity. Enabling factors for children with ADHD would be their family resources, does the family have resources to acquire ADHD treatment and services. The need factor for a child with ADHD would be the child's and family's perceived need for

treatment for the child's ADHD. If the child or the family does not feel there is a need to be treated for their ADHD, the child may not be treated. Finally, health services systems for children with ADHD include the availability and access to medical care services for these children. According to Sciutto (2015) the use of and the decision to seek medical care is based on the conceptual framework that integrates the perspective of individual, environmental, and provider-related variables. The child's perspective is important in seeking treatment and care for their ADHD. Environmental factors may hinder a child with ADHD access to care based on where they live and the community where they live (citation). Important for this study is provider-related variables in how the provider influences and interacts with a child with ADHD to use treatment and services. Some of the reasons a child does not receive the needed treatment for their ADHD may encompass some or all the elements of this conceptual framework.

The ADHD help-seeking behavior model is similar to the behavioral model of healthcare utilization and is a framework used to understand factors that help predict services used (Sciutto, 2015). According to Sciutto (2015), the ADHD help-seeking behavior model, unlike the behavioral model of healthcare utilization, is focused on children and adolescents with ADHD, taking into account their specific characteristics and factors such as parental and teachers characteristics, social network, culture and race/ethnicity.

Conceptual Framework

Race, specifically non-Hispanic Blacks, Hispanics, and non-Hispanic Whites, and the disparity that may exist in treatment modality based on severity of ADHD symptoms,

was the basis for this study's conceptual framework. This framework incorporated the diagnosis of ADHD, race, the severity of ADHD symptoms, and treatment modality. Other variables that are associated with the severity ADHD such as attributes of the child and the treatment modalities such as socioeconomic factors. Figure 1 is the conceptual framework for treatment ADHD symptoms severity and race.

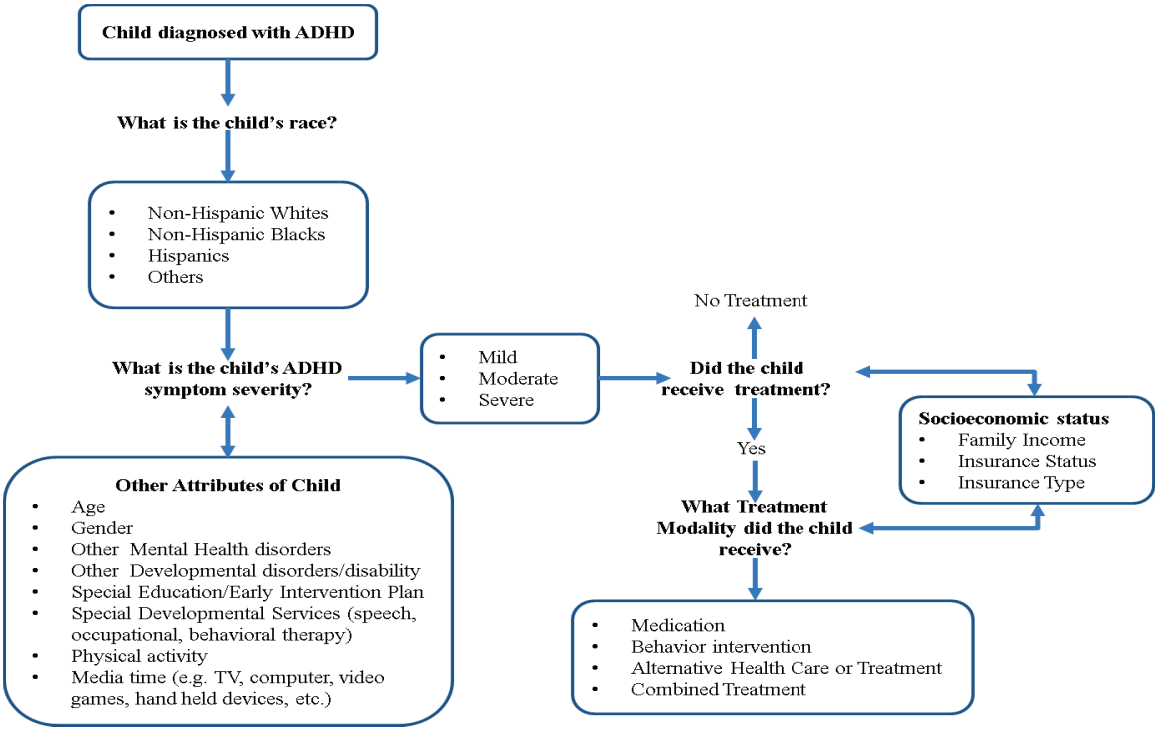

Figure 1. Conceptual framework for race and ADHD symptoms severity treatment.

Nature of the Study

This study is a cross-sectional quantitative study of children aged 3 through 17 living in the United States. In this study, I specifically looked at children diagnosed with ADHD based on race, severity of ADHD symptoms, and treatment modality. The most common neurobehavioral disorder in children is ADHD (Booth, 2016) and this problem aligns with this study which was to determine if there is a disparity among racial groups

on treatment modality based on ADHD severity. There are many factors and attributes of the child that can affect ADHD treatment and severity and was controlled and addressed in this study: mental health comorbidities, income, insurance status, type of insurance, physical activity, media time, and sleep. Children with sleep deprivation have been shown to display ADHD-like behavior such as impulsivity, inattentiveness, and hyperactivity (Um, Hong, & Jeong, 2017). The number of hours of sleep that a child in this study receives was a confounder since lack of sleep can exacerbate ADHD symptoms in children (see Tasdelen, Karakaya, Kahraman, & Oztop, 2015). Sleep is a confounding factor in ADHD symptoms and severity since the successful management of sleep disturbances may result in improvement in daytime impairment in children with ADHD (Hvolby, 2015; Weiss et al., 2015). Screen time overuse has been correlated with ADHD severity (Zimlich, 2018). Conversely, exercise has been shown to improve symptoms of ADHD (Bustamante et al., 2016) and has been controlled in this study.

Literature Search Strategy

The literature review search strategy used library databases, peer-reviewed journals, the Center of Disease Control and Prevention (CDC) database, the National Center for Health Statistics database, and textbooks. Initial search engine used was Thoreau Multi-Database Search for quick search on the research topic. This was useful in finding several peer-reviewed articles and to get more generalized research and articles for my research. Other search engines used were CINAHL & MEDLINE Combined Search, CINAHL Plus, ERIC and Education Source Combine Search, ProQuest Science Journals, ProQuest Nursing & Allied Health Sources, Psychology Databases Combined

Search, Research Gate articles and Google Scholar. The key terms and combination of terms used to search for articles for my research were *Attention Deficit Hyperactivity Disorder in children along with racial disparity, social economic status (SES), academic achievement, consequences, symptoms severity, treatment, treatment disparity, physical activity, sleep,* and *screen time*. The CDC and the National Center for Health Statistics website was searched for prevalence and race/ethnicity data for ADHD. Over 200 articles were reviewed during the literature search. The criteria used to narrow the scope of the articles used included the following: (a) specificity and relevance to the topic of ADHD treatment in children, (b) reliability and peer review of the article, (c) factors that specifically may affect ADHD symptomatology, and (d) the age of publication.

Literature Review Related to Key Variables and Concepts

ADHD and Racial Disparity in Diagnosis

According to the CDC in children aged 5-17, the prevalence of ADHD among non-Hispanic White and non-Hispanic Black children are similar at 10.8 and 10.2 per 1000 children respectively and with Hispanic children being slightly lower at 6.6 per 1000 children (National Center for Health Statistics, 2017). However, Alvarado and Modesto-Lowe (2017) found that diagnosis of ADHD is quite different with non-Hispanic White children being diagnosed in significantly higher numbers than non-Hispanic Black and Hispanic children. The authors believed the lower rate of diagnosis is multifactorial including parental view, socioeconomic status (SES), and cultural norms (Alvarado & Modesto-Lowe, 2017). Similarly, Coker et al. (2016) found that non-Hispanic White children with symptoms of ADHD were more than likely to be diagnosed

with ADHD than non-Hispanic Black and Hispanic children. The authors surveyed 4297 children and parents using a multisite population-based sample over three waves of fifth, seventh and 10th graders (Coker et al., 2016). Across over all three waves Coker et al. (2016) found that non-Hispanic Blacks and Hispanics children had a lower odd of being diagnosed with ADHD than their non-Hispanic White counterparts. The authors showed based on their findings that the racial disparity among non-Hispanic Black and Hispanic children is more related to under diagnosis of these children rather than over diagnosis of non-Hispanic White children (Coker et al., 2016).

Collins and Cleary (2016) found similar results using data of 190,408 children aged 5-17 years from the NSCH in three waves (2003, 2007, and 2011). The authors found a dramatic increase in prevalence of ADHD with 42% for non-Hispanic Whites, 66% for non-Hispanic Blacks and 79% for Hispanics children with linear increase in diagnosis from 2003 to 2011 (Collins & Cleary, 2016). Collins and Cleary also indicated that living in poverty among all race/ethnic groups except Hispanics is related to higher ADHD prevalence rate. The authors also found that homes with non-English language among all racial/ethnic groups were significantly less likely to be diagnosed with ADHD (Collins & Cleary, 2016). The lower diagnosis of ADHD among non-English language homes, according to Collins and Cleary, may be a result of language barrier which limits awareness and access to care and subsequent ADHD diagnosis.

Looking at diagnosis of ADHD from kindergarten to eighth grade, Morgan et al. (2016) found that ethnic minority were less likely to receive ADHD diagnosis than non-Hispanic White children. The authors used the Early Childhood Longitudinal Study,

Kindergarten (ECLS-K) of 17,100 children who entered Kindergarten in the fall of 1998 controlling for time-variant and varying confounding factors (lower SES and lower behavioral and academic functioning) and capitalized on the data set ADHD diagnosis timing and sociodemographic characteristics (Morgan et al., 2016). According to Morgan et al., (2016) looking at race/ethnicity and using time as predictor Hispanic children had 56% lower odds and African Americans had 36% lower odds of ADHD diagnosis than their White counterparts. The authors showed that African American and Hispanic children are significantly less likely to be diagnosed with ADHD despite controlling for time-varying factors relating to behavioral risk indicators of ADHD and academic achievement (Morgan et al., 2016).

Social, Functional and Academic Impact of ADHD

ADHD symptoms are associated with impairment in psychosocial functioning and affect the quality of life (QoL) of children and their families (Ros & Graziano, 2018). In fact, according to a meta-analysis study by Lee et al. (2016), children with ADHD are affected moderately in the physical and severely in the psychosocial (emotional, social, and school) domains and this is consistent with both parent ratings and child/adolescent self-reports. Most importantly, the authors found that a child's age was a determining factor of the emotional severity and was negatively correlated in that symptoms improved as the child got older based on parental rating (Lee et al., 2016). The physical domain has often been overlooked and Lee et al. found that children with ADHD have greater skills deficits, are less likely to participate in physical activity, are more prone to injuries, health issues and sleep problems. Another study conducted by Magistro, Bardaglio, and

Rabaglietti (2015) on typical development of children with ADHD found that gross motor skills and academic achievement is mediated by ADHD-related behaviors. Academic achievement particularly in mathematics is affected by gross motor skills and by improving cognitive functioning but ADHD reduces this positive effect (Magistro et al., 2015). This study was different from other studies in that Magistro et al. (2015) looked at typical developing children with ADHD and not with children with atypical development gross motor skills on all academic achievements and observed ADHD mediating effects.

Similarly, DuPaul et al. (2016) analyzed data from the ECLS-K and found that children with ADHD had lower interpersonal skills based on the Social Skills Rating system. This study was unique in that the authors looked at distinct impairment trajectories in reading, mathematics and interpersonal skills which showed consistently below average performance among subgroups of children with ADHD (DuPaul et al., 2016). DuPaul et al. showed that functional trajectory overlapped among academic skills and to a lesser degree between academic skills and social performance. In other words, if a child is impaired academically, they are more likely to be impaired socially, however, the converse in not necessarily seen (DuPaul et al., 2016).

Functional impact was also looked at in a study where Efron et al. (2014) found that functional domains were worse in children with ADHD and more significantly by their second year of school. The authors used a two-stage screening process with Stage 1 using the Connors 3 ADHD Index and in Stage 2 the positive screens were randomly matched on gender and school to a negative screen and participants were interviewed and

assessed (Efron et al., 2014). Functional differences were more significant among children with ADHD than non-ADHD children in externalizing and internalizing disorders, peer problems, and children were more likely to have multiple impairments (Efron et al., 2014). Efron et al. also looked at academic performance and found in their study that children with ADHD had lower standard scores in both word reading and math computation on the Wide Range Achievement Test 4 than non-ADHD children. The ADHD group in this study also had a lower estimated IQ scores than the non-ADHD control group. In addition, typical executive function deficits in children with ADHD are also likely contributing factor to academic performance (Efron et al., 2014).

ADHD not only impacts the child it can significantly impact the family cohesiveness and function (Moen et al., 2016). According to Moen et al. (2016), single parents who present with weaker well-being and parents with ADHD are the most affected by their child with ADHD and presents with more psychological distress. Children with ADHD and who are not medicated provide parents more psychological distress, weaker well-being, poorer family functioning and less family sense of cohesiveness (Moen et al., 2016).

Children with ADHD had lower academic achievement (DuPaul et al., 2016; Efron et al., 2014;) along with social, emotional, and functional difficulties (DuPaul et al., 2016; Efron et al., 2014; Lee et al., 2016). Minority children, particularly Hispanic children with ADHD, endure significant social and emotional difficulties due to added stigma of ADHD, language and cultural barriers, and racism (Araujo, Pfiffner, & Haack,

2017). Children with ADHD often have impairments in social function with lower social skills and cognition and greater rates of peer rejections (Ros & Graziano, 2018).

Consequences of ADHD

One of the consequences of ADHD is that it may manifest into adulthood. About 40-60% of children with ADHD will have symptoms that persist into adulthood (Sibley et al., 2017). Adults with ADHD may have significant impairment particularly with limited employment advancement, lower educational and academic achievement, more relationship and marital problems, criminal violation, and psychiatric comorbidities (Roman-Ithier et al., 2017). In contrast, in African Americans Behnken et al. (2014) found no direct effect of ADHD diagnosis on adult outcome. Although in African Americans ADHD diagnosis does have significant indirect influences and may indirectly, through lower standardized test scores, predict adult arrests (Behnken et al., 2014). According to Behnken et al. (2014) improving the academic outcome of African American children with ADHD can improve the odds of positive outcome into adulthood.

Similarly, Soltis et al. (2017) found that children with ADHD, particularly those with comorbidities, are at risk for delinquency and future incarceration. Different from other studies, the authors looked at incarcerated juveniles and distinguished those that are diagnosed with ADHD and the type of ADHD along with those with comorbid disorder (Soltis et al., 2017). According to Soltis et al. (2017) juveniles with more severe ADHD symptoms are more likely to display criminal behaviors and higher risk of incarceration. In this study the authors found that even after adjusting for diagnosis and gender, Black

youths with ADHD were more likely to be incarcerated than White youths (Soltis et al., 2017).

Delinquency and incarceration are not the only consequences of ADHD. Adults with ADHD are less likely to be married and to be employed, more likely to smoke and have experience alcoholism (Able, Haynes, & Hong, 2014). In the areas of work productivity and health care resource use Able, Haynes and Hong (2014) found that ADHD resulted in lower productivity and negatively impacted their career success and overall physical and mental health.

ADHD and Screen Time, Physical Activity and Sleep

There are other factors that may affect ADHD in children such as screen time, physical activity, and sleep. The average screen time of United States school-aged children is substantial at seven hours a day (Hale & Guan, 2015). Overuse of electronic media is associated with ADHD and is directly correlated with symptom severity (Zimlich, 2018). Conversely, symptoms are exacerbated with extended screen time/electronic media use (Zimlich, 2018). A study by Ra et al. (2018) found that higher frequency of digital media use was associated with subsequent ADHD symptoms. Importantly this was a longitudinal cohort study of children without significant symptoms of ADHD and some of that cohort subsequently developed significant ADHD symptoms that were associated with extended digital media use (Ra et al., 2018).

Physical activity may also be an important factor in symptoms of ADHD. Brain function and structure is affected by physical activity and cognitive development can be significantly impacted over short- and long-term activity (Suarez-Manzano et al., 2018).

A study by Suarez-Manzano et al. (2018) found that children with ADHD that participate in moderate physical activity for 20-30 minutes have positive effects on their working memory and executive functioning. A recent randomized controlled study in a predominately African American community by Bustamante et al. (2016) showed similar results of improvement of hyperactivity symptoms, verbal working memory and visuospatial working memory with exercise. In this study most of the children were obese with low fitness level and low income and in both groups showed significant improvement in primary executive function outcome with physical activity (Bustamante et al. 2016). In this study Bustamante et al. (2016) suggests that a physical activity intervention even among a high poverty African American community with limited mental health resources can improve symptoms of ADHD.

Sleep disorders may also contribute to and aggravate symptoms of ADHD (Lunsford-Avery, Krystal, & Kollins, 2016). Children that are sleep deprived or with poor sleep quality unlike adults may display symptoms of ADHD (Peppers et al., 2016). In addition, children with ADHD with sleep disturbances have significant impact on their functioning and overall quality of life (Vaidyanathan, Shah, & Gayal, 2016). In a sibling study, Viadyanathan, Shah, and Gayal. (2016) found that sleep disturbances are more prevalent in children with ADHD particularly those presenting with predominately hyperactive/impulsive presentation than their healthy siblings. Reduction of sleep disturbance was also associated with increased age and accordingly reduction of ADHD symptoms (Vaidyanathan, Shah, & Gayal, 2016). Limitations of this study are that

medication use was not considered nor was its impact on sleep (Vaidyanathan, Shah, & Gayal, 2016).

ADHD and Disparity in Treatment

Ethnic minority in the United States are less likely to be diagnosed with ADHD and receive treatment services than their nonminority counterparts (Alsalamah, 2018). Medication use among fifth- and eighth-grade children diagnosed with ADHD were much less likely among Hispanic and African American children than White children (Morgan et al., 2016). Similarly, Alvarado and Modesto-Lowe (2017) found disparity in treatment of Hispanic and African American children with ADHD in which treatment was much lower compared to Caucasians. Coker et al. (2016) in their population-based, multisite study of children and parents over three waves found comparable results of disparity of medication use among both Hispanics and African American children with ADHD. In all three waves (fifth, seventh, and tenth grades) both African Americans and Hispanic children with ADHD had a lower odd ratio of taking ADHD medication compared to Caucasian children with ADHD (Coker et al., 2016). Significant is that even with severe ADHD symptoms Coker et al. (2016) found that African American and Hispanic children continue to have a lower proportion of ADHD medication use compared to Caucasian children. Barrier to treatment among Hispanic and African American children may be financial due to lower rates of insurance and limited access to health care system, knowledge and cultural attitudes and beliefs of ADHD (Alvarado & Modesto-Lowe, 2017).

In addition to having lower rates of treatment among Hispanic and African American children, discontinuation of medication rates were higher compared to their Caucasian children counterpart (Cummings et al., 2017). Cumming et al. (2017) found that African American parents are less likely to consider ADHD as a medical condition that requires treatment and less likely to administer ADHD medication due to its efficacy and risk of side effects. Significant is that African American and Hispanic youths are more likely to receive psychotherapy than Caucasian youth which is consistent with research that their parents prefers psychotherapy over medication for treatment of ADHD (Cumming et al., 2017).

Definitions

Academic underachievement: Not achieving academically at the level predicted by a child age or IQ (Efron et al., 2014).

ADHD childhood diagnosis: Individual younger than 17 who display at least six of nine symptoms of inattentiveness and/or hyperactivity symptoms and symptoms must be present for 6 months and to a degree that is below the child's developmental level (American Psychiatric Association [APA], 2013; Pettersson, Soderstrom, & Nilsson, 2018). See Appendix A for DSM-5 Diagnosis Criteria for ADHD.

ADHD medication: There are two main types of medication in the treatment of ADHD: nonstimulants and stimulants (Hennissen, 2017).

Behavioral therapy: Behavioral therapy is modifying physical and social environment to change behavior through specific intervention (Walls et al., 2017). There are three types of evidence based behavioral intervention: behavioral parent training

(BPT), behavioral classroom management, and behavioral peer interventions (BPI; Chronis-Tuscano et al., 2017). See Appendix C for description of each type of intervention.

Nonstimulant medication: There are three commonly used nonstimulant medications for the treatment of ADHD which include Atromoxetime (Straterra), Clonidine hydrochloride (Kapvay), and Guanfacine (Intuniv which is long acting, Tenex which is short acting). These nonstimulant medications are used alone or in combination with a stimulant to improve symptoms of hyperactivity, inattentiveness, and impulsivity (Sibley et al., 2014).

Screen time: Time on computers, video games, mobile devices, and television (Hale & Guan, 2015).

Severity types of ADHD: ADHD has three severity levels which are classified as the following: (a) mild with few symptoms and clinical impairments, (b) moderate with between mild and severe symptoms with functional impairment and significant clinical impairment, and (c) severe with several symptoms and severe impairment in symptoms (APA, 2013;Vazquez, Sibley, & Campez, 2018). See Appendix B for severity classification.

Sleep disturbances: Problems with sleep, including bedtime resistance, sleep-onset difficulties, night awakenings, difficulties with morning awakenings, sleep breathing problems, and daytime sleepiness (Vaidyanathan et al., 2016). For this study, sleep disturbance was measured by number of hours of sleep.

Stimulant medication: Stimulants come in short-acting, immediate-acting, and long-acting forms. Stimulants are the first-line medication in the treatment of ADHD and are used to help ameliorate ADHD symptoms such as inattentiveness, impulsivity, and hyperactivity (Bachmann et al., 2017; Sibley et al., 2014). There are several types of stimulants: amphetamines, amphetamine/dextroamphetamine, dextroamphetamine, dexmethylphenidate, lisdexamfetamine, and methyphenidate (Bachmann et al., 2017; Sibley et al., 2014).

Types of ADHD: There are three types of ADHD according to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM V): (a) Combined type with both core symptoms for the past 6 months, (b) predominately inattentive type, and (c) predominately hyperactive-impulsive type (APA, 2013; Pettersson et al., 2018).

Assumptions

My research analyzed secondary data from the 2016 NSCH. Information for this survey was obtained from a parent or household adult member who is familiar with the child's health and healthcare (Child and Adolescent Health Measurement Initiative, 2016). The main assumption was that this national survey and its database were valid, accurate, and reliable. Danielson et al. (2018), using the 2016 NSCH for their study, found that the study had limitations since the survey relied on parent reports of diagnosis and treatment. However, the authors looked at similar parent reporting of ADHD diagnosis which suggested convergent validity of estimated prevalence from both analysis of administrative claim and parent report (Danielson et al., 2018). Within this survey, the greatest assumption was that the parent or adult household member answering

the survey understood the questions and that the answers were accurate. According to a study by Ahmed, Borst, Yong, and Aslani (2014), the public is not well informed about ADHD and ADHD medications. However, several parent-reported ADHD diagnosis studies had findings similar to medical records suggestive of validity of estimated prevalence of ADHD diagnosis (Danielson et al., 2018). In addition, Bourgeois et al. (2007) found that parent-reported information compared to national and regional disease surveillance systems was more sensitive in correctly identifying a disease category. A study by Bied, Biederman, and Faraone (2017) also found that the accuracy for ADHD diagnosis between parents and teachers were statistically indistinguishable. Even though the likelihood that the parent reported survey may be accurate it cannot be demonstrated as completely true.

Scope and Delimitations

The aspect of the research problem that my study was focused on was the disparity that may exist in the diagnosis and treatment of ADHD based on ethnicity/race and severity of symptoms. My focus was based on the fact ADHD is the top neurodevelopmental disorder among children in the United States and it affects approximately 6.4 million children with a 42% increase since 2003 (see Visser et al., 2015). More importantly, African American, and Hispanic children are underdiagnosed and undertreated for ADHD compared to non-Hispanic White children although prevalence rates are similar (Coker et al., 2016). In my study, I looked at if this disparity among African American and Hispanic children compared to non-Hispanic White children in the diagnosis and treatment are similar based on their severity of symptoms.

This is important since the more severe the symptoms, the greater the social impairment and lower academic achievements (Owens & Jackson, 2017).

The population that I focused on in this study was specifically African American, Hispanic, and non-Hispanic White children although the survey includes other ethnic and racial groups. I chose African American and Hispanic children and compared them to non-Hispanic White children since they are the three largest racial groups in the United States (see United States Census Bureau, 2017). Less data are available on other specific racial groups and they are usually included together as one group in most studies. Hispanic and other racial/ethnics groups had similar results in being less likely to be diagnosed with ADHD compared to non-Hispanic Whites (Morgan et al., 2016). In this study, I have not specifically looked at ADHD and comorbidities although comorbidities may affect symptom severity (see Rajeh et al, 2017). Since there are almost an endless number of comorbidities that may be associated with ADHD it would be impractical for my purpose and focus to include them specifically as part of my research question.

Significance, Summary, and Conclusion

The goal of my study was to improve treatment and care of non-Hispanic Blacks and Hispanics children with ADHD particularly based on their severity of symptoms. This goal of improved treatment and care may be accomplished by understanding the disparity that may exist in the diagnosis and treatment of children with ADHD among African American and Hispanic children compared to non-Hispanic White children. Currently, ADHD is the most common neurobehavioral disorder in children (Booth, 2016) with both social and economic costs. Children with ADHD have higher direct and

indirect medical expensive than children without ADHD (Gupte-Singh, Singh, & Lawson, 2017). The social cost of ADHD in children is great with children with ADHD being three times more likely to enter the juvenile justice system than their non-ADHD counterparts (Silva, Colvin, Glauert, & Bower, 2014). Inadequate treatment of ADHD is associated with higher rates of delinquency, incarceration, learning problems, sexually transmitted diseases, and teen pregnancy (Baggio et al., 2018; Hall & Myers, 2016). In addition, quality of life is improved in adults treated for their ADHD as children particularly those with severe ADHD symptoms (O'Callaghan & Sharma, 2014). Understanding that there may be a disparity in treatment and care of these children with ADHD and its implications to public health will hopefully help bring ADHD to the forefront. Accordingly, public health resources can better be allocated to help close the treatment gap and ultimately improve health and neurobehavioral outcomes of these children (Lahey et al., 2016).

The results of this study can also provide a better understanding to public health officials and health care providers of the disparity that may exist in their treatment and care of non-Hispanic Blacks and Hispanic children with ADHD particularly based on these children's symptom severity. Knowledge acquired from this study will help public health officials and health care providers allocate resources and care for specific population disproportionally affected by ADHD. Severity of ADHD symptoms will affect a child more significantly in later academic achievement if not treated (Owens & Jackson, 2017). Thus, knowing that there may be a disparity in the treatment of ADHD based on severity of symptoms health care, providers may be alerted to the needs of these

children with more severe symptoms which may help improve quality of life, academic achievement, and health outcomes of these children.

As previously noted, the implications for positive social change are important and substantial. I am hoping to provide knowledge of the disparity that may exist in the treatment and care of non-Hispanic Blacks and Hispanic children with ADHD and by doing so help improve the health and development of these children. Using a large national survey such as the NSCH which was first conducted in 2003 and with over 50,000 survey participants across the United States in 2016 will add depth and wealth to this study (The Child & Adolescent Health Measurement Initiative [CAHMI], 2017).

Section 2: Research Design and Data Collection

Introduction

In the United States, ADHD is the most commonly diagnosed neurodevelopmental disorder in children that leads to functional impairment in multiple settings (Danielson et al., 2017). There are three different types of ADHD that can be diagnosed using the DSM V: (a) Combined type with both core symptoms for the past 6 months; (b) predominately inattentive type; and (c) predominately hyperactive-impulsive type (APA, 2013; Pettersson et al.n, 2018). ADHD has three severity levels which are classified as follows: mild with few symptoms and clinical impairments, moderate with between mild and severe with functional impairment and significant clinical impairment, and severe with several symptoms and severe impairment in symptoms (APA, 2013; Vazquez et al., 2018). The purpose of this doctoral study was to determine whether there was an association between race and treatment modality based on symptoms severity among children with ADHD. This section will review the research design and rationale, methodology and variable operationalization for my doctoral study.

Research Design and Rational

The study was a cross-sectional quantitative study in which I used secondary data from the 2016 NSCH. Variables used for this research included demographics such as race, sex, age, and poverty level. It also included specific ADHD related questions and control variable questions. Tables 1 and 2 below show the variables and codes for the research questions.

Table 1

Codes for Independent, Dependent and Control Variables

Description	Code	Variable	Variable type
Race	C#_RACE	Independent	Categorical
Age	C#_AGE_YEARS	Control	Categorical
Sex	C#_SEX	Control	Categorical
Does the child have ADHD	K2Q31B	Independent	Quantitative
Severity mild, moderate, or severe	K2Q31C	Independent	Categorical
Currently taking medication for ADHD	K2Q31D	Dependent	Quantitative
Past 12 months received behavioral treatment	ADDTREAT	Dependent	Quantitative
Past 12 months use any type of alternative health care or treatment	ALTHEALTH	Dependent	Quantitative
Ever had as special education or early intervention plan	K6Q15	Control	Quantitative
Ever received special services to meet developmental needs	K4Q36	Control	Quantitative
Ever any healthcare insurance coverage	K5Q20_R	Control	Quantitative
Currently covered by any healthcare insurance	CURRCOV	Control	Quantitative
How often does your health insurance cover benefits and services for child's behavioral health	MENBEVCOV	Control	Quantitative
Physical activity at least 60min	PHYSACTIV	Control	Quantitative
How many hours of sleep	HOURSLEEP	Control	Quantitative
Average time spent watching TV or playing video games	K7Q60_R	Control	Quantitative
Average time spent on computer and electronic devices other than for schoolwork	K7Q91_R	Control	Quantitative
Poverty level of this household based on DHHS guide	Povlev4_16	Control	Categorical

Table 2

Research Questions Variables

Research question	Independent variable	Dependent variable	Confounding variable
1	Race	Medication treatment	Age, gender, other attributes of the child, and socioeconomic status
2	Race	Behavioral treatment	Age, gender, other attributes of the child, and socioeconomic status
3	Race	Alternative health care	Age, gender, other attributes of the child, and socioeconomic status
4	Race	Combined treatment	Age, gender, other attributes of the child, and socioeconomic status
5	Race ADHD severity	Medical treatment	Age, gender, other attributes of the child, and socioeconomic status
6	Race ADHD severity	Behavioral treatment	Age, gender, other attributes of the child, and socioeconomic status
7	Race ADHD severity	Alternative health care	Age, gender, other attributes of the child, and socioeconomic status
8	Race ADHD severity	Combined treatment	Age, gender, other attributes of the child, and socioeconomic status

The 2016 NSCH is a national survey with over 50,000 survey participants and approximately 985 surveys from each state of children health and health care in the United States (CAHMI, 2017). The 2016 NSCH was a cross sectional survey administered by mail and the internet unlike the 2012-2012 NSCH which was a cross sectional telephone survey using only landline telephones (CDC, 2017; CAHMI, 2017). Across-sectional study design is useful in prevalence studies of behavior or disease in a population (Sedgwick, 2014). In addition, cross-sectional studies are usually less expensive and quicker to conduct than other research design and are useful for planning, monitoring and evaluation in public health research and programs (Setia, 2016). The

cross-sectional study design helped to estimate prevalence among each group (African American, Hispanics, and non-Hispanic White children) and show the association, if any, in the disparity among children with ADHD across race and severity of symptoms.

Methodology

Population

The population from this study was drawn from the 2016 NSCH national survey. The target population of the 2016 NSCH national survey were noninstitutionalized children ages 17 or younger living in the United States and the District of Columbia (U.S. Census Bureau, 2018). The target population for my research was African American, Hispanic, and non-Hispanic White children aged 3 to 17 with ADHD. In the sample population 4,741 respondents stated the child had ADHD of the 49,822 total respondents of that question (CAHMI, 2017).

Sampling and Sampling Procedure

The 2016 NSCH national survey sampled 364,150 households across 50 states, including the District of Columbia, after which samples were stratified by state and a child-presence indicator (U.S. Census Bureau, 2018). The survey used screeners to help identify households with children and from that original screen a roster was developed of children in the household and one child was selected randomly to be the subject of the age-specific topical survey (U.S. Census Bureau, 2018). In the subsampling of household that reported more than one child, those with a young child or with special health care need were place at a higher probability for selection and others were randomly selected (U.S. Census Bureau, 2018).

The study screened a total of 138,009 questionnaires from June 2016 to January 2017 with 50,212 completed the topical questionnaire out of the 67, 047 eligible for the topical questionnaire (U.S. Census Bureau, 2018). Household selected were mailed invitation to respond to survey by web instrument and nonrespondents were sent paper instrument (U.S. Census Bureau, 2018). In addition, addresses of nonrespondent that were considered as Low Web with a low probability of responding by web received a paper instrument sooner (U.S. Census Bureau, 2018).

Instrumentation

The 2016 NCHS is a parent-caretaker reported respondent survey. Due to the type of survey, the data collected relies on the parent-caretaker's reporting accuracy, recall ability, and objective response. In this study, the parent-caretaker report of ADHD diagnosis and treatment may be subject to recall bias and have not been validated against actual medical records or medical provider clinical judgment (see Danielson et al., 2018). However, according to Danielson et al. (2018), both the parent report of ADHD diagnosis and the medical record documentation of ADHD had similar prevalence estimates, which suggests convergent validity of estimate prevalence of both data sources. The instrumentation used in the 2016 NCHS was either web or paper based and had three different topical questionnaires that were aimed at three different age groups: T1 children 0 to 5 years old, T2 children 6 to 11 years old, and T3 children 12 to 17 years old (U.S. Census Bureau, 2018). The questionnaire had 11 sections: Section A – This Child's Health, Section B – This Child as an infant, Section C – Health Care Services, Section D – Experience with This Child's Health Care Providers, Section E – This Child's Health

Insurance Coverage, Section F – Providing for this Child's Health, Section G – This Child's Learning/Schooling and Activities, Section H – About You and This Child, Section I – About Your Family and Household, Section J – About You, and Section K – Household Information (U.S. Census Bureau, 2018). To maximize response rate, cash incentives, toll-free telephone numbers, follow-up mailing, and translated questionnaires were available to the participants (U.S. Census Bureau, 2018). The paper and web instruments, along with the invitation, were available in English and Spanish. Two hundred and fifty-four of the respondents completed the Spanish version of the web instrument topical questionnaire (U.S. Census Bureau, 2018). To verify the validity of the Spanish instrument the Census Bureau reviewed and verified previously translated the Spanish language instrument, both paper and web versions, and made revisions and translations as needed (U.S. Census Bureau, 2018).

Access to Data and Permission

The data set and codebook is available upon request from the Data Resource Center for Child & Adolescent Health (DRC). The request can be made online by completing and submitting the request for data sets and/or codebook. The request requires information about how the researcher plans to use the data (e.g. for thesis/dissertation research), needs assessment, research publication, policy research, and to elaborate specifically how it will be used. Once approved, the DRC sends the researcher an email on where and how to download the data sets and codebook.

Operationalization Independent Variable

Race. What is the child's race? Coded as C#_RACE. This question has 15 answer choices: (1) White, (10) Other Asian, (11) Native Hawaiian, (12) Guamanian or Chamorro, (13) Samoan, (14) Other Pacific Islander, (15) Some other race, (2) Black or African American, (3) American Indian or Alaska Native, (4) Asian Indian, (5) Chinese, (6) Filipino, (7) Japanese, (7) Korean, and (9) Vietnamese. (DRC, 2016)

ADHD. Has a doctor or other health care provider EVER told you that this child has Attention Deficit Disorder or Attention-Deficit/Hyperactivity Disorder that is, ADD or ADHD? Coded as K2Q31A. There are only two answers either (1) yes or (2) no. Does this child CURRENTLY have this condition? Coded as K2Q31B. There are only two answers either (1) yes or (2) no (DRC, 2016).

Severity of ADHD. Is it mild, moderate, or severe? Coded as K2Q31C. There are three answers: (1) Mild, (2) Moderate, and (3) Severe (DRC, 2016).

Operationalization Dependent Variable

ADHD medication. Is this child CURRENTLY taking medication for ADD or ADHD? Coded as K2Q31D. There are only two answers (1) yes or (2) no (DRC, 2016).

Behavioral Treatment. At any time DURING THE PAST 12 MONTHS, did this child receive behavioral treatment for ADD or ADHD, such as training or an intervention that you or this child received to help with his or her behavior? Coded as ADDTREAT. There are only two answers (1) yes or (2) no (DRC, 2016).

Alternative health care or treatment. DURING THE PAST 12 MONTHS, did this child use any type of alternative health care or treatment? Alternative health care can

include acupuncture, chiropractic care, relaxation therapies, herbal supplements, and others. Some therapies involve seeing a health care provider, while others can be done on your own. Coded as ALTHEALTH. There are only two answers (1) yes or (2) no (DRC, 2016).

Research Questions and Hypotheses

RQ1: Is there an association between race and diagnosis of ADHD after adjusting for age, gender, attributes of the child and socioeconomic status?

$H_0$1: There is no association between diagnosis of ADHD and race.

H_a1: There is an association between diagnosis of ADHD and race.

RQ2: Is there an association between race and receiving medication to treat ADHD after adjusting for age, gender, attributes of the child and socioeconomic status?

$H_0$2: There is no association between receiving medication to treat ADHD and race.

H_a2: There is an association between receiving medication to treat ADHD and race.

RQ3: Is there an association between race and receiving behavioral treatment for ADHD after adjusting for age, gender, attributes of the child and socioeconomic status?

$H_0$3: There is no association between receiving behavioral treatment for ADHD and race.

H_a3: There is an association between receiving behavioral treatment for ADHD and race.

RQ4: Is there an association between race and receiving alternative health care or treatment for ADHD after adjusting for age, gender, attributes of the child and socioeconomic status?

$H_0$4: There is no association between receiving alternative health care or treatment for ADHD and race.

H_a4: There is an association between receiving alternative health care or treatment for ADHD and race.

RQ5: Is there an association between race and receiving combined treatment for ADHD after adjusting for age, gender, attributes of the child and socioeconomic status?

$H_0$5: There is no association between receiving combined treatment for ADHD and race.

H_a5: There is an association between receiving combined treatment for ADHD and race.

RQ6: Is there an association between race and receiving medication treatment based on ADHD severity after adjusting for age, gender, attributes of the child and socioeconomic status?

$H_0$6: There is no association between receiving medication to treat ADHD and race based on ADHD severity.

H_a6: There is an association between receiving medication to treat ADHD and race based on ADHD severity.

RQ7: Is there an association between race and receiving behavior treatment based on ADHD severity after adjusting for age, gender, attributes of the child and socioeconomic status?

$H_0$7: There is no association between receiving behavioral treatment for ADHD and race based on ADHD severity.

H_a7: There is an association between receiving behavioral treatment for ADHD and race based on ADHD severity.

RQ8: Is there an association between race and receiving alternative health care or treatment based on ADHD severity after adjusting for age, gender, attributes of the child and socioeconomic status?

$H_0$8: There is no association between receiving alternative health care or treatment for ADHD and race based on ADHD severity.

H_a8: There is an association between receiving alternative health care or treatment for ADHD and race based on ADHD severity.

RQ9: Is there an association between race and receiving combined treatment for ADHD severity after adjusting for age, gender, attributes of the child and socioeconomic status?

$H_0$9: There is no association between receiving combined treatment for ADHD and race based on ADHD severity.

H_a9: There is an association between receiving combined treatment for ADHD and race based on ADHD severity.

Data Analysis

Both descriptive and inferential data analyses were used to analyses the data and test the research hypotheses. Descriptive statistics analysis was mainly used to show demographic characteristic of the sample population of this study. To test the hypotheses of this study, logistic regression analysis was used since it is the best way to analyze the relationship between one or more independent variables with a dichotomous dependent variable (see Laerd Statistics, 2016).

Confounding variables affect the variables being studied and may produce results that show the actual relationship between the variables being studied (Houwen, van der Veer, Visser, & Cantell, 2017). In this study, an important confounding variable was sleep. Children that have poor sleep often has symptoms of ADHD and by not including sleep as a confounder may produce a false positive (Type I) error (Brooks, Zoumpoulaki, & Bowman, 2017). Other potential confounding variables in this study are screen time, physical activity, and socioeconomic status. A covariate is similar to an independent variable and complements or relates to the dependent variable (Mojirsheibani & Shaw, 2018). Inclusion or exclusion of a covariant depends on the research question, the study design, and the sample size (Mojirsheibani & Shaw, 2018).

Logistic regression analysis was used to test the hypotheses of this study. Logistic regression analysis is a means to analyze the relationship between one or more explanatory variable with a qualitative response variable (Sperandei, 2014). To determine the adequacy of the model, the Hosmer and the Lemeshow goodness of fit test was used (see Laerd Statistics, 2016). The Nagelkerke R^2 test was used to determine how much

variation in the dependent variable can be explained by the model (see Laerd Statistics, 2016). The statistical significance of each of the independent variable was determined by using the Wald test and test significance (see Laerd Statistics, 2016). The expected B coefficient, Exp(B), along with the confidence intervals, provided the change in the odds for each increase in one unit of the independent variable (see Laerd Statistics, 2016).

Having more than one explanatory variable that can be either continuous or categorical is an important advantage of using logistic regression analysis for this study (Laerd Statistics, 2016). Another very important advantage of using logistic regression particularly compared to chi-square analysis is that when analyzing the association of all variable together the confounding effects are avoided (Sperandei, 2014). One disadvantage is that the independent variable cannot be entered as an ordinal variable, if it is measured at the ordinal level it must be entered as either a continuous or nominal variable (Laerd Statistics, 2016). Another potential disadvantage is there may be an assumption that the variables follow a particular direction and this assumption may not hold true for certain associations in logistic regression analysis (Ranganathan, Pramesh, & Aggarwal, 2017).

Threat to Validity

Threat to External Validity

External validity is whether different measures, persons, settings, and times can be generalized as a causal relationship (Andrade, 2018). Volunteer bias can threaten the external validity of the study by reducing the homogeneity of the characteristic of the population (Laerd dissertation, 2016). A person may be reluctant to participate in a

survey for specific or cultural reasons. Among Hispanics, refusal to answer questions or nonparticipation in a survey is often driven by suspicion of the government, language, and cultural barriers (Brown, 2015). Nonparticipation may be overcome by community outreach and education along with cultural sensitivity of the screener, instrumentation, and study design.

Threat to Internal Validity

Internal validity is whether an observed covariation can be generalized or interpreted as a causal relationship (Andrade, 2018). The main threat to internal validity in this study may be the instrumentation. The instrumentation used in the study was both paper and Web-based and were only administered in English and Spanish. All other language may be accommodated by the respondent calling to talk to a screener translator. The use of Web-based survey is restricted to those who have experience with a computer and access to the internet (Ebert et al., 2018). The 2016 NCHS addressed this by providing telephone helpline to aid respondents in using the web-based survey. Another internal threat to validity is only having the survey in English and Spanish while the survey included a multitude of racial and ethnic groups which may or may not speak one of the two languages. To address this issue a respondent can call to speak to a screener to translate in their language of preference. A threat to validity may also be in the respondent subjective response to certain questions such as the severity of their child's ADHD. The parents may base their response on what they subjectively observe rather than what their medical provider have told them if the medical provider told them

anything at all. This threat to validity may have been averted if there were definition of each type of ADHD severity on the survey.

Ethical Procedures

The Data Resource Center for Child & Adolescent Health has agreed in providing data set and codebook from the 2016 NSCH. The data set and codebook once approved can be downloaded off a secured password protected web site. The use of data file signifies the user agreement to use the data files for the purpose of statistical reporting and analysis and to make no use of the identity of any person discovered, inadvertently or otherwise (Health Resources & Services Administration, 2018). To protect confidentiality the data files went through extensive disclosure review and responses for certain variable were collapsed or suppressed (Health Resources & Services Administration, 2018).

Prior to getting institutional review board (IRB) approval I obtained preliminary ethics feedback from the IRB by first completing Form A (Description of Data Sources and Partner Sites). This preliminary ethics feedback helped the researcher identify and resolve any privacy or ethical problems that may arise prior to submission for formal IRB approval (Walden University, 2019). The researcher obtained Walden Institutional Review Board (IRB) approval prior to starting the study. The IRB approval number for this study is 12-03-19-0586241.

The 2016 NSCH or any NSCH data collection does not undergo external IRB process. It is the responsibilities of the U.S. Census Bureau and Office of Management and Budget (OMB) to review methods and procedures to ensure that NSCH participant

data is protected and treated with sensitivity (Health Resources & Services Administration, 2018). NSCH was in compliance with the standards of practice to protect and preserve the rights and wellbeing of participants involved in the 2016 NSCH data collection in accordance to Title 45 CFR §46.103 and the authorizing agency, the U.S. Census Bureau (Health Resources & Services Administration, 2018). The U.S. Census Bureau must maintain written satisfactory assurance that the methods used for both data collection and storage are altogether appropriate (Health Resources & Services Administration, 2018).

Summary

A cross-sectional quantitative analysis using secondary data from the 2016 NSCH was used for this study. There were over 50,000 survey participants across all 50 states including the District of Columbia. The instrumentation for this study was both paper and Web-based surveys provided in both English and Spanish.

This study specially examined the disparity in diagnosis and treatment of ADHD among non-Hispanic Black and Hispanic children compared to non-Hispanic White children based on severity of symptoms. There are eight research questions in this study. One of the main research questions is if there is an association between race and receiving medication to treat ADHD based on severity of symptoms. Logistic regression analysis along with descriptive statistical analysis was used for data analysis. The results of this study will hopefully shed light on how children with ADHD are treated particularly non-Hispanic Blacks and Hispanic children and provide justification for focusing resources and education for these children.

Section 3: Presentation of the Results and Findings

Introduction

The purpose of this doctoral study was to determine if there was a disparity that exists in the diagnosis and treatment among Hispanic and non-Hispanic Black children compared to non-Hispanic White children with ADHD based on severity of symptoms. The data were extracted from the 2016 NSCH of children 3-17 years of age. The following research questions and hypotheses were developed to examine the association of the independent variable on the dependent variable using logistic regression analysis.

Research Questions and Hypotheses

RQ1: Is there an association between race and diagnosis of ADHD after adjusting for age, gender, attributes of the child and socioeconomic status?

$H_0$1: There is no association between diagnosis of ADHD and race.

H_a1: There is an association between diagnosis of ADHD and race.

RQ2: Is there an association between race and receiving medication to treat ADHD after adjusting for age, gender, attributes of the child and socioeconomic status?

$H_0$2: There is no association between receiving medication to treat ADHD and race.

H_a2: There is an association between receiving medication to treat ADHD and race.

RQ3: Is there an association between race and receiving behavioral treatment for ADHD after adjusting for age, gender, attributes of the child and socioeconomic status?

$H_0$3: There is no association between receiving behavioral treatment for ADHD and race.

H_a3: There is an association between receiving behavioral treatment for ADHD and race.

RQ4: Is there an association between race and receiving alternative health care or treatment for ADHD after adjusting for age, gender, attributes of the child and socioeconomic status?

$H_0$4: There is no association between receiving alternative health care or treatment for ADHD and race.

H_a4: There is an association between receiving alternative health care or treatment for ADHD and race.

RQ5: Is there an association between race and receiving combined treatment for ADHD after adjusting for age, gender, attributes of the child and socioeconomic status?

$H_0$5: There is no association between receiving combined treatment for ADHD and race.

H_a5: There is an association between receiving combined treatment for ADHD and race.

RQ6: Is there an association between race and receiving medication treatment based on ADHD severity after adjusting for age, gender, attributes of the child and socioeconomic status?

$H_0$6: There is no association between receiving medication to treat ADHD and race based on ADHD severity.

H_a6: There is an association between receiving medication to treat ADHD and race based on ADHD severity.

RQ7: Is there an association between race and receiving behavior treatment based on ADHD severity after adjusting for age, gender, attributes of the child and socioeconomic status?

H_07: There is no association between receiving behavioral treatment for ADHD and race based on ADHD severity.

H_a7: There is an association between receiving behavioral treatment for ADHD and race based on ADHD severity.

RQ8: Is there an association between race and receiving alternative health care or treatment based on ADHD severity after adjusting for age, gender, attributes of the child and socioeconomic status?

H_08: There is no association between receiving alternative health care or treatment for ADHD and race based on ADHD severity.

H_a8: There is an association between receiving alternative health care or treatment for ADHD and race based on ADHD severity.

RQ9: Is there an association between race and receiving combined treatment for ADHD severity after adjusting for age, gender, attributes of the child and socioeconomic status?

H_09: There is no association between receiving combined treatment for ADHD and race based on ADHD severity.

H_a9: There is an association between receiving combined treatment for ADHD and race based on ADHD severity.

In this section, I detailed the data collection process of the secondary data set used in my research study. This section also included descriptive and demographic characteristics of this data set sample. Finally, I presented and reviewed the results of my research using descriptive statistics and logistic regression analysis.

Data Collection of Secondary Data Set

The 2016 NSCH national survey sampled 364,150 households across 50 states including the District of Columbia after which samples were stratified by state and a child-presence indicator (U.S. Census Bureau, 2018). The study screened a total of 138,009 questionnaires from June 2016 to January 2017 with 50,212 completed the topical questionnaire out of the 67, 047 eligible for the topical questionnaire (U.S. Census Bureau, 2018). Household selected were mailed invitation to respond to survey by web instrument and nonrespondents were sent paper instrument (U.S. Census Bureau, 2018). In addition, addresses of nonrespondents that were considered as Low Web with a low probability of responding by web received a paper instrument sooner (U.S. Census Bureau, 2018).

The estimated proportion of eligible addresses that completed the screener and topical questionnaires were used to calculate the response rate of this secondary data (U.S. Census Bureau, 2018). The interview completion rate (ICR) is the product of the screener conversion rate and the topical conversion rate which yields a national weighted ICR of 69.7%. The weighted overall response rate for this national survey was 40.7%.

Table 3 displays the baseline demographics and covariates such as sex of the child, age, and race/ethnicity of this study sample population. Both the weighted estimate of the screener and topical file generalizes to state and national resident child populations (U.S. Census Bureau, 2018).

Table 3

Respondent Demographics of the Sample Population

		All children 3 to 17 y.o.		Diagnosed ADHD		Children 3-17 y.o. diagnosed ADHD
		n	%	*n*	%	%
Sex of the child	Male	22,010	51.3	3,250	14.8	68.8
	Female	20,925	48.7	1,476	7.1	31.2
Age	3-4 y.o.	5,037	11.7	72	1.4	1.5
	5-7 y.o.	6,981	16.3	397	5.7	8.4
	8-10 y.o.	7,652	17.8	946	12.4	20.0
	11-13 y.o.	8,665	20.2	1,262	14.6	26.7
	14-17 y.o.	14,600	34.0	2,049	14.0	43.4
Race/ethnicity	Hispanic	4,708	11.0	478	10.2	10.1
	White, non-Hispanic	30,201	70.3	3,482	11.5	73.7
	Black, non-Hispanic	2,518	5.9	325	12.9	6.9
	Other/Multiracial, non-Hispanic	5,508	12.8	441	8.0	9.3

Results

The population from this study was drawn from the 2016 NSCH national survey. The target population of the 2016 NSCH national survey was noninstitutionalized children ages 17 or younger living in the United States and the District of Columbia (U.S. Census Bureau, 2018). The target population for my research was non-Hispanic Black, Hispanic, and non-Hispanic White children aged 3 to 17 with ADHD. However, for RQ1, the selection criteria for the sample was based only on age and the population consisted

of children aged 3 to 17 years old, an independent functional population with ADHD. This sample was used to look at the relationship between race and ADHD diagnosis as stated in RQ1. For the rest of the research questions (2 to 9) were based on the target population.

Descriptive statistics

The secondary data for this study was derived from the 2016 NSCH and consisted of 43,283 children aged 3 to 17 years old (that were used for the first research question) and 4,276 of them were diagnosed ADHD and therefore were included into the sample for RQ2- 9. Descriptive statistics for both sample populations is provided in Table 4.

There were almost equal numbers of male and female children (51.3% and 48.7%) in the overall sample while the number of boys was higher among those who were diagnosed with ADHD (68.8% male to 31.2% female). The age of the children also differed between samples with more equal distribution in the overall sample (all age groups account for 11% to 34%) while the distribution was skewed to older ages among those who had ADHD (90.1% of them were older than 8 years). The race of the children was similar in both samples with the majority (over 70%) of the children belonging to non-Hispanic White, about one-tenth being Hispanic (up to 11%), and approximately the same amount being in the Other/Multiracial group (9%-12%). The lowest share was measured for non-Hispanic Black children accounting for about 6% of the sample.

Table 4

Descriptive Statistics for Sample Population (Children Aged 3-17)

		All children 3 to 17 y.o.		Diagnosed ADHD		Children 3-17 y.o. diagnosed ADHD
		n	%	*n*	%	%
Sex of the child	Male	22,010	51.3	3,250	14.8	68.8
	Female	20,925	48.7	1476	7.1	31.2
Age	3-4 y.o.	5,037	11.7	72	1.4	1.5
	5-7 y.o.	6,981	16.3	397	5.7	8.4
	8-10 y.o.	7,652	17.8	946	12.4	20.0
	11-13 y.o.	8,665	20.2	1,262	14.6	26.7
	14-17 y.o.	14,600	34.0	2,049	14.0	43.4
Race/ethnicity	Hispanic	4,708	11.0	478	10.2	10.1
	White, non-Hispanic	30,201	70.3	3,482	11.5	73.7
	Black, non-Hispanic	2,518	5.9	325	12.9	6.9
	Other/Multiracial, non-Hispanic	5,508	12.8	441	8.0	9.3
Special education	Yes	6,543	15.2	2,391	36.5	50.6
	No	36,216	84.4	2,315	6.4	49.0
	Missing	176	0.4	20	11.4	0.4
Received special services	Yes	7,546	17.6	2,200	29.2	46.6
	No	35,085	81.7	2,483	7.1	52.5
	Missing	304	0.7	43	14.1	0.9
Current insurance	No insurance					
	Insured *without* mental or behavioral health services	1,442	3.4	134	9.3	2.8
	Insured *with* mental or behavioral health services	33,606	78.3	1,686	5.0	35.7
	Missing	7,435	17.3	2,855	38.4	60.4
	None	452	1.1	51	11.3	1.1
Time spent watching TV	Less than 1 hour	7,417	17.3	630	8.5	13.3
	1 hour	12,056	28.1	1,091	9.0	23.1
	2 hours	12,727	29.6	1,417	11.1	30.0
	3 hours	5,043	11.7	719	14.3	15.2
	4 or more hours	3,424	8.0	668	19.5	14.1
	Missing answer	466	1.1	41	8.8	0.9
	None	2,901	6.8	214	7.4	4.5
Time spent with computers	Less than 1 hour	8,378	19.5	623	7.4	13.2

		All children 3 to 17 y.o.		Diagnosed ADHD		Children 3-17 y.o. diagnosed ADHD
		n	%	*n*	%	%
	1 hour	10,198	23.8	959	9.4	20.3
	2 hours	10,312	24.0	1,198	11.6	25.3
	3 hours	5,031	11.7	705	14.0	14.9
	4 or more hours	5,682	13.2	987	17.4	20.9
	Missing answer	433	1.0	40	9.2	0.8
Household poverty level[a]	0-99% FPL	4,180	9.7	652	15.6	13.8
	100-199% FPL	6,841	15.9	853	12.5	18.0
	200-399% FPL	13,238	30.8	1,381	10.4	29.2
	400% FPL or greater	18,676	43.5	1,840	9.9	38.9

[a] Imputed based on DHHS guidelines.

More than 80% of the children of the total sample did not have a special education plan and did not receive special services, while among those children who had ADHD about a half received both special education plan and special services. Most of the children in the overall sample (78.3%) had ordinal current insurance without mental or behavioral health services, while among those children who had ADHD almost two-thirds (60.4%) had full insurance with mental or behavioral health services. The socioeconomic status of the children was similar in both samples with most of them belonging to families with 200 percent below the federal poverty level (FPL) (70.4% in the total sample and 68.1% among children with ADHD). The lowest income group made up to 9.7% in the total sample and 13.8% among children with ADHD.

Most of the children in both samples watched no more than 2 hours TV (79.2% in the total sample and 69.8% among children with ADHD) and spent no more than 2 hours by the computer (74.8% in the total sample and 63.4% among children with ADHD). For children aged 6 years old and older, the dataset contained information regarding average

physical activity and length of sleep. The results showed that children in both samples had similar physical activity with more than a third having exercised for 1-3 days and up to third having exercised four to six times a week. The amount of sleep the children have is also similar with half of them getting 8-9 hours of sleep and about a quarter getting 10 hours of sleep and a quarter getting less than 8 hours. The frequency of ADHD diagnosis was lower with more time spent on physical exercises and having more hours of sleep (from 20.8% to 12.1% for physical activity and from 29.5% to 11.4% for length of sleep).

ADHD diagnosis was more frequent among boys (14.8%) than girls (7.1%). The prevalence of the diagnosis became higher with increasing age of the child (from 1.4% for age group 3-4 y.o. to 14.6% for age group 11-13 y.o.). Black children had the highest prevalence of ADHD (12.9%) compared with the other ethnic groups, while Other/Multiracial group showed the lowest frequency of 8.0%. multiracial

Children receiving special education and special services had a higher prevalence of ADHD (up to 36.5% and 29.2% correspondingly). The highest rate of ADHD diagnosis was among those who had mental or behavioral health services insurance (38.4%). The frequency of diagnosis rose with more time spent watching TV and spent with the computer (up to 19.5% and 17.4% correspondingly for the group with the highest time spent on TV/computer). As for poverty level, the highest prevalence of ADHD diagnosis was in the poorest group (15.6%) with the prevalence getting lower with increasing income (9.9% in the wealthiest group).

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Table 5

Physical Activity and Average Length of Sleep for Sample Population (Children Aged 6-17)

		All children aged 6 to 17 y.o.		Diagnosed ADHD	Children aged 6 to 17 y.o. being diagnosed ADHD	
		n	%	%	*n*	%
Physical Activity for 60 Minutes[a]	0 days	2784	7.9	20.8	580	12.6
	1 - 3 days	13,075	36.9	13.8	1,801	39.3
	4 - 6 days	11,307	31.9	10.7	1,210	26.4
	Every day	7,509	21.2	12.1	908	19.8
	Missing answer	741	2.1	11.7	87	1.9
Average Hours of Sleep[b]	Less than 6 hours	349	1.0	29.5	103	2.2
	6 hours	1,139	3.2	20.6	235	5.1
	7 hours	4,484	12.7	15.6	698	15.2
	8 hours	11,533	32.6	13.1	1,513	33.0
	9 hours	10,138	28.6	12.1	1,226	26.7
	10 hours	6,027	17.0	10.2	612	13.3
	11 or more hours	960	2.7	11.4	109	2.4
	Missing answer	786	2.2	11.5	90	2.0

[a] Includes exercise play and sport

[b] Based on reported sleep for the past week

To assess the ADHD severity of the child and the treatment the child received, the distribution of dependent variables and severity of ADHD were investigated (Table 6). The results showed that most of the children have mild (*n* = 1868, 39.5%) or moderate (n = 1866, 39.5%) ADHD while about a tenth of the cases (*n* = 471, 10.0%) indicated severe ADHD. Over half of the children (*n* = 2809, 59.4%) currently received medication for their ADHD, almost half (*n* = 2017, 42.9%) received behavioral treatment. About a third of the children (*n* = 1382, 29.2%) received combined treatment (both medication and

behavioral) and a little more than a tenth of the children (n = 629, 13.3%) received alternative health care.

Table 6

Descriptive Statistics for ADHD Severity and Treatment

		Children aged 3 to 17 y.o. being diagnosed ADHD	
		n	%
ADD/ADHD Severity	Mild	1,868	39.5
	Moderate	1,866	39.5
	Severe	471	10.0
	Missing	521	11.0
ADD/ADHD - Medication Currently	Yes	2,809	59.4
	No	1,880	39.8
	Missing	37	0.8
ADD/ADHD - Behavioral Treatment	Yes	2,017	42.7
	No	2,687	56.9
	Missing	22	0.5
Alternative Health Care	Yes	629	13.3
	No	4,052	85.7
	Missing	45	1.0
Combined Treatment	Yes	1,382	29.2
	No	3,290	69.6
	Missing	54	1.1

Statistical Analysis

Inferential statistics were used to answer the research questions of the study by using binomial logistic regression as all dependent variables were measured on a nominal scale with two possible answers (Yes-No). The quality of the models and statistical significance of the results was assessed by the Hosmer and the Lemeshow goodness of fit

test and Nagelkerke R^2 test were used to determine how much variation in the dependent variable can be explained by the model (see Laerd Statistics, 2016). To determine the statistical significance of each variable's impact on the dependent variable the expected B coefficient, Exp(B) proved by the Wald test was used. Along with the confidence intervals, these measures indicate the change in the odds for each increase in one unit of the independent variable (Laerd Statistics, 2016).

One important issue of the current study was the impact confounding variables such as sleep, age, and other sociodemographic characteristics may have on the ADHD diagnosis and treatment. To avoid this impact, a binomial logistic regression was performed both for independent variables and covariates, which was the best fit as it allowed avoidance of confounding effects by analyzing the association of all variables together (see Sperandei, 2014). Before running the regression analysis, the only continuous independent variable, age of the child, was proved to fit the assumption of linearity of the continuous variables with respect to the logic of the dependent variable via the Box-Tidwell (1962). For both samples and all dependent variables, the assumption was violated as the *p*-values corresponding the age and logit of age variables interaction were lower than 0.001 meaning that age was not linearly related to dependent variables in any of the models. To overcome this violation the age variable was recoded into a categorical variable with five age groups: 3-4 years old, 5-7 years old, 8-10 years old, 11-13 years old and 14-17 years old. This transformation allowed avoiding linearity test and using new age groups in the regression models.

Another assumption of the logistic regression was the absence of significant outliers. For every model presented in the next section, all cases that showed a standardized residual value of more than 2.5 standard deviations were excluded from the analysis. This issue occurred only in running regression for all research questions except RQ2. However, due to a large enough sample size excluding part of the cases did not affect the results but increased the predictive power of the model as assessed by Nagelkerke R^2test.

One more limitation of the covariates included into the analysis was that variables measuring physical activity (PHYSACTIV) and length of sleep (HOURS SLEEP) in the dataset which were defined only for children older than 6 years old. Therefore, the models were constructed twice: first excluding these two variables for age group 3 to 17 years old and then including these covariates for children aged 6 to 17 years old. The relationship of ADHD diagnosis and treatment and race of the child was checked in every model.

Research Questions and Hypotheses

To answer the research questions regarding the association between ADHD diagnosis, treatment patterns and children's race after adjusting for confounders, the first the models without any additional variables were constructed. Considering, two of the probable confounders (physical activity and average sleep) were asked only among children aged 6 years and older, two unadjusted models were constructed (Table 7).

Table 7

Logistic Regression Results for Testing the Relationship Between Race and ADHD Diagnosis: Unadjusted Models for Ages 3-17 and Ages 6-17.

	Odds ratio	95% CI for Odds ratio		*p*
		Lower	Upper	
Ages 3-17				
Race[a]				< .001*
Hispanic	.862	.769	.966	.011*
Black	1.196	1.046	1.367	.009*
Other/Multi	.657	.584	.739	< .001*
Ages 6-17				
Race[a]				< .001*
Hispanic	.832	.739	.937	.002*
Black	1.170	1.018	1.345	.027*
Other/Multi	.671	.595	.757	< .001*

[a] White is the reference category.

*$p < .05$.

The quality of the models was assessed using omnibus test that showed that both modes were statistically significant ($\chi^2(3) = 69.075$, $p < .0005$ and $\chi^2(3) = 60.065$, $p < .0005$). However, the dependent variable variance explained by the models was very low and was only 4% (both models Nagelkerke R^2 did not exceed the value of 0.04) with 91.3% (for model based on age 3-17) and 89.5% (for model based on age 6-17) of correctly classified cases. Nagelkerke R^2 was an approximation of usual coefficient of determination R^2 that was used to assess the regression model when the outcome variable was categorical. The theoretical range of Nagelkerke R^2 was the same as for the coefficient of determination (from 0 to 1), with higher values corresponding to better predictive power of the logistic regression model. Therefore, including the covariates was

a way to improve the overall model quality and provide more reliable results on the association between ADHD and race.

The results of both unadjusted models showed that there was a statistically significant relationship between ADHD diagnosis and race, with Black children having a statistically significantly higher chance (*OR* = 1.196, *p* = .009 and *OR* = 1.170, *p* = .027) for being diagnosed with ADHD compared with White children. While Hispanic and Other/Multi nations showed a lower chance of being diagnosed with ADHD (*OR* = .862, *p* = .011 and *OR* = .657, *p* < .0005 correspondingly in the model for children age 3-17 and *OR* = .832, *p* = .002 and *OR* = .671, *p* < .0005 correspondingly in model for children aged 6-17).

One of the criteria for a variable being a true confounder must be distributed unequally among the groups being compared. To check for this criterion a Chi-square test was used to explore if there were independence of the distribution of covariates by race groups. The results of the analysis showed that all the chosen variables could be considered as probable confounders, as their distribution within race groups was unequal (all Chi-square *p* < .05).

Univariate analysis performed to check the association between each probable confounder and outcome (ADHD diagnosis) showed that all the covariates should be included in the model (Table D1) as each of them had a statistically significant (*p* < .05) association with the outcome variable of ADHD diagnosis. The univariate analysis was performed for both age groups 3-17 years old (without physical activity and length of sleep variables) and 6-17 years old with all variables chosen as probable confounders.

The next part of the description of the results consists of data analysis performed for each of the 9 research questions put forward in the study based on the null and alternative hypothesis. Each of the questions along with corresponding hypotheses was stated before the results of logistic regression for reference.

Research question 1. Is there an association between race and diagnosis of ADHD after adjusting for age, gender, attributes of the child and socioeconomic status? Null hypothesis (H_o1): There is no association between diagnosis of ADHD and race. Alternative hypothesis (H_a1): There is an association between diagnosis of ADHD and race.

Taking into account a large number of covariates the detailed results of regression models are presented in the appendix, while here only the information related directly to the hypotheses test was presented. Although all the covariates were checked for fitting the criteria of a confounder and showed that they can be used in the logistic model, some of them were deleted from the final model as they had insignificant impact on the outcome after adjusting for other confounders. To perform this selection of covariates a backward stepwise logistic regression procedure was used, that was a step by step adjustment of a model starting with all covariates and then stepwise deleting one covariate at a time that had statistically insignificant impact on the outcome.

Before performing logistic regression, the variables were checked to fit the assumptions of the analysis. The results of the test revealed 1071 outliers in the data that showed a standardized residual value higher than 3 standard deviations. Taking into account the total number of cases included in the model was very high (n = 41704) the

decision was made to exclude outlying cases. Nevertheless, the analysis was performed twice and showed similar results, but with the improved value of model fit (Nagelkerke R^2 was larger after excluding the outliers). The next test performed to evaluate the overall quality of the model was the Hosmer–Lemeshow test. It showed very low p-value ($p < 0.001$) that might indicate that the predictive power of the model was rather low, however according to Fagerland and Hosmer (2017) this test was extremely sensitive to the sample size and can provide low p-values when the number of cases exceeds 30,000.

The model was constructed with covariates characterizing the sociodemographics (gender, age), socioeconomic (special education, special services, insurance, poverty level) as well as behavioral habits (time spent watching TV, time with computer) of the children showed a much better model fit compared with the unadjusted model. The quality of the model assessed by omnibus test showed that it was statistically significant ($\chi^2(25) = 11057.179$, $p < .005$). The dependent variable variance that can be explained by the model was 53.6% (Nagelkerke R^2), with 92.9% of correctly classified cases. Taking into account that the Nagelkerke R^2 increased much higher compared with the unadjusted model, the model with covariates was used for further analysis. The results of stepwise logistic regression analysis showed that time spent in front of computer did not have statistically significant effect on the ADHD presence ($p = .432$), and therefore this variable was excluded from the final model (Table 8).

Table 8

Logistic Regression Results for Checking the Relationship Between Race and ADHD Diagnosis (Model 1.1, Ages 3-17)

	Unadjusted OR	Adjusted OR	95% CI for Odds ratio		
			Lower	Upper	*p*
Race					< .001*
Hispanic	.862	.718	.616	.838	< .001*
Black	1.196	.932	.770	1.130	.474
Other/Multi	.657	.635	.543	.743	< .001*

Note. White is the reference category. Sociodemographic variables included in the model: gender, age, special education, special services, insurance, time spent watching TV, poverty level.

*$p < .05$.

Similar results were obtained for the model including physical activity and length of sleep variables (for children 6 y.o. and older). The overall model fit got better after including covariates that were statistically significant based on logistic regression (all characteristics except time spent in front of the computer ($p = .471$) and physical activity ($p = .235$)). The model was statistically significant ($\chi^2(25) = 9585.3$, $p < .0005$), and it explained 52.1% (Nagelkerke R^2) of the dependent variable variance and provided a correct classification of 91.6% of the cases.

There was a statistically significant ($p < .001$) relationship between race and ADHD diagnosis both among children 3-17 years old and among 6-17 years old when adjusted for gender, age, special education, special services, insurance, time spent watching TV, poverty level and length of sleep (for children aged 6-17; Tables 7 and 8). The results for both age groups showed that there was a lower chance of being diagnosed ADHD for Hispanic (*OR* = 0.718, $p <.001$ in age group 3-17 and *OR* = .688, $p <.001$ in

age group 6-17) and Other/Multi nations children (*OR* = 0.635, *p* <.001 for age group 3-17 and *OR* = .627, *p* <.001 for age group 6-17) compared with White children. However, after adjusting for socioeconomic characteristics of the children, the chances of being diagnosed ADHD among Black children compared with White was not statistically significant.

Table 9

Logistic Regression Results for Checking the Relationship Between Race and ADHD Diagnosis (Model 1.2, Ages 6-17)

	Unadjusted OR	Adjusted OR	95% CI for Odds ratio		
			Lower	Upper	*p*
Race					< .001*
Hispanic	.832	.688	.587	.806	< .001*
Black	1.170	.824	.675	1.006	.057
Other/Multi	.671	.627	.534	.737	< .001*

Note. White is the reference category. Sociodemographic variables included in the model: gender, age, special education, special services, insurance, time spent watching TV, poverty level, length of sleep.

*$p < .05$.

Based on all regression analysis results the null hypothesis of no relationship between race and ADHD diagnosis should be rejected ($p < .001$ for race as independent predictor in both models) and the association was significant and the adjusted odds ratio shows that there was a positive association with race and a higher odds of having a diagnosis of ADHD after adjusting for age, gender, attributes of the child and socioeconomic status. However, the association was only significant with Hispanic not Black children.

The next eight research question correspond to ADHD treatment and therefore we investigated based on the subsample of children aged 3 to 17 years old having ADHD. Again, considering physical activity and length of sleep were measured only for children who were 6 years old or older. Two models were constructed to investigate each of the following research questions.

Research question 2. Is there an association between race and receiving medication to treat ADHD after adjusting for age, gender, attributes of the child and socioeconomic status? Null hypothesis (Ho2): There is no association between receiving medication to treat ADHD and race. Alternative hypothesis (H_a2): There is an association between receiving medication to treat ADHD and race.

First, a model unadjusted for any probable confounders was constructed to estimate possible relationship between race and receiving medication to treat ADHD (Table 10). Considering that two of the probable confounders are determined only for children aged 6 years and older, two unadjusted models were constructed for each age group (3-17 and 6-17, respectively).

The quality of the models was assessed using omnibus test, which showed both modes were statistically significant ($\chi^2(3) = 20.868$, $p < .0005$ and $\chi^2(3) = 16.831$, $p = .001$). However, the dependent variable variance explained by the models was very low and was 6% or less (Nagelkerke R^2 was equal to 0.06 for the first (3-17 y.o. children) and 0.05 for the second model), with 59.9% (for model based on age 3-17) and 60.8% (for model based on age 6-17) of correctly classified cases. Therefore, including the

covariates improved the overall model quality and provided more reliable results to test the association between ADHD treatment and race.

Table 10

Logistic Regression Results for Checking the Relationship Between Race and Receiving Medication to Treat ADHD: Unadjusted Models for Ages 3-17 and Ages 6-17

	Odds ratio	95% CI for Odds ratio		*p*
		Lower	Upper	
Ages 3-17				
Race**				< .001*
Hispanic	.649	.535	.787	< .001*
Black	.894	.708	1.128	.345
Other/Multi	.837	.685	1.023	.082
Ages 6-17				
Race**				.001*
Hispanic	.663	.542	.811	< .001*
Black	.923	.725	1.175	.515
Other/Multi	.859	.697	1.057	.151

Note. White is the reference category.

*$p < .05$.

The results of both unadjusted models showed that there was a statistically significant relationship between receiving medication to treat ADHD and race ($p < .01$). Specifically, Hispanic children had a statistically significantly lower chance ($OR = 0.649$, $p < .001$ and $OR = 0.663$, $p < .001$) to receive treatment for ADHD compared with White children.

The covariates selected for the study were first checked for fitting the criteria of being a probable confounder. The comparison of the covariate distribution within race groups was tested and confirmed in the previous step of the analysis so here only the

results of univariate analysis were checked to select the variables that have a statistically significant association with the outcome – receiving medication to treat ADHD. The univariate analysis was performed for both age groups 3-17 years old (without physical activity and length of sleep variables) and 6-17 years old with all variables chosen as probable confounders. It showed that special services ($p = .292$ and $p = .165$ for age groups 3-17 y.o. and 6-17 y.o. correspondingly), physical activity ($p = .071$) and hours of sleep ($p = .254$) along with poverty level for 6-17 y.o. group ($p = .143$) should be excluded from the analysis as these variables did not show a statistically significant association with the outcome variable. Other covariates should be included in the model (Table D2) as each of them had a statistically significant ($p < .05$) association with the outcome variable of receiving medication to treat ADHD.

Before running the models adjusted for probable confounders the assumptions of logistic regression were proved. Testing the variables for fitting logistic regression assumptions revealed only one outlier with a standardized residual value higher than 3 standard deviations, however, it was left in the analysis as the deviation was only 3.05 SD and did not influence the regression results. For model 2 (with two additional independent covariates) there were no outliers detected.

The results of stepwise logistic regression analysis showed that sex ($p = .114$ for 3-17 y.o. group and p = .158 for 6-17 y.o. group) and special education ($p = .500$ and $p = .333$ correspondingly) did not have statistically significant effect on receiving medication to treat ADHD, and therefore these variables were excluded from the final model (Table 11). The final models presented in Tables 5.2 and 5.3 included only the

covariates that had statistically significant effect on receiving medication for ADHD treatment.

Both models were statistically significant as assessed by omnibus test ($\chi^2(22) = 319.7$, $p < .0005$ for model 2.1 and $\chi^2(21) = 241.6$, $p < .0005$ for model 2.2). However, the total variance explained by the models assessed by Nagelkerke R^2 was exceptionally low, reaching only 9.1% for model 2.1 and 7.3% for model 2.2. These values were in line with the relatively low classification quality, with 63.6% of the cases being correctly classified by model 2.1 and 63.4% by model 2.2.

Table 11

Logistic Regression Results for Checking the Relationship Between Race and Receiving Medication to Treat ADHD (Model 2.1, Ages 3-17, Adjusted for Covariates)

	Unadjusted OR	Adjusted OR	95% CI for Odds ratio		
			Lower	Upper	*p*
Race					< .001*
Hispanic	.649	.638	.520	.784	< .001*
Black	.894	.899	.698	1.158	.409
Other/Multi	.837	.820	.664	1.013	.065

Note. White is the reference category. Sociodemographic variables included in the model: age, insurance, time spent watching TV, time with computer, poverty level.

*$p < .05$.

Considering that both models were statistically significant, they can be used to investigate the relationship between race and receiving medication for ADHD. There was a statistically significant ($p < .001$) relationship between race and receiving ADHD medication, both among children 3-17 years old and among 6-17 years old when also adjusted for the covariates) (Tables 11 and 12).

Table 12

Logistic Regression Results for Checking the Relationship Between Race and Receiving Medication to Treat ADHD (Model 2.2, Ages 6-17, Adjusted for Covariates)

	Unadjusted OR	Adjusted OR	95% CI for Odds ratio		
			Lower	Upper	*p*
Race					< .001*
Hispanic	.663	.644	.522	.795	< .001*
Black	.923	.884	.684	1.142	.345
Other/Multi	.859	.809	.652	1.003	.054

Note. White is the reference category. Sociodemographic variables included in the model: age, insurance, time spent watching TV, time with computer.

*$p < .05$.

The results of both models for both age groups showed similar results with Hispanic children being less likely ($OR = .638$, p <.001 and $OR = .644$, $p < .001$) to receive medication for ADHD treatment compared with White, non-Hispanic children. These results prove there was an association between race and receiving medication to treat ADHD, the null hypothesis of no association should be rejected ($p < .001$ for the race as an independent predictor in both models) and the association was significant and the unadjusted ratio shows that here was a positive association with race and a lower odds of receiving medication for ADHD treatment after adjusting for age, gender, attributes of the child and socioeconomic status. Once again, the association was only significant with Hispanic not Black children.

Research question 3. Is there an association between race and receiving behavioral treatment for ADHD after adjusting for age, gender, attributes of the child and socioeconomic status? Null hypothesis (Ho3): There is no association between receiving

behavioral treatment for ADHD and race. Alternative hypothesis (H_a3): There is an association between receiving behavioral treatment for ADHD and race.

First, the cases included in the analysis were tested for outliers and there were 17 outlying cases revealed with a standardized residual value higher than 3 standard deviations. The decision was made to exclude these cases from the analysis as they did not affect the total sample size in a significant way (they accounted for no more than 0.5% of all the cases included in the analysis) but exclusion increased the quality of the model as assessed by Nagelkerke R^2. Like the previous research questions, the first models without any covariates were constructed to estimate the unadjusted OR (Table 13).

Table 13

Logistic Regression Results for Checking the Relationship Between Race and Receiving Behavioral Treatment for ADHD: Unadjusted Models for Ages 3-17 and Ages 6-17.

	Odds ratio	95% CI for Odds ratio		*p*
		Lower	Upper	
Ages 3-17				
Race [a]				< .001*
Hispanic	1.091	.899	1.324	.380
Black	1.553	1.234	1.954	< .001*
Other/Multi	1.289	1.056	1.573	.013*
Ages 6-17				
Race [a]				.001*
Hispanic	1.073	.876	1.314	.496
Black	1.491	1.176	1.891	.001*
Other/Multi	1.292	1.052	1.587	.015*

[a] White is the reference category.

*$p < .05$.

The quality of the models was assessed by an omnibus test that showed both modes to be statistically significant ($\chi2(3) = 18.681$, $p < .0005$ and $\chi2(3) = 15.386$, $p = .002$). However, the dependent variable variance explained by the models was very low and was no more than 5% (Nagelkerke R^2 was equal to 0.05 for both models), with 57.6% (for model based on age 3-17) and 57.9% (for model based on age 6-17) of correctly classified cases. Therefore, including the covariates was a way to improve the overall model quality and provided more reliable results on the association between ADHD treatment and race.

The results of both unadjusted models showed that there was a statistically significant relationship between receiving behavioral treatment for ADHD and race ($p < .01$). Specifically, Black ($OR = 1.553$, $p < .001$ within 3-17 age group and $OR = 1.491$, $p = .001$ within 6-17 y.o. age group.) and Other/Multiracial children ($OR = 1.289$, $p = .013$ within 3-17 age group and $OR = 1.292$, $p = .015$ within 6-17 y.o. age group.) are more likely to receive behavioral treatment for ADHD compared with White children.

Then, to construct adjusted models, the covariates selected were checked for fitting the criteria of being a probable confounder. The univariate analysis was performed for both age groups 3-17 years old (without physical activity and length of sleep variables) and 6-17 years old with all variables chosen as probable confounders. It showed that time watching TV ($p = .538$ and $p = .512$ for age groups 3-17 y.o. and 6-17 y.o. correspondingly) along with sex ($p = .055$) and physical activity ($p = .217$) for 6-17 y.o. group should be excluded from the analysis as these variables did not show a statistically significant association with the outcome variable. Other covariates may be

included in the model (Table D3) as they had statistically significant ($p < .05$) association with the outcome variable of receiving behavioral treatment for ADHD.

The results of stepwise logistic regression analysis showed that sex ($p = .219$ for 3-17 y.o. group and $p = .320$ for 6-17 y.o. group), time spent by the computer ($p = .316$ and $p = .385$ correspondingly) and poverty level ($p = .396$ and $p = .502$ correspondingly) did not have statistically significant effect on receiving behavioral treatment for ADHD, and therefore these variables were excluded from the final model. The final models presented in Tables 14 and 15 included only the covariates that had statistically significant effect on receiving behavioral treatment for ADHD treatment.

After adjusting for chosen covariates, both models appeared to be statistically significant as assessed by omnibus test ($\chi^2(11) = 1056.9$, $p < .0005$ for model 3.1 and $\chi^2(16) = 1033.2$, $p < .0005$ for model 3.2). The total variance explained by the models assessed by Nagelkerke $R^2$was similar for both models with 27.8% for model 3.1 and 28.5% for model 3.2. Similarly, the classification quality was 69.9%, the cases being correctly classified in model 3.1 and 69.8% in model 3.2.

The association between race and likelihood of receiving behavioral treatment for ADHD was at the borderline of significance ($p = .040$) when examined among children 3-17 and was not significant in the model for older children also adjusted for length of sleep ($p = .058$) (Tables 6.2 and 6.3). In-depth look at the effect of race on the chance of receiving a behavioral treatment for ADHD after adjusting for covariates showed that, for both age groups, Black children have a higher chance to receive such therapy (*OR* =

1.433, $p = .008$ for age group of 3-17 and $OR = 1.422$, $p = .013$ for age group 6-17) compared with White children.

Table 14

Logistic Regression Results for Checking the Relationship Between Race and Receiving Behavioral Treatment for ADHD (Model 3.1, Ages 3-17, Adjusted for Covariates)

	Unadjusted OR	Adjusted OR	95% CI for Odds ratio		
			Lower	Upper	*p*
Race					.043*
Hispanic	1.091	.945	.756	1.182	.622
Black	1.553	1.420	1.087	1.855	.010*
Other/Multi	1.289	1.141	.908	1.432	.257

Note. White is the reference category. Sociodemographic variables included in the model: age, special education, special services, insurance.

*$p < .05$.

Table 15

Logistic Regression Results for Checking the Relationship Between Race and Receiving Behavioral Treatment for ADHD (Model 3.2, Ages 6-17, Adjusted for Covariates)

	Unadjusted OR	Adjusted OR	95% CI for Odds ratio		
			Lower	Upper	*p*
Race					.082
Hispanic	1.073	.975	.774	1.229	.832
Black	1.491	1.391	1.053	1.836	.020*
Other/Multi	.914	1.156	.914	1.462	.227

Note. White is the reference category. Sociodemographic variables included in the model: age, special education, special services, insurance, length of sleep.

*$p < .05$.

The results of this analysis allow rejecting the null hypothesis only for the first model, while within the second model the null hypothesis of no association was proved by the analysis. Taking into account age was a significant predictor in both models

($p < .001$, Tables A4 and A5) it can be concluded that the association between race and likelihood of receiving behavioral treatment exists only among all children as a whole, while the association weakens when older age groups are considered for the analysis. This allows giving a positive answer to the third research question only for children aged 3 to 17.

Research Question 4. Is there an association between race and receiving alternative health care or treatment for ADHD after adjusting for age, gender, attributes of the child and socioeconomic status? Null hypothesis (Ho4): There is no association between receiving alternative health care or treatment for ADHD and race. Alternative hypothesis (H_a4): There is an association between receiving alternative health care or treatment for ADHD and race.

Testing the variables for fitting logistic regression assumptions revealed 92 outliers with a standardized residual value higher than 3 standard deviations for the first model and 84 outliers for the second one. The decision was made to exclude these cases (that accounted to no more than 2% of the sample) as it led to increase in overall variance explained by the model and improved the share of correctly classified cases. Before investigating the research question, the models without any covariates were constructed to estimate the unadjusted OR (Table 16).

The quality of the models was assessed using omnibus test. The test showed that both modes were statistically significant ($\chi2(3) = 26.314$, $p < .0005$ and $\chi2(3) = 24.686$, $p < .0005$). However, the dependent variable variance explained by the models was very low and reached no more than 1.1% (Nagelkerke R^2 was equal to 0.011 for both models),

with 88.3% (for model based on age 3-17) and 88.1% (for model based on age 6-17) of correctly classified cases. Therefore, including the covariates was worthwhile to improve the overall model quality and provide more reliable results to test the association between race and receiving alternative health care or treatment for ADHD.

Table 16

Logistic Regression Results for Checking the Relationship Between Race and Receiving Alternative Health Care to Treat ADHD: Unadjusted Models for Ages 3-17 and Ages 6-17

	Odds ratio	95% CI for Odds ratio		*p*
		Lower	Upper	
Ages 3-17				
Race[a]				< .001*
Hispanic	.594	.414	.851	.004*
Black	.438	.269	.713	.001*
Other/Multi	1.273	.959	1.689	.095
Ages 6-17				
Race[a]				< .001*
Hispanic	.597	.410	.869	.007*
Black	.471	.289	.767	.002*
Other/Multi	1.351	1.016	1.797	.039*

[a] White is the reference category

*$p < .05$.

The results of both unadjusted models showed that there was a statistically significant relationship between receiving alternative health care or treatment for ADHD and race (p <.001). Specifically, Hispanic (OR = 0.594, p =.004 within 3-17 age group and OR = 0.597 , p = .007 within 6-17 y.o. age group.) and Black (OR = 0.438, p = .001 within 3-17 age group and OR = 0.471, p = .002 within 6-17 y.o. age group.) had a lower chance to receive alternative health care for ADHD compared with White children. In the

older age group, Other/Multiracial children (*OR* = 1.351, *p* = .039.) are more likely to receive alternative treatment for ADHD compared with White children.

To construct adjusted models, the covariates were checked for fitting the criteria of being a probable confounder. Univariate analyses were performed for both age groups 3-17 years old and 6-17 years old with all variables chosen as probable confounders. It showed that almost all the covariates (except sex for 6-17 y.o. age group, *p* = .115) should be included in the model having a statistically significant relationship with the outcome variable - receiving alternative treatment for ADHD (Table D6).

The results of stepwise logistic regression analysis showed that special education (*p* = .430) within 3-17 y.o. model did not have statistically significant effect on receiving alternative treatment for ADHD, and therefore this variable was excluded from the final model. The final models presented in Tables 17 and 18 included only the covariates that had statistically significant effect on receiving alternative treatment for ADHD treatment.

Both adjusted models appeared to be statistically significant as assessed by omnibus test ($\chi^2(24) = 266.5$, $p < .0005$ for model 4.1 and $\chi^2(32) = 263.1$, $p < .0005$ for model 4.2). The total variance explained by the models assessed by Nagelkerke R^2 was rather low for the first model, explaining 11.3% of the variance, while the second model explained 11.6% of the variance. Similarly, the classification quality was 88.3% of the cases being correctly classified by model 4.1 and 88.1% by model 4.2.

Table 17

Logistic Regression Results for Checking the Association Between Race and Receiving Alternative Treatment for ADHD (Model 4.1, Ages 3-17, Adjusted for Covariates)

	Unadjusted OR	Adjusted OR	95% CI for Odds ratio		
			Lower	Upper	*p*
Race					.001*
Hispanic	.594	.626	.428	.915	.016*
Black	.438	.504	.297	.857	.011*
Other/Multi	1.273	1.284	.953	1.732	.101

Note. White is the reference category. Sociodemographic variables included in the model: gender, age, special services, insurance, time spent watching TV, time with computer, poverty level.

*$p < .05$.

Table 18

Logistic Regression Results for Checking the Association Between Race and Receiving Alternative Treatment for ADHD (Model 4.2, Ages 6-17, Adjusted for Covariates)

	Unadjusted OR	Adjusted OR	95% CI for Odds ratio		
			Lower	Upper	*p*
Race					.001*
Hispanic	.597	.664	.448	.983	.041*
Black	.471	.523	.307	.890	.017*
Other/Multi	1.351	1.462	1.083	1.974	.013*

Note. White is the reference category. Sociodemographic variables included in the model: age, special education, special services, insurance, time spent watching TV, time with computer, poverty level, physical activity, length of sleep.

*$p < .05$.

The results of logistic regression analysis showed there was a statistically significant relationship between race and the likelihood of receiving alternative treatment for ADHD in both models ($p = .001$). In both models Hispanic and Black children had a lower chance of receiving alternative treatment for ADHD compared with White

children. For Hispanic the *OR*s were *OR* = .626, *p* = .016 for age group 3-17 and *OR* = .664, *p* = .041 for age group 6-17; for Black children the chances were almost twice lower than for White – *OR* = .504, *p* = .011 for age group 3-17 and *OR* = .523, *p* = .017 for age group 6-17.

The results of the analysis showed that there was a statistically significant association between race and the likelihood of receiving alternative help. Therefore, the null hypothesis should be rejected (*p* = .001) and the association was significant, and the adjusted odds ratio showed that there was a positive association with race and a lower odds of receiving alternative treatment for ADHD.

Research Question 5. Is there an association between race and receiving combined treatment for ADHD after adjusting for age, gender, attributes of the child and socioeconomic status? Null hypothesis (Ho5): There is no association between receiving combined treatment for ADHD and race. Alternative hypothesis (H_a5): There is an association between receiving combined treatment for ADHD and race.

Similar to the previous analysis, the data were first checked for outliers and 71 cases for the first models (3-17 years old, without controlling for physical activity and length of sleep) and 62 for the second models (6-17 years old, controlling for physical activity and length of sleep) were excluded from further analysis. As in previous regression analyses, this led to an improvement in explained variance but lowered the p-value of the Hosmer-Lemeshow test.

First, the unadjusted models were constructed to conduct further comparison for the adjusted ones (Table 19). The quality of the models was assessed using omnibus test

which showed both modes to be statistically significant ($\chi2(3) = 9.476$, p =.024 and $\chi2(3) = 7.942$, p .047), although the second one showed a borderline p-value. However, the dependent variable variance explained by the models was extremely low and reached no more than 0.3% (Nagelkerke R^2 was equal to 0.003 for both models); with 71.5% (for model based on age 3-17) and 71.2% (for model based on age 6-17) of correctly classified cases. Therefore, including the covariates was necessary to improve the overall model quality and provide more reliable results testing the association between race and receiving alternative health care or treatment for ADHD.

Table 19

Logistic Regression Results for Checking the Relationship Between Race and Receiving Combined Treatment for ADHD: Unadjusted Models for Ages 3-17 and Ages 6-17.

	Odds ratio	95% CI for Odds ratio		*p*
		Lower	Upper	
Ages 3-17				
Race[a]				.021*
Hispanic	.964	.775	1.198	.739
Black	1.428	1.120	1.819	.004*
Other/Multi	1.148	.923	1.428	.215
Ages 6-17				
Race[a]				.043*
Hispanic	.956	.762	1.199	.699
Black	1.399	1.088	1.798	.009*
Other/Multi	1.136	.907	1.422	.267

[a] White is the reference category.

*$p < .05$.

The results of both unadjusted models showed that there was a statistically significant relationship between receiving alternative health care or treatment for ADHD

and race (p = .021 in the model for age group 3-17 and p = .043 for the age group 6-17). In both models, Black children had a higher chance to receive combined treatment for ADHD compared with White children OR = 1.428, p =.004 and OR = 1.399, p = .009 correspondingly).

Univariate analysis was performed for both age groups 3-17 years old and 6-17 years old with all variables chosen for adjustment to check them for fitting the criteria of being a probable confounder. It showed that almost all the covariates (except time watching TV for both 3-17 y.o. and for 6-17 y.o. age groups, p = .676 and p = .297 correspondingly) should be included in the model having a statistically significant relationship to the outcome variable - receiving combined treatment for ADHD (Table D7).

The results of stepwise logistic regression analysis showed that time spent by the computer (p = .100 within 3-17 y.o. model and p = 170 within 6-17 y.o. model), poverty level (p = .203 within 3-17 y.o. model and p = 419 within 6-17 y.o. model) and physical activity in 6-17 y.o. model (p = .652) did not have statistically significant effect on receiving combined treatment for ADHD, and therefore these variables were excluded from the final model. The final models presented in Tables 20 and 21 included only the covariates that had statistically significant effect on receiving combined treatment for ADHD.

Table 20

Logistic Regression Results for Checking the Association Between Race and Receiving Combined Treatment for ADHD (Model 5.1, Ages 3-17 and Model 5.2, Ages 6-17, Adjusted for Covariates)

	Unadjusted OR	Adjusted OR	95% CI for Odds ratio		
			Lower	Upper	*p*
Model 5.1 (age 3-17)					
Race					.032*
Hispanic	.964	.825	.644	1.055	.125
Black	1.428	1.407	1.061	1.865	.018*
Other/Multi	1.148	1.010	.791	1.289	.937
Model 5.2 (age 6-17)					
Race					.137
Hispanic	.956	.856	.664	1.103	.229
Black	1.399	1.317	.984	1.762	.064
Other/Multi	1.136	.963	.750	1.237	.771

Note. White is the reference category. Sociodemographic variables included in the models: 5.1: gender, age, special education, special services, insurance. Sociodemographic variables included in the model 5.2: gender, age, special education, special services, insurance, length of sleep.

*$p < .05$.

Both models were statistically significant as assessed by omnibus test ($\chi^2(17) = 980.4$, $p < .0005$ for model 5.1 and $\chi^2(10) = 929.5$, $p < .0005$ for model 5.2). The total variance explained by the models assessed by Nagelkerke R^2 reached almost a third, with 28.2% of the variance for the first model. The second model showed similar results reaching a level of 27.9% of explained variance. Similarly, the classification quality was 72.7% of the cases being correctly classified by model 5.1 and 72.5% by model 5.2.

Considering that both models were statistically significant, they can be used to investigate the relationship between race and receiving combined treatment for ADHD. There was a statistically significant ($p = .032$) association between the likelihood of

receiving combined treatment for ADHD and race only for the overall sample of all 3-17 years old children without controlling for physical activity and length of sleep. The second model for older children (6-17 y.o.) showed no association (p = .137); Table 20). The difference in the chances to receive combined help for ADHD between children of different race revealed that Black children have a higher chance to receive such help compared to White children (OR = 1.407, p = .018).

These results were similar to those received when analyzing the association between race and the likelihood of receiving behavioral treatment for ADHD. The results of this analysis allow a rejection of the null hypothesis only for the first model, while within the second one the null hypothesis of no association was proved by the analysis. Taking into account age was a significant predictor in both models ($p < .001$, Tables D14 and D15) it can be concluded that the association between race and likelihood of receiving combined treatment exists only among all children as a whole, while it gets weaker when only older age groups are considered for the analysis.

The next four research questions consecrate on investigating the association between race and ADHD treatment based on ADHD severity. To find an answer to these questions a variable indicating an interaction between severity of ADHD and children's race was used. The comparisons were performed between different race and reference group (White children) within each severity group.

Research Question 6. Is there an association between race and receiving medication treatment based on ADHD severity after adjusting for age, gender, attributes of the child and socioeconomic status? Null hypothesis (Ho6): There is no association

between receiving medication to treat ADHD and race based on ADHD severity. Alternative hypothesis (H_a6): There is an association between receiving medication to treat ADHD and race based on ADHD severity.

Testing the variables for fitting logistic regression assumptions revealed 12 outliers with a standardized residual value higher than 3 standard deviations for the first model and 9 outliers for the second one. Taking into account the relatively small number of outliers the decision was made to exclude these cases as it led to an increase in overall variance explained by the model and improved the share of correctly classified cases.

The first two models unadjusted for any covariates were constructed to serve as baseline for further comparison (Table 21). The quality of the models was assessed using omnibus test that showed both modes to be statistically significant ($\chi2(11) = 321.298$, $p < .001$, and $\chi2(11) = 308.559$, $p < .001$). However, the dependent variable variance explained by the models was rather low and reached around 10% (Nagelkerke R^2 was equal to 0.102 for model constructed within 3-17 age group and 0.104 for 6-17 age group), with 66.5% (for model based on age 3-17) and 67.1% (for model based on age 6-17) of correctly classified cases.

The results of both unadjusted models showed that there was a statistically significant relationship between race and likelihood of receiving ADHD medication based on ADHD severity ($p < .001$). However, for both models, the differences were revealed within Mild severity group where Hispanic, Black and Other/Multiracial children had a lower chance of receiving medication for ADHD compared with White children ($OR = .641$, $p = .005$ and $OR = .675$, $p = 017$ for Hispanic children in models

constructed for age group 3-17 and 6-17 correspondingly; *OR* = .546, *p* = .005 and *OR* = .605, *p* = 025 for Black children and *OR* = .695, *p* = .026 and *OR* = .705, *p* = 036 for Other/Multiracial children, respectively). Within moderate severity group, only Hispanic children differed from White, having an almost twice lower chance of receiving medication for ADHD (*OR* = .565, *p* = .001 and *OR* = .586, *p* = 003, respectively).

Table 21

Logistic Regression Results for Checking the Association Between Race and Receiving Medication for ADHD Based on the Severity Level: Unadjusted Models for Ages 3-17 and Ages 6-17.

			95% CI for Odds ratio		
		Odds ratio	Lower	Upper	*p*
Ages 3-17					
Race by Severity					< .001*
Mild	Hispanic	.641	.470	.873	.005*
	Black	.546	.356	.836	.005*
	Other/Multi	.695	.504	.958	.026*
Moderate	Hispanic	.565	.406	.786	.001*
	Black	.727	.491	1.076	.111
	Other/Multi	.808	.575	1.137	.222
Severe	Hispanic	.561	.279	1.127	.105
	Black	1.052	.467	2.368	.903
	Other/Multi	1.777	.607	5.203	.294
Ages 6-17					
Race by Severity					< .001*
Mild	Hispanic	.675	.489	.932	.017*
	Black	.605	.390	.938	.025*
	Other/Multi	.705	.508	.977	.036*
Moderate	Hispanic	.586	.413	.832	.003*
	Black	.749	.496	1.132	.170
	Other/Multi	.850	.591	1.224	.383
Severe	Hispanic	.539	.254	1.143	.107
	Black	.889	.390	2.026	.780
	Other/Multi	2.089	.616	7.083	.237

Note. White is the reference category within each severity group.

*$p < .05$.

The next step of the analysis was to construct adjusted models including all statistically significant covariates. Taking into account the results of univariate analysis investigating the association between covariates and outcome variable measuring presence of medication (or other treatment when studying further research questions) the list of probable confounders included only variables having a statistically significant impact on outcome variable. For the models investigating the association between race and receiving medication treatment based on ADHD severity the variables indicating special services, physical activity and hours of sleep, along with poverty level for 6-17 y.o. group should be excluded from the analysis as these variables did not showed a statistically significant association with the outcome variable (Table D4).

The results of stepwise logistic regression analysis showed that gender (p = .239 within 3-17 y.o. model and p = 265 within 6-17 y.o. model), did not have statistically significant effect on receiving medication for ADHD, and therefore this variable was excluded from the final models. The final models presented in tables 9.2 and 9.3 included only the covariates that had statistically significant effect on receiving medication for ADHD.

Both models (Tables 22 and 23) were statistically significant as assessed using omnibus test ($\chi^2(31) = 548.6$, $p < .0005$ for model 6.1 and $\chi^2(30) = 426.0$, $p < .0005$ model 6.2). The total variance explained by the models assessed by Nagelkerke R^2 reached almost fifth, with 17.4% for the first model and 14.4% for the second model. Similarly, the classification quality was 68.3% of the cases being correctly classified in both models. Considering both models were significant and fit all the assumptions of

adequate regression model they can be used to investigate the relationship between race and receiving medication treatment based on ADHD severity. To run this analysis a new variable indicating interaction between ADHD severity and the race was used.

The results showed that this variable was one of the significant predictors of receiving medication treatment ($p < .001$). The comparisons of children of different races aged 3-17 years old were done within each severity group. The results (Table 9.2) showed that within mild and moderate severity of ADHD, Hispanic children have lower chance of receiving medication for ADHD compared with White children (*OR* = .683, $p = .021$ within mild severity and *OR* = .633, $p = .011$ within moderate severity group).

Table 22

Logistic Regression Results for Checking the Association Between Race and Receiving Medication for ADHD Based on the Severity Level (Model 6.1, Ages 3-17, Adjusted for Covariates)

		Unadjusted OR	Adjusted OR	95% CI for Odds ratio		
				Lower	Upper	*p*
Race by Severity						< .001*
Mild	Hispanic	.641	.683	.494	.944	.021*
	Black	.546	.644	.411	1.010	.055
	Other/Multi	.695	.723	.518	1.009	.057
Moderate	Hispanic	.565	.633	.446	.900	.011*
	Black	.727	.825	.540	1.259	.371
	Other/Multi	.808	.903	.628	1.298	.581
Severe	Hispanic	.561	.530	.246	1.141	.105
	Black	1.052	1.006	.436	2.320	.990
	Other/Multi	1.777	2.350	.659	8.385	.188

Note. White is the reference category within each severity group. Sociodemographic variables included in the model: age, special education, insurance, time spent watching TV, time with computer, poverty level.

*$p < .05$.

The next model was constructed for the age group of 6-17 that contained information regarding physical activity and length of sleep (Table 9.3). The results were in line with previous model proving that there was a relationship between race and receiving medication for ADHD based on the severity level of the illness ($p < .001$). Detailed analysis revealed that within mild ADHD severity, Hispanic ($OR = .660$, $p = .013$), Black ($OR = .625$, $p = .042$) and Other/Multiracial ($OR = .697$, p = .034) children had a lower chance of receiving a medication compared with White children. Within moderate severity, only Hispanic children showed a lower chance of receiving medication ($OR = 615$, $p = .009$) compared with White children.

Table 23

Logistic Regression Results for Checking the Association Between Race and Receiving Medication for ADHD Based on the Severity Level (Model 6.2, Ages 6-17, Adjusted for Covariates)

		Unadjusted OR	Adjusted OR	95% CI for Odds ratio		
				Lower	Upper	*p*
Race by Severity						< .001*
Mild	Hispanic	.675	.660	.475	.917	.013*
	Black	.605	.625	.398	.982	.042*
	Other/Multi	.705	.697	.499	.973	.034*
Moderate	Hispanic	.586	.615	.427	.884	.009*
	Black	.749	.733	.477	1.128	.158
	Other/Multi	.850	.871	.599	1.267	.470
Severe	Hispanic	.539	.570	.256	1.271	.169
	Black	.889	.830	.359	1.919	.663
	Other/Multi	2.089	3.038	.698	13.218	.139

Note. White is the reference category within each severity group. Sociodemographic variables included in the model: age, special education, insurance, time spent watching TV, time with computer.

*$p < .05$.

The results of the regression analysis for the current research question showed there was a statistically significant difference between race and likelihood of receiving ADHD medication based on ADHD severity ($p < .05$). The appropriate null hypothesis can be rejected, the association was significant, and the adjusted odds ratio showed that there was a positive association with race and lower odds of receiving ADHD medication based on ADHD severity.

Research Question 7. Is there an association between race and receiving behavior treatment based on ADHD severity after adjusting for age, gender, attributes of the child and socioeconomic status? Null hypothesis (Ho7): There is no association between receiving behavioral treatment for ADHD and race based on ADHD severity. Alternative hypothesis (H_a7): There is an association between receiving behavioral treatment for ADHD and race based on ADHD severity.

Similar to previous analysis the data were first checked for outliers and 10 cases for the first model (3-17 years old, without controlling for physical activity and length of sleep) along with 15 cases for the second models (6-17 years old, controlling for physical activity and length of sleep) were excluded from further analysis. As in previous regression analyses, this led to an improvement in explained variance.

The unadjusted models were calculated first for both age groups (Table 24). The quality of the models was assessed using omnibus test which showed that both modes are statistically significant ($\chi2(11) = 303.019$, $p < .001$, and $\chi2(11) = 289.279$, $p < .001$). However, the proportion of the variance of the dependent variable explained by the models was rather low and was just 9.4% (Nagelkerke R^2 was equal to 0.094 for both

models), with 61.4% (for model based on age 3-17) and 61.5% (for model based on age 6-17) of correctly classified cases.

Table 24

Logistic Regression Results for Checking the Association Between Race and Receiving Behavioral Treatment Based on ADHD Severity Level: Unadjusted Models for Ages 3-17 and Ages 6-17.

			95% CI for Odds ratio		
		Odds ratio	Lower	Upper	*p*
Ages 3-17					
Race by Severity					< .001*
Mild	Hispanic	.862	.617	1.203	.382
	Black	1.026	.657	1.601	.910
	Other/Multi	1.151	.823	1.609	.412
Moderate	Hispanic	1.443	1.050	1.982	.024*
	Black	1.512	1.052	2.173	.026*
	Other/Multi	1.495	1.097	2.038	.011*
Severe	Hispanic	.856	.463	1.583	.620
	Black	3.209	1.324	7.777	.010*
	Other/Multi	.827	.424	1.614	.578
Ages 6-17					
Race by Severity					< .001*
Mild	Hispanic	.794	.557	1.132	.203
	Black	.859	.531	1.388	.534
	Other/Multi	1.161	.825	1.632	.392
Moderate	Hispanic	1.431	1.027	1.992	.034*
	Black	1.477	1.015	2.148	.042*
	Other/Multi	1.453	1.053	2.005	.023*
Severe	Hispanic	.878	.459	1.681	.695
	Black	3.073	1.261	7.488	.013*
	Other/Multi	.979	.487	1.971	.953

Note. White is the reference category within each severity group.

*$p < .05$.

The results of both unadjusted models showed that there was statistically significant relationship between race and likelihood of receiving behavioral treatment for ADHD based on severity level of the disease ($p < .001$). For both models, the differences were revealed only within Moderate and Severe groups. Within moderate level ADHD group, all ethnic groups of children (Hispanic, Black and Other/Multi) had a higher chance of receiving behavioral treatment for ADHD compared with White children (within 3-17 age group $OR = 1.443$, $p = .024$ for Hispanic, $OR = 1.512$, $p = .026$ for Black and $OR = 1.495$, p = .011 for Other/Multiracial; within 6-17 age group $OR = 1.431$, $p = .034$ for Hispanic, $OR = 1.477$, $p = .042$ for Black and $OR = 1.453$, $p = .023$ for Other/Multiracial). Among children with severe ADHD, Black children have higher chance of receiving behavioral treatment compared with White children ($OR = 3.209$, $p = .010$ for 3-17 age group and $OR = 3.073$, $p = .013$ for 6-17 age group).

Considering the results of univariate analysis performed for research question 3, the variables time watching TV, sex for both models and physical activity for 6-17 y.o. group should be excluded from the analysis as these variables did not showed a statistically significant association with the outcome variable (all $p > .05$, Table D7). The results of stepwise logistic regression showed that after including covariates as shown by univariate analysis, the variables indicating time with the computer and poverty appeared to be statistically insignificant ($p = .721$ and $p = .211$, respectively) and were also excluded from the model constructed for 3-17 y.o. children group. Similarly, for 6-17 y.o. model, the same covariates were excluded due to having insignificant effect on the outcome variable ($p = .639$ and $p = .372$, respectively).

Both adjusted models were statistically significant as assessed by omnibus test ($\chi^2(19) = 984.2$, $p < .0005$ for model 7.1 and $\chi^2(24) = 974.1$, $p < .0005$ for model 7.2). The total variance explained by the models assessed by Nagelkerke R^2 exceeded a fourth with 28.7% for the first model and 29.8% for the second model. Similarly, the classification quality was 69.8% of the cases being correctly classified in model 7.1 and 69.9% in model 7.2. To investigate the relationship between race and receiving behavioral treatment based on ADHD severity a new variable indicating interaction between ADHD severity and the race was used.

The results showed that this variable was one of the significant predictors of receiving behavioral treatment ($p < .001$). The comparisons of children of different races aged 3-17 years old were done within each severity group. The results (Table 25) showed that within moderate and severe groups of ADHD only Black children have higher chance of receiving behavioral treatment for ADHD compared with White children (*OR* = 1.559, $p = .036$ within moderate group and *OR* = 3.396, $p = .011$ within severe group).

The next model was constructed for the age group of 6-17 that contained information regarding physical activity and length of sleep (Table 26). The results were in line with previous model, proving that there was a relationship between race and receiving medication for ADHD based on the severity level of the illness ($p < .001$). However, the comparison between ethnic groups showed only Black children with severe ADHD have a higher chance of receiving behavioral therapy for ADHD compared with White children with the same severity of ADHD (*OR* = 3.522, $p = .010$ correspondingly).

Table 25

Logistic Regression Results for Checking the Association Between Race and Receiving Behavioral Treatment for ADHD Based on the Severity Level (Model 7.1, Ages 3-17, Adjusted for Covariates)

		Unadjusted OR	Adjusted OR	95% CI for Odds ratio		
				Lower	Upper	*p*
Race by Severity						< .001*
Mild	Hispanic	.862	.724	.497	1.053	.091
	Black	1.026	.987	.604	1.613	.959
	Other/Multi	1.151	1.044	.721	1.511	.821
Moderate	Hispanic	1.443	1.339	.942	1.902	.103
	Black	1.512	1.559	1.029	2.363	.036*
	Other/Multi	1.495	1.349	.956	1.905	.088
Severe	Hispanic	.856	.837	.417	1.678	.616
	Black	3.209	3.396	1.328	8.682	.011*
	Other/Multi	.827	.708	.342	1.465	.352

Note. White is the reference category within each severity group. Sociodemographic variables included in the model: age, special education, special services, insurance.

*$p < .05$.

Table 26

Logistic Regression Results for Checking the Association Between Race and Receiving Behavioral Treatment for ADHD Based on the Severity Level (Model 7.2, Ages 6-17, Adjusted for Covariates)

		Unadjusted OR	Adjusted OR	95% CI for Odds ratio		
				Lower	Upper	*p*
Race by Severity						< .001*
Mild	Hispanic	.794	.706	.478	1.045	.082
	Black	.859	.911	.539	1.540	.728
	Other/Multi	1.161	1.017	.696	1.486	.930
Moderate	Hispanic	1.431	1.381	.955	1.997	.086
	Black	1.477	1.515	.984	2.332	.059
	Other/Multi	1.453	1.344	.940	1.922	.105
Severe	Hispanic	.878	.908	.440	1.874	.793
	Black	3.073	3.522	1.353	9.170	.010*
	Other/Multi	.979	.893	.413	1.931	.774

Note. White is the reference category within each severity group. Sociodemographic variables included in the model: age, special education, special services, insurance, length of sleep.

*$p < .05$.

Stable and consistent throughout different models results along with high values of Wald statistics prove there was an association between race and behavioral treatment for ADHD within different ADHD severity groups. The association was significant, and the adjusted odds ratio showed that there was a positive association with race and having lower odds of receiving behavioral treatment for ADHD based on severity of symptoms.

Research Question 8. Is there an association between race and receiving alternative health care or treatment based on ADHD severity after adjusting for age, gender, attributes of the child and socioeconomic status? Null hypothesis (Ho8): There is no association between receiving alternative health care or treatment for ADHD and race based on ADHD severity. Alternative hypothesis (H_a8): There is an association between receiving alternative health care or treatment for ADHD and race based on ADHD severity.

Checking for outliers performed before running logistic regression revealed 84 cases with standardized residual value outlying for more than 3 standard deviations for the first model and 73 for the second one. Considering exclusion of the outliers lead to improvement of model predictive power (assessed by Nagerkerke R^2 and the share of correctly classified cases) the decision was made to calculate the models without outliers.

The unadjusted models were calculated first for both age groups (Table 27). The quality of the models was assessed using omnibus test that showed both modes to be statistically significant ($\chi^2(11) = 60.1$, $p < .001$, and $\chi^2(11) = 54.8$, $p < .001$). However, the dependent variable variance explained by the models was low and did not exceed a

3% level (Nagelkerke R^2 was equal to 0.028 for model based on 3-17 age group and 0.027 for model based on 6-17 age group), with 88.1% (for model based on age 3-17) and 87.9% (for model based on age 6-17) of correctly classified cases.

Table 27

Logistic Regression Results for Checking the Association Between Race and Receiving Alternative Health Care or Treatment Based on ADHD Severity Level: Unadjusted Models for Ages 3-17 and Ages 6-17.

			95% CI for Odds ratio		
		Odds ratio	Lower	Upper	*p*
Ages 3-17					
Race by Severity					< .001*
Mild	Hispanic	.447	.231	.864	.017*
	Black	.083	.011	.599	.014*
	Other/Multi	.942	.562	1.579	.819
Moderate	Hispanic	.502	.259	.972	.041*
	Black	.682	.350	1.330	.261
	Other/Multi	1.982	1.330	2.952	.001*
Severe	Hispanic	1.087	.529	2.232	.820
	Black	.723	.325	1.611	.428
	Other/Multi	.708	.285	1.758	.457
Ages 6-17					
Race by Severity					< .001*
Mild	Hispanic	.446	.223	.891	.022*
	Black	.091	.013	.659	.018*
	Other/Multi	1.148	.704	1.871	.581
Moderate	Hispanic	.537	.277	1.044	.067
	Black	.643	.319	1.298	.218
	Other/Multi	1.920	1.270	2.903	.002*
Severe	Hispanic	1.114	.523	2.370	.780
	Black	.769	.343	1.726	.525
	Other/Multi	.846	.357	2.005	.705

Note. White is the reference category within each severity group.

*$p < .05$.

The results of both unadjusted models showed that there was a statistically significant relationship between race and likelihood of receiving alternative health care or treatment for ADHD based on severity level of the disease ($p < .001$). In both models, the differences were revealed only within Mild and Moderate groups. Within mild level of ADHD, Hispanic and Black children had a significantly lower chance of receiving alternative treatment compared with White children (within 3-17 age group $OR = .447$, $p = .017$ for Hispanic, $OR = .083$, $p = .014$ for Black; within 6-17 age group $OR = .446$, $p = .022$ for Hispanic, $OR = .091$, $p = .018$ for Black). For children aged 3-17 who have a moderate level of ADHD, Hispanic children have twice lower chance of receiving alternative treatment than White children ($OR = .502$, $p = .041$), however this is not true for older children. On the contrary Other/Multiracial children in both models have a higher chance to receive alternative treatment compared with White ($OR = 1.982$, $p = .001$ for 3-17 age group and $OR = 1.920$, $p = .002$ for 6-17 age group).

Taking into account results of univariate analysis performed for research question 4, almost all the covariates (except sex for 6-17 y.o. age group) should be included in the model, having statistically significant relationship with the outcome variable - receiving alternative treatment for ADHD (Table D10). The results of stepwise logistic regression showed that, after including covariates, tested using univariate analysis, the variables indicating presence of special education appeared to be statistically insignificant ($p = .430$ and $p = .125$ within models for 3-17 y.o. and 6-17 y.o. groups, correspondingly) and was also excluded from the constructed regression models.

Both adjusted models were statistically significant as assessed by omnibus test ($\chi^2(32) = 272.8$, $p < .0005$ for model 8.1 and $\chi^2(39) = 259.3$, $p < .0005$ for model 8.2. The total variance explained by the models assessed by Nagelkerke R^2 reached 12.9% for the first model and 12.7% for the second model. Similarly, the classification quality was 88.2% of the cases being correctly classified in model 8.1 and 87.9% in model 8.2. To investigate the relationship between race and receiving alternative treatment based on ADHD severity, a new variable indicating interaction between ADHD severity and the race was used.

The results showed this variable to be one of the significant predictors of receiving alternative treatment ($p < .001$). The comparisons of children of different nations aged 3-17 years old were done within each severity group. The results (Table 28) showed that within mild severity of ADHD, Hispanic children had more than twice lower chance to receive alternative treatment ($OR = .470$, $p = .028$) compared with White children. Similarly, within moderate severity group, Hispanic children had twice lower chance to receive alternative treatment ($OR = .490$, $p = .048$) compared with White children, while Other/Multiracial children had a higher chance to receive such treatment ($OR = 2.067$, $p = .001$) compared with White children.

The next model was constructed for the age group of 6-17 that contained information regarding physical activity and length of sleep (Table 29). The results were in line with the previous model but with less statistically significant differences. Within mild level of ADHD, Hispanic children had a lower chance of getting alternative treatment for ADHD compared with White children ($OR = .488$, $p = .047$). Within

moderate severity level group Other/Multiracial children had almost twice higher chance to get alternative treatment compared with White children (*OR* = 2.158, *p* = 001).

In both models, within severe level of ADHD, there were no statistically significant differences in access to alternative treatment.

The results of the analysis provided a positive answer to eighth research question stating there was an association between race and receiving alternative health care or treatment based on ADHD severity. Additionally, it can be noted that the difference between race groups was revealed only for mild and moderate ADHD levels.

Table 28

Logistic Regression Results for Checking the Association Between Race and Receiving Alternative Treatment for ADHD Based on the Severity Level (Model 8.1, Ages 3-17, Adjusted for Covariates)

		Unadjusted OR	Adjusted OR	95% CI for Odds ratio		
				Lower	Upper	*p*
Race by Severity						< .001*
Mild	Hispanic	.447	.470	.239	.921	.028*
	Black	.083	<.001	<.001	<.001	.996
	Other/Multi	.942	.977	.573	1.665	.931
Moderate	Hispanic	.502	.490	.241	.995	.048*
	Black	.682	.843	.408	1.742	.645
	Other/Multi	1.982	2.067	1.353	3.159	.001*
Severe	Hispanic	1.087	1.639	.730	3.682	.231
	Black	.723	1.003	.426	2.358	.995
	Other/Multi	.708	.627	.244	1.612	.332

Note. White is the reference category within each severity group. Sociodemographic variables included in the model: gender, age, special services, insurance, time watching TV, time with computer, poverty.

*$p < .05$.

Table 29

Logistic Regression Results for Checking the Association Between Race and Receiving Alternative Treatment for ADHD Based on the Severity Level (Model 8.2, Ages 6-17, Adjusted for Covariates)

		Unadjusted OR	Adjusted OR	95% CI for Odds ratio		
				Lower	Upper	*p*
Race by Severity						< .001*
Mild	Hispanic	.446	.488	.241	.990	.047*
	Black	.091	<.001	<.001	<.001	.997
	Other/Multi	1.148	1.231	.742	2.042	.421
Moderate	Hispanic	.537	.546	.269	1.111	.095
	Black	.643	.749	.349	1.608	.459
	Other/Multi	1.920	2.158	1.395	3.339	.001*
Severe	Hispanic	1.114	1.873	.831	4.222	.130
	Black	.769	1.045	.436	2.504	.921
	Other/Multi	.846	.797	.324	1.963	.622

Note. White is the reference category within each severity group. Sociodemographic variables included in the model: age, special services, insurance, time watching TV, time with computer, poverty, physical activity, length of sleep.

*$p < .05$.

Research Question 9. Is there an association between race and receiving combined treatment for ADHD severity after adjusting for age, gender, attributes of the child and socioeconomic status? Null hypothesis (Ho9): There is no association between receiving combined treatment for ADHD and race based on ADHD severity. Alternative hypothesis (H_a9): There is an association between receiving combined treatment for ADHD and race based on ADHD severity.

Similar to previous analysis, the data were first checked for outliers and 52 cases for the first model (3-17 years old, without controlling for physical activity and length of sleep) along with 44 cases for the second models (6-17 years old, controlling for physical

activity and length of sleep) were excluded from further analysis. As in previous regression analyses, this led to an improvement in explained variance.

The unadjusted models were constructed first for both age groups (Table 30). The quality of the models was assessed by an omnibus test that showed both modes were statistically significant ($\chi2(11) = 468.150$, $p < .001$, and $\chi2(11) = 442.736$, $p < .001$). However, the dependent variable variance explained by the models was not very high and reached the level of 15.1% (Nagelkerke R^2 was equal to 0.151 for both models) with 71.1% (for model based on age 3-17) and 70.8% (for model based on age 6-17) of correctly classified cases.

The results of both unadjusted models showed that there was a statistically significant relationship between race and likelihood of receiving combined treatment for ADHD based on severity level of the disease ($p < .001$). However, the differences between ethnic groups were not high. Within severe level of ADHD, Black children aged 3-17 had a higher chance of receiving combined treatment than White children (OR = 1.983, p = .039). In the second unadjusted model, the only difference revealed was in group with mild level of ADHD: namely Black children had a lower chance to receive combined treatment than White children (OR = .452, p = .048).

Based on the results of univariate analysis performed for research question 5, almost all the covariates (except time watching TV for both 3-17 y.o. and for 6-17 y.o. age groups) should be included in the model, having statistically significant relationship with the outcome variable - receiving combined treatment for ADHD (Table D13). The results of stepwise logistic regression showed that after including covariates, as shown

Table 30

Logistic Regression Results for Checking the Association Between Race and Receiving Combined Treatment Based on ADHD Severity Level – Unadjusted Models for Ages 3-17 and Ages 6-17.

			95% CI for Odds ratio		
		Odds ratio	Lower	Upper	*p*
Ages 3-17					
Race by Severity					< .001*
Mild	Hispanic	.735	.464	1.164	.189
	Black	.493	.235	1.032	.061
	Other/Multi	.926	.591	1.451	.737
Moderate	Hispanic	1.097	.796	1.513	.571
	Black	1.179	.818	1.698	.377
	Other/Multi	1.228	.901	1.674	.193
Severe	Hispanic	.898	.497	1.622	.721
	Black	1.983	1.035	3.801	.039*
	Other/Multi	1.131	.592	2.159	.710
Ages 6-17					
Race by Severity					< .001*
Mild	Hispanic	.706	.437	1.141	.155
	Black	.452	.206	.994	.048*
	Other/Multi	.886	.561	1.401	.605
Moderate	Hispanic	1.103	.789	1.540	.567
	Black	1.183	.812	1.725	.381
	Other/Multi	1.243	.902	1.714	.184
Severe	Hispanic	.909	.485	1.703	.766
	Black	1.799	.930	3.478	.081
	Other/Multi	1.259	.643	2.467	.502

Note. White is the reference category within each severity group.

*$p < .05$.

using univariate analysis, within 3-17 y.o. age group model gender ($p = .128$) and time spent by the computer ($p = .205$) appeared to be statistically insignificant and were therefore excluded from the final model. Similarly for 6-17 y.o. age group model gender ($p = .254$), time spent by the computer ($p = .133$), poverty level ($p = .210$), physical

activity ($p = .676$) and length of sleep ($p = .187$) were excluded from the final model having insignificant effects on the outcome variable after adjusting for other covariates.

Both adjusted models were statistically significant as assessed by omnibus test ($\chi^2(22) = 1054.3$, $p < .0005$ for model 9.1 and $\chi^2(23) = 966.51$, $p < .0005$ for model 9.2). The total variance explained by the models assessed by Nagelkerke R^2 reached almost a third with 32.5% for the first model and 31.3% for the second model. Similarly, the classification quality was 73.9% of the cases being correctly classified in model 9.1 and 73.6% in model 9.2. To investigate the relationship between race and receiving combined treatment based on ADHD severity, a new variable indicating interaction between ADHD severity and the race was used.

The results showed that this variable was one of the significant predictors of receiving combined treatment ($p < .001$). However, the comparisons of children of different ethnic groups within separate ADHD severity groups did not reveal any statistically significant differences (Table 31). This result was overall in line with the results of research question 5 that did not reveal a stable significant relationship between race and receiving combined treatment.

The next model was constructed for the age group of 6-17 that contained information regarding physical activity and length of sleep (Table 32). The results were in line with the previous model showing that there were a lower chance of receiving combined treatment for Hispanic ($OR = .592$, $p = .048$) and Black ($OR = 438$, $p = .047$) children aged 6-17 years old compared with White children of the same age. However,

the p-values were almost at the borderline of 0.05 and therefore these results should be interpreted with caution.

Table 31

Logistic Regression Results for Checking the Association Between Race and Receiving Combined Treatment for ADHD Based on the Severity Level (Model 9.1, Ages 3-17, Adjusted for Covariates)

		Unadjusted OR	Adjusted OR	95% CI for Odds ratio		
				Lower	Upper	*p*
Race by Severity						< .001*
Mild	Hispanic	.735	.612	.368	1.018	.059
	Black	.493	.522	.242	1.126	.097
	Other/Multi	.926	.844	.525	1.356	.483
Moderate	Hispanic	1.097	1.043	.732	1.486	.815
	Black	1.179	1.365	.895	2.083	.149
	Other/Multi	1.228	1.142	.811	1.608	.448
Severe	Hispanic	.898	.843	.425	1.672	.626
	Black	1.983	1.915	.937	3.917	.075
	Other/Multi	1.131	.952	.471	1.925	.891

Note. White is the reference category within each severity group. Sociodemographic variables included in the model: age, special education, special services, insurance, and poverty.

*$p < .05$.

The overall results were similar for both models and did not showed a strong association between the likelihood of getting a combined treatment for children of different race groups within ADHD severity groups. The only difference observed was mentioned in the model of 6-17 years old children and showed borderline p-value. Therefore, the null hypothesis of no association between race and the likelihood of receiving combined treatment for ADHD can be accepted for both age groups. Correspondingly, this research question can be answered negatively, stating there was no

association between race and receiving combined treatment for ADHD severity after adjusting for covariates.

Table 32

Logistic Regression Results for Checking the Association Between Race and Receiving Combined Treatment for ADHD Based on the Severity Level (Model 9.2, Ages 6-17, Adjusted for Covariates)

		Unadjusted OR	Adjusted OR	95% CI for Odds ratio		
				Lower	Upper	*p*
Race by Severity						< .001*
Mild	Hispanic	.706	.592	.352	.995	.048*
	Black	.452	.438	.194	.989	.047*
	Other/Multi	.886	.769	.475	1.243	.283
Moderate	Hispanic	1.103	1.023	.711	1.472	.904
	Black	1.183	1.231	.802	1.891	.342
	Other/Multi	1.243	1.112	.783	1.580	.553
Severe	Hispanic	.909	.938	.466	1.887	.857
	Black	1.799	1.739	.851	3.557	.129
	Other/Multi	1.259	1.137	.550	2.353	.729

Note. White is the reference category within each severity group. Sociodemographic variables included in the model: age, special education, special services, insurance.

*$p < .05$.

Summary

The purpose of this quantitative study was to examine if there was a disparity in treatment among non-Hispanic Black and Hispanic children with ADHD compared to non-Hispanic Whites children with ADHD based on the severity of their symptoms. In this section I reviewed the data collection procedure of the secondary data from the 2016 NSCH. In addition, I used both descriptive and inferential statistics to analyze the data in this quantitative study. Based on the results of the data analysis all research questions null

hypotheses were rejected except for RQ9 and partially for RQ3 and RQ5. Therefore, based on the result of RQ9 there were no association between race and receiving combined treatment for ADHD severity after adjusting for age, gender, attributes of the child and socioeconomic status. While for RQ3 and RQ5 the null hypothesis was rejected only for the entire age group of children 3-17 rather than in each age group. In the next section the results from this data analysis will be interpreted and discussed in detail along with implications for professional practice and social change.

Section 4: Application to Professional Practice and Implications for Social Change

Introduction

The purpose of this study was to assess the relationship in the care and treatment of non-Hispanic Black and Hispanic children compared to non-Hispanic White children based on the severity of symptoms of their ADHD. The goal was to increase awareness of such a disparity, if it exists, in order to be able to create appropriate prevention and management programs. Key findings of this study were that there was significant association between race and diagnosis and treatment of children with ADHD. Furthermore, the findings were also significant based on severity of symptoms. This section will provide an in-depth review and interpretation of the study findings, limitations of the study, recommendations based on the study findings and finally, the implications for professional practice and social change.

Interpretation of the Findings

The findings of this study are consistent with previous research in that there was an association between race and the diagnosis of ADHD (see Alvarado & Modesto-Lowe, 2017; Coker et al., 2016; Collins & Cleary, 2016). Compared to previous studies in which non-Hispanic White children were diagnosed at a higher rate than both non-Hispanic Black and Hispanic children (see Alvarado & Modesto-Lowe, 2017; Coker et al., 2016; Morgan et al., 2016), this study found the odds of being diagnosed with ADHD were only significantly lower among Hispanic children compared to non-Hispanic White children. In addition, there were no significant differences in the odds of being diagnosed with ADHD among non-Hispanic White and non-Hispanic Black children. Trends in

studies by previous authors (Alvarado & Modesto-Lowe, 2017; Collins & Cleary, 2016; Coker et al., 2016; Morgan et al., 2016) all showed Hispanic children with the lowest odds of being diagnosed with ADHD, which is consistent with the findings of this study (*OR* = .718, *p*<.001 in age group 3-17 and *OR* = .688, *p*<.001 in age group 6-17). Figure 2 shows the odds ratio in the diagnosis of ADHD among Black and Hispanic children with non-Hispanic Whites as reference category. Collins and Cleary (2016) found that although trends for diagnosis of ADHD have been trending upwards, particularly among Hispanic children, there is still a gap in diagnosis compared to non-Hispanic White children. The reason for the gap in diagnosis, as seen in previous studies (e.g., Alvarado & Modesto-Lowe, 2017; Collins & Cleary, 2016; Coker et al., 2016; Morgan et al., 2016) and in this study, is unclear; however, evidence suggests that socioeconomic factors may play a major role in the diagnosis of ADHD (Rowland et al., 2018; Russell, Ford, & Russell, 2015). In older children 6 to 17 years, when adjusting for physical activity and sleep, results were similar as above except that there was a significant difference between non-Hispanic White and non-Hispanic Black children and no significant difference between Hispanic and non-Hispanic Black children in the diagnosis of ADHD.

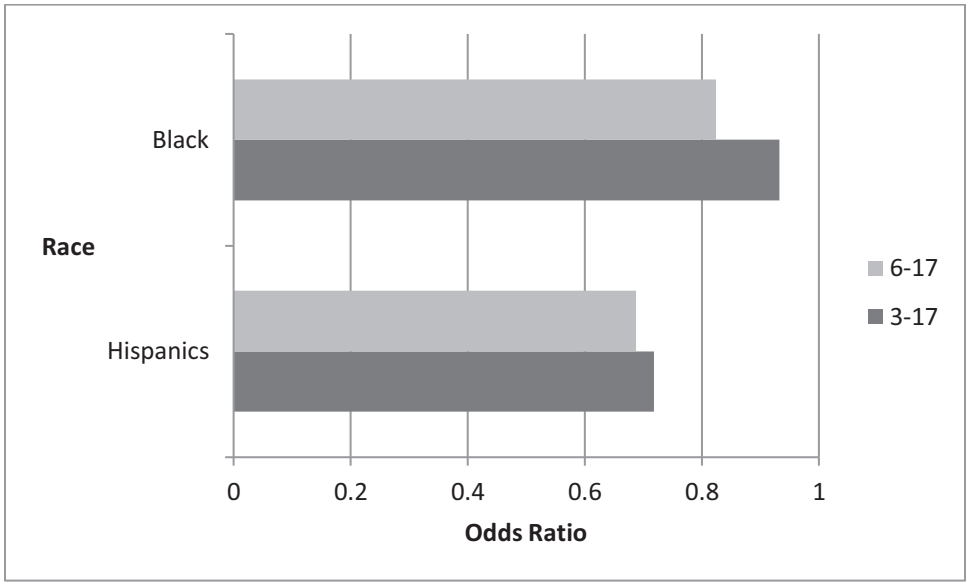

Figure 2. Odds ratio between race and ADHD diagnosis in both model using non-Hispanic Whites as a reference category.

Medication treatment for ADHD was similar to ADHD diagnosis in which Hispanic children were less likely to receive medication for their ADHD compared to non-Hispanic Whites and non-Hispanic Black children. In addition, there were no significant differences between non-Hispanic White and non-Hispanic Black children in receiving medication for their ADHD. Figure 3 shows the odds ratio in receiving medication for ADHD among Black and Hispanic children with non-Hispanic Whites as reference category. The findings are consistent with other studies (e.g., Alsalamah, 2018; Alvarado & Modesto-Lowe, 2017; Morgan et al., 2016) in which non-Hispanic Whites were more likely to receive medication treatment for their ADHD when compared to Hispanic children.

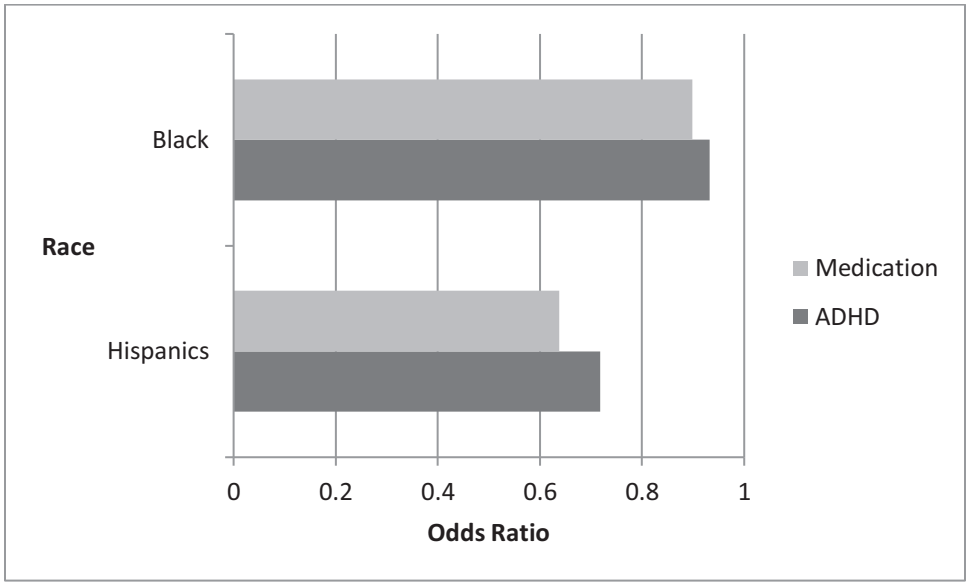

Figure 3. Odds ratio in diagnosis of ADHD and receiving medication among Black and Hispanic children with non-Hispanic White children as a reference category.

Cultural and language barriers may play key roles in ethnic minorities, particularly Hispanics, receiving medical care for their ADHD (Bailey, Jaquez-Gutierrez, & Madhoo, 2014; Rostain, Diaz, & Pedraza, 2015). Similar to diagnosis of ADHD among Hispanic and non-Hispanic Black children, barriers to treatment for ADHD included socioeconomic factors, parental views, and cultural norms (Alvardo & Modesto-Lowe, 2017). An important aspect of this disparity in medication management of ADHD among races is how parents view medication. Non-Hispanic Blacks and Hispanics are more likely to be concerned about the risk of ADHD medications and the harm it may cause to their child compared to non-Hispanic Whites (Ji, Druss, Lally, & Cummings, 2017). These barriers to care can explain some of the disparities that exist in medication management among Hispanic and non-Hispanic Black children. Severity of symptoms was also a significant predictor of receiving medication treatment. Non-Hispanic White children with mild symptoms had a higher likelihood of receiving medication for ADHD

compared to non-Hispanic Blacks and Hispanic children. Among children with moderate and severe symptoms non-Hispanic White children had a higher odd of receiving medication compared to only Hispanic children. In general, children with mild ADHD symptoms are less likely to receive medication yet may benefit more academically from treatment than children with more severe symptoms who may require higher doses and have comorbid conditions (Owens & Jackson, 2017). Consequently, non-Hispanic Black and Hispanic children with ADHD with mild symptoms of ADHD may be further hindered academically by not receiving medication that may help improve their ADHD symptoms and ultimately their academic progress.

The association between race and likelihood in receiving behavioral treatment for ADHD was borderline significant among all children and not significant when adjusting for physical activity and sleep among children 6-17years old. Non-Hispanic Black children had a higher probability of receiving behavioral treatment for ADHD than both Hispanic and non-Hispanic White children. The findings in this study were consistent with non-Hispanic White children being less likely to receive behavioral therapy than non-Hispanic Black and Hispanic children with ADHD (Visser et al., 2015; Cummings et al., 2017). Cummings et al (2017) found parents of Hispanic and non-Hispanic Black children culturally prefer behavioral therapy over medication for management of their child's ADHD. Regarding severity of symptoms of ADHD there are similar results in receiving behavioral therapy. Figure 4 below shows the odds ratio in diagnosis of ADHD based on severity and receiving behavioral treatment among Black and Hispanic children with non-Hispanic White children as a reference category. Non-Hispanic Black children

had higher odds of receiving behavioral therapy compared to non-Hispanic White children in the moderate group and all races in the severe ADHD group.

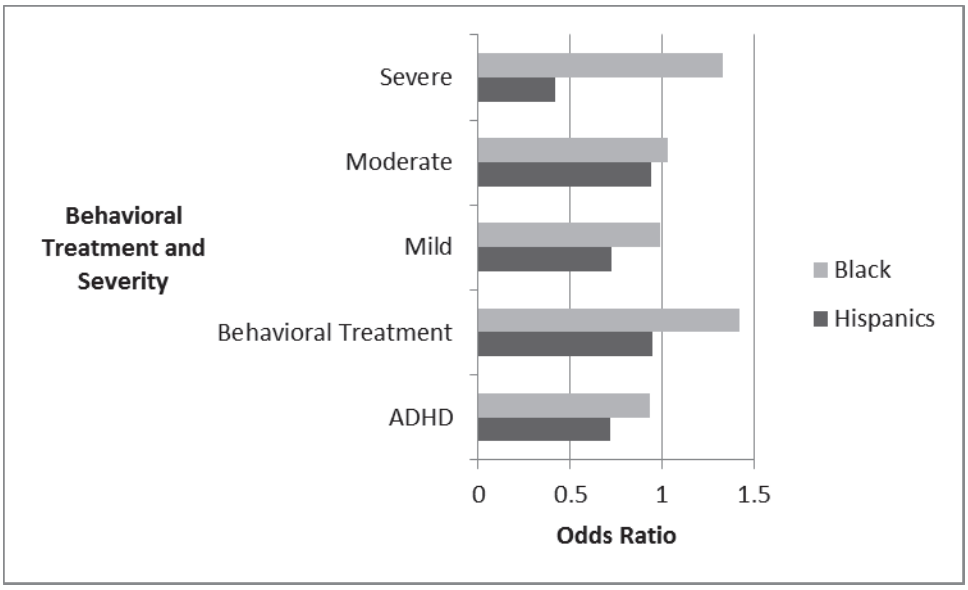

Figure 4. Odds ratio in diagnosis of ADHD based on severity and receiving behavioral treatment among Black and Hispanic children with non-Hispanic White children as a reference category.

In this study there was a statistically significant relationship between race and the odds of receiving alternative treatment for ADHD. Non-Hispanic White children were more likely to receive alternative treatment compared to non-Hispanic Black and Hispanic children. There are no known previous studies on the relationship between race and alternative treatment of ADHD, but alternative treatments, such as dietary supplement use, were more prevalent in the western part of the United States and less likely among low income families and those on public insurance (Visser et al., 2015). Among children in both the mild and moderate ADHD severity group Hispanic children had a lower likelihood of receiving alternative therapy compared only to non-Hispanic

White children. The severe ADHD severity group did not have any association among any of the racial groups for alternative treatment.

Combination of medication and behavioral therapy is the preferred treatment for ADHD according to guidelines by the American Academy of Pediatrics (Cummings et al., 2017). In this study, there was no association with race and combined therapy for ADHD among children 6- 17 years old after controlling for physical activity and sleep. However, when considering all children 3-17 years, there was a significant difference among race and receiving combined therapy. Hispanic and non-Hispanic White children both had lower odds of receiving combined therapy for ADHD compared to non-Hispanic Black children and only in the aged 3-17 model. Visser et al. (2015) had similar findings with non-Hispanic Whites less likely to receive combined therapies compared to non-Hispanic Blacks and Hispanics. While Cumming et al. (2017) found that among Medicaid-enrolled non-Hispanic Blacks and Hispanic youth, they both were more likely to receive combined treatment compared to non-Hispanic Whites. The findings that non-Hispanic Black and Hispanic children were more likely to receive combine treatment in my research and previous research were not expected. In fact, non-Hispanic Black and Hispanic children were more likely to receive combined treatment compared to non-Hispanic White children although they are less likely to adhere to treatment (Cummings et al., 2017; Ji et al., 2018). Among severity of ADHD there were no racial differences for the likelihood of receiving combined treatment for ADHD.

In summary, this study showed that there are disparities in the diagnosis and treatment of ADHD based on race. As seen in Figure 5, Hispanic children are less likely

to receive the diagnosis of ADHD and receive treatment in all modalities, except for alternative treatment compared to non-Hispanic White and non-Hispanic Black children. Non-Hispanic Black children have higher odds of receiving behavioral and combined treatment compared to non-Hispanic White and Hispanic children.

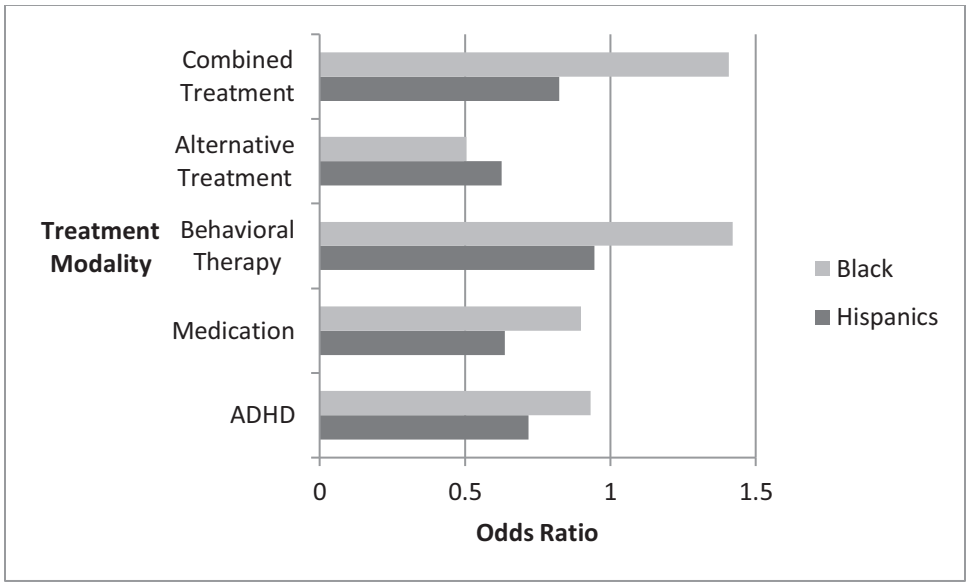

Figure 5. Odds ratio for diagnosis of ADHD and treatment modality based on race with non-Hispanic White children as reference category.

Disparity in treatment modality also exists based on the child's severity of their ADHD symptoms and race as displayed in Figure 6. In non-Hispanic Black children when symptoms are mild the odds of receiving treatment in all modalities, except for all behavioral treatment, are less likely than both non-Hispanic White and Hispanic children. Among Hispanic children with moderate and severe symptoms the odds of receiving treatment were less likely in all modality except for alternative treatment compared to non-Hispanic Black and non-Hispanic White children.

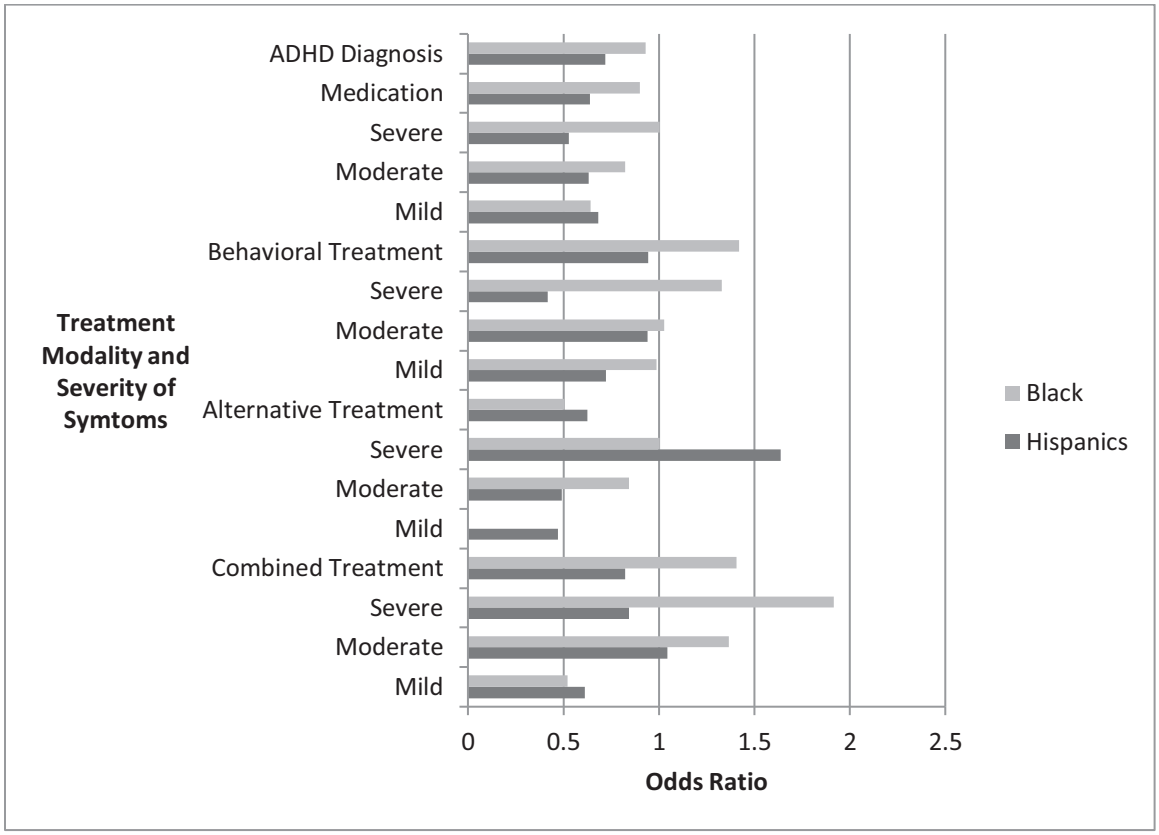

Figure 6. Odds ratio for treatment modality and severity of symptoms based on race using non-Hispanic White children as reference category.

Limitations of the Study

The greatest limitation of this study was that the data collected was solely based on parent reports not verified against medical records. It was based on parent interpretations and understanding of the questions and is subject to recall bias. Another significant limitation was lack of specificity of some of the questions. Most notably, the questions did not always provide details on the type of medication, behavioral therapy, and alternative treatment. There are several types of medication in the treatment of ADHD and possibly the child, particularly with comorbidity, may not actually be receiving ADHD medication rather medication for their comorbidity. This is important

since approximately 50% of children with ADHD will have at least one psychiatric comorbidity and may be on medication for that comorbidity (Al Ghriwati et al., 2017). The question does not specifically explain behavioral therapy and the parent may mistake other type of therapies for behavior therapy or vice versa. Alternative treatment is a broad area and it may range from nutritional supplements and specific diets (e.g. gluten free, Feingold diet) to neurofeedback and memory training, which were not specified in the question. The lack of specificity in the survey questions of this study may lead to overestimation or underestimation of the type of treatment or therapy depending on how the parent interprets the question (Danielson et al., 2018). Healthcare resource use on self-reported questionnaires are often under or overreported based on how the question was formulated and validated (Leggett et al., 2016). Finally, missing data may also be a limitation as the ADHD severity question had the highest number of missing data at 10%. Missing data greater than 10% is likely to result in bias in the statistical analysis (Madley-Dowd et al., 2019).

Recommendations

ADHD is the most commonly diagnosed mental health disorder among children in the United States (Collins & Cleary, 2016). This study highlighted the disparity that exists among Hispanic and non-Hispanic Black children compared to non-Hispanic White children in the United States in the diagnosis and treatment of ADHD. Particularly this study also showed that this disparity was also apparent based on severity of symptoms. What was important to note is that both disparity in diagnosis and treatment were seen more consistently among Hispanic children. This study did not look into the

reason for why non-Hispanic Blacks and particularly Hispanic children do not receive similar care compared to their non-Hispanic White counterparts for their ADHD. Concerning from this study is that 13.8% of children with ADHD compared to 9.7% of the total sample make up the lowest income group. In addition, only 68% of children with ADHD had full insurance with mental or behavioral health services. According to Bronheim, Soto, and Anthony (2015) Hispanic children with special health care needs are significantly more likely (28.4%) to have unmet healthcare needs compared to non-Hispanic White children (20.7%). Lack of access to healthcare services among children with special needs particularly Hispanic children is associated with poorer healthcare outcomes (Bronheim, Soto, and Anthony, 2015). Access to healthcare encompassed both having access and gaining access and both are often inadequate with children with ADHD (Wright et al., 2015). Access to healthcare to all, especially ethnic minority children with ADHD is needed and there needs to be more research and programs available looking into improving access to these children. Currently African American and Hispanic children make up 48% of the United States child population and account for 53% of all uninsured children (Flores et al., 2016).

Parent's beliefs in medication efficacy and side effects were important reasons for not initiating or discontinuing ADHD medication for their child among non-Hispanic Black compared to non-Hispanic White parents (Cummings et al., 2017). In a study by Bailey, Jaquez-Gutierrez and Madhoo (2014) they found that access to care, cultural attitudes/beliefs and perceived prejudice and stigmatization may be strong factors in the underuse of treatment for ADHD among African American and Hispanic children. We

know from this study that non-Hispanic Blacks and Hispanic children with ADHD do not receive equal medical treatment for their ADHD and more studies needs to look more at how this may be influenced by cultural beliefs and knowledge. Also, it is important not to generalize when looking at culture. Hispanics of Puerto Rican origin and Mexican Hispanics are culturally different and native English versus Spanish speaking Hispanics are also different. Native Spanish speaking Hispanic mothers were less likely to describe a child with ADHD behavior as normal and more interested in discussing their child's behavior with a physician (Wright et al., 2015). African American parents, particularly from educationally disadvantaged families, often have negative perceptions of ADHD and lack of knowledge and are less likely to seek help for their child (Bailey et al., 2014).

Implication for Professional Practice and Social Change

My research has wide implications for healthcare professionals that work with children with ADHD. My research will increase awareness that Hispanic and non-Hispanic Black children are disproportionally diagnosed at a lower rate and not receiving equal medical care for their ADHD compared to their non-Hispanic White counterparts. By disseminating this information and informing healthcare professionals via social media, medical conferences, and public health forums, they will be more conscious of this disparity and children that have the appropriate symptoms of ADHD will be diagnosed and treated appropriately and equally. Early diagnosis and treatment are important particularly with children with more severe symptoms of ADHD which may result in academic underachievement and impact their school performance (Owens & Jackson, 2017). Further, untreated ADHD can lead to poor family functioning and

psychological distress (Moen, Hedelin, & Hall-Lord, 2016) along with higher risk of criminal behavior and incarceration as adults (Hamed, Kauer, & Stevens, 2015; Holthe & Lanvik, 2017) with data showing that non-Hispanic Black males are disproportionally incarcerated (Behnken, 2014).

On a grander scale my study will hopefully promote social change by increasing the awareness of the disparity in the diagnosis and treatment of ADHD among Hispanic and non-Hispanic Black children. This insight will increase the public and health official knowledge of this disparity and effectively promote change through implementation of public health policies and programs to improve the effectiveness in the management of ADHD in children particularly among the most vulnerable population. ADHD can be a lifelong impairment if not managed properly with nearly 65% of children with ADHD exhibits symptoms that persists into adulthood (Caci et al., 2015). Effective management of ADHD in these children by providing appropriate diagnoses and treatment will improve their quality of life, health outcomes and ultimately decrease the disease burden of ADHD in the community and society.

Conclusion

ADHD is increasing dramatically with 1 in 10 children diagnosed with ADHD in the United States (Visser et al., 2015). My study showed overall that there was a significant positive association in the diagnosis and treatment of ADHD among Hispanic and non-Hispanic Black children compared to non-Hispanic White children. This association was also significant based on a child severity of ADHD symptoms. In both diagnosis and treatment for ADHD the disparity was most apparent among Hispanic

children. Among Hispanic children fewer are diagnosed with ADHD and less likely to receive medication and behavioral treatment than both non-Hispanic Blacks and non-Hispanic White children. Hispanic children are the fastest growing population in the United States with 9% in 1980 to 25% in 2016 (Child Trends, 2018). The rapid population growth of Hispanic children in the United States whom also have the highest rate of being uninsured (Monnat, 2017) make it even more imperative that health care providers and public health official acknowledge this disparity and provide appropriate diagnosis and treatment of these children along with improving public knowledge and policy.

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Appendix A: DSM-5 Criteria for Diagnosis of ADHD

1. Inattention: Six or more symptoms of inattention for children up to age 16, or five or more for adolescents 17 and older and adults; symptoms of inattention have been present for at least 6 months, and they are inappropriate for developmental level:
    a. Often fails to give close attention to details or makes careless mistakes in schoolwork, at work, or with other activities.
    b. Often has trouble holding attention on tasks or play activities.
    c. Often does not seem to listen when spoken to directly.
    d. Often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (e.g., loses focus, side-tracked).
    e. Often have trouble organizing tasks and activities.
    f. Often avoids, dislikes, or is reluctant to do tasks that require mental effort over a long period of time (such as schoolwork or homework).
    g. Often loses things necessary for tasks and activities (e.g. school materials, pencils, books, tools, wallets, keys, paperwork, eyeglasses, mobile telephones).
    h. Is often easily distracted
    i. Is often forgetful in daily activities.
2. Hyperactivity and Impulsivity: Six or more symptoms of hyperactivity-impulsivity for children up to age 16, or five or more for adolescents 17 and older

and adults; symptoms of hyperactivity-impulsivity have been present for at least 6 months to an extent that is disruptive and inappropriate for the person's developmental level:

   a. Often fidgets with or taps hands or feet, or squirms in seat.
   b. Often leaves seat in situations when remaining seated is expected.
   c. Often runs about or climbs in situations where it is not appropriate (adolescents or adults may be limited to feeling restless).
   d. Often unable to play or take part in leisure activities quietly.
   e. Is often "on the go" acting as if "driven by a motor".
   f. Often talks excessively.
   g. Often blurts out an answer before a question has been completed.
   h. Often has trouble waiting his/her turn.
   i. Often interrupts or intrudes on others (e.g., butts into conversations or games)

3. In addition, the following conditions must be met:
   a. Several inattentive or hyperactive-impulsive symptoms were present before age 12 years.
   b. Several symptoms are present in two or more setting, (such as at home, school or work; with friends or relatives; in other activities).
   c. There is clear evidence that the symptoms interfere with, or reduce the quality of, social, school, or work functioning.

   d. The symptoms are not better explained by another mental disorder (such as a mood disorder, anxiety disorder, dissociative disorder, or a personality disorder). The symptoms do not happen only during the course of schizophrenia or another psychotic disorder.

4. Based on the types of symptoms, three kinds (presentations) of ADHD can occur:
   a. *Combined Presentation*: if enough symptoms of both criteria inattention and hyperactivity-impulsivity were present for the past 6 months
   b. *Predominantly Inattentive Presentation*: if enough symptoms of inattention, but not hyperactivity-impulsivity, were present for the past six months
   c. *Predominantly Hyperactive-Impulsive Presentation*: if enough symptoms of hyperactivity-impulsivity, but not inattention, were present for the past six months.

(Centers for Disease Control and Prevention [CDC], 2018)

Appendix B: DSM-5 Severity Level for ADHD

Mild is restricted to cases where there are few, if any, symptoms beyond those required to make the diagnosis and no more than minor impairment in functioning.

Moderate is simply defined as symptoms or functional impairment between 'mild' and 'severe'. People in this category may not necessarily show clinically significant impairment.

Severe is reserved for cases with many symptoms in excess of those required for the diagnosis, or several symptoms that are especially severe, or marked impairment resulting from symptoms.

(Rabiner, 2013)

Appendix C: List of Applicable Questions From the National Survey of Children's Health (NSCH) 2016

1. What is this child's race?
2. How old is this child?
3. What is this child's sex?
4. Has a doctor or other health care provider EVER told you that this child has Attention Deficit Disorder or Attention Deficit/Hyperactivity Disorder that is, ADD or ADHD?
5. Does this child CURRENTLY have this condition?
6. If yes, is it Mild, Moderate, or Severe?
7. Is this child CURRENTLY taking medication for ADD or ADHD?
8. At any time DURING THE PAST 12 MONTHS, did this child receive behavioral treatment for ADD or ADHD, such as training or an intervention that you or this child received to help with his or her behavior?
9. In the past 12 MONTHS, did this child use any type of alternative health care or treatment?
10. Have a doctor or other health care provider EVER told you that this child has:
    a. Anxiety problems
    b. Depression
    c. Behavioral or Conduct Problems
    d. Substance Abuse Disorders
    e. Developmental Delays

f. Intellectual Disability

g. Speech or Other Language Disorder

h. Learning Disability

i. Autism or Autism Spectrum Disorder

j. Any other Mental Health Disorder

11. Has this child EVER had a special education or early intervention plan?

    a. How old was this child as the time of the FIRST plan?

    b. Is this child CURRENTLY receiving services under one of these plans?

12. Has this child EVER received special services to meet his or her developmental needs such as speech, occupational or behavioral therapy?

    a. How old was this child when he or she began receiving these special services?

    c. Is this child CURRENTLY receiving these special services?

13. DURING THE PAST 12 MONTHS, was this child EVER covered by ANY kind of health insurance or health coverage plan?

14. Is this child CURRENTLY covered by ANY kind of health insurance or health coverage plan?

15. Is this child covered by any of the following type of health insurance or health coverage plans?

    a. Insurance through a current or former employer or union

    b. Insurance purchased directly from and insurance company

c. Medicaid, Medical Assistance or any kind of government assistance plan for those with low incomes or a disability
d. TRICARE or other military health care
e. Indian Health Service
f. Other, specify

16. Thinking specifically about this child's mental or behavioral health needs, how often does this child health insurance offer benefits or cover services that meet these needs?
17. DURING THE PAST WEEK, on how many days did this child exercise, play a sport, or participate in physical activity at least 60 minutes?
18. ON AN AVERAGE WEEKDAY, about how much time does this child usually spend in front of a TV watching TV programs, videos, or playing video games?
19. ON AN AVERAGE WEEKDAY, about how much time does this child usually spend with computers, cell phones, handheld video games, and other electronic devices doing things other than schoolwork?
20. DURING THE PAST WEEK, how many hours of sleep did this child get [during an average day (count both nighttime sleep and naps)/on an average weeknight]?
21. Think about your total combined family income IN THE LAST CALENDER YEAR for all members of the family. What is that amount before taxes?

Appendix D: Detailed Regression Model Results

Table D1

Logistic Regression Results for Testing the Relationship Between Each Covariate and ADHD Diagnosis: Univariate Models for Ages 3-17 and Ages 6-17

	Ages 3-17				*Ages 6-17*			
	Odds ratio	95% *CI* for odds ratio			Odds ratio	95% *CI* for odds ratio		
		Lower	Upper	*p*		Lower	Upper	*p*
Male	2.421	2.249	2.605	< .001*	2.440	2.263	2.631	< .001*
Age Group				< .001*				< .001*
3-4 y.o.	.038	.025	.057	< .001*				
5-7 y.o.	.336	.295	.382	< .001*	.466	.405	.536	< .001*
8-10 y.o.	.888	.810	.973	.011*	.884	.806	.969	.009*
11-13 y.o.	1.045	.960	1.136	.311	1.042	.957	1.135	.344
Special Education(yes)	14.754	13.686	15.905	< .001*	13.893	12.854	15.016	< .001*
Special Services(yes)	7.817	7.275	8.399	< .001*	7.584	7.040	8.170	< .001*
Insurance[a]				< .001*				< .001*
No insurance	.121	.098	.149	< .001*	.132	.106	.164	< .001*
Insurance without mental or behavioral health services	.035	.032	.039	< .001*	.040	.037	.044	< .001*
Time watching TV[b]				< .001*				< .001*
None	.379	.309	.464	< .001*	.423	.343	.521	< .001*
Less than 1 hour	.341	.299	.389	< .001*	.378	.330	.433	< .001*
1 hour	.375	.334	.421	< .001*	.415	.368	.468	< .001*
2 hours	.467	.418	.521	< .001*	.513	.457	.575	< .001*
3 hours	.671	.591	.761	< .001*	.715	.628	.814	< .001*
Time with Computer [b]				< .001*				< .001*
None	.377	.318	.447	< .001*	.768	.641	.921	.004*
Less than 1 hour	.348	.309	.392	< .001*	.501	.443	.566	< .001*
1 hour	.431	.387	.479	< .001*	.497	.445	.554	< .001*
2 hours	.562	.508	.622	< .001*	.595	.537	.660	< .001*
3 hours	.736	.656	.826	< .001*	.756	.672	.850	< .001*
Poverty Level[c]				< .001*				< .001*
0-99% FPL	1.845	1.660	2.050	< .001*	1.844	1.651	2.060	< .001*

	Ages 3-17				*Ages 6-17*			
	Odds ratio	95% *CI* for odds ratio			Odds ratio	95% *CI* for odds ratio		
		Lower	Upper	*p*		Lower	Upper	*p*
100-199% FPL	1.377	1.250	1.515	< .001*	1.409	1.276	1.555	< .001*
200-399% FPL	1.051	.967	1.143	.245	1.088	.998	1.185	.055
Physical activity[d]								< .001*
0 days					2.299	2.028	2.607	< .001*
1 - 3 days					1.284	1.165	1.415	< .001*
4 - 6 days					.901	.811	1.001	.052
Hours of sleep[e]								< .001*
Less than 6 hours					3.454	2.499	4.776	< .001*
6 hours					2.031	1.559	2.647	< .001*
7 hours					1.336	1.058	1.687	.015*
8 hours					1.087	.869	1.359	.464
9 hours					.989	.789	1.238	.921
10 hours					.808	.639	1.022	.075

[a] "Mental or behavioral health services insurance" reference category

[b] "4 or more hours" reference category.

[c] "400% FPL or greater" reference category.

[d] "Every day" reference category.

[e] "11 or more hours" reference category.

*$p < .05$.

Table D2

Logistic Regression Predicting the Likelihood of ADHD Diagnosis Based on Race and Confounding Variables (for Children Aged 3-17)

Model 1.1	*β*	Wald	df	*p*	Odds ratio	95% CI for Odds ratio Lower	Upper
Race[a]		44.4	3	< .001*			
Hispanic	-.331	17.7	1	< .001*	.718	.616	.838
Black, non-Hispanic	-.070	0.5	1	.474	.932	.770	1.130
Other/Multiracial, non-Hispanic	-.454	32.1	1	< .001*	.635	.543	.743
Male	.791	251.6	1	< .001*	2.206	2.000	2.432
Age Group		374.3	4	< .001*			
3-4 y.o.	-3.569	214.9	1	< .001*	.028	.017	.045
5-7 y.o.	-1.072	152.5	1	< .001*	.342	.289	.406
8-10 y.o.	-.009	0.0	1	.884	.991	.875	1.122
11-13 y.o.	.038	0.4	1	.513	1.039	.926	1.165
Special Education(yes)	2.112	1,268.1	1	< .001*	8.265	7.358	9.284
Special Services(yes)	.286	22.6	1	< .001*	1.331	1.183	1.498
Insurance[b]		3,593.4	2	< .001*			
No insurance	-1.961	252.3	1	< .001*	.141	.110	.179
Insurance without mental or behavioral health services	-3.075	3,543.6	1	< .001*	.046	.042	.051
Time watching TV[c]		31.7	5	< .001*			
None	-.403	8.4	1	.004*	.668	.509	.877
Less than 1 hour	-.421	21.0	1	< .001*	.656	.548	.786
1 hour	-.250	9.4	1	.002*	.779	.664	.914
2 hours	-.213	7.4	1	.006*	.808	.693	.942
3 hours	-.038	0.2	1	.666	.963	.809	1.145
Poverty Level[c]		35.2	3	< .001*			
0-99% FPL	.418	28.8	1	< .001*	1.519	1.304	1.770
100-199% FPL	.227	11.1	1	.001*	1.255	1.098	1.434
200-399% FPL	.037	0.4	1	.512	1.038	.929	1.160
Constant	-1.520	322.5	1	< .001*	.219		

[a] White" reference category

[b] "Mental or behavioral health services insurance" reference category

[c] "4 or more hours" reference category

[d] "400% FPL or greater" reference category

*$p < .05$.

Table D3

Logistic Regression Predicting the Likelihood of ADHD Diagnosis Based on Race and Confounding Variables (for Children Aged 6-17)

Model 1.2	*β*	Wald	df	*p*	Odds ratio	95% CI for Odds ratio Lower	Upper
Race[a]		48.3	3	< .001*			
Hispanic	-.374	21.3	1	< .001*	.688	.587	.806
Black, non-Hispanic	-.194	3.6	1	.057	.824	.675	1.006
Other/Multiracial, non-Hispanic	-.466	32.2	1	< .001*	.627	.534	.737
Male	.782	237.1	1	< .001*	2.186	1.979	2.415
Age Group		58.6	3	< .001*			
5-7 y.o.	-.568	33.6	1	< .001*	.567	.468	.687
8-10 y.o.	.132	3.7	1	.055	1.141	.997	1.305
11-13 y.o.	.149	6.0	1	.014*	1.160	1.030	1.307
Special Education(yes)	2.125	1,240.7	1	< .001*	8.371	7.437	9.421
Special Services(yes)	.273	20.0	1	< .001*	1.314	1.166	1.481
Insurance[b]		3,384.2	2	< .001*			
No insurance	-1.907	235.8	1	< .001*	.149	.116	.189
Insurance without mental or behavioral health services	-3.035	3,341.8	1	< .001*	.048	.043	.053
Time watching TV[c]		30.8	5	< .001*			
None	-.370	6.8	1	.009*	.691	.523	.913
Less than 1 hour	-.401	18.1	1	< .001*	.670	.557	.805
1 hour	-.220	6.9	1	.009*	.803	.681	.946
2 hours	-.177	4.8	1	.028*	.838	.716	.981
3 hours	.013	0.0	1	.883	1.013	.849	1.210
Poverty Level[d]		23.3	3	< .001*			
0-99% FPL	.347	18.5	1	< .001*	1.415	1.208	1.658
100-199% FPL	.210	9.1	1	.003*	1.233	1.076	1.413
200-399% FPL	.045	0.6	1	.439	1.046	.934	1.171
Hours of sleep[e]		47.5	6	< .001*			
Less than 6 hours	.618	7.3	1	.007*	1.854	1.185	2.903
6 hours	.392	4.4	1	.036*	1.480	1.026	2.135
7 hours	.175	1.1	1	.287	1.191	.863	1.645
8 hours	-.019	0.0	1	.905	.981	.721	1.335
9 hours	-.098	0.4	1	.534	.907	.666	1.235
10 hours	-.261	2.6	1	.110	.770	.559	1.061
Constant	-1.589	83.8	1	< .001*	.204		

[a] "White" reference category

[b] "Mental or behavioral health services insurance" reference category

[c] "4 or more hours" reference category

[d] "400% FPL or greater" reference category

*$p < .05$.

Table D4

Logistic Regression Results for Testing the Relationship Between Each Covariate and Receiving Medication for ADHD: Univariate Models for Age 3-17 and Age 6-17

	Ages 3-17				*Ages 6-17*			
	Odds ratio	95% *CI* for odds ratio			Odds ratio	95% *CI* for odds ratio		
		Lower	Upper	*p*		Lower	Upper	*p*
Male	1.149	1.013	1.302	.031*	1.139	1.000	1.296	.049*
Age Group				< .001*				< .001*
3-4 y.o.	.150	.078	.286	< .001*				
5-7 y.o.	1.089	.875	1.355	.444	1.253	.984	1.597	.068
8-10 y.o.	1.662	1.415	1.954	< .001*	1.657	1.407	1.951	< .001*
11-13 y.o.	1.572	1.359	1.819	< .001*	1.580	1.363	1.831	< .001*
Special Education(yes)	1.145	1.019	1.288	.023*	1.156	1.025	1.305	.018*
Special Services(yes)	1.065	.947	1.198	.292	1.090	.965	1.231	.165
Insurance[a]				< .001*				< .001*
No insurance	.412	.291	.584	< .001*	.398	.276	.572	< .001*
Insurance without mental or behavioral health services	.476	.421	.539	< .001*	.477	.420	.542	< .001*
Time watching TV[b]				.026*				.021*
None	.759	.537	1.074	.120	.716	.503	1.020	.064
Less than 1 hour	.967	.775	1.205	.763	.906	.721	1.137	.394
1 hour	1.116	.917	1.359	.273	1.075	.878	1.316	.486
2 hours	1.190	.986	1.436	.069	1.137	.937	1.381	.193
3 hours	1.195	.963	1.483	.106	1.177	.942	1.471	.152
Time with Computer[b]				.003*				.001*
None	1.381	1.017	1.876	.038*	1.739	1.243	2.434	.001*
Less than 1 hour	1.091	.890	1.336	.403	1.178	.953	1.454	.129
1 hour	1.264	1.055	1.516	.011*	1.302	1.081	1.567	.005*
2 hours	1.400	1.178	1.665	< .001*	1.424	1.194	1.698	< .001*
3 hours	1.148	.943	1.398	.169	1.177	.963	1.438	.112
Poverty Level[c]				.036*				.143
0-99% FPL	.908	.755	1.091	.303	.948	.782	1.150	.587
100-199% FPL	.841	.712	.994	.042*	.878	.740	1.042	.137
200-399% FPL	.820	.711	.947	.007*	.849	.733	.983	.029*
Physical activity[d]								.071
0 days					.807	.652	.998	.048*

	Ages 3-17				*Ages 6-17*			
	Odds ratio	95% *CI* for odds ratio			Odds ratio	95% *CI* for odds ratio		
		Lower	Upper	*p*		Lower	Upper	*p*
1 - 3 days					1.025	.869	1.209	.768
4 - 6 days					1.036	.867	1.238	.698
Hours of sleep[e]								.254
Less than 6 hours					.782	.450	1.357	.382
6 hours					.878	.551	1.396	.582
7 hours					.896	.593	1.355	.604
8 hours					1.021	.686	1.520	.919
9 hours					1.060	.709	1.583	.777
10 hours					1.137	.748	1.728	.547

[a] 'Mental or behavioral health services insurance" reference category" reference category

[b] "4 or more hours' reference category" reference category

[c] "400% FPL or greater" reference category

[d] "Every day" reference category

[e] "11 or more hours" reference category

*$p < .05$.

Table D5

Logistic Regression Predicting the Likelihood of Receiving Medication for ADHD Based on Race and Confounding Variables (for Children Aged 3-17)

Model 2.1	*β*	Wald	*df*	*p*	Odds ratio	95% CI for odds ratio Lower	Upper
Race[a]		20.1	3	< .001*			
Hispanic	-.449	18.3	1	< .001*	.638	.520	.784
Black, non-Hispanic	-.107	0.7	1	.409	.899	.698	1.158
Other/Multiracial, non-Hispanic	-.199	3.4	1	.065	.820	.664	1.013
Age Group		89.4	4	< .001*			
3-4 y.o.	-2.056	33.7	1	< .001*	.128	.064	.256
5-7 y.o.	.037	0.1	1	.764	1.037	.816	1.319
8-10 y.o.	.486	27.8	1	< .001*	1.626	1.357	1.948
11-13 y.o.	.426	29.0	1	< .001*	1.531	1.311	1.787
Insurance[b]		145.8	2	< .001*			
No insurance	-.853	21.0	1	< .001*	.426	.296	.614
Insurance without mental or behavioral health services	-.765	136.3	1	< .001*	.465	.409	.529
Time watching TV[c]		13.5	5	.019*			
None	-.523	7.2	1	.007*	.593	.405	.868
Less than 1 hour	-.258	3.6	1	.058	.773	.592	1.008
1 hour	-.116	0.8	1	.357	.891	.697	1.139
2 hours	-.025	0.0	1	.830	.975	.775	1.227
3 hours	.011	0.0	1	.931	1.011	.785	1.302
Time with Computer[d]		14.0	5	.016*			
None	.472	6.8	1	.009*	1.604	1.124	2.288
Less than 1 hour	.106	0.6	1	.421	1.111	.859	1.437
1 hour	.232	3.9	1	.048*	1.261	1.003	1.586
2 hours	.329	9.2	1	.002*	1.390	1.124	1.718
3 hours	.155	1.8	1	.182	1.168	.930	1.467
Poverty Level[e]		8.0	3	.046*			
0-99% FPL	-.075	0.5	1	.467	.928	.758	1.136
100-199% FPL	-.190	4.4	1	.037*	.827	.692	.988
200-399% FPL	-.193	6.3	1	.012*	.825	.710	.958
Constant	.610	35.7	1	< .001*	1.841		

[a] "White" reference category

[b] Mental or behavioral health services insurance' reference category

[c] 4 or more hours' reference category

*$p < .05$.

Table D6

Logistic Regression Predicting the Likelihood of Receiving Medication for ADHD Based on Race and Confounding Variables (for Children Aged 6-17)

Model 2.2	*β*	Wald	*df*	*p*	Odds ratio	95% CI for odds ratio Lower	Upper
Race[a]		18.9	3	< .001*			
Hispanic	-.440	16.7	1	< .001*	.644	.522	.795
Black, non-Hispanic	-.124	0.9	1	.345	.884	.684	1.142
Other/Multiracial, non-Hispanic	-.212	3.7	1	.054	.809	.652	1.003
Age Group		40.8	3	< .001*			
5-7 y.o.	.154	1.3	1	.246	1.167	.899	1.515
8-10 y.o.	.475	26.1	1	< .001*	1.609	1.340	1.930
11-13 y.o.	.426	28.6	1	< .001*	1.531	1.310	1.789
Insurance[b]		139.0	2	< .001*			
No insurance	-.898	22.5	1	< .001*	.407	.281	.591
Insurance without mental or behavioral health services	-.756	128.6	1	< .001*	.469	.412	.535
Time watching TV[c]		14.1	5	.015*			
None	-.555	8.0	1	.005*	.574	.390	.844
Less than 1 hour	-.335	5.9	1	.015*	.715	.545	.938
1 hour	-.176	1.9	1	.170	.839	.652	1.078
2 hours	-.097	0.7	1	.417	.907	.717	1.148
3 hours	-.045	0.1	1	.734	.956	.738	1.239
Time with Computer[d]		15.4	5	.009*			
None	.524	7.6	1	.006*	1.689	1.164	2.450
Less than 1 hour	.146	1.2	1	.278	1.157	.889	1.505
1 hour	.274	5.3	1	.021*	1.316	1.042	1.660
2 hours	.364	11.0	1	.001*	1.439	1.160	1.784
3 hours	.197	2.8	1	.095	1.218	.966	1.536
Constant	.531	31.7	1	< .001*	1.700		

[a] "White" reference category" reference category

[b] 'Mental or behavioral health services insurance" reference category" reference category

[c] "4 or more hours" reference category

*$p < .05$.

Table D7

Logistic Regression Results for Testing the Relationship Between Each Covariate and Receiving Behavioral Treatment for ADHD: Univariate Models for Age 3-17 and Age 6-17

	Ages 3-17				*Ages 6-17*			
	Odds ratio	95% *CI* for odds ratio			Odds ratio	95% *CI* for odds ratio		
		Lower	Upper	*p*		Lower	Upper	*p*
Male	1.142	1.007	1.294	.039*	1.135	.998	1.291	.055
Age Group				< .001*				< .001*
3-4 y.o.	1.744	1.085	2.804	.022*				
5-7 y.o.	2.859	2.292	3.567	< .001*	3.066	2.403	3.912	< .001*
8-10 y.o.	2.023	1.729	2.368	< .001*	2.000	1.705	2.345	< .001*
11-13 y.o.	1.452	1.257	1.678	< .001*	1.456	1.258	1.685	< .001*
Special Education(yes)	2.115	1.879	2.381	< .001*	2.157	1.909	2.437	< .001*
Special Services(yes)	2.670	2.369	3.010	< .001*	2.704	2.390	3.058	< .001*
Insurance[a]				< .001*				< .001*
No insurance	.369	.256	.533	< .001*	.345	.234	.509	< .001*
Insurance without mental or behavioral health services	.146	.126	.169	< .001*	.143	.122	.166	< .001*
Time watching TV[b]				.583				.512
None	1.269	.898	1.793	.177	1.266	.890	1.801	.189
Less than 1 hour	.956	.767	1.192	.689	.932	.743	1.170	.543
1 hour	.940	.773	1.143	.534	.928	.759	1.134	.463
2 hours	.937	.777	1.129	.491	.927	.766	1.123	.441
3 hours	.985	.796	1.218	.886	.996	.801	1.240	.975
Time with Computer[b]				< .001*				< .001*
None	1.888	1.401	2.545	< .001*	1.921	1.399	2.639	< .001*
Less than 1 hour	1.536	1.254	1.882	< .001*	1.537	1.246	1.897	< .001*
1 hour	1.203	1.004	1.442	.045*	1.211	1.006	1.457	.043*
2 hours	.987	.830	1.174	.885	.976	.818	1.165	.788
3 hours	1.081	.886	1.317	.443	1.045	.854	1.279	.668
Poverty Level[c]				.003*				.004*
0-99% FPL	1.343	1.121	1.608	.001*	1.353	1.121	1.633	.002*
100-199% FPL	1.111	.943	1.311	.209	1.125	.950	1.333	.172
200-399% FPL	.963	.835	1.110	.600	.972	.840	1.124	.700

	Ages 3-17				*Ages 6-17*			
	Odds ratio	95% *CI* for odds ratio		*p*	Odds ratio	95% *CI* for odds ratio		*p*
		Lower	Upper			Lower	Upper	
Physical activity[d]								.217
0 days					.948	.767	1.172	.621
1 - 3 days					.986	.838	1.159	.863
4 - 6 days					.853	.716	1.018	.078
Hours of sleep[e]								< .001*
Less than 6 hours					.608	.352	1.053	.076
6 hours					.514	.324	.815	.005*
7 hours					.459	.305	.692	< .001*
8 hours					.485	.327	.720	< .001*
9 hours					.513	.345	.762	.001*
10 hours					.752	.498	1.136	.176

[a] 'Mental or behavioral health services insurance" reference category" reference category

[b] "4 or more hours' reference category" reference category

[c] "400% FPL or greater" reference category

[d] "Every day" reference category

[e] "11 or more hours" reference category

*$p < .05$.

Table D8

Logistic Regression Predicting the Likelihood of Receiving Behavioral Treatment for ADHD Based on Race and Confounding Variables (for Children Aged 3-17)

Model 3.1	*β*	Wald	df	*p*	Odds ratio	95% CI for Odds ratio Lower	Upper
Race[a]		8.1	3	.043*			
Hispanic	-.056	0.2	1	.622	.945	.756	1.182
Black, non-Hispanic	.351	6.6	1	.010*	1.420	1.087	1.855
Other/Multiracial, non-Hispanic	.132	1.3	1	.257	1.141	.908	1.432
Age Group		112.0	4	< .001*			
3-4 y.o.	.652	5.3	1	.022*	1.919	1.100	3.348
5-7 y.o.	1.089	71.9	1	< .001*	2.973	2.311	3.824
8-10 y.o.	.742	66.4	1	< .001*	2.099	1.756	2.509
11-13 y.o.	.372	20.0	1	< .001*	1.451	1.232	1.708
Special Education(yes)	.372	22.4	1	< .001*	1.451	1.244	1.693
Special Services(yes)	.583	55.5	1	< .001*	1.791	1.537	2.088
Insurance[b]		542.8	2	< .001*			
No insurance	-1.022	26.5	1	< .001*	.360	.244	.531
Insurance without mental or behavioral health services	-1.827	534.9	1	< .001*	.161	.138	.188
Constant	-.576	64.0	1	< .001*	.562		

[a] "White" reference category" reference category

[b] 'Mental or behavioral health services insurance" reference category" reference category

*$p < .05$.

Table D9

Logistic Regression Predicting the Likelihood of Receiving Behavioral Treatment ADHD Based on Race and Confounding Variables (for Children Aged 6-17)

Model 3.2	*β*	Wald	df	*p*	Odds ratio	95% CI for Odds ratio Lower	Upper
Race[a]		6.7	3	.082			
Hispanic	-.025	0.0	1	.832	.975	.774	1.229
Black, non-Hispanic	.330	5.4	1	.020*	1.391	1.053	1.836
Other/Multiracial, non-Hispanic	.145	1.5	1	.227	1.156	.914	1.462
Age Group		94.6	3	< .001*			
5-7 y.o.	1.124	60.7	1	< .001*	3.076	2.318	4.081
8-10 y.o.	.750	59.4	1	< .001*	2.116	1.749	2.561
11-13 y.o.	.378	19.0	1	< .001*	1.460	1.232	1.730
Special Education(yes)	.380	22.1	1	< .001*	1.462	1.248	1.712
Special Services(yes)	.600	56.0	1	< .001*	1.822	1.557	2.132
Insurance[b]		514.1	2	< .001*			
No insurance	-1.074	26.9	1	< .001*	.342	.228	.513
Insurance without mental or behavioral health services	-1.845	505.2	1	< .001*	.158	.135	.186
Hours of sleep[c]		14.1	6	.028*			
Less than 6 hours	-.388	1.5	1	.220	.678	.364	1.262
6 hours	-.508	3.5	1	.060	.602	.354	1.021
7 hours	-.478	4.0	1	.046*	.620	.388	.992
8 hours	-.525	5.2	1	.022*	.591	.377	.927
9 hours	-.632	7.5	1	.006*	.531	.338	.835
10 hours	-.300	1.6	1	.212	.741	.463	1.186
Constant	-.103	0.2	1	.660	.902		

[a] "White" reference category" reference category

[b] 'Mental or behavioral health services insurance" reference category" reference category

[c] "11 or more hours" reference category

*$p < .05$.

Table D10

Logistic Regression Results for Testing the Relationship Between Each Covariate and Receiving Alternative Treatment for ADHD: Univariate Models for Age 3-17 and Age 6-17

	Ages 3-17				*Ages 6-17*			
	Odds ratio	95% CI for Odds ratio		*p*	Odds ratio	95% CI for Odds ratio		*p*
		Lower	Upper			Lower	Upper	
Male	.790	.654	.953	.014*	.856	.705	1.039	.115
Age Group				.015*				.040*
3-4 y.o.	1.197	.622	2.305	.590				
5-7 y.o.	.527	.351	.791	.002*	.643	.427	.969	.035*
8-10 y.o.	.854	.671	1.088	.201	.825	.646	1.054	.124
11-13 y.o.	.805	.644	1.006	.056	.776	.620	.973	.028*
Special Education(yes)	1.319	1.100	1.582	.003*	1.203	1.000	1.447	.050*
Special Services(yes)	1.811	1.507	2.177	< .001*	1.718	1.425	2.071	< .001*
Insurance[a]				< .001*				< .001*
No insurance	.147	.046	.463	.001*	.159	.050	.504	.002*
Insurance without mental or behavioral health services	.517	.419	.637	< .001*	.549	.445	.678	< .001*
Time watching TV[b]				< .001*				< .001*
None	4.175	2.521	6.916	< .001*	4.441	2.638	7.479	< .001*
Less than 1 hour	3.535	2.404	5.199	< .001*	3.838	2.563	5.747	< .001*
1 hour	2.442	1.683	3.544	< .001*	2.576	1.743	3.807	< .001*
2 hours	1.584	1.087	2.308	.017*	1.738	1.173	2.574	.006*
3 hours	2.015	1.347	3.015	.001*	2.245	1.478	3.410	< .001*
Time with Computer[b]				< .001*				< .001*
None	1.722	1.094	2.711	.019*	1.702	1.043	2.778	.033*
Less than 1 hour	2.184	1.602	2.977	< .001*	2.285	1.656	3.151	< .001*
1 hour	1.561	1.159	2.103	.003*	1.569	1.153	2.135	.004*
2 hours	1.374	1.027	1.838	.032*	1.553	1.157	2.086	.003*
3 hours	1.123	.797	1.581	.508	1.263	.895	1.780	.184
Poverty Level[c]				< .001*				< .001*
0-99% FPL	.390	.271	.560	< .001*	.382	.261	.560	< .001*
100-199% FPL	.743	.573	.964	.025*	.751	.576	.980	.035*

200-399% FPL	.888	.720	1.096	.270	.915	.739	1.133	.415
Physical activity[d]								.037*
0 days					.807	.575	1.133	.216
1 - 3 days					1.082	.848	1.380	.525
4 - 6 days					.792	.600	1.044	.098
Hours of sleep[e]								.001*
Less than 6 hours					.862	.400	1.855	.704
6 hours					.493	.245	.993	.048*
7 hours					.769	.437	1.354	.363
8 hours					.531	.307	.918	.024*
9 hours					.863	.501	1.485	.594
10 hours					.824	.466	1.456	.505

[a] 'Mental or behavioral health services insurance" reference category" reference category

[b] "4 or more hours' reference category" reference category

[c] "400% FPL or greater" reference category

[d] "Every day" reference category

[e] "11 or more hours" reference category

*$p < .05$.

Table D11

Logistic Regression Predicting the Likelihood of Receiving Alternative Treatment for ADHD Based on Race and Confounding Variables (for Children Aged 3-17)

Model 4.1	*β*	Wald	df	*p*	Odds ratio	95% CI for Odds ratio Lower	Upper
Race[a]		15.8	3	.001*			
Hispanic	-.469	5.8	1	.016*	.626	.428	.915
Black, non-Hispanic	-.685	6.4	1	.011*	.504	.297	.857
Other/Multiracial, non-Hispanic	.250	2.7	1	.101	1.284	.953	1.732
Male	-.269	6.8	1	.009*	.764	.624	.935
Age Group		30.7	4	< .001*			
3-4 y.o.	-.226	0.3	1	.560	.798	.373	1.707
5-7 y.o.	-1.083	22.8	1	< .001*	.339	.217	.528
8-10 y.o.	-.508	13.2	1	< .001*	.602	.458	.791
11-13 y.o.	-.384	9.8	1	.002*	.681	.536	.866
Special Services(yes)	.609	36.6	1	< .001*	1.839	1.509	2.240
Insurance[b]		42.6	2	< .001*			
No insurance	-2.782	7.6	1	.006*	.062	.009	.448
Insurance without mental or behavioral health services	-.675	35.9	1	< .001*	.509	.409	.635
Time watching TV[c]		39.5	5	< .001*			
None	1.233	18.5	1	< .001*	3.431	1.955	6.020
Less than 1 hour	1.083	21.9	1	< .001*	2.954	1.876	4.653
1 hour	.821	13.2	1	< .001*	2.273	1.460	3.540
2 hours	.405	3.3	1	.069	1.499	.968	2.320
3 hours	.755	10.6	1	.001*	2.127	1.349	3.355
Time with Computer[c]		19.0	5	.002*			
None	.453	3.0	1	.083	1.573	.943	2.625
Less than 1 hour	.679	11.9	1	.001*	1.971	1.341	2.898
1 hour	.349	3.6	1	.057	1.418	.989	2.034
2 hours	.243	1.9	1	.164	1.276	.906	1.797
3 hours	-.077	0.2	1	.691	.926	.632	1.355
Poverty Level[d]		19.6	3	< .001*			
0-99% FPL	-.870	18.2	1	< .001*	.419	.281	.625
100-199% FPL	-.136	0.9	1	.337	.873	.662	1.152
200-399% FPL	.005	0.0	1	.962	1.005	.807	1.253
Constant	-2.440	134.3	1	< .001*	.087		

[a] "White" reference category" reference category

[b] 'Mental or behavioral health services insurance" reference category" reference category

[c] "4 or more hours" reference category

[d] "400% FPL or greater" reference category

*$p < .05$.

Table D12

Logistic Regression Predicting the Likelihood of Receiving Alternative Treatment ADHD Based on Race and Confounding Variables (for Children Aged 6-17)

Model 4.2	*β*	Wald	df	*p*	Odds ratio	95% CI for Odds ratio Lower	Upper
Race[a]		17.6	3	.001*			
Hispanic	-.409	4.2	1	.041*	.664	.448	.983
Black, non-Hispanic	-.648	5.7	1	.017*	.523	.307	.890
Other/Multiracial, non-Hispanic	.380	6.1	1	.013*	1.462	1.083	1.974
Age Group		31.2	3	< .001*			
5-7 y.o.	-1.027	18.8	1	< .001*	.358	.225	.570
8-10 y.o.	-.635	18.0	1	< .001*	.530	.395	.711
11-13 y.o.	-.503	15.2	1	< .001*	.605	.470	.778
Special Education(yes)	-.213	3.3	1	.069	.808	.643	1.017
Special Services(yes)	.607	26.2	1	< .001*	1.836	1.454	2.317
Insurance[b]		39.3	2	< .001*			
No insurance	-2.082	8.3	1	.004*	.125	.030	.513
Insurance without mental or behavioral health services	-.648	32.2	1	< .001*	.523	.418	.654
Time watching TV[c]		43.4	5	< .001*			
None	1.310	20.1	1	< .001*	3.707	2.091	6.573
Less than 1 hour	1.161	24.0	1	< .001*	3.193	2.006	5.081
1 hour	.874	14.2	1	< .001*	2.396	1.520	3.778
2 hours	.437	3.7	1	.056	1.548	.989	2.423
3 hours	.792	11.1	1	.001*	2.207	1.384	3.519
Time with Computer[c]		12.0	5	.035*			
None	.353	1.6	1	.204	1.423	.826	2.452
Less than 1 hour	.588	8.3	1	.004*	1.801	1.206	2.689
1 hour	.302	2.5	1	.113	1.353	.931	1.965
2 hours	.351	3.8	1	.050	1.421	1.000	2.018
3 hours	.010	0.0	1	.959	1.010	.688	1.484
Poverty Level[d]		16.2	3	.001*			
0-99% FPL	-.813	14.8	1	< .001*	.444	.293	.671
100-199% FPL	-.116	0.7	1	.420	.890	.671	1.181
200-399% FPL	.023	0.0	1	.839	1.023	.818	1.280
Physical activity[e]		15.2	3	.002*			
0 days	-.282	2.2	1	.141	.754	.518	1.098
1 - 3 days	.041	0.1	1	.761	1.042	.801	1.355
4 - 6 days	-.413	7.6	1	.006*	.662	.494	.888

Model 4.2	*β*	Wald	df	*p*	Odds ratio	95% CI for Odds ratio Lower	Upper
Hours of sleep[f]		23.7	6	.001*			
Less than 6 hours	-.113	0.1	1	.784	.893	.397	2.007
6 hours	-.869	5.3	1	.021*	.419	.200	.878
7 hours	-.483	2.5	1	.115	.617	.339	1.125
8 hours	-.868	8.7	1	.003*	.420	.235	.749
9 hours	-.366	1.6	1	.208	.693	.392	1.226
10 hours	-.398	1.7	1	.191	.672	.370	1.219
Constant	-1.864	26.1	1	< .001*	.155		

[a] "White" reference category

[b] 'Mental or behavioral health services insurance" reference category" reference category

[c] "4 or more hours' reference category" reference category

[d] "400% FPL or greater" reference category

[e] "Every day" reference category

[f] "11 or more hours" reference category

*$p < .05$.

Table D13

Logistic Regression Results for Testing the Relationship Between Each Covariate and Receiving Combined Treatment for ADHD: Univariate Models for Age 3-17 and Age 6-17.

	Ages 3-17				*Ages 6-17*			
	Odds ratio	95% CI for Odds ratio			Odds ratio	95% CI for Odds ratio		
		Lower	Upper	*p*		Lower	Upper	*p*
Male	1.255	1.089	1.445	.002*	1.228	1.063	1.419	.005*
Age Group				< .001*				< .001*
3-4 y.o.	.157	.049	.502	.002*				
5-7 y.o.	2.017	1.600	2.542	< .001*	2.181	1.695	2.805	< .001*
8-10 y.o.	1.965	1.657	2.331	< .001*	2.007	1.688	2.385	< .001*
11-13 y.o.	1.563	1.332	1.834	< .001*	1.587	1.349	1.866	< .001*
Special Education(yes)	2.051	1.797	2.341	< .001*	2.087	1.823	2.390	< .001*
Special Services(yes)	2.404	2.106	2.744	< .001*	2.457	2.146	2.814	< .001*
Insurance[a]				< .001*				< .001*
No insurance	.427	.283	.643	< .001*	.376	.242	.584	< .001*
Insurance without mental or behavioral health services	.078	.062	.098	< .001*	.082	.065	.104	< .001*
Time watching TV[b]				.676				.297
None	.778	.520	1.165	.223	.730	.483	1.102	.134
Less than 1 hour	.931	.731	1.187	.565	.882	.687	1.131	.321
1 hour	.883	.711	1.095	.257	.842	.675	1.049	.125
2 hours	.970	.791	1.190	.773	.948	.770	1.167	.615
3 hours	.999	.791	1.261	.990	1.027	.811	1.301	.825
Time with Computer[b]				.001*				< .001*
None	1.777	1.302	2.424	< .001*	2.028	1.463	2.809	< .001*
Less than 1 hour	1.237	.989	1.546	.062	1.307	1.039	1.644	.022*
1 hour	1.203	.985	1.469	.070	1.227	1.001	1.504	.049*
2 hours	1.009	.832	1.224	.925	1.037	.853	1.262	.713
3 hours	.976	.781	1.220	.829	.975	.777	1.225	.829
Poverty Level[c]				.002*				.004*
0-99% FPL	1.346	1.108	1.634	.003*	1.359	1.110	1.664	.003*
100-199% FPL	1.095	.913	1.312	.329	1.153	.959	1.387	.130
200-399% FPL	.917	.781	1.075	.285	.951	.808	1.119	.544

	Ages 3-17				*Ages 6-17*			
	Odds ratio	95% CI for Odds ratio			Odds ratio	95% CI for Odds ratio		
		Lower	Upper	*p*		Lower	Upper	*p*
Physical activity[d]								.419
0 days					.986	.780	1.245	.903
1 - 3 days					1.029	.861	1.229	.757
4 - 6 days					.895	.737	1.087	.264
Hours of sleep[e]								< .001*
Less than 6 hours					.889	.502	1.577	.689
6 hours					.627	.385	1.023	.062
7 hours					.599	.391	.918	.019*
8 hours					.650	.433	.975	.037*
9 hours					.660	.438	.994	.047*
10 hours					.979	.641	1.496	.923

[a] 'Mental or behavioral health services insurance" reference category" reference category

[b] "4 or more hours' reference category" reference category

[c] "400% FPL or greater" reference category

[d] "Every day" reference category

[e] "11 or more hours" reference category

*$p < .05$.

Table D14

Logistic Regression Predicting the Likelihood of Receiving Combined Treatment for ADHD Based on Race and Confounding Variables (for Children Aged 3-17, Excluding Physical Activity and Length of Sleep Variables)

Model 5.1	*β*	Wald	df	*p*	Odds ratio	95% CI for Odds ratio Lower	Upper
Race[a]		8.8	3	.032*			
Hispanic	-.193	2.4	1	.125	.825	.644	1.055
Black, non-Hispanic	.341	5.6	1	.018*	1.407	1.061	1.865
Other/Multiracial, non-Hispanic	.010	0.0	1	.937	1.010	.791	1.289
Male	.208	6.5	1	.011*	1.231	1.050	1.444
Age Group		75.6	4	< .001*			
3-4 y.o.	-2.066	11.6	1	.001*	.127	.039	.415
5-7 y.o.	.630	22.7	1	< .001*	1.877	1.448	2.433
8-10 y.o.	.680	48.2	1	< .001*	1.974	1.629	2.392
11-13 y.o.	.442	23.3	1	< .001*	1.555	1.300	1.860
Special Education(yes)	.320	13.5	1	< .001*	1.377	1.161	1.633
Special Services(yes)	.455	27.5	1	< .001*	1.576	1.329	1.868
Insurance[b]		429.5	2	< .001*			
No insurance	-.891	16.3	1	< .001*	.410	.266	.632
Insurance without mental or behavioral health services	-2.468	421.6	1	< .001*	.085	.067	.107
Constant	-1.226	168.7	1	< .001*	.294		

[a] "White" reference category

[b] 'Mental or behavioral health services insurance" reference category" reference category

*$p < .05$.

Table D15

Logistic Regression Predicting the Likelihood of Receiving Combined Treatment ADHD Based on Race and Confounding Variables (for Children Aged 6-17)

Model 5.2	*β*	Wald	df	*p*	Odds ratio	95% CI for Odds ratio Lower	Upper
Race[a]		5.5	3	.137			
Hispanic	-.156	1.4	1	.229	.856	.664	1.103
Black, non-Hispanic	.275	3.4	1	.064	1.317	.984	1.762
Other/Multiracial, non-Hispanic	-.037	0.1	1	.771	.963	.750	1.237
Male	.172	4.3	1	.037*	1.188	1.010	1.398
Age Group		58.8	3	< .001*			
5-7 y.o.	.669	20.7	1	< .001*	1.951	1.463	2.602
8-10 y.o.	.738	50.3	1	< .001*	2.091	1.705	2.564
11-13 y.o.	.464	23.9	1	< .001*	1.591	1.321	1.916
Special Education(yes)	.343	15.0	1	< .001*	1.410	1.185	1.678
Special Services(yes)	.453	26.4	1	< .001*	1.573	1.323	1.870
Insurance[b]		413.2	2	< .001*			
No insurance	-.971	17.7	1	< .001*	.379	.241	.595
Insurance without mental or behavioral health services	-2.417	404.2	1	< .001*	.089	.070	.113
Hours of sleep[c]		12.7	6	.048*			
Less than 6 hours	-.005	0.0	1	.988	.995	.521	1.902
6 hours	-.336	1.4	1	.233	.715	.411	1.241
7 hours	-.283	1.3	1	.252	.753	.464	1.224
8 hours	-.316	1.8	1	.179	.729	.459	1.156
9 hours	-.445	3.5	1	.060	.641	.403	1.020
10 hours	-.078	0.1	1	.752	.925	.572	1.497
Constant	-.939	14.6	1	< .001*	.391		

[a] "White" reference category

[b] 'Mental or behavioral health services insurance" reference category" reference category

[c] "11 or more hours" reference category

*$p < .05$.

Table D16

Logistic Regression Predicting the Likelihood of Receiving Medication for ADHD Based on Race and Based on ADHD Severity Along With Confounding Variables (for Children Aged 3-17)

Model 6.1		*β*	Wald	df	*p*	Odds ratio	95% CI for Odds ratio Lower	Upper
Race by Severity[a]			285.9	11	< .001*			
Mild	Hispanic	-.381	5.3	1	.021*	.683	.494	.944
	Black, non-Hispanic	-.439	3.7	1	.055	.644	.411	1.010
	Other/Multiracial	-.324	3.6	1	.057	.723	.518	1.009
Mode-rate	Hispanic	.575	10.5	1	.001*	1.777	1.255	2.518
	White, non-Hispanic	1.032	137.9	1	< .001*	2.806	2.362	3.333
	Black, non-Hispanic	.839	15.2	1	< .001*	2.313	1.517	3.527
	Other/Multiracial	.929	25.6	1	< .001*	2.533	1.767	3.631
Severe	Hispanic	1.150	10.2	1	.001*	3.158	1.558	6.401
	White, non-Hispanic	1.785	94.9	1	< .001*	5.960	4.161	8.535
	Black, non-Hispanic	1.791	20.1	1	< .001*	5.993	2.740	13.108
	Other/Multiracial	2.639	17.5	1	< .001*	14.006	4.061	48.307
Age Group			87.9	4	< .001*			
3-4 y.o.		-3.001	48.7	1	< .001*	.050	.021	.116
5-7 y.o.		-.377	7.8	1	.005*	.686	.527	.893
8-10 y.o.		.195	3.6	1	.056	1.215	.995	1.485
11-13 y.o.		.363	16.0	1	< .001*	1.438	1.204	1.717
Special Services(yes)		-.202	7.7	1	.005*	.817	.709	.942
Insurance[b]			40.1	2	< .001*			
No insurance		-.784	13.8	1	< .001*	.457	.302	.691
Insurance without mental or behavioral health services		-.419	30.7	1	< .001*	.658	.567	.763
Time watching TV[c]			19.3	5	.002*			
None		-.697	10.3	1	.001*	.498	.326	.762
Less than 1 hour		-.360	5.4	1	.020*	.698	.514	.946
1 hour		-.189	1.7	1	.188	.828	.625	1.096
2 hours		-.028	0.0	1	.835	.972	.747	1.266
3 hours		-.030	0.0	1	.841	.971	.728	1.295

Model 6.1	*β*	Wald	df	*p*	Odds ratio	95% CI for Odds ratio Lower	Upper
Time with Computer[c]		18.2	5	.003*			
None	.466	5.1	1	.024*	1.594	1.062	2.393
Less than 1 hour	.204	1.9	1	.168	1.227	.918	1.640
1 hour	.379	8.1	1	.004*	1.461	1.126	1.896
2 hours	.482	15.1	1	< .001*	1.619	1.270	2.065
3 hours	.227	3.0	1	.086	1.255	.969	1.626
Poverty Level[d]		19.7	3	< .001*			
0-99% FPL	-.458	15.4	1	< .001*	.632	.503	.795
100-199% FPL	-.310	9.0	1	.003*	.734	.599	.898
200-399% FPL	-.241	7.7	1	.005*	.786	.663	.931
Constant	.369	8.5	1	.004*	1.446		

[a] "Mild and White" reference category

[b] "Mental or behavioral health services insurance" reference category

[c] "4 or more hours" reference category

[d] "400% FPL or greater" reference category

*$p < .05$.

Table D17

Logistic Regression Predicting the Likelihood of Receiving Medication for ADHD Based on Race and Based on ADHD Severity Along With Confounding Variables (for Children Aged 6-17)

Model 6.2		*β*	Wald	df	*p*	Odds ratio	95% CI for Odds ratio Lower	Upper
Race by Severity[a]			257.9	11	< .001*			
Mild	Hispanic	-.416	6.1	1	.013*	.660	.475	.917
	Black, non-Hispanic	-.470	4.1	1	.042*	.625	.398	.982
	Other/Multiracial	-.361	4.5	1	.034*	.697	.499	.973
Mode-rate	Hispanic	.512	7.8	1	.005*	1.669	1.166	2.388
	White, non-Hispanic	.999	126.2	1	< .001*	2.715	2.281	3.232
	Black, non-Hispanic	.689	10.0	1	.002*	1.991	1.301	3.048
	Other/Multiracial	.861	20.9	1	< .001*	2.366	1.636	3.422
Severe	Hispanic	1.081	8.3	1	.004*	2.948	1.410	6.166
	White, non-Hispanic	1.643	78.2	1	< .001*	5.172	3.593	7.446
	Black, non-Hispanic	1.457	13.5	1	< .001*	4.294	1.975	9.337
	Other/Multiracial	2.754	14.1	1	< .001*	15.712	3.732	66.150
Age Group			27.4	3	< .001*			
5-7 y.o.		-.289	4.0	1	.046	.749	.564	.995
8-10 y.o.		.176	2.9	1	.087	1.193	.975	1.459
11-13 y.o.		.365	16.1	1	< .001*	1.441	1.206	1.723
Special Education(yes)		-.183	6.1	1	.013*	.833	.721	.962
Insurance[b]			40.8	2	< .001*			
No insurance		-.908	17.8	1	< .001*	.403	.264	.615
Insurance without mental or behavioral health services		-.405	27.8	1	< .001*	.667	.574	.775
Time watching TV[c]			17.2	5	.004*			
None		-.692	10.0	1	.002*	.501	.326	.769
Less than 1 hour		-.399	6.4	1	.011*	.671	.493	.914
1 hour		-.228	2.5	1	.117	.796	.598	1.059
2 hours		-.093	0.5	1	.500	.911	.696	1.193
3 hours		-.078	0.3	1	.603	.925	.689	1.241

Model 6.2	*β*	Wald	df	*p*	Odds ratio	95% CI for Odds ratio Lower	Upper
Time with Computer[c]		20.8	5	.001*			
None	.520	5.8	1	.016*	1.683	1.101	2.571
Less than 1 hour	.260	3.0	1	.085	1.297	.965	1.745
1 hour	.443	10.8	1	.001*	1.558	1.197	2.027
2 hours	.528	17.7	1	< .001*	1.695	1.326	2.167
3 hours	.267	4.0	1	.046*	1.305	1.004	1.697
Constant	.209	3.0	1	.083	1.232		

[a] "Mild and White" reference category

[b] "Mental or behavioral health services insurance" reference category

[c] "4 or more hours" reference category

*$p < .05$.

Table D18

Logistic Regression Predicting the Likelihood of Receiving Behavioral Treatment for ADHD Based on Race and Based on ADHD Severity Along With Confounding Variables (for Children Aged 3-17)

Model 7.1		*β*	Wald	df	*p*	Odds ratio	95% CI for Odds ratio Lower	Upper
Race by Severity[a]			109.1	11	< .001*			
Mild	Hispanic	-.324	2.9	1	.091	.724	.497	1.053
	Black, non-Hispanic	-.013	0.0	1	.959	.987	.604	1.613
	Other/Multiracial	.043	0.1	1	.821	1.044	.721	1.511
Mode-rate	Hispanic	.698	14.9	1	< .001*	2.009	1.410	2.861
	White, non-Hispanic	.406	21.6	1	< .001*	1.501	1.265	1.780
	Black, non-Hispanic	.850	15.9	1	< .001*	2.340	1.541	3.553
	Other/Multiracial	.705	15.8	1	< .001*	2.025	1.431	2.866
Severe	Hispanic	.849	6.4	1	.011*	2.338	1.212	4.512
	White, non-Hispanic	1.028	46.9	1	< .001*	2.795	2.082	3.750
	Black, non-Hispanic	2.250	23.5	1	< .001*	9.490	3.823	23.555
	Other/Multiracial	.683	3.8	1	.052	1.980	.993	3.946
Age Group			74.8	4	< .001*			
3-4 y.o.		.554	3.5	1	.062	1.741	.973	3.113
5-7 y.o.		.945	49.2	1	< .001*	2.572	1.975	3.350
8-10 y.o.		.630	43.4	1	< .001*	1.877	1.556	2.264
11-13 y.o.		.368	17.3	1	< .001*	1.445	1.215	1.720
Special Education(yes)		.293	12.3	1	< .001*	1.341	1.138	1.580
Special Services(yes)		.529	40.6	1	< .001*	1.698	1.443	1.999
Insurance[b]			399.2	2	< .001*			
No insurance		-1.049	22.9	1	< .001*	.350	.228	.538
Insurance without mental or behavioral health services		-1.658	390.7	1	< .001*	.191	.162	.225
Constant		-.743	71.3	1	< .001*	.476		

[a] "Mild and White" reference category

[b] "Mental or behavioral health services insurance" reference category

*$p < .05$.

Table D19

Logistic Regression Predicting the Likelihood of Receiving Behavioral Treatment for ADHD Based on Race and Based on ADHD Severity Along With Confounding Variables (for Children Aged 6-17)

Model 7.2		β	Wald	df	p	Odds ratio	95% CI for Odds ratio Lower	Upper
Race by Severity[a]			103.9	11	< .001*			
Mild	Hispanic	-.348	3.0	1	.082	.706	.478	1.045
	Black, non-Hispanic	-.093	0.1	1	.728	.911	.539	1.540
	Other/Multiracial	.017	0.0	1	.930	1.017	.696	1.486
Mode-rate	Hispanic	.731	14.9	1	< .001*	2.077	1.433	3.010
	White, non-Hispanic	.408	20.6	1	< .001*	1.504	1.261	1.793
	Black, non-Hispanic	.824	13.9	1	< .001*	2.278	1.477	3.514
	Other/Multiracial	.703	14.6	1	< .001*	2.021	1.409	2.897
Severe	Hispanic	.907	6.7	1	.010*	2.478	1.248	4.922
	White, non-Hispanic	1.004	42.0	1	< .001*	2.730	2.015	3.700
	Black, non-Hispanic	2.263	22.9	1	< .001*	9.616	3.802	24.323
	Other/Multiracial	.891	5.7	1	.017*	2.438	1.170	5.080
Age Group			63.8	3	< .001*			
5-7 y.o.		1.007	44.0	1	< .001*	2.738	2.033	3.686
8-10 y.o.		.626	37.3	1	< .001*	1.870	1.530	2.285
11-13 y.o.		.358	15.0	1	< .001*	1.431	1.193	1.715
Special Education(yes)		.307	12.7	1	< .001*	1.359	1.148	1.609
Special Services(yes)		.551	41.7	1	< .001*	1.735	1.468	2.051
Insurance[b]			380.3	2	< .001*			
No insurance		-1.102	23.1	1	< .001*	.332	.212	.521
Insurance without mental or behavioral health services		-1.682	371.0	1	< .001*	.186	.157	.221
Hours of sleep[c]			13.1	6	.042*			
Less than 6 hours		-.548	2.6	1	.107	.578	.297	1.125
6 hours		-.485	2.9	1	.088	.616	.353	1.075
7 hours		-.406	2.6	1	.108	.667	.406	1.093
8 hours		-.423	3.1	1	.079	.655	.408	1.050

Model 7.2	*β*	Wald	df	*p*	Odds ratio	95% CI for Odds ratio Lower	Upper
9 hours	-.529	4.8	1	.029*	.589	.366	.947
10 hours	-.157	0.4	1	.534	.855	.522	1.401
Constant	-.353	2.0	1	.158	.702		

[a] "Mild and White" reference category

[b] "Mental or behavioral health services insurance" reference category

[c] "11 or more hours" reference category

*$p < .05$.

Table D20

Logistic Regression Predicting the Likelihood of Receiving Alternative Treatment for ADHD Based on Race and Based on ADHD Severity Along With Confounding Variables (for Children Aged 3-17)

Model 8.1		*β*	Wald	df	*p*	Odds ratio	95% CI for Odds ratio Lower	Upper
Race by Severity[a]			38.1	11	< .001*			
Mild	Hispanic	-.756	4.8	1	.028*	.470	.239	.921
	Black, non-Hispanic	-18.940	0.0	1	.996	.000	0.000	
	Other/Multiracial	-.024	0.0	1	.931	.977	.573	1.665
Mode-rate	Hispanic	-.882	5.9	1	.015*	.414	.204	.842
	White, non-Hispanic	-.168	1.7	1	.187	.845	.659	1.085
	Black, non-Hispanic	-.338	0.8	1	.362	.713	.344	1.476
	Other/Multiracial	.558	6.6	1	.010*	1.747	1.142	2.673
Severe	Hispanic	.923	5.4	1	.020*	2.517	1.154	5.487
	White, non-Hispanic	.429	5.6	1	.018*	1.535	1.076	2.190
	Black, non-Hispanic	.431	1.0	1	.309	1.539	.670	3.536
	Other/Multiracial	-.039	0.0	1	.934	.962	.384	2.410
Male		-.279	6.4	1	.011*	.757	.610	.939
Age Group			30.2	4	< .001*			
3-4 y.o.		-.103	0.1	1	.797	.903	.413	1.970
5-7 y.o.		-1.200	24.7	1	< .001*	.301	.188	.484
8-10 y.o.		-.486	11.2	1	.001*	.615	.462	.818
11-13 y.o.		-.358	7.5	1	.006*	.699	.542	.903
Special Services(yes)		.509	22.1	1	< .001*	1.664	1.345	2.058
Insurance[b]			43.0	2	< .001*			
No insurance		-2.650	6.9	1	.009*	.071	.010	.514
Insurance without mental or behavioral health services		-.783	36.8	1	< .001*	.457	.355	.589
Time watching TV[c]			29.4	5	< .001*			
None		1.220	15.8	1	< .001*	3.389	1.855	6.191
Less than 1 hour		1.062	18.3	1	< .001*	2.892	1.777	4.708
1 hour		.782	10.5	1	.001*	2.185	1.361	3.508
2 hours		.475	4.0	1	.045*	1.608	1.011	2.557
3 hours		.747	9.2	1	.002*	2.111	1.301	3.423

Model 8.1	*β*	Wald	df	*p*	Odds ratio	95% CI for Odds ratio Lower	Upper
Time with Computer[c]		18.8	5	.002*			
None	.339	1.4	1	.229	1.404	.808	2.439
Less than 1 hour	.703	11.3	1	.001*	2.019	1.341	3.039
1 hour	.397	4.1	1	.042*	1.487	1.014	2.180
2 hours	.256	1.9	1	.168	1.292	.898	1.860
3 hours	-.110	0.3	1	.597	.896	.596	1.346
Poverty Level[d]		15.2	3	.002*			
0-99% FPL	-.727	12.7	1	< .001*	.483	.324	.721
100-199% FPL	-.049	0.1	1	.746	.952	.709	1.279
200-399% FPL	.067	0.3	1	.577	1.069	.845	1.354
Constant	-2.418	109.1	1	< .001*	.089		

[a] "Mild and White" reference category

[b] "Mental or behavioral health services insurance" reference category

[c] "4 or more hours" reference category

[d] "400% FPL or greater" reference category

*$p < .05$.

Table D21

Logistic Regression Predicting the Likelihood of Receiving Alternative Treatment for ADHD Based on Race and Based on ADHD Severity Along With Confounding Variables (for Children Aged 6-17)

Model 8.2		*β*	Wald	df	*p*	Odds ratio	95% CI for Odds ratio Lower	Upper
Race by Severity[a]			38.5	11	< .001*			
Mild	Hispanic	-.717	4.0	1	.047*	.488	.241	.990
	Black, non-Hispanic	-18.926	0.0	1	.997	.000	0.000	
	Other/Multiracial	.208	0.6	1	.421	1.231	.742	2.042
Mode-rate	Hispanic	-.732	4.1	1	.044*	.481	.236	.979
	White, non-Hispanic	-.128	1.0	1	.322	.880	.683	1.133
	Black, non-Hispanic	-.416	1.1	1	.286	.659	.307	1.418
	Other/Multiracial	.641	8.2	1	.004*	1.899	1.225	2.943
Severe	Hispanic	1.080	7.4	1	.007*	2.945	1.349	6.428
	White, non-Hispanic	.453	5.9	1	.015*	1.572	1.091	2.265
	Black, non-Hispanic	.497	1.3	1	.251	1.643	.704	3.837
	Other/Multiracial	.226	0.3	1	.610	1.254	.526	2.991
Age Group			30.2	3	< .001*			
5-7 y.o.		-1.109	20.3	1	< .001*	.330	.204	.535
8-10 y.o.		-.604	15.4	1	< .001*	.546	.404	.739
11-13 y.o.		-.511	14.0	1	< .001*	.600	.459	.784
Special Services(yes)		.387	12.7	1	< .001*	1.473	1.190	1.823
Insurance[b]			37.2	2	< .001*			
No insurance		-1.922	7.0	1	.008*	.146	.035	.607
Insurance without mental or behavioral health services		-.722	31.1	1	< .001*	.486	.377	.626
Time watching TV[c]			30.6	5	< .001*			
None		1.158	14.1	1	< .001*	3.185	1.741	5.827
Less than 1 hour		1.024	17.0	1	< .001*	2.784	1.712	4.527
1 hour		.734	9.3	1	.002*	2.083	1.298	3.342
2 hours		.368	2.4	1	.121	1.445	.908	2.299
3 hours		.673	7.5	1	.006*	1.960	1.211	3.172
Time with Computer[c]			11.4	5	.044*			
None		.259	0.8	1	.376	1.296	.730	2.302

Model 8.2	*β*	Wald	df	*p*	Odds ratio	95% CI for Odds ratio Lower	Upper
Less than 1 hour	.578	7.1	1	.008*	1.783	1.167	2.723
1 hour	.294	2.1	1	.145	1.341	.904	1.990
2 hours	.343	3.3	1	.070*	1.409	.973	2.041
3 hours	-.046	0.0	1	.827	.955	.634	1.439
Poverty Level[d]		13.5	3	.004*			
0-99% FPL	-.756	12.5	1	< .001*	.469	.309	.714
100-199% FPL	-.070	0.2	1	.644	.932	.692	1.256
200-399% FPL	.011	0.0	1	.930	1.011	.796	1.284
Physical activity[e]		12.6	3	.006*			
0 days	-.258	1.6	1	.203	.772	.519	1.150
1 - 3 days	.057	0.2	1	.686	1.059	.803	1.397
4 - 6 days	-.385	5.9	1	.015*	.681	.500	.928
Hours of sleep[f]		20.2	6	.003*			
Less than 6 hours	-1.377	6.0	1	.014*	.252	.084	.759
6 hours	-.790	4.4	1	.037*	.454	.216	.952
7 hours	-.637	4.1	1	.043*	.529	.285	.981
8 hours	-.805	7.2	1	.007*	.447	.249	.804
9 hours	-.314	1.1	1	.288	.731	.410	1.304
10 hours	-.464	2.2	1	.135	.628	.342	1.155
Constant	-1.738	21.0	1	< .001*	.176		

[a] "Mild and White" reference category

[b] "Mental or behavioral health services insurance" reference category

[c] "4 or more hours" reference category

[d] "400% FPL or greater" reference category; [d] 'Every day' reference category; [e] '11 or more hours' reference category

[e] "Every day" reference category

[f] "11 or more hours" reference category

*$p < .05$.

Table D22

Logistic Regression Predicting the Likelihood of Receiving Combined Treatment for ADHD Based on Race and Based on ADHD Severity Along With Confounding Variables (for Children Aged 3-17)

Model 9.1		*β*	Wald	df	*p*	Odds ratio	95% CI for Odds ratio Lower	Upper
Race by Severity[a]			252.0	11	< .001*			
Mild	Hispanic	-.491	3.6	1	.059	.612	.368	1.018
	Black, non-Hispanic	-.651	2.7	1	.097	.522	.242	1.126
	Other/Multiracial	-.170	0.5	1	.483	.844	.525	1.356
Mode-rate	Hispanic	1.045	31.1	1	< .001*	2.845	1.970	4.108
	White, non-Hispanic	1.003	100.4	1	< .001*	2.727	2.241	3.318
	Black, non-Hispanic	1.314	34.9	1	< .001*	3.722	2.407	5.755
	Other/Multiracial	1.136	39.1	1	< .001*	3.114	2.181	4.446
Severe	Hispanic	1.502	19.9	1	< .001*	4.489	2.320	8.688
	White, non-Hispanic	1.672	120.0	1	< .001*	5.323	3.947	7.179
	Black, non-Hispanic	2.322	43.1	1	< .001*	10.196	5.096	20.397
	Other/Multiracial	1.623	22.1	1	< .001*	5.068	2.575	9.975
Age Group			50.4	4	< .001*			
3-4 y.o.		-2.212	12.9	1	< .001*	.109	.033	.366
5-7 y.o.		.437	9.6	1	.002*	1.549	1.174	2.044
8-10 y.o.		.531	26.3	1	< .001*	1.700	1.388	2.082
11-13 y.o.		.419	18.4	1	< .001*	1.520	1.255	1.841
Special Education(yes)		.209	5.1	1	.024*	1.233	1.028	1.479
Special Services(yes)		.349	14.4	1	< .001*	1.418	1.184	1.698
Insurance[b]			324.0	2	< .001*			
No insurance		-.928	13.8	1	< .001*	.395	.242	.645
Insurance without mental or behavioral health services		-2.079	316.9	1	< .001*	.125	.099	.157
Poverty Level[c]			7.1	3	.069			
0-99% FPL		-.259	4.3	1	.039*	.772	.603	.987
100-199% FPL		-.235	4.3	1	.039*	.791	.633	.988
200-399% FPL		-.176	3.3	1	.070	.839	.694	1.014
Constant		-1.443	170.1	1	< .001*	.236		

[a] "Mild and White" reference category

[b] "Mental or behavioral health services insurance" reference category

[c] "400% FPL or greater" reference category

*$p < .05$.

Table D23

Logistic Regression Predicting the Likelihood of Receiving Combined Treatment for ADHD Based on Race and Based on ADHD Severity Along With Confounding Variables (for Children Aged 6-17)

Model 9.2		*β*	Wald	df	*p*	Odds ratio	95% CI for Odds ratio Lower	Upper
Race by Severity[a]			230.3	11	< .001*			
Mild	Hispanic	-.524	3.9	1	.048*	.592	.352	.995
	Black, non-Hispanic	-.826	3.9	1	.047*	.438	.194	.989
	Other/Multiracial	-.263	1.2	1	.283	.769	.475	1.243
Mode-rate	Hispanic	.975	25.9	1	< .001*	2.652	1.822	3.861
	White, non-Hispanic	.953	90.2	1	< .001*	2.593	2.130	3.157
	Black, non-Hispanic	1.161	26.8	1	< .001*	3.193	2.058	4.954
	Other/Multiracial	1.059	32.7	1	< .001*	2.884	2.006	4.146
Severe	Hispanic	1.473	18.5	1	< .001*	4.363	2.230	8.537
	White, non-Hispanic	1.538	101.2	1	< .001*	4.653	3.449	6.279
	Black, non-Hispanic	2.091	35.6	1	< .001*	8.094	4.073	16.087
	Other/Multiracial	1.666	21.8	1	< .001*	5.292	2.630	10.648
Age Group			35.7	3	< .001*			
5-7 y.o.		.490	10.5	1	.001*	1.633	1.213	2.198
8-10 y.o.		.549	27.9	1	< .001*	1.732	1.413	2.123
11-13 y.o.		.421	18.4	1	< .001*	1.524	1.257	1.846
Special Education(yes)		.248	6.9	1	.009*	1.281	1.065	1.541
Special Services(yes)		.333	12.8	1	< .001*	1.395	1.162	1.674
Insurance[b]			306.7	2	< .001*			
No insurance		-1.066	16.9	1	< .001*	.344	.207	.573
Insurance without mental or behavioral health services		-2.013	297.4	1	< .001*	.134	.106	.168
Constant		-1.544	217.1	1	< .001*	.214		

[a] "Mild and White" reference category

[b] "Mental or behavioral health services insurance" reference category

*$p < .05$.